



## SMS Evolution

Version 4.02.0

~~04 February 2019~~ 10 November 2020

*This is a Non-binding Permanent Reference Document of the GSMA*

---

### Security Classification: Non-confidential

Access to and distribution of this document is restricted to the persons permitted by the security classification. This document is confidential to the Association and is subject to copyright protection. This document is to be used only for the purposes for which it has been supplied and information contained in it must not be disclosed or in any other way made available, in whole or in part, to persons other than those permitted under the security classification without the prior written approval of the Association.

### Copyright Notice

Copyright © 2020 GSM Association

### Disclaimer

The GSM Association ("Association") makes no representation, warranty or undertaking (express or implied) with respect to and does not accept any responsibility for, and hereby disclaims liability for the accuracy or completeness or timeliness of the information contained in this document. The information contained in this document may be subject to change without prior notice.

### Antitrust Notice

The information contain herein is in full compliance with the GSM Association's antitrust compliance policy.

## Table of Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
1.1	Overview	4
1.2	Abbreviations	4
1.3	Definitions	7
1.4	Document Cross-References	7
<b>2</b>	<b>SMS Requirements</b>	<b>8</b>
2.1	SMS service	8
2.1.1	SMS Mobile Originating (SMS-MO, Mobile Originated)	8
2.1.2	SMS Terminating (SMS-MT, Mobile Terminated)	9
2.2	SMS for MTC/MIoT	9
2.3	SMS security	10
2.4	SMS Number Portability	11
<b>3</b>	<b>SMS use cases</b>	<b>12</b>
3.1	<2/3G> SMS over MAP	12
3.2	<4G> SMS over SGsAP and MAP	13
3.3	<4G> SMS over Diameter	13
3.4	<IMS> SMS over MAP/Diameter	15
3.5	<5G> SMS in MAP/Diameter	16
3.6	<MTC/MIoT>	16
<b>4</b>	<b>SMS protocols</b>	<b>17</b>
4.1	2/3G SMS over MAP	17
4.2	4G SMS over SGsAP	18
4.3	4G SMS over Diameter	18
4.4	IMS SMS over MAP/Diameter	19
4.4.1	MAP is used between IP-SM-GW and HLR/HSS	19
4.5	5G SMS in MAP/Diameter	20
<b>5</b>	<b>SMS home architecture</b>	<b>20</b>
5.1	Current architecture	20
5.2	Potential future architecture	22
5.3	Pro/Cons for protocols	23
<b>6</b>	<b>SMS roaming</b>	<b>23</b>
6.1	Current roaming SMS architecture	23
6.2	Future roaming SMS architecture	24
6.3	Pro/Cons for roaming	<a href="#">2625</a>
<b>7</b>	<b>SMS interconnection</b>	<a href="#">2625</a>
7.1	Current bilateral architecture	<a href="#">2725</a>
7.2	Future bilateral architecture	<a href="#">2726</a>
7.2.1	Evolution of access network	<a href="#">2726</a>
7.2.2	Evolution of SMS interconnection NNI	<a href="#">2928</a>
7.2.3	Pro/CONS for interconnection	<a href="#">2928</a>
7.3	Current SMS Hubbing Architecture	<a href="#">3029</a>
7.4	Future SMS Hubbing architecture.	<a href="#">3029</a>
7.5	Pro/CONS for SMS Hubbing	<a href="#">3130</a>

<b>8</b>	<b>Ways to move forward</b>	<b><a href="#">3234</a></b>
<b>Annex A</b>	<b>&lt;2/3G&gt; SMS over MAP</b>	<b><a href="#">3433</a></b>
<b>Annex B</b>	<b>&lt;4G&gt; SMS over SGsAP and MAP</b>	<b><a href="#">3534</a></b>
B.1	Introduction	<a href="#">3534</a>
B.2	4G SMS over SGs Mobile originated case.	<a href="#">3534</a>
B.3	4G SMS over SGs mobile terminated case.	<a href="#">3635</a>
<b>Annex C</b>	<b>&lt;4G&gt; SMS over Diameter</b>	<b><a href="#">3736</a></b>
C.1	Introduction	<a href="#">3837</a>
<b>Annex D</b>	<b>&lt;IMS&gt; SMS over MAP/Diameter</b>	<b><a href="#">3938</a></b>
D.1	IPSMGW Functionalities	<a href="#">3938</a>
D.2	SMS transfer successfully sent from IMS	<a href="#">4039</a>
D.3	Successful SMS reception via IMS.	<a href="#">4241</a>
<b>Annex E</b>	<b>&lt;5G&gt; SMS over MAP/Diameter</b>	<b><a href="#">4443</a></b>
<b>Annex F</b>	<b>&lt;MTC/MIoT&gt; SMS</b>	<b><a href="#">4645</a></b>
<b>Annex G</b>	<b>Global architecture</b>	<b><a href="#">4746</a></b>
<b>Annex H</b>	<b>GSMA_Survey SMS Evolution Result summary</b>	<b>2</b>
H.1	Survey participation.	2
H.2	Survey result summary	2
H.3	Conclusions and survey lessons	4
<b>Annex I</b>	<b>Document Management</b>	<b>5</b>
I.1	Document History	5
	Other Information	5

# 1 Introduction

## 1.1 Overview

The scope of this document is to analyse the SMS evolution, specifically related to 4G, IMS, 5G, and MIoT introduction, this also includes the impact on roaming and the interconnection domain.

One of the key questions is, are there opportunities to move from MAP to Diameter protocol for different networks (4/5G and IMS) at home, roaming or interconnection context?

## 1.2 Abbreviations

Term	Description
A2P	Application to Person
AMF	Access Management Function
EC-GSM-IoT	Extended Coverage GSM Internet of Things
e-MTC	Enhanced Machine Type Communication
EPS	Evolved Packet Core
CS	Circuit Switched
GMSC	Gateway Mobile Switching Center
GT	Global Title
GW	Gateway
HLR	Home Location Register
HPMN	Home Private Mobile Network
HSS	Home Subscriber Server
iFC	Initial Filter Criteria
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
IPX	IP Packet exchange
IWF	Interworking Functionality
IWMSC	Inter Working Mobile Switching Centre
LTE	Long Term Evolution

LTE-M	LTE Mobile
LPWA	Low Power Wide Area
M2M	Machine to Machine
MAP	Mobile Application Part
MCC	Mobile Country Code
MIoT	Mobile Internet of Things
MME	Mobility Management Entity
MNC	Mobile Network Code
MNP	Mobile Number Portability
MNO	Mobile Network Operator
MO	Mobile Originated
MSISDN	Mobile Station International Subscriber Directory Number
MSC	Mobile Switching Center
MT	Mobile Terminated
MTC	Machine Type Communication
MTC-IWF	MTC InterWorking Function
MTC/MIoT	Machine Type Communication/Mobile IoT
NAS	Non Access Stratum Protocol
NB-IoT	Narrow Band IoT
NNI	Network-to-Network Interface
NP	Number Portability
OC-SMS	Open Connectivity SMS
ODB	Operator Determined Barring
OFA	Forward ShortMessage Operation
OTA	Over the Air
P2P	Person to Person
PDU	Protocol Data Unit
PGW	Packet Data Network Gateway
PS	Packet Switched

S8HR	S8 Home Routing
SCEF	Service Capability Exposure Function
SCCP	Signaling Connection Control Part
SCTP	Simple Control Transmission Protocol
SG	Signalling Gateway
SGSN	Service GPRS Support Node
SIM	Subscriber Identify Module
SM	Short Message
SME	Short Message Entity
SMS	Short Message Service (MO: Mobile Originating / MT: Mobile Terminating)
SMS-C	Short Message Service Center
SMSF	SMS Function (5G)
SMS-MO	SMS Mobile Originating
SMS-MT	SMS Mobile Terminating
SIGTRAN	Signalling Transport
SIP	Session Initialization Protocol
SS7	Signalling System 7
TCP	Transmission Control Protocol
TFA	TransFer Allowed
TFR	TransFer Restricted
UAC	User Agent Client
UAS	User Agent Server
UDM	Unified Data Management
UE	User Equipment
U-SIM	UMTS Subscriber Identify Module
VLR	Visitor Location Register
VPMN	Visited Private Mobile Network

### 1.3 Definitions

Term	Description
MloT	Mobile Internet of Things is a GSMA term which refers to the 3GPP standardised LPWA (Low Power Wide Area) technologies using the licenced band (aka LTE-M (LTE-Mobile), NB-IoT (Narrow Band IoT) and EC-GSM-IoT (Extended Coverage GSMA Internet of Things). From 3GPP Release 13 and the following Releases, the Category of UEs (User Equipment) that support power consumption optimisation, extended coverage and lower complexity are part of Mobile IoT, MloT (CAT M1, CAT NB1 from Release 13 and CAT M2, CAT NB2 from Release 14). As this particular term is widely used throughout GSMA, it is utilized also in this document. Not to be confused with the term “mIoT” which means 5G massive IoT in 3GPP terminology.
MTC	Machine Type Communications is a 3GPP term referring to pre-Rel-13 enhancements for M2M (Machine to Machine) applications over 3GPP technologies. 3GPP further developed the features for Machine Type Communications in Release 13 and later Releases, and the term enhanced MTC (eMTC) is used. The term eMTC is known as LTE-M at GSMA

### 1.4 Document Cross-References

ref	Document Number	Title
1	3GPP TS 23.040	Technical realization of the Short Message Service (SMS)
2	3GPP TS 29.002	Mobile application Part (MAP) specifications
3	3GPP TS 23.272	Circuit Switched (CS) fallback in Evolved Packet System (EPS)
4	3GPP TS 29.118	Mobility Management Entity (MME) - Visitor Location Register (VLR) SGs interface specification
5	3GPP TS 29.338	Diameter based protocols to support Short Message Service (SMS) capable Mobile Management Entities (MMEs)
6	3GPP TS 23.204	Support of Short Message Service (SMS) over generic 3GPP Internet Protocol (IP) access
7	3GPP TS 23.501	System Architecture for the 5G System (including SMS requirement)
8	3GPP TR 29.891	5G System (SMS section 9.1)
9	3GPP TS 23.682	Architecture enhancements to facilitate communications with packet data networks and applications
10	3GPP TS24.301	Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS)
11	3GPP 24.341	Support of SMS over IP networks; Stage 3
12	3GPP Rel.13	3GPP Rel.13
13	GSMA PRD IR.70	SMS SS7 Fraud
14	GSMA PRD IR.71	SMS SS7 Fraud prevention
15	GSMA PRD IR.75	Open Connectivity SMS Hubbing Architecture

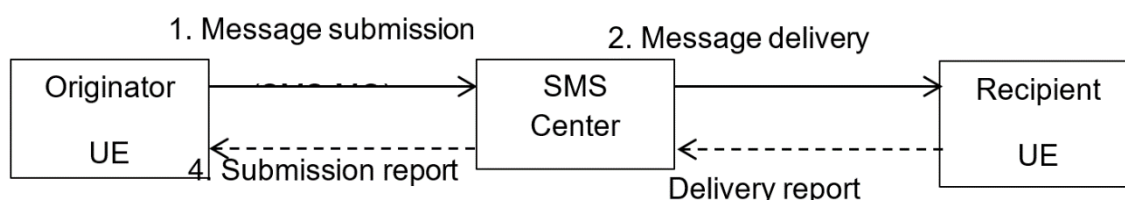
16	GSMA PRD IR.92	IMS profile for voice and SMS
17	GSMA PRD NG.108	IMS Profile for Voice and SMS for UE category M1
18	GSMA PRD BA.64	SMS and MMS Interworking
19	GSMA PRD AA.19	Addendum to the International GSM Roaming Agreement: SMS Interworking Agreement
20	RFC 6733	Diameter Base Protocol
21	GSMA PRD CLP.28	NB-IoT Deployment Guide to Basic Feature Set Requirements v2.0 (April18) <a href="https://infocentre2.gsma.com/gp/pr/IoT/MIoT/NB-IoT/OfficialDocuments/CLP.28%20NB-IoT%20Deployment%20Guide%20to%20Basic%20Feature%20set%20Requirements%20v2.0%20(Current)/CLP.28%20v2.0.pdf">https://infocentre2.gsma.com/gp/pr/IoT/MIoT/NB-IoT/OfficialDocuments/CLP.28%20NB-IoT%20Deployment%20Guide%20to%20Basic%20Feature%20set%20Requirements%20v2.0%20(Current)/CLP.28%20v2.0.pdf</a>
22	GSMA PRD CLP.29	LTE-M Deployment Guide to Basic Feature Set Requirements v2.0 (April18)

## 2 SMS Requirements

### 2.1 SMS service

SMS (Short Message Service) is divided into two steps:

1. Message submission.
2. Message delivery, which also includes a delivery report.



**Figure 1 SMS service**

The SMS is used for various use cases:

- Person-to-Person (P2P)
- Application-to-Person (A2P): very popular for generating significant wholesale interconnection revenues and also valid for MIoT (Mobile Internet of Things)
- Technical enabler: OTA (Over the Air) messaging for (U)SIM (UMTS Subscriber Identify Module) provisioning, IP (Internet Protocol) session wake-up.

#### 2.1.1 SMS Mobile Originating (SMS-MO, Mobile Originated)

Text messages are routed to a Short Message Service Centre (SMS-C) which is essentially an electronic message store. If the SMS-C receives the SMS successfully,



the SMS-C sends an acknowledgement to the originating handset which is often displayed to the sender as "message sent" (this does not mean that the recipient has received the text message). If there was a problem in sending the SMS: the sending handset may display a "message sending failure indication" to the sender.

### **2.1.2 SMS Terminating (SMS-MT, Mobile Terminated)**

If the SMS reached the SMS-C successfully, the SMS-C will then attempt to deliver the SMS to the receiving handset. If the receiving handset is switched on and in good coverage, then the SMS will be delivered. If the receiving phone is switched off or not in good coverage: the SMS-C will keep the SMS and try to deliver it when it knows the receiving handset is available to receive the SMS (retry mechanism and alerting mechanism)

The sender of the SMS will only know if the recipient has received the SMS if the sender of the Text Message selected the "delivery confirmation" option available on most handsets.

It is important at this stage to remember that the Short Message (SM originator) will always use SMSC(s) on its home network. This SMSC will also be responsible to deliver the SM to the receptor (also if the receptor is roaming or receptor is another network's user).

## **2.2 SMS for MTC/MIoT**

In the (Machine Type Communication) MTC/MIoT (Machine Type Communication/Mobile IoT) initiatives, the SMS could be a key technical enabler to exchange with objects with the following features:

- Wake-up for IP session: an SMS is sent to the object in order to wake-up an IP session. The solution is based on the MTC InterWorking Function (MTC-IWF, Interworking Functionality). The SMS message presents an indicator allowing the UE and the network to distinguish an MT message carrying device triggering information from any other type of message. In addition, useful Device trigger information named Trigger payload may be inserted in the SMS message.
- SMS without CS (Circuit Switch) minimizes the usage of the MSC (Mobile Switching Centre), especially in the case of a massive deployment of objects

NOTE: Today, this requirement is not confirmed by the NB-IOT and LTE-M (Long Term Evolution Mobile) communities. In fact, the results of recent surveys lead to conclude that: "Operators do not yet have consistent deployment plans. Therefore, the SMS is not a key feature for the short term deployment, and no related recommendation can be provided" NB-IoT clarified that MNOs do not yet have consistent deployment plans for SMS.

The survey document references can be found in section 1.4 of this document [18] and [19].

LTE-M has been updated following a later survey, which clarified that "SMS will be deployed for global LTE-M deployments". Therefore, this will have dependency on

networks supporting SMS without combined attached, or “consistent attached, or “consistent with the MNO’s existing implementation of SMS over legacy Long Term Evolution, LTE networks”.

### **2.3 SMS security**

SMS should be a trusted enabler from the end user perspective, and from the wholesale perspective. However, the SMS is facing a couple of security issues described in GSMA PRD IR.71 [11]

Despite any technical aspect, the sending of messages follows the normal procedure.

- **SMS Spamming:** is related to unsolicited SMS received by a subscriber. There are no specific technical aspects. The sending of messages follows the normal procedure.
- **SMS Flooding:** appears when a very large number of messages are sent to one or more destinations.

With specific technical aspects - Protocol is manipulated to send messages bypassing the normal procedure for message sending.

- **SMS Faking:** is a specific case where SCCP (Signalling Connection Control Part) or the MAP (Mobile Application Part) originator addresses are manipulated and replaced wrongly or stolen from a valid originator. The objective of this manipulation is to deliver the SMS for free (impossible for the receiver network to invoice the correct originator).
- **SMS Spoofing:** is related to an illegal use of the HPMN SMSC by a third party. To do that, the A-MSISDN (A- Mobile Station International Subscriber Directory Number) that originates the SMS is manipulated to be able to use the HPMN SMSC. Therefore, the SMS could be sent for free by the sending customer.
- **Global Title GT scanning:** is sending a SM-MO to ALL GTs of one network to detect SMSC and especially SMS-C not controlling the A-number. The final objective is to be able to send the SMS for free.
- **Open SMSC:** is SMS-C not controlling the A-number. The SMSC can be used by illegal customers (not part of HPMN).

Taking relevant actions to avoid these issues (via SMS control solution), the SMS is considered as a trusted solution to exchange a message of the identified user. This solution is largely used by example to identify the user when a login/password must be reset. Other advantages of using SMS technology for user authentication is that SMS is a “universal technology” (SMS is support by all devices; network natively)

However, after a couple of Signalling System 7, SS7 vulnerability audits, the SMS as a trusted solution has been challenged and other technologies are slowly replacing the SMS.

If we have already take actions to avoid SS7 vulnerability (SS7 Control solution), it is important to take actions to avoid direct vulnerability for new protocols (Diameter, SIP, Session Initialization Protocol) and continue to make the SMS a universal trusted technology to authenticate the customer.

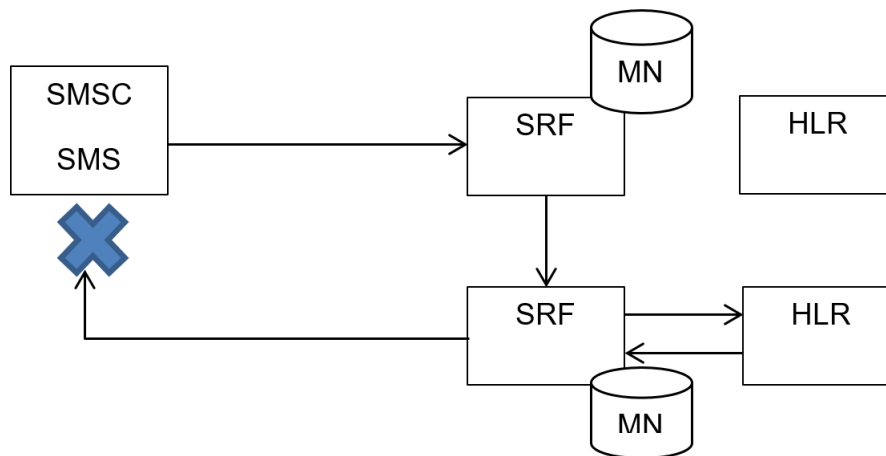
## 2.4 SMS Number Portability

If the management of MNP (Mobile Number Portability) for SMS delivery in a national context is fully controlled and efficient, it is not always the case in the international interconnection context.

The major issue to terminate a SMS appears when the recipient network does not have signalling connectivity with the SMS Sender Network or the SMS Hub provider.

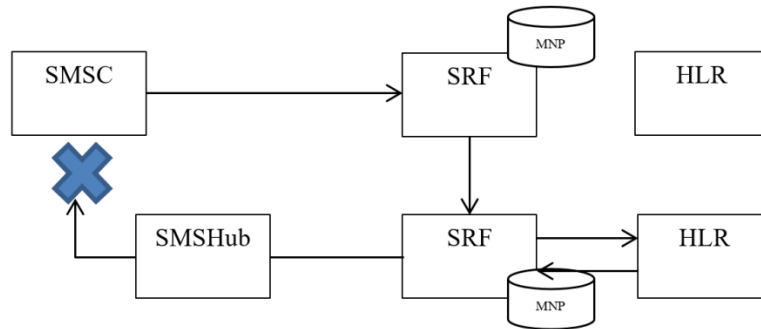
Signalling message Routing Based on MSISDN, the sender is not aware about the MSISDN Number porting OUT so the message related SMS MT procedures will be routed to the number range holder network. If the number is ported out, the messages related to the SMS MT procedure will be forwarded to the recipient network.

But if the recipient network does not have signalling open with the SMS Sender network or the SMS hub then the SMS MT procedure could not be completed.



**Figure 2 SMS Number Portability fails – Case 1**

To complete the picture, we have to take into account the case where signalling connectivity is non-existent between the SMS hub used by the Recipient Network and the SMSC of the SMS Sender Network.



**Figure 3 SMS Number Portability fails – Case 2**

This issue has been largely demonstrated on the current deployment based on MAP but a solution has not been provided to solve this issue.

The correct way to manage Mobile Number portability delivering SMS to any customer on any network in any country is to have connectivity with ALL operators in that country. This connectivity can be completed via bilateral agreement between operators or more simply through an SMS hub connectivity.

### 3 SMS use cases

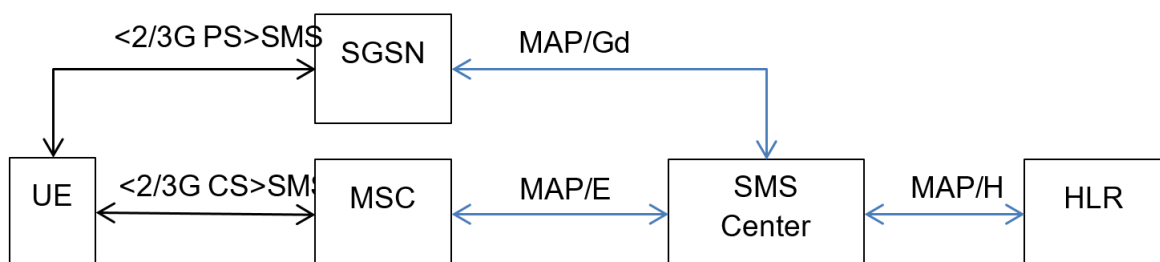
This section will detail the different protocols used to transport SMS over the core network.

#### 3.1 <2/3G> SMS over MAP

Three MAP interfaces have been defined to support the Short Message Service:

1. H interface between HLR (Home Location Register) and the SMS C (SMS-GMSC, Gateway Mobile Switching Center)
2. E interface between MSC and the SMSC (SMS-GMSC, SMS-IWMSC, Inter Working Mobile Switching Centre)
3. Gd interface between SGSN (Service GPRS Support Node) and the SMSC (SMS-GMSC, SMS-IWMSC)

MAP interface is built on top of SS7 (TDM or SIGTRAN, Signalling Transport) using the following layers (TCAP, SCCP and MTP).



### Figure 4 SMS over MAP interfaces

For M2M applications/devices that only require Packet Switched, (PS) data, avoiding to attach to the CS domain is trivial. However, for other applications/devices, attachment to the CS domain can be avoided only when the following conditions are satisfied:

- a) The UE only needs PS domain services and SMS.
- b) The SGSN supports SMS.
- c) The HLR/HSS (Home Subscriber Server) supports SMS via SGSN.
- d) For roaming cases, the roaming agreement allows SMS via SGSN

### 3.2 <4G> SMS over SGsAP and MAP

With 4G introduction, an intermediate environment (without IMS, International Mobile Subscriber Identity) was specified. This is called SMS over the Signalling Gateways SGs (evolved Gs interface) and it is a hybrid approach that allows the transmission of native SMS from a CS infrastructure over the LTE radio network. SMS over SGs was specified in 3GPP TS 29.118 [4] (running on top of SCTP, Simple Control Transmission Protocol).

The SGs based on GS is used to handle mobility management and paging procedures between the EPS and CS domain, however for SMS it is used to deliver both mobile originating and terminating SMS.

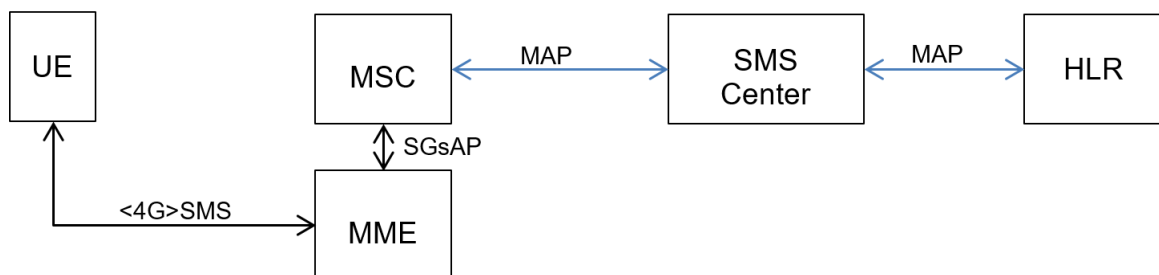


Figure 5 SMS over SGsAP and MAP interfaces

### 3.3 <4G> SMS over Diameter

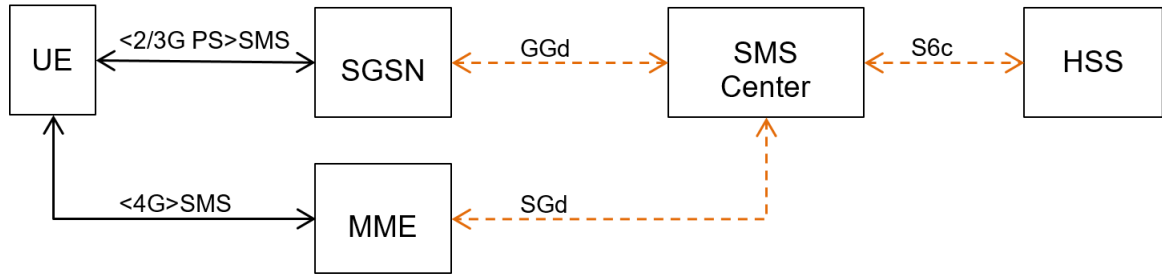
Diameter protocol was introduced with 4G to transport SMS between MME (Mobility Management Entity) and SMSC. It could also apply on some SGSN supporting EPS interfaces.

SMS in MME enables support of MO and MT SMS over LTE without requiring any involvement of any MSCs. Instead of delivering MT-SMS via the MSC (which would require the UE to be registered in the CS domain), the Short Messages pass directly between the MME and the SMSC using a new Diameter-based interface SGd.

The following Diameter interfaces have been defined to support Short Message service.

- S6c interface between HSS and the central SMS function (SMS-GMSC, SMS Router);

- SGd interface between MME, the SMS-IWMSC, the SMS-GMSC and the SMS Router;
- Gdd interface between the SGSN, the SMS-IWMSC, the SMS-GMSC and the SMS Router



**Figure 6 SMS over Diameter interfaces**

**NOTE:** In the <4G> context and as specified in 3GPP TS24.301, the Non Access Stratum Protocol, NAS transport message procedures to carry the encapsulated SMS messages between the UE and MME is used. The SMS messages CP-DATA, CP-ACK and CP-ERROR are carried in the NAS Message Container IE in the Uplink or Downlink NAS Transport message within the NAS PDU (Non Access Stratum Protocol Data Unit).

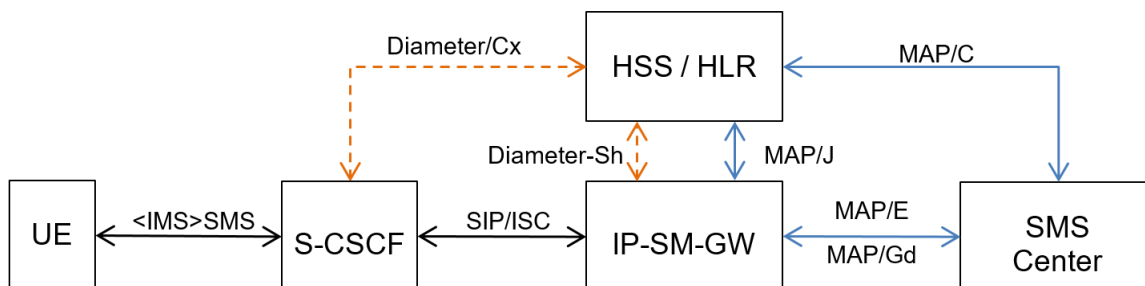
The Non Access Stratum (NAS) is a set of protocols in the Evolved Packet System. The NAS is used to convey non radio signalling between UE and MME for LTE/E UTRAN.

### 3.4 <IMS> SMS over MAP/Diameter

With the IMS introduction, VoLTE network could also support the SMS sent over SIP and the VoLTE phone will receive it. IP-SM-GW, placed between the IMS core and the legacy domain, provides the possibility for the users to register and deregister, in order to enable or disable the possibilities to send/receive SMSs over IP.

It is important to note that IP-SM-GW is connected to the HLR/HSS and is able to communicate with it both with MAP and Diameter:

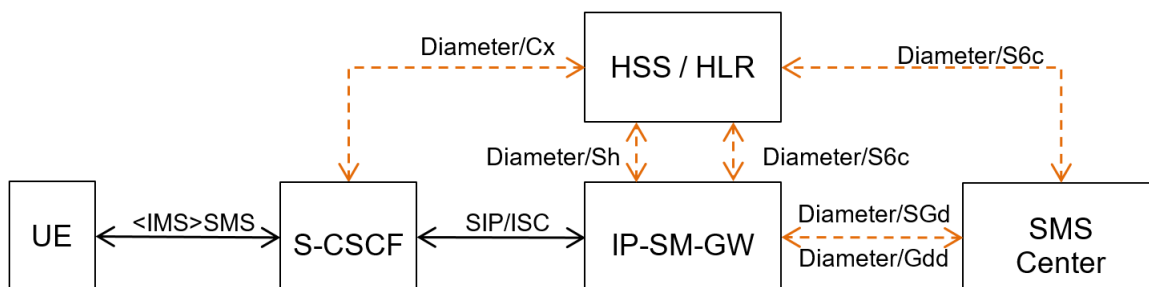
#### MAP is used between IP-SM-GW and HLR/HSS



**Figure 7 SMS over IMS interfaces (MAP)**

#### Diameter is used between IP-SM-GW and HLR/HSS

(Recently standardized in 3GPP TS 23.204 v14.0.0, April 2107[6])

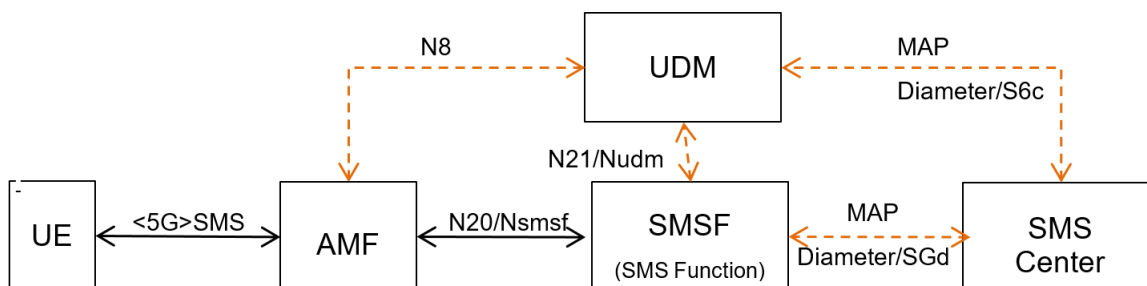


**Figure 8 SMS over IMS interfaces (Diameter)**

**3.5 <5G> SMS in MAP/Diameter**

SMS is defined in 5G as a clear requirement in 3GPP 23.501 [7] [section 4.4.2].

SMS architecture is defined in 3GPP 29.891 [8] [section 9.1].



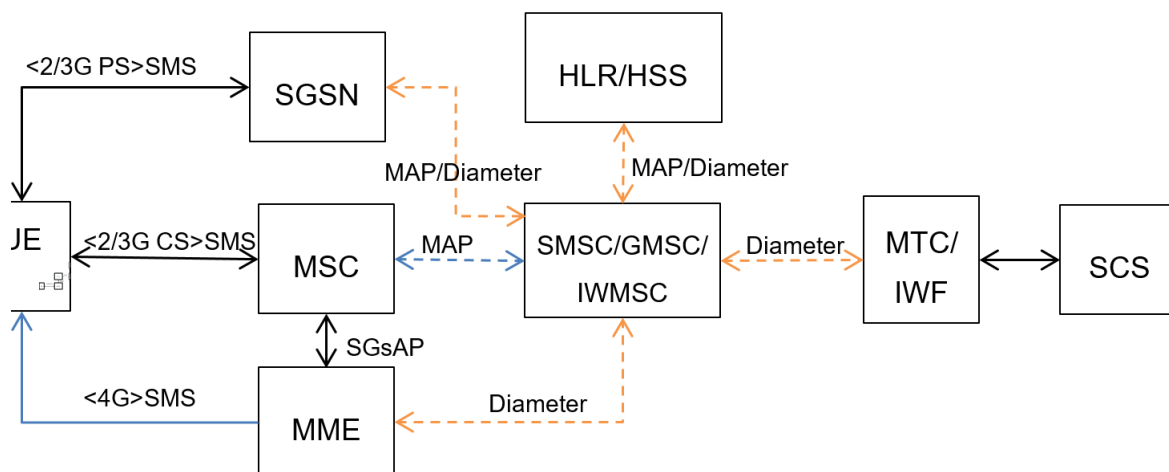
MAP and Diameter are supported in 5G between the SMS function, SMSF and SMSC.

**Figure 9 SMS over 5G interfaces (MAP/Diameter)**

**3.6 <MTC/MIoT>**

SMS will also be used for objects for:

- Wake-up IP session: using MTC-IWF environment (defined in 3GPP TS 23.682 [9]), SMS will be delivered using <2/3G> or <4G> SMS use cases. The global ecosystem around this is Diameter oriented (T4, T6, T7 Diameter interface)

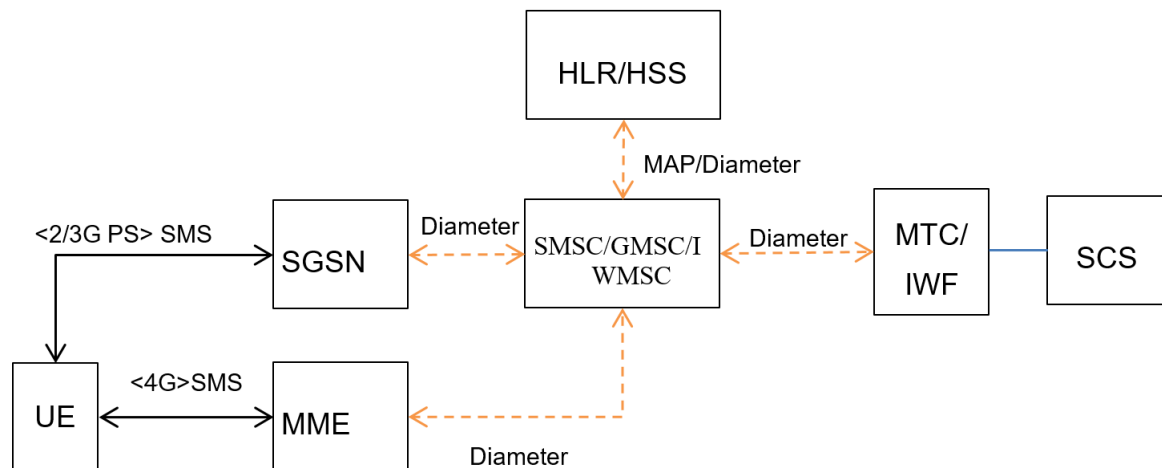


**Figure 10 MTC/MIoT via MAP or Diameter for Wake-up IP session**

- SMS delivery without CS usage in order to avoid double attachment (CS/PS); 2 cases are foreseen:
  1. 2/3G: PS only, using SMS via SGSN
  2. 4G: “SMS transfer without combined attach” allows an NB-IoT UE to request SMS service by launching an EPS Attach procedure instead of a combined



attach procedure. The MME shall request to be registered for SMS by indicating its MME Number for MT SMS in the Location Update Request to the HSS, including the SMS-Register-Request AVP (SMS in MME Required, SMS in MME not Preferred, No Preference for SMS in MME)



**Figure 11 MTC/MIoT via Diameter for without CS usage**

- **SMS using CloT EPS optimisation:** As part of the MTC evolution, 3GPP Rel.13 introduced a new work item called Cellular IoT (CloT) with EPS optimisation to allow infrequent small data transport. There are two ways for SMS/Data transfer using Control-plane or User-plane CloT EPS optimisation, depending on configuration. The UE can be registered with the EPS network without activating a PDN connection and using Control Plane optimization. The device can now exchange SMS data. SMS transfer can therefore be supported without the need for a combined attach for CloT devices. Both Control Plane NAS PDU via S11-U between S-GW and MME or User Plane via S1-U between SGW and eNB can be used for SMS/Data transfer. Also note that SMS service can be used simultaneously with both IP data (terminated at the PGW Packet Data Network Gateway) and non-IP data (terminated at the PGW or at the SCEF) using Control Plane CloT EPS optimisation.

## 4 SMS protocols

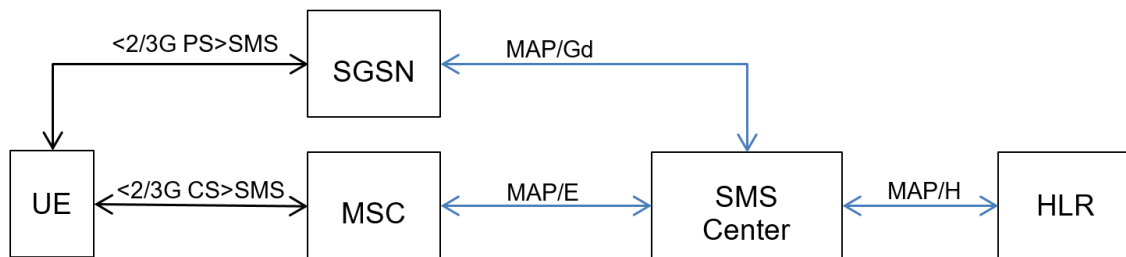
This section will detail the various protocols used to transport SMS over the core network.

### 4.1 2/3G SMS over MAP

Three MAP interfaces have been defined to support the Short Message Service:

1. H interface between HLR and the SMS C (SMS-GMSC)
2. E interface between MSC and the SMSC (SMS-GMSC, SMS-IWIMSC)
3. Gd interface between SGSN and the SMSC (SMS-GMSC, SMS-IWIMSC)

MAP interface is built on top of SS7 (TDM or SIGTRAN) using the following layers (TCAP, SCCP and MTP)

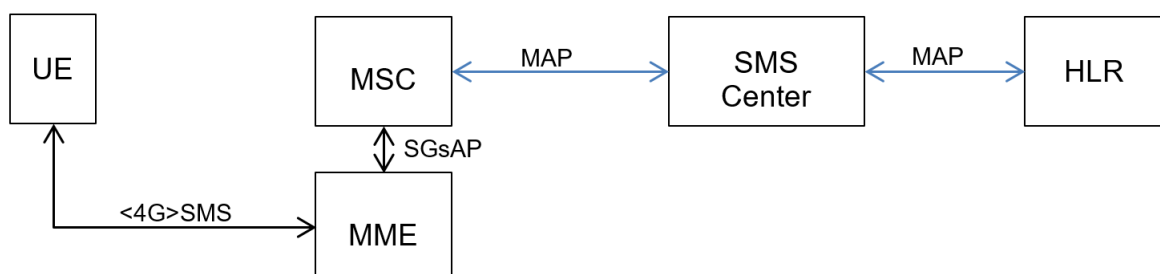


**Figure 12 SMS over MAP interfaces**

#### 4.2 4G SMS over SGsAP

With 4G introduction, an intermediate environment (without IMS) was specified. This is called SMS over SGs (evolved Gs interface). A hybrid approach that allows the transmission of native SMS form CS infrastructure over the LTE radio network. SMS over SGs was specified in 3GPP TS 29.118 [4] (running on top of SCTP).

The SGs based on Gs is used to handle mobility management and paging procedures between EPS and CS domain, and, for SMS, to deliver both mobile originating and mobile terminating SMS.



**Figure 13 SMS over SGsAP interfaces**

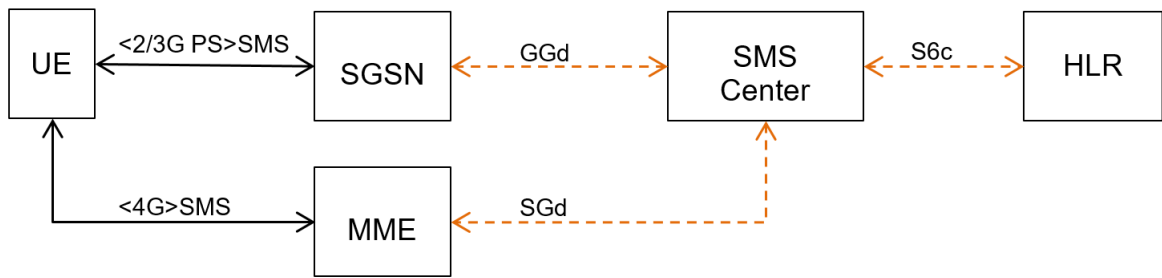
#### 4.3 4G SMS over Diameter

Diameter protocol was introduced with 4G, in order to transport SMS between MME and SMSC, and could also apply on some SGSN supporting EPS interfaces

The following Diameter interfaces have been defined to support Short Message services

- S6c interface between HSS and the central SMS function (SMS-GMSC, SMS Router);
- SGd interface between MME, the SMS-IWMSC, the SMS-GMSC and the SMS Router;

- GGd interface between the SGSN, the SMS-IWMSC, the SMS-GMSC and the SMS Router



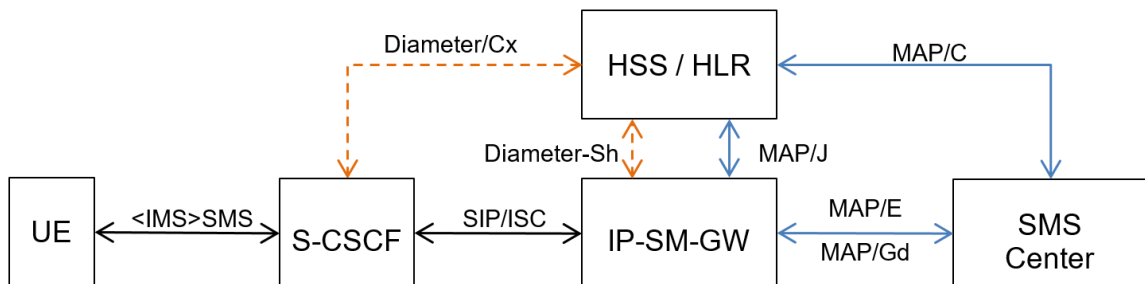
**Figure 14 SMS over Diameter interfaces**

#### 4.4 IMS SMS over MAP/Diameter

With IMS introduction, VoLTE network could also support the SMS sent over SIP. IP-SM-GW, placed between the IMS core and the legacy domain, provides the possibility for the users to register and deregister, in order to enable or disable the possibilities to send/receive SMSs over IP.

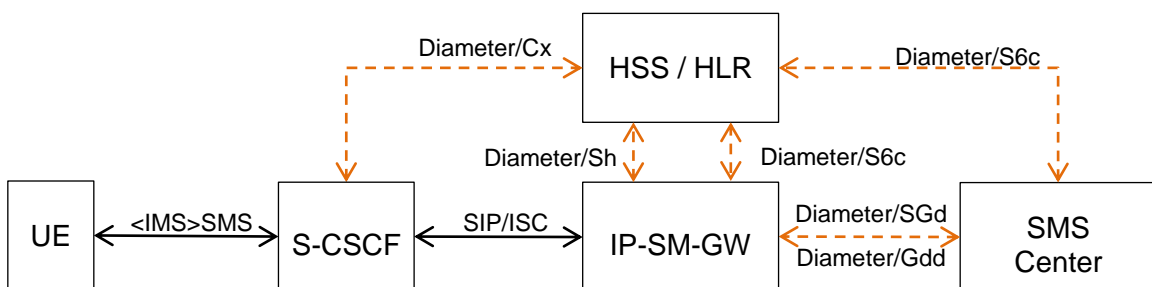
It is important to notice that IP-SM-GW is connected to the HLR/HSS and is able to communicate with it both with MAP and Diameter:

##### 4.4.1 MAP is used between IP-SM-GW and HLR/HSS



**Figure 15 SMS over IMS interfaces (MAP)**

Diameter is used between IP-SM-GW and HLR/HSS



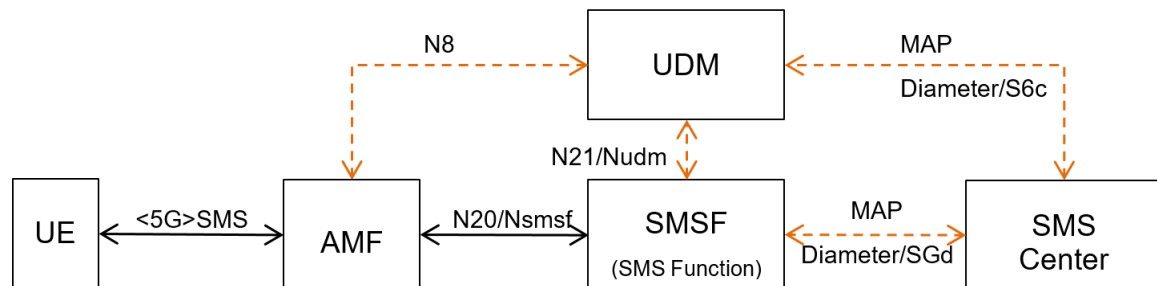
**Figure 16 SMS over IMS interfaces (Diameter)**

#### 4.5 5G SMS in MAP/Diameter

SMS is defined in 5G as a clear requirement in 3GPP 23.501 [7] [section 4.4.2].

SMS architecture is defined in 3GPP 29.891[8] [section 9.1].

MAP and Diameter are supported in 5G between SMSF and SMSC.



**Figure 17 SMS over 5G interfaces (MAP/Diameter)**

Therefore, the protocols group CT4 has decided that network protocols should be used for SBA. It will be HTTP2 on top of TCP, Transmission Control Protocol (no longer SCTP).

5G signalling (based on HTTP2/JSON) shall apply in the 5G Core Network. The SMSF also supports legacy SMSC interworking via the MAP or Diameter interface. So the SMS evolution towards 5G will see the potential support for legacy MAP/Diameter signalling for SMS.

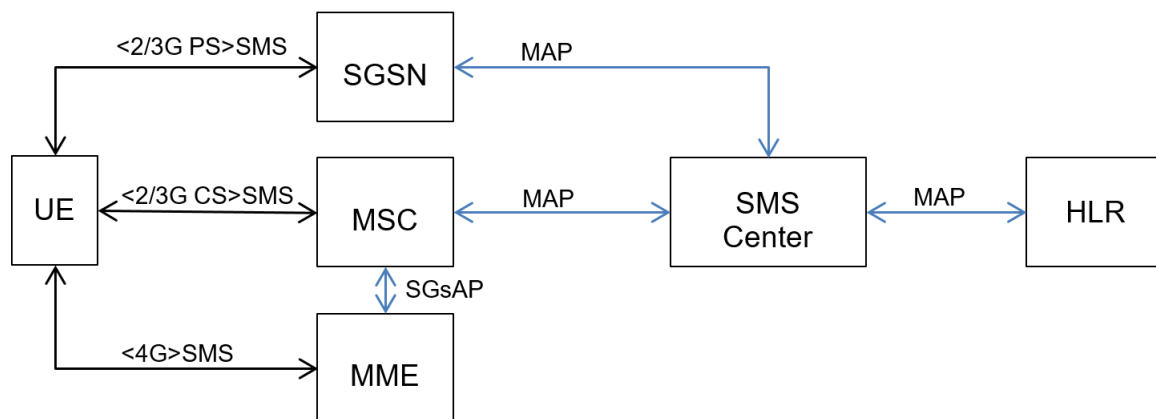
## 5 SMS home architecture

Different architectures are foreseen in the future to transport SMS, taken into account 4G (using Diameter), IMS (using SIP) and 5G evolution.

This section introduces the Home Network architecture and will focus on the roaming impact while section 6 will describe the interconnection impacts.

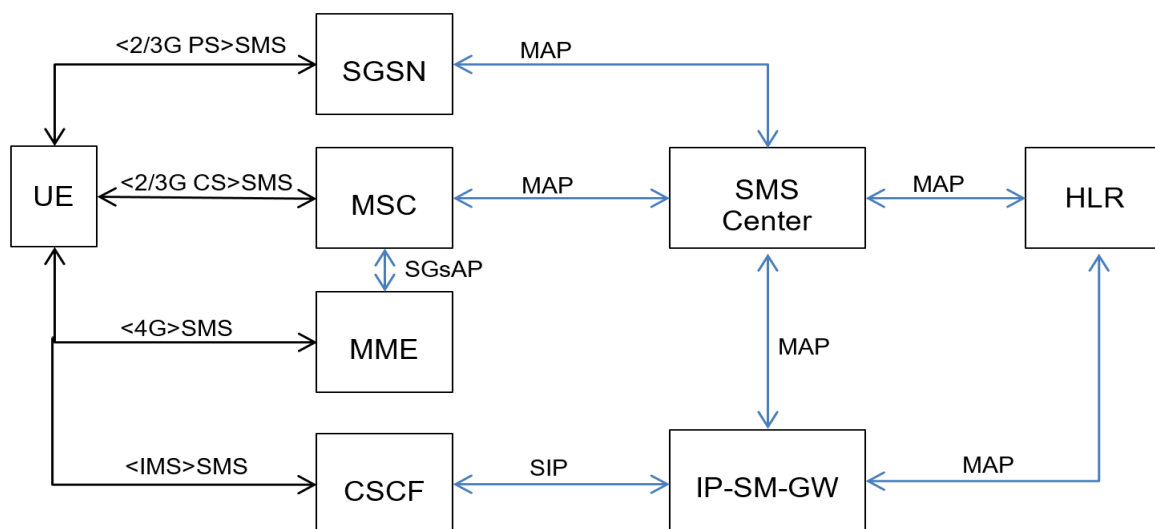
### 5.1 Current architecture

The current core network architecture to transport SMS is based on MAP (2/3G) and SGsAP (4G) protocol, capitalising on SS7 networks.

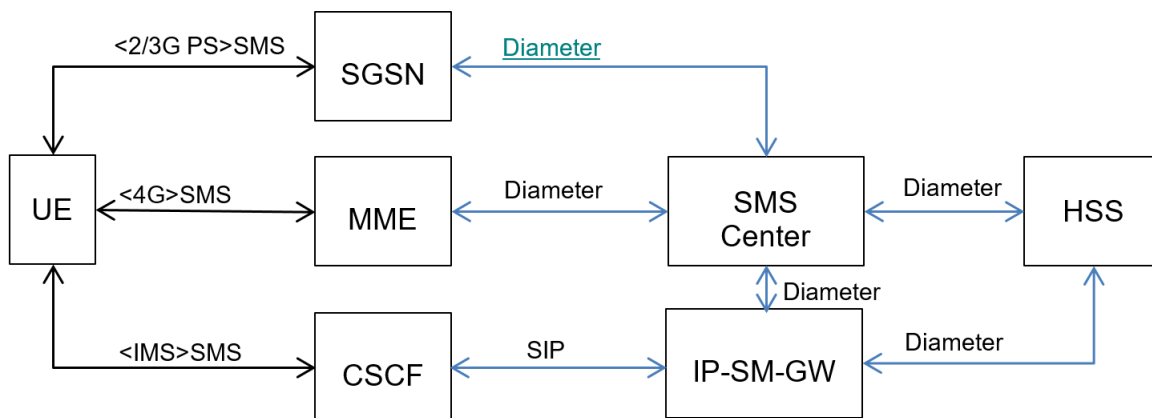


**Figure 18 Current SMS architecture (MAP/SGsAP)**

The current IMS core network architecture to transport SMS over IP is described in the following diagrams for (i) in combination with the legacy CS network; (ii) standalone EPC network.



**Figure 19- Current SMS architecture (MAP/SMSoIP)**

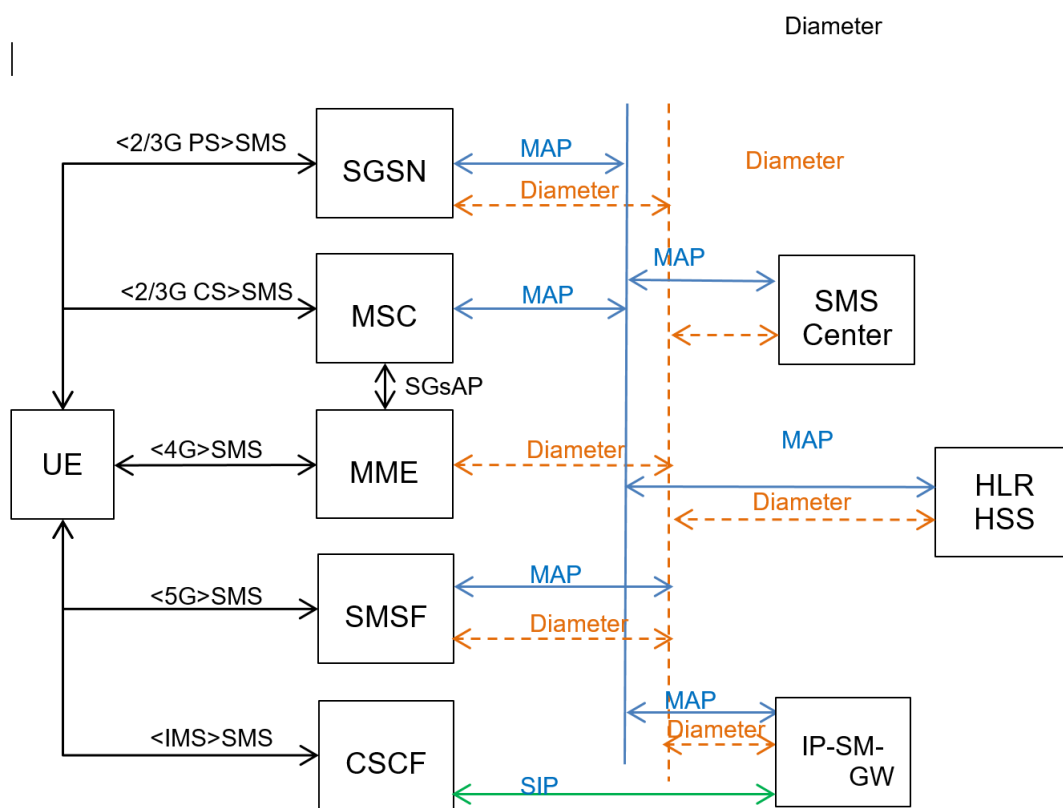


**Figure 20 EPC/IMS SMS architecture (Diameter/SMSoIP)**

## 5.2 Potential future architecture

Different architectures are foreseen in the future to transport SMS, taken into account 4G (using Diameter), IMS (using SIP) and 5G evolution.

The 4G SMS could be transported by Diameter while IMS/5G SMS could select MAP or Diameter in order to interconnect with SMSC and HLR/HSS.



**Figure 21 Future SMS architecture (4G/IMS/5G)**

**NOTE:** For 4G SMS, and at this stage, no recommendation whether to use Diameter or SGsAP can be done.

NOTE: For 5G, is it better to reuse MAP, or to implement Diameter?

NOTE: Nx interface: 3GPP is studying the possibility to use HTTP and to replace Diameter by JSON over HTTP2.

### 5.3 Pro/Cons for protocols

	Pros	Cons
MAP	MAP is a common transport mechanism for 2/3/4G	Need to have MSC involved
Diameter	Diameter is a common protocol for 4G and IMS Bypass MSC (no more need to be attached on CS, especially important for objects) Enable IP wake-up	Migration from MAP to Diameter
SIP	Common protocol for VoLTE Bypass MSC (no more need to be attached on CS)	Low technical efficiency Not possible to wake-up an IP session using IP

Table 1 Protocols Pros Vs Cons

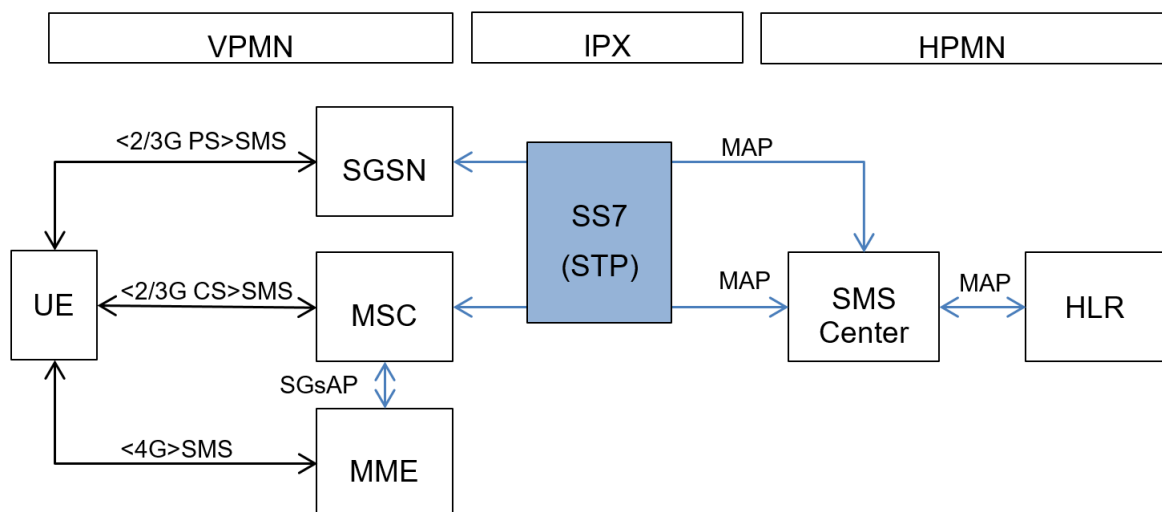
## 6 SMS roaming

This section will analyse the current and potential future of the roaming architecture.

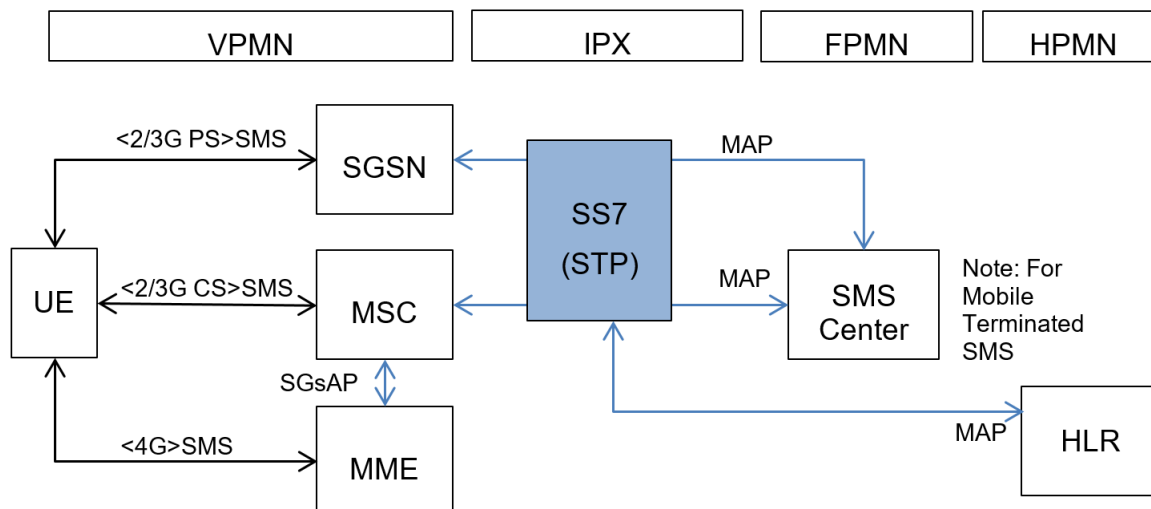
### 6.1 Current roaming SMS architecture

The current roaming architecture is based on SS7 network connecting the VPMN, and HPMN.

All roaming SMS are routed via the SS7 network: 4G SMS are anchored to the MSC.



**Figure 22 Current roaming SMSO architecture (SS7)**



**Figure 23 Current roaming SMST architecture (SS7)**

## 6.2 Future roaming SMS architecture

For roaming, the key issue is related to 4G (and 5G evolution) for the usage of Diameter in order to replace MAP protocol. For IMS, the choice between MAP and Diameter is a HPMN internal issue, because IMS SMS roaming are always anchored to the home IP-SM-GW (S8HR, S8 Home Routing scenario).



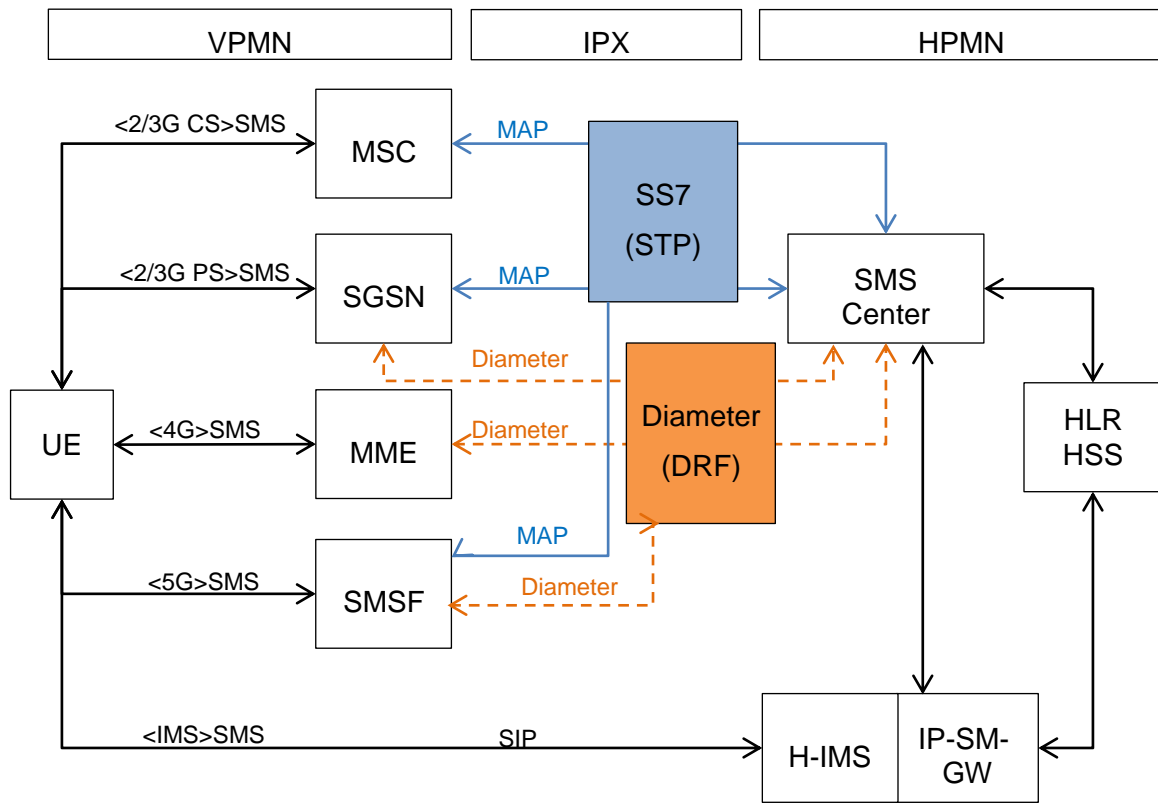
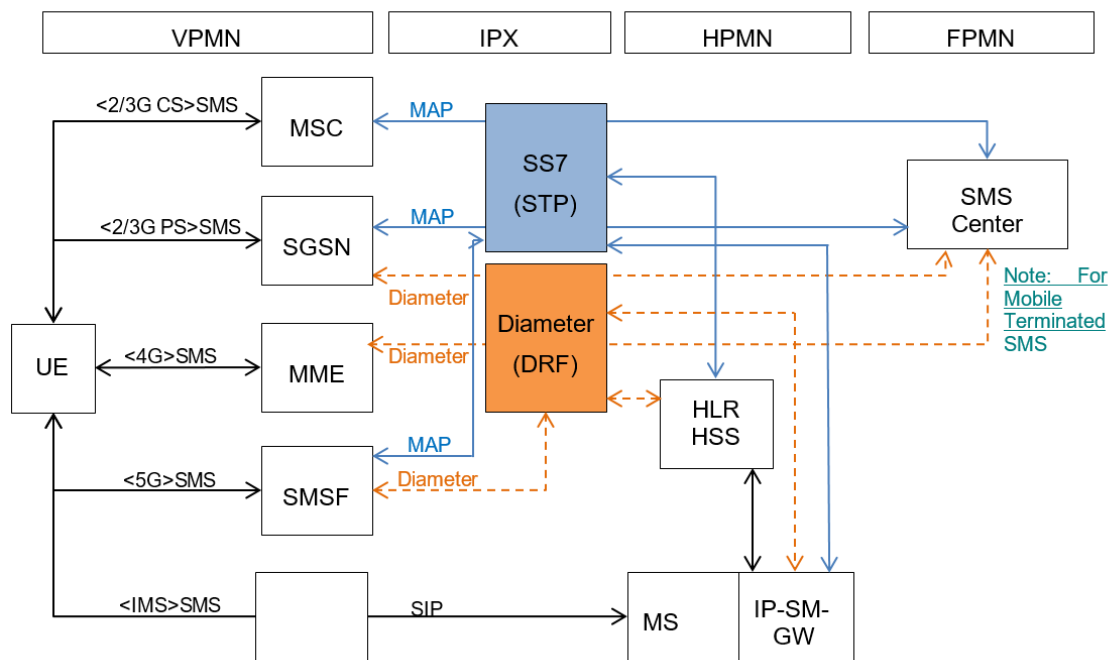


Figure 24- Future roaming SMS architecture (Diameter)



**Figure 25- Future roaming SMS architecture (Diameter)**

NOTE: SGSN could also use Diameter for Location Update procedures (instead of MAP)

### 6.3 Pro/Cons for roaming

	Pros	Cons
MAP	MAP is a common transport mechanism for 2/3/4G	Continued potential support in 5G although concerns for SS7 security will need to be addressed especially on the roaming interface.
Diameter	Reduce SS7 investment for MNO and Carriers Bypass MSC (no more need to be attached on CS), specially for MIIoT Enable IP wake-up Future proof for 5G?	New interface for roaming Diameter vulnerability could be an issue (today) or an advantage (using signed AVP), specially to protect networks against SMS-MO spoofing

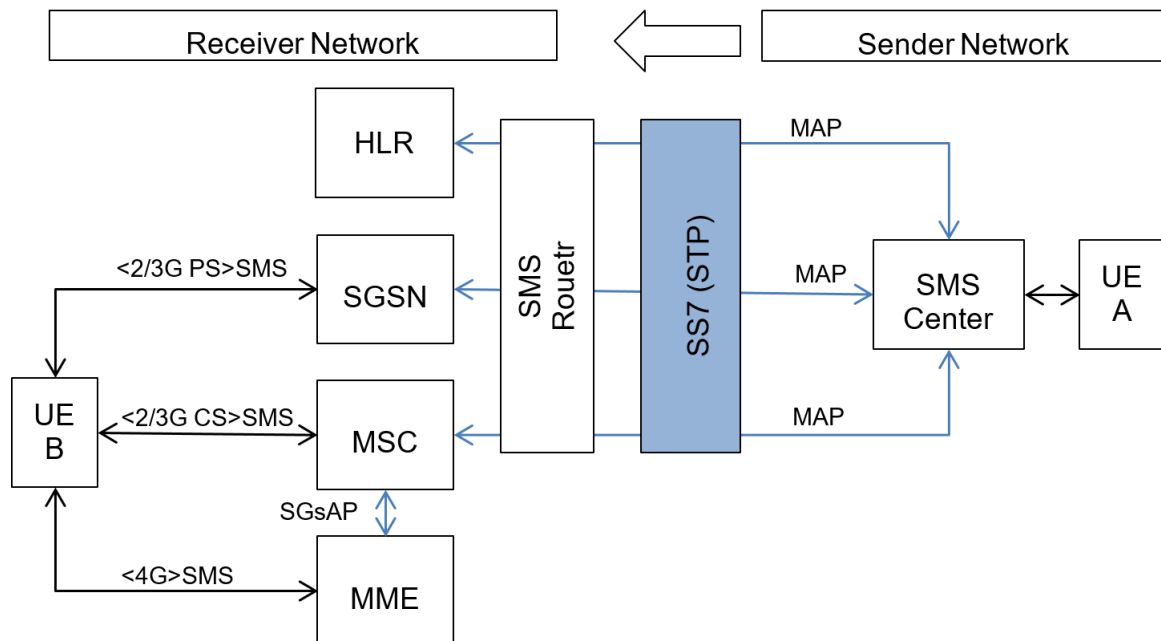
## 7 SMS interconnection

This section will analyse the current and potential future interconnection architecture for national and international environment.

## 7.1 Current bilateral architecture

All interconnection SMS are routed via the SS7 network: 4G SMS are anchored to the MSC.

In the receiver network, an SMS Firewall (FW) is responsible to Home Route all incoming SMS, especially in order to protect receiver network (signalling vulnerability).



**Figure 26- Current interconnection SMS architecture (SS7)**

NOTE: SMS Router is highly recommended in order to protect the network against signalling vulnerabilities.

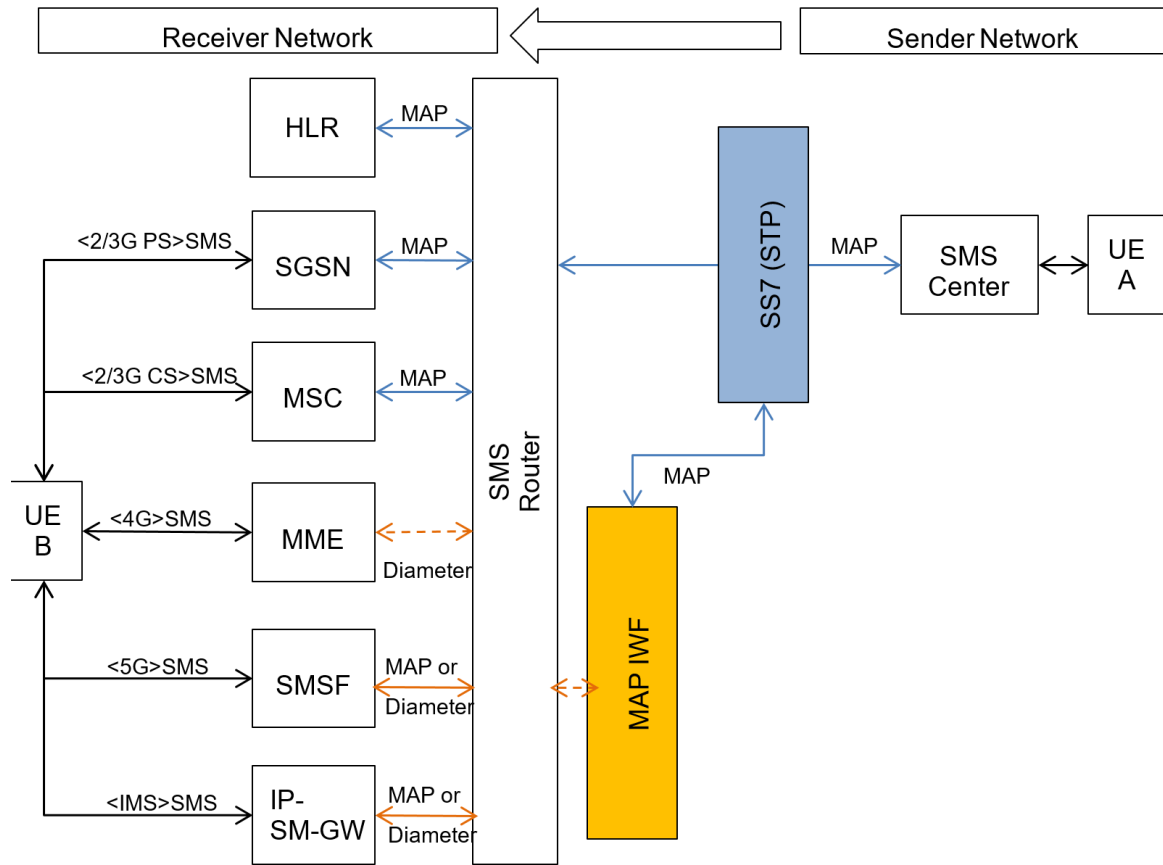
## 7.2 Future bilateral architecture

### 7.2.1 Evolution of access network

The interconnection could be affected by the evolution of the access network technology, moving to 4G, IMS and 5G.

The figure hereafter describes the evolution based on a MAP NNI (Network-to-Network Interface) between the Sending and the Receiving Networks: the SMS firewall, implementing the Home routing policy, will be able to deliver the SMS over various access technologies, using MAP or Diameter. Typically, this function is supported by the MAP IWF as described in 29.305.

The SMS home Routing policy is also mandatory in order to hide the access technology to the Sender network.



**Figure 27 Future interconnection SMS architecture (Access network evolution)**

### 7.2.2 Evolution of SMS interconnection NNI

The NNI could also evolve from MAP to Diameter for SMS interconnection. The critical issue is to resolve the Number Portability, (NP).

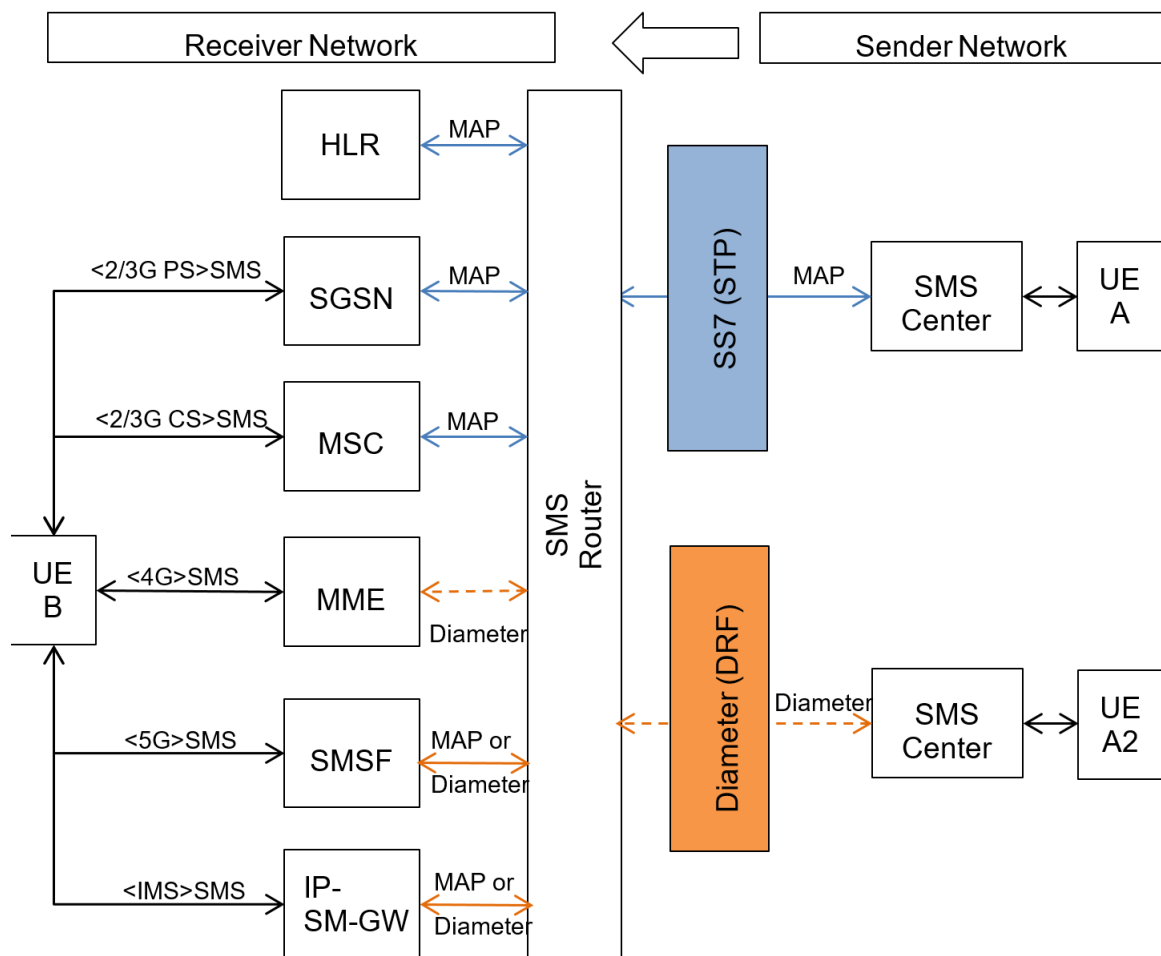


Figure 28 Future interconnection SMS architecture (NNI evolution)

### 7.2.3 Pro/CONs for interconnection

NNI	Pros	Cons
MAP	MAP is a common transport mechanism for 2/3/4G NP portability resolution	Continued potential support in 5G although with some concerns for SS7 security that will need to be addressed especially on the interconnect interface.
Diameter	Reduce SS7 investment for MNO and Carriers Future proof for 5G?	New interface for interconnection Diameter vulnerability could be an issue (today) or an advantage (using signed AVP), specially to protect networks against SMS-MT faking NP portability resolution to be re-build

Table 2 Interconnection Pros Vs Cons

### 7.3 Current SMS Hubbing Architecture

Currently, a client operator can choose to connect the OC-SMS Hubbing Solution provider using SS7 MAP based interface or IP based SMPP interface as described in GSMA IR75 Open Connectivity SMS Hubbing.

NOTE: To simplify, the SMS Router in the receiver network is not represented but can exist.

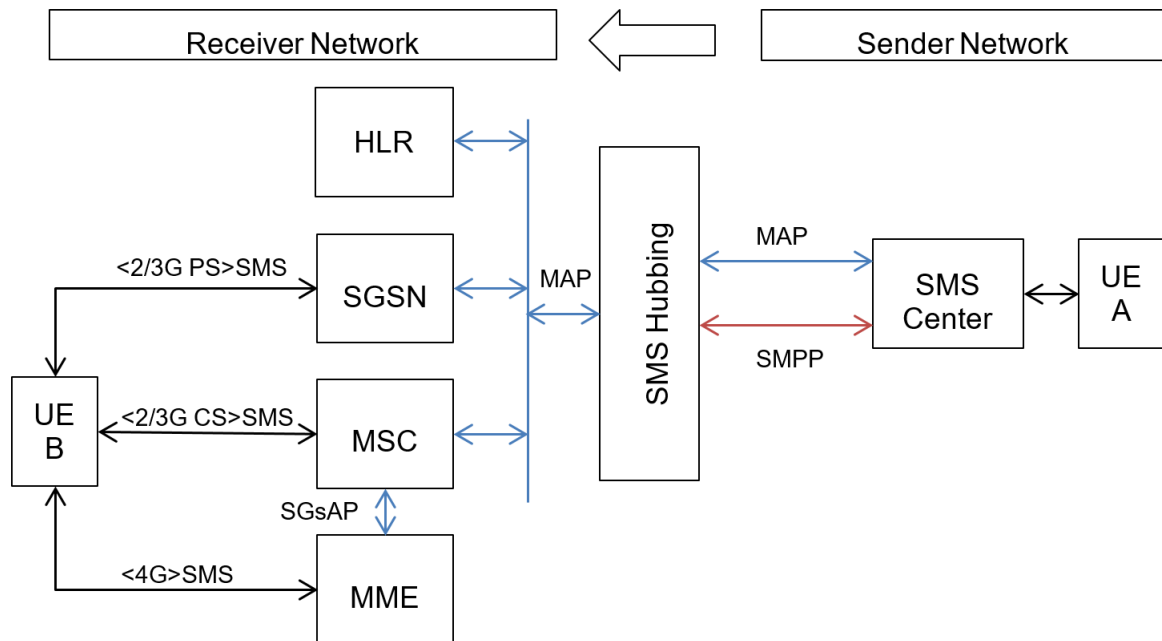
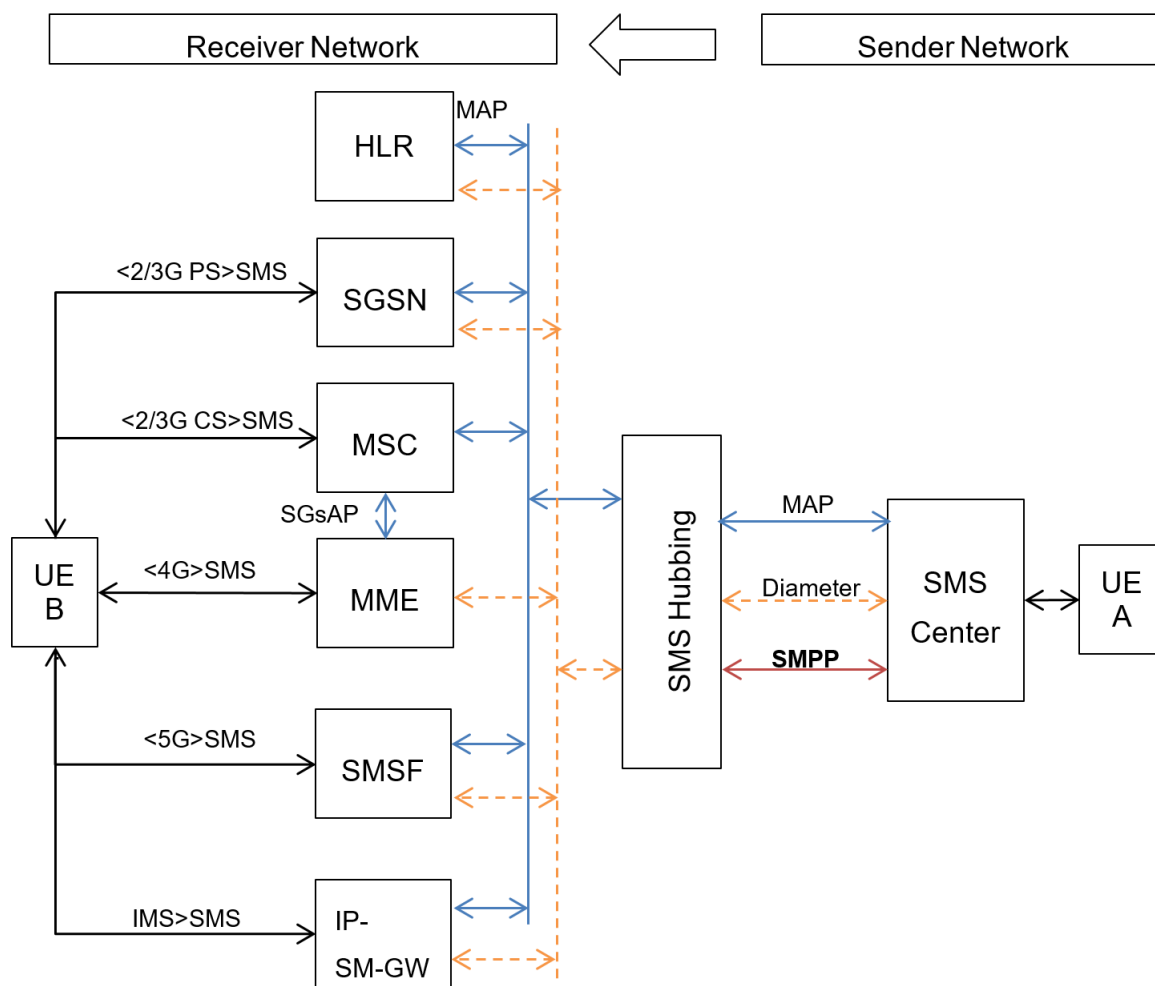


Figure 29 Current SMS Hubbing architecture (SS7/SMPP)

### 7.4 Future SMS Hubbing architecture.

The client operator connection could be affected by the evolution of the network access technology, moving to 4G, IMS and 5G.

With 4G, the SMS Hubbing solution provider could propose the client operator a new Diameter interface to connect SMS Hubbing solution.



**Figure 30 Future SMS Hubbing architecture (SS7/SMPP/Diameter)**

NOTE: Diameter is currently not defined as a possible interface to connect the client operator to SMS Hubbing solution in GSMA PRD IR.75 Open Connectivity SMS Hubbing v.2.0.

### 7.5 Pro/CONS for SMS Hubbing

Pro/Cons are similar to Pro/Cons for NNI interconnection.

SMS Hubbing	Pros	Cons
MAP	MAP is a common transport mechanism for 2/3/4G NP portability resolution	Continued potential support in 5G although with some concerns for SS7 security that will need to be addressed especially on the interconnect interface.
Diameter	Reduce SS7 investment for MNO and Carriers Future proof for 5G?	New interface for interconnection Diameter vulnerability could be an issue (today) or an advantage (using signed AVP), specially to protect networks

		against SMS-MT faking NP portability resolution to be re-build
--	--	---

**Table 3 SMS Hubbing Pros Vs Cons**

## 8 Ways to move forward

The results of the SMS survey provide a very interesting overview on the SMS evolution and the possible introduction of new protocols to support SMS.

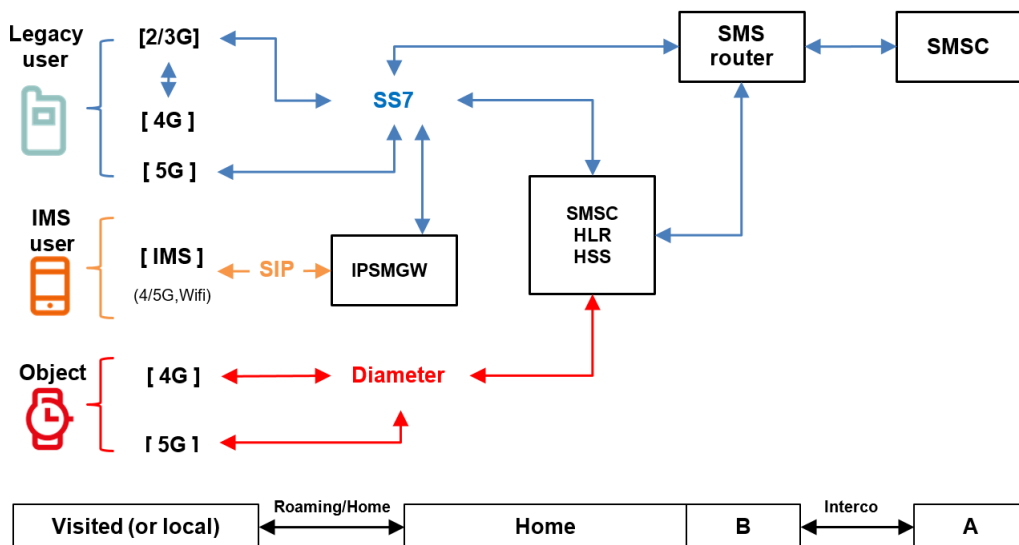
The responses of different operators who participated in this survey clearly indicate a change in the SMS according to the type of user and not an overall trend for any type of users.

Three categories of users could be identified:

1. Legacy users - there are no drivers to justify a change of technology for the SMS transport for legacy users.
2. IMS User - for IMS users, the SMS migration to IP using SIP is no longer in doubt, benefiting from VoLTE convergence and capabilities to offer SMS service under Wi-Fi coverage. This SMSoIMS technology can also be considered in a roaming situation (SMS-MO and SMS-MT).
3. Objects - as the survey showed, operators consider SMS to be a very important technical enabler in the context of MIoT. The most frequently use cases are the "Wake Up IP session" and OTA, besides standard MO and MT-SMS. But in the particular context of MIoT, the SMS service must be considered without a double attachment on the circuit switch and packet switch networks. Objects should only be attached on packet switch in order to minimise non futureproof capacity extension on the legacy network. With MIoT, SMS service migration on diameter seems recommended and also in line with Diameter eco-system to connect SCEF.

The figure below illustrates the trend resulting from the analysis of the survey results and shows a differentiated evolution of the support of the SMS service according to the type of user: Legacy, IMS or Object.





**Figure 31 SMS Evolution by User type.**

The technology that will be used to support the SMS will therefore depend on the type of user as already mentioned but also according to the use case: Home, Roaming or Interco.

The table below allows a clear visual of the evolution of the technology supporting the SMS service according to the type of user and the use case.

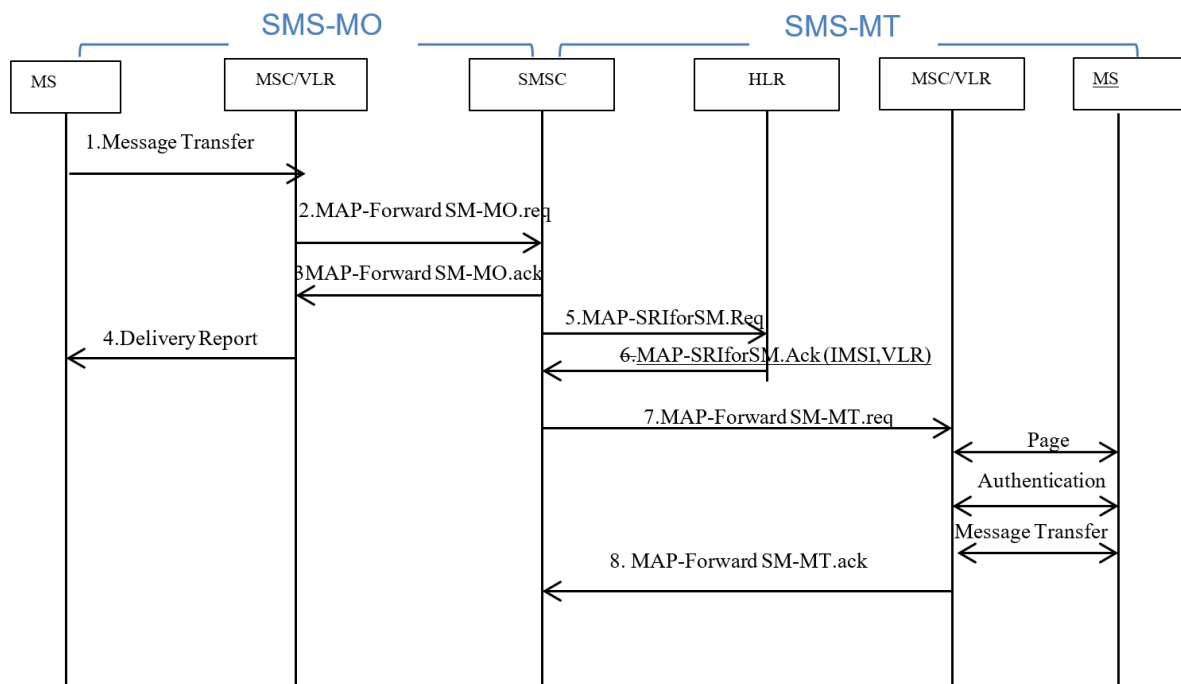
	Home	Roaming	Interco
Legacy User	SS7	SS7	SS7
IMS User	SIP	SIP	SS7
Object	Diameter	Diameter	NA

**Table 4 Evolution of Technology**

As a conclusion, we can say that the evolution of the SMS technology will not be uniform for all users but will depend on the specific needs of the three major classes of users identified: Legacy, IMS and Object.

If the migration of the SMS over IP is already well under way for the IMS users, however the migration of SMS over Diameter for Objects is still, today, at an early stage with many items to be still solved.

## Annex A <2/3G> SMS over MAP



**Figure 32 SMS Over Map Signaling flow**

1. The MS transfers the SM to the MSC. The MSC interrogates the VLR (Visitor Location Register) to verify that the message transfer does not violate the supplementary services invoked or the restrictions imposed.
2. The MSC sends the short message to the SMSC using the forwardShortMessage operation.
3. The SMSC acknowledges the MSC the successful outcome of the forwardShortMessage operation.
4. The MSC returns the MS outcome of the MO-SM operation.
5. After completing its internal processing, the SMSC interrogates the HLR and receives the routing information for the mobile subscriber.
6. The SMSC sends the short message to the MSC using the forwardShortMessage operation. The MSC retrieves the subscriber information from the VLR. This operation may include an authentication procedure.
7. The MSC transfers the short message to MS.
8. The MSC returns the SMSC the outcome of the forwardShortMessage operation. If requested by the SME (Short Message Entity), the SMSC returns a status report indicating delivery of the short message.

## Annex B <4G> SMS over SGsAP and MAP

### B.1 Introduction

SMS over SGs is independent from Circuit Switched Fall Back. As no fallback takes place, SMS over SGs does not require overlapped coverage of LTE and legacy technologies.

Supporting SMS over SGs requires some slight modifications to the EPS attach procedure, which is based on the combined EPS/IMSI (International Mobile Subscriber Identity) Attach procedure. Compared to the conventional attach, additional information about CS domain capabilities is exchanged. The EPS Attach Type in the ATTACH REQUEST message indicates that the UE requests a combined EPS/IMSI attach and informs the network whether the UE requests “SMS only” services (“SMS only” – included in the ATTACH REQUEST only if no CSFB is required).

During the Attach, the SGs association between MME and MSC/VLR entities is created.

### B.2 4G SMS over SGs Mobile originated case.

The following pictures are taken from 3GPP TS 23.272 [3] technical specification [section 8 other CS Services].

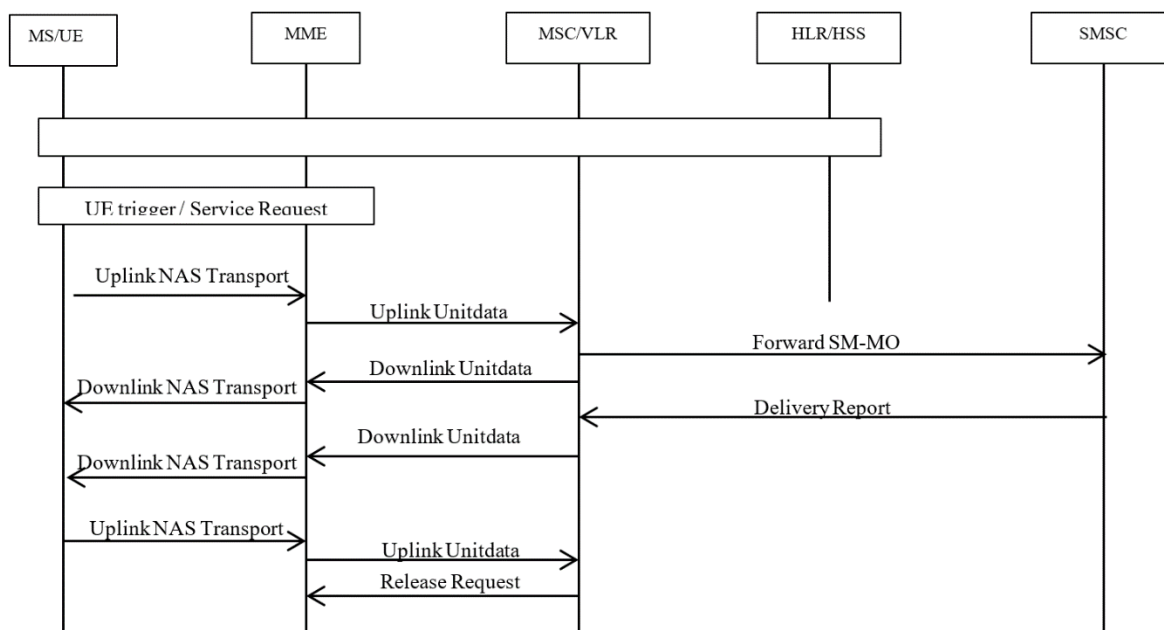
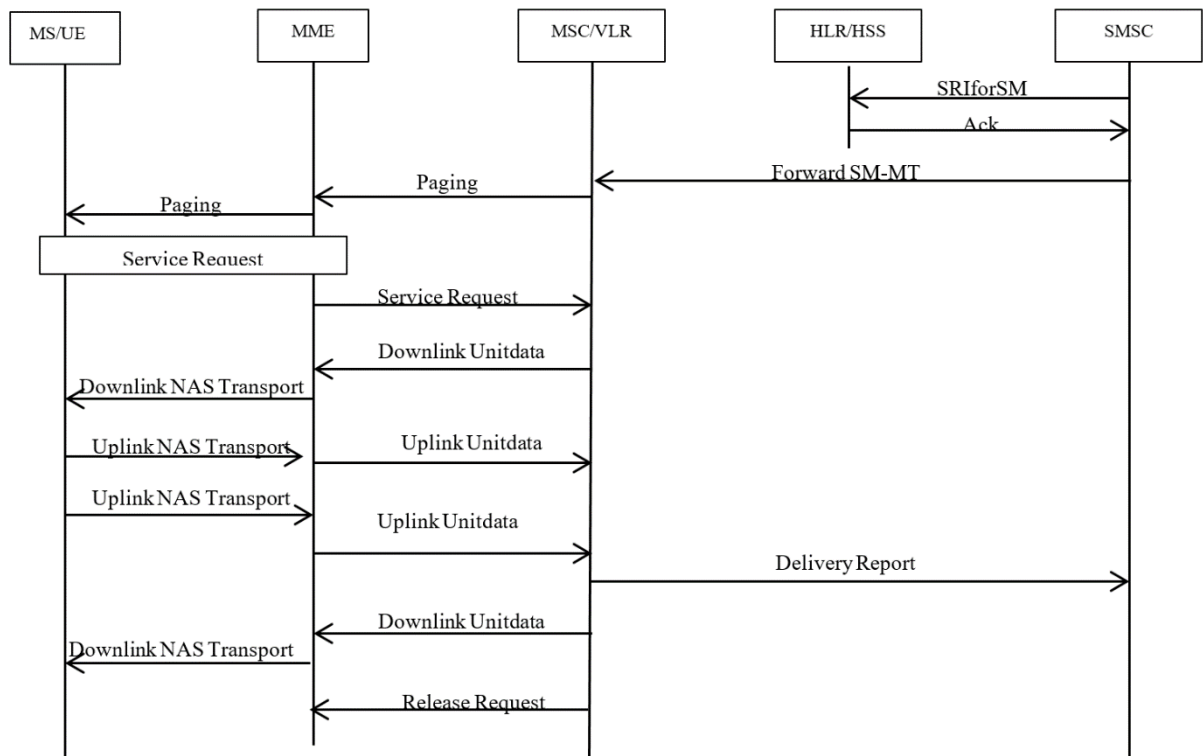


Figure 33 SMSO over SG flow

After the EPS/IMSI Attach, the UE triggers a service request to initiate a mobile originating SMS procedure. The SMS is encapsulated in a NAS message and sent to the MME, which forwards the SMS to the MSC/VLR that acknowledges the reception of the SMS to the UE. The SMS is forwarded to the SMSC that returns a Delivery Report message. The Delivery Report is forwarded back to the UE. The UE acknowledges the reception of the Delivery Report to the MSC/VLR and the MSC/VLR indicates to the MME that no more NAS messages that need to be tunnelled.

### B.3 4G SMS over SGs mobile terminated case.

The following pictures are taken from 3GPP TS 23.272 [3] technical specification [section 8 other CS Services].



**Figure 34 SMST over SG flow**

The service Center initiates the transfer of the SMS. The HLR is requested for the routing information for the SMS services and the SMS is forwarded to the right MSC/VLR where the UE is attached.

The MSC/VLR issues a paging to the MME, and the MME initiates a paging to each LTE base station with cells in the tracking area(s) in which the UE is registered. Upon successful paging, the UE sends a Service Request message to the MME who issues a Service Request to the MSC/VLR. The MSC/VLR builds the SMS and forwards it to the MME which encapsulates the SMS in a NAS message to the UE. The UE acknowledges the reception of the SMS to the MSC/VLR and Issues a delivery report (if initially requested). The Delivery Report is forwarded to the SMSC. The MSC/VLR acknowledges the reception of the Delivery Report to the UE and indicates to the MME that no more NAS messages need to be tunnelled.

## Annex C <4G> SMS over Diameter

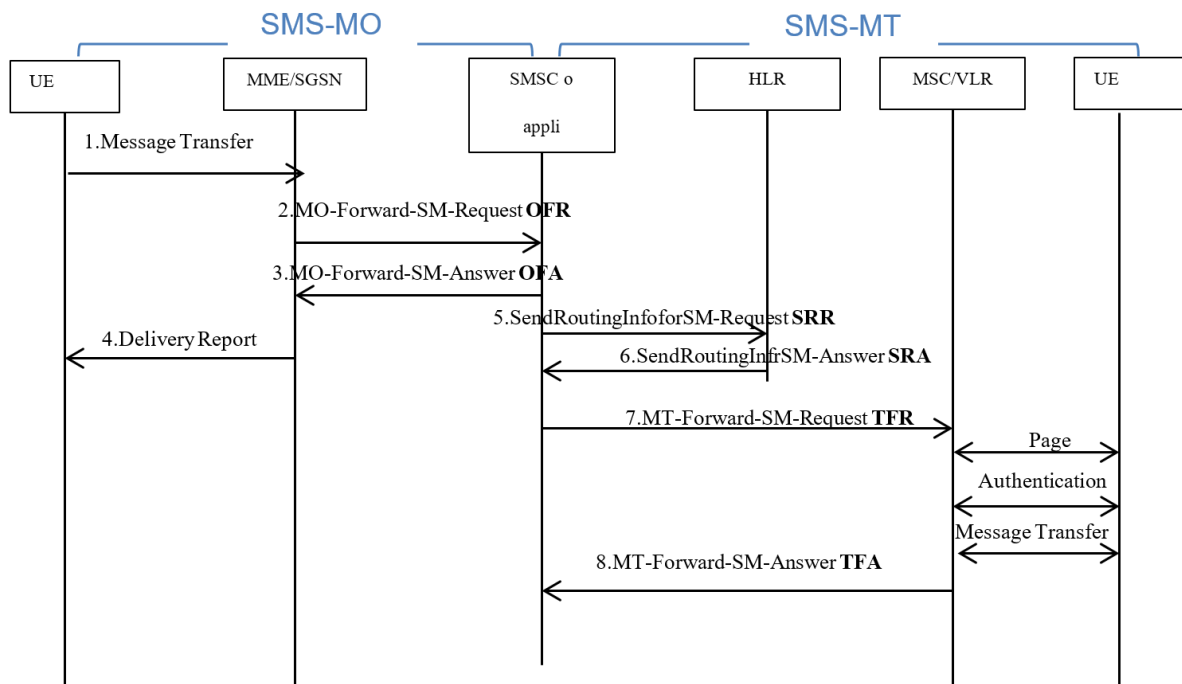
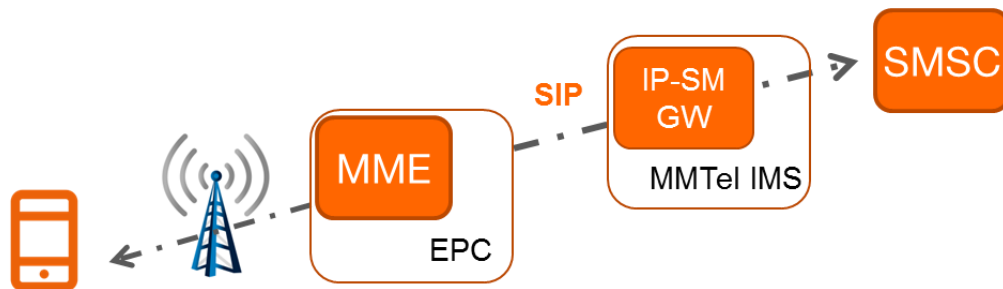


Figure 35 SMS over Diameter flow

1. The UE transfers the SM to the MME/SGSN. The MME/SGSN shall check if the SMS related subscription data (e.g. ODB, Operator Determined Barring data and Call Baring) allows the forwarding of the short message.
2. The MME/SGSN sends the short message to the SMSC using the forwardShortMessage operation (**OFR**).
3. The SMSC acknowledges to the MME/SGSN the successful outcome of the forwardShortMessage operation (**OFA**).
4. The MME/SGSN returns to the MS outcome of the MO-SM operation.
5. After completing its internal processing, the SMSC interrogates the HSS and receives the routing information needed for routing the short message to the serving MME/SGSN.
6. The SMSC sends the short message to the serving MME/SGSN using the forwardShortMessage operation (**TFR**). The MME/SGSN checks if the IMSI is known. Then the MME/SGSN attempts to deliver the short message to the UE is, if successful, the MME/SGSN returns a Result Code set to Diameter\_Success. In any other case, the relevant error is returned.
7. The MME/SGSN transfers the short message to MS.
8. The MME/SGSN returns to the SMSC the outcome of the forwardShortMessage operation (**TFA**). If requested by the SME, the SMSC returns a status report indicating the delivery of the short message.

## C.1 Introduction

As described in GSMA IR.92 [13], VoLTE network has to support the SMS sent over SIP. The VoLTE phone will receive a common (binary) SMS and the native client will display this message as any other. The only difference is that this time the SMS is sent from an IMS network over SIP protocol. The purpose is not just to support common text messages, but (more importantly) to support OTA messaging for (U)SIM provisioning, SMS 'non-text' applications or Message Waiting Indication for Voice Mail.



**Figure 36 SMS over IMS interfaces**

IMS allows the sending of messages of 200 bytes with acknowledgement. The messages are sent between users in real-time. The service provides a fast enough exchange of messages for an interactive conversation to take place.

In IMS there are two types of messages: page-mode message and session-mode message: for SMS, only page mode will be used.

A page-mode message is very similar to an SMS. It is a SIP MESSAGE. It is not related to any previously sent message and requires no answer. It can be a test sent between two subscribers, or a notification. The User Agent Client (UAC) sends the SIP MESSAGE to the proxy, and the proxy forwards it to the User Agent Server (UAS), which responds with a 200 OK message.

### Example

```
MESSAGE sip:bob@example.org SIP/2.0
Via: SIP/2.0/TCP alicepc.example.com;branch=z9hG4bK776sgd43d
Max-Forwards: 70
From: Alice sip:bob@example.org
Call-ID: a3d3hdj5ws223ns61k8djds
Cseq: 1 MESSAGE
Content-Type: text/plain
Content-Length: 31

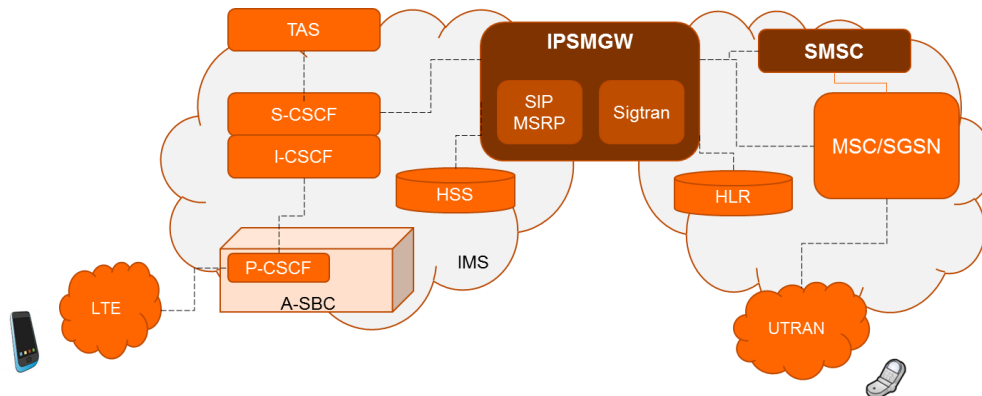
Hi, what is going today,
```

The general form of SIP MESSAGE is presented above. The first line defines the message type, followed by a number of headers used for the routing of the message and the control of the session. At the bottom we find the message body, this is an actual case of text sent by the subscriber

## Annex D <IMS> SMS over MAP/Diameter

### D.1 IP-SMGW Functionalities

The network functionality which provides messaging service in the IMS network is called IP-SM Gateway (IP-SM-GW) and from the IMS point of view it is an Application Server.



**Figure 37 IP-SMGW architecture**

From the picture above we can see that the IP-SM-GW is a bridge between 2/3G networks and IMS. We have two types of IP-SM-GWs defined in 3GPP TS 23.204 [6] (and some OMA enhancements in 3GPP TR 23.824). Firstly, it is a Service Level Interworking (SLI) which can work with Session or Pager Mode Messaging. Then it is a Transport Level Interworking (TLI) which can work with SMS over IP only (SMoIP). This time we will focus on the TLI. The specification of the TLI is the 3GPP 24.341. If not familiar with the SMS flow, the SMS in 2G/3G first can be studied.

3GPP 23.204 [6] has identified the following function to be supported by IP-SM-GW:

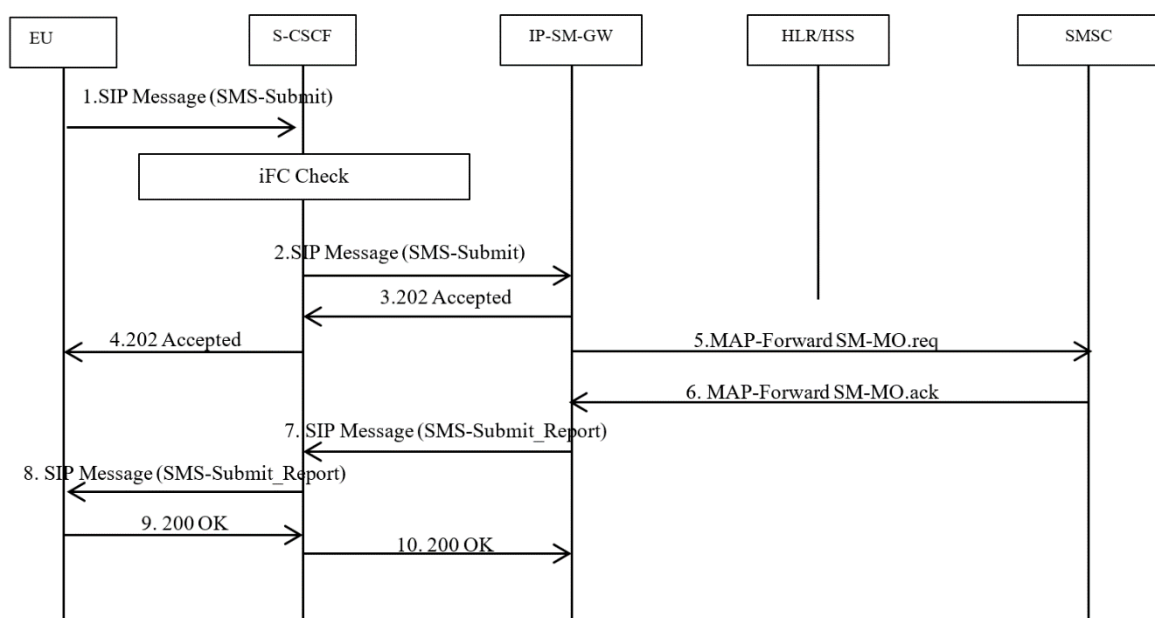
- Identify the domain where the short message must be delivered (CS, DS or IMS).
- Assures the transmission to the legacy network Seamless:
  - The SMS-GMSC sees it as if it where MSC or SGSN connecting to it via MAP;
  - The SMS-IW-MSC sees it as if it where MSC or SGSN, connecting to via MAP.
- Responds with its own address to the Routing Information for Short Message MAP requests received from the HSS
- When sending a message to the legacy domain, it must connect via the HSS to find the address of the MSC/SGSN concerned
- Keep the data correlation between the MSIDN/IMSI and the address of the associated S-CSCF
- In case the Short Message is sent from IMS towards legacy domain, it must check that the sender and receiver addresses are correct in the SIP headers

- For messages sent from legacy domain towards IP based domain, a translation from the MSIDN/IMSI to TEL URI or to SIP URI (only possible if IMSI information is available), must be done
- Act as an Application Server for the IMS core
- To read from the HSS and interpret the available flags for the SMS receiver.

The introduction of the IP-SM-Gateway has an impact on the function to be supported by HSS. These “complementary” functions are also described in the 3GPP 23.204 [6].

- To now for each subscriber the address of its corresponding IP-SM-GW
- Have flags for each subscription (terminal) which indicate its registration to an IP-SM-GW
- To respond with the address of the MSC/SGSN to the Routing Information for Short Message requests received from the IP-SM-GW
- To forward to the IP-SM-GW the Routing Information for Short message query. It also must respond with the IMSI and the associated MSC/SGSN address
- When the terminal is not available to receive of the message, the HSS stores the address of the SC in the Message Waiting Data file. It must then inform the SC when the terminal becomes available for receiving the message through the IP-SM-GW
- Send a notification to the IP-SM-GW when the user becomes available after a delivery failure
- Accept delivery status reports from IP-SM-GWs instead of SMS-GMSC.

## D.2 SMS transfer successfully sent from IMS



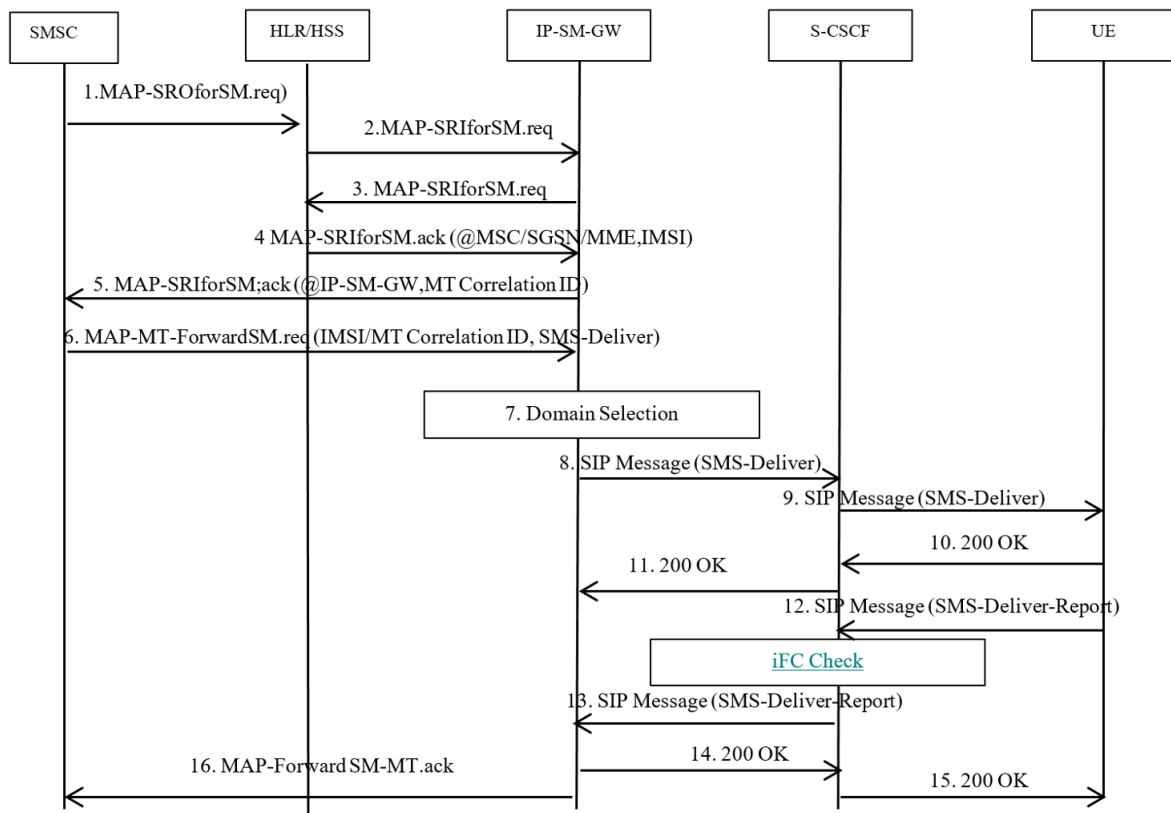
**Figure 38 SMS transfer via IMS flow**

9. UE submits the SMS message (SMS-Submit, SC Address) to the S-CSCF using the SIP Message method.



10. S-CSCF forwards the Message to IP-SM-GW based on the stored iFC (Initial Filter Criteria). iFC is a service mark in the service profile of the SMS originator (if the sender has no subscription to SMS service, iFC is provided with SMS filtering/blocking).
11. IP-SM-GW acknowledges the SIP message with 202 meaning; this means the message has been received but not yet delivered to the destination user.
12. SIP message acknowledges that is forwarded by S-CSCF to UE.
13. IP-SM-GW performs service authorization based on the stored subscriber data. IP-SM-GW shall check whether the subscriber is authorised to use the short message service (e.g. Operator Determining Barring), similar to the authorization performed by MSC/SGSN when SMS is delivered via CS or PS; Moreover, the IP-SM-GW will check if the user is authorised to receive IMS encapsulated Short Message delivery procedure. If the user is not authorised, IP-SM-GW will not forward the message to SMSC but will return the appropriated error information to the UE in a failure report. Otherwise, the IP-SM-GW extracts the SMS message (SMS-Submit) and forwards it to the SMSC (SC Address) using a standard MAP message.
14. SMSC sends a MAP message acknowledgement to IP-SM-GW
15. IP-SM-GW sends a SUBMIT-REPORT to S-CSCF, using the SIP message method.
16. S-CSCF sends the SUBMIT-REPORT.
17. UE acknowledge the SUBMIT-REPORT
18. Acknowledgement of the SUBMIT-REPORT is forwarded by S-CSCF to IP-SM-GW.

### D.3 Successful SMS reception via IMS.



**Figure 39 - SMS reception via IMS**

19. The SMSC interrogates the HSS to retrieve routing information.
20. Based on the pre-configured IP-SM-GW address for the user, the HSS forwards the request to the corresponding IP-SM-GW.
21. The IP-SM-GW queries the HLR/HSS to obtain the IMS and the address(es) of the current MSC, SGSN and/or MME
22. The HLR/HSS returns the IMSI and the address(es) of the current MSC, SGSN and/or MME to the IP-SM-GW for the delivery of the SM in CS/PS domain.
23. The IP-SM-GW creates a MT Correlation ID as defined in TS 23.040, which associates the Routing Info retrieval with the subsequent Forward Short Message message(s), and stores this along with the IMSI of the received subscriber. The IP-SM-GW returns to the SMSC its own address along with the MT Correlation ID in the IMSI field, as routing information.
24. The SMSC delivers the Short Message to the IP-SM-GW in the same manner that it delivers the Short Message to a MSC, SGSN or MME, including the MT correlation ID received from the P-SM-GW, in place of the IMSI.
25. The IP-SM-GW performs domain selection.
26. The IP-SM-GW knows that the UE is registered with the IMS domain. It translates the received MAP message into a SIP Message method and sends it to the S-CSCF of the UE.
27. The S-CSCF routes it to the UE.
28. The UE acknowledges it by a 200 OK.

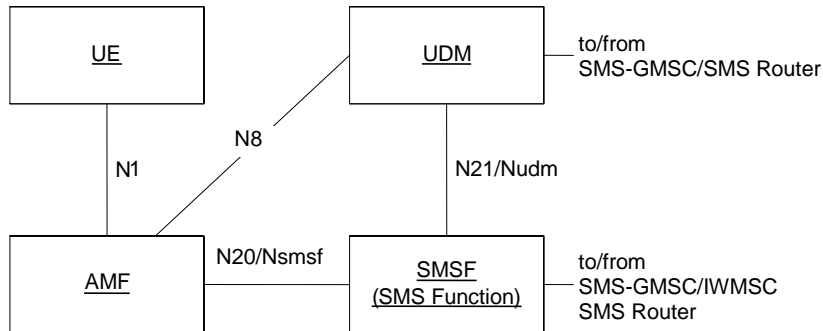
29. 200 OK is forwarded by the S-CSCF
30. The UE returns a SMS-DELIVER-REPORT within a SIP MESSAGE request to S-CSCF.
31. S-CSCF forwards it to IP-SM-GW.
32. IP-SM-GW acknowledges the SIP MESSAGE request by 200 OK.
33. S-CSCF forwards the 200 OK to UE.
34. The IP-SM-GW sends an acknowledgement of SMS delivery to the SMSC using the MAP protocol.

## Annex E <5G> SMS over MAP/Diameter

The 5G SMS architecture is defined in the following documents:

- SMS is defined in 5G as a clear requirement and its functional architecture is provided in 3GPP TS 23.501 [section 4.4.2].
- SMS architecture is defined in 3GPP 29.891[8] [section 9.1].

The SMS in 5G will be delivered by AMF and SMSF functions, relaying the SMS to the SMSC (defined on 3GPP TS 23.501 [section 4.4.2])



**Figure 40 SMS over MAP/Diameter Architecture**

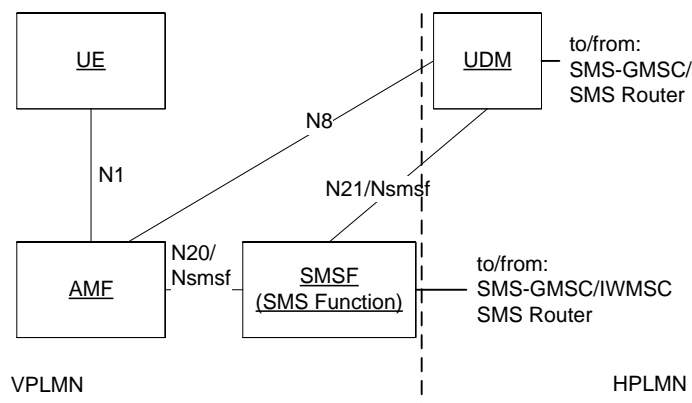
SMS Function (SMSF) may be connected to the SMS-GMSC/IWMSC/SMS Router via one of the standardized interfaces as shown in TS 23.040 [1].

UDM may be connected to the SMS-GMSC/SMS Router via one of the standardized interfaces as shown in TS 23.040 [51].

Each UE is associated with only one SMS Function.

When the serving AMF is relocated for a given UE, the SMS function for a given UE does not need to change. Thus the source AMF includes SMSF identifier as part of UE context transfer during AMF relocation to target AMF

Figure hereafter shows the roaming architecture to support SMS over NAS.



**Figure 41 SMS over NAS Architecture**

### Reference point to support SMS over NAS

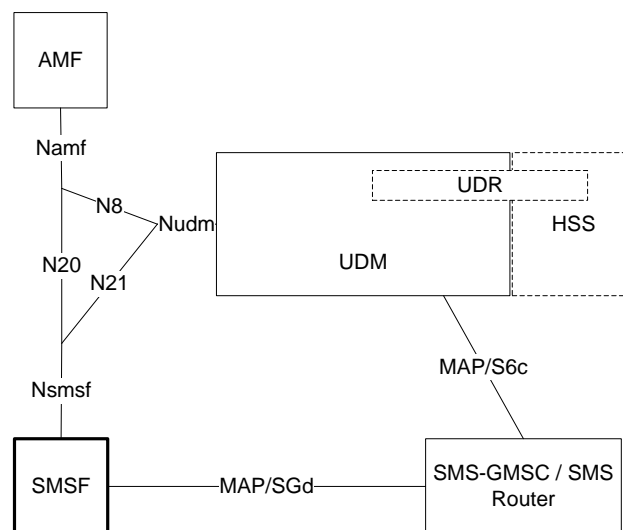
- N1: Reference point for SMS transfer between UE and AMF via NAS.
- N8: Reference point for SMS function address retrieval between AMF and UDM.
- N20: Reference point for SMS transfer between AMF and SMS Function.
- N21: Reference point for SMS subscription retrieval and SMS notification procedure between SMS Function and UDM.

### Service based interface to support SMS over NAS

- Nsmsf: Service-based interface exhibited by SMSF.

For SMS over NAS support, the UDM may be connected to the SMS-GMSC/SMS-Router via one of the standardized interfaces as shown in 3GPP TS 23.040 [1] (which is MAP or Diameter S6c). In addition, the SMSF may be connected to the SMS-GMSC/IWMSC/SMS-Router via one of the standardized interfaces as shown in 3GPP TS 23.040 [1] (which is MAP or Diameter SGd).

Figure hereafter provides an architecture overview with focus on the SMSF.



**Figure 42 SMSF role in SMS over NAS**

## Annex F <MTC/MIoT> SMS

Extract from 3GPP TS 23.682 [9]

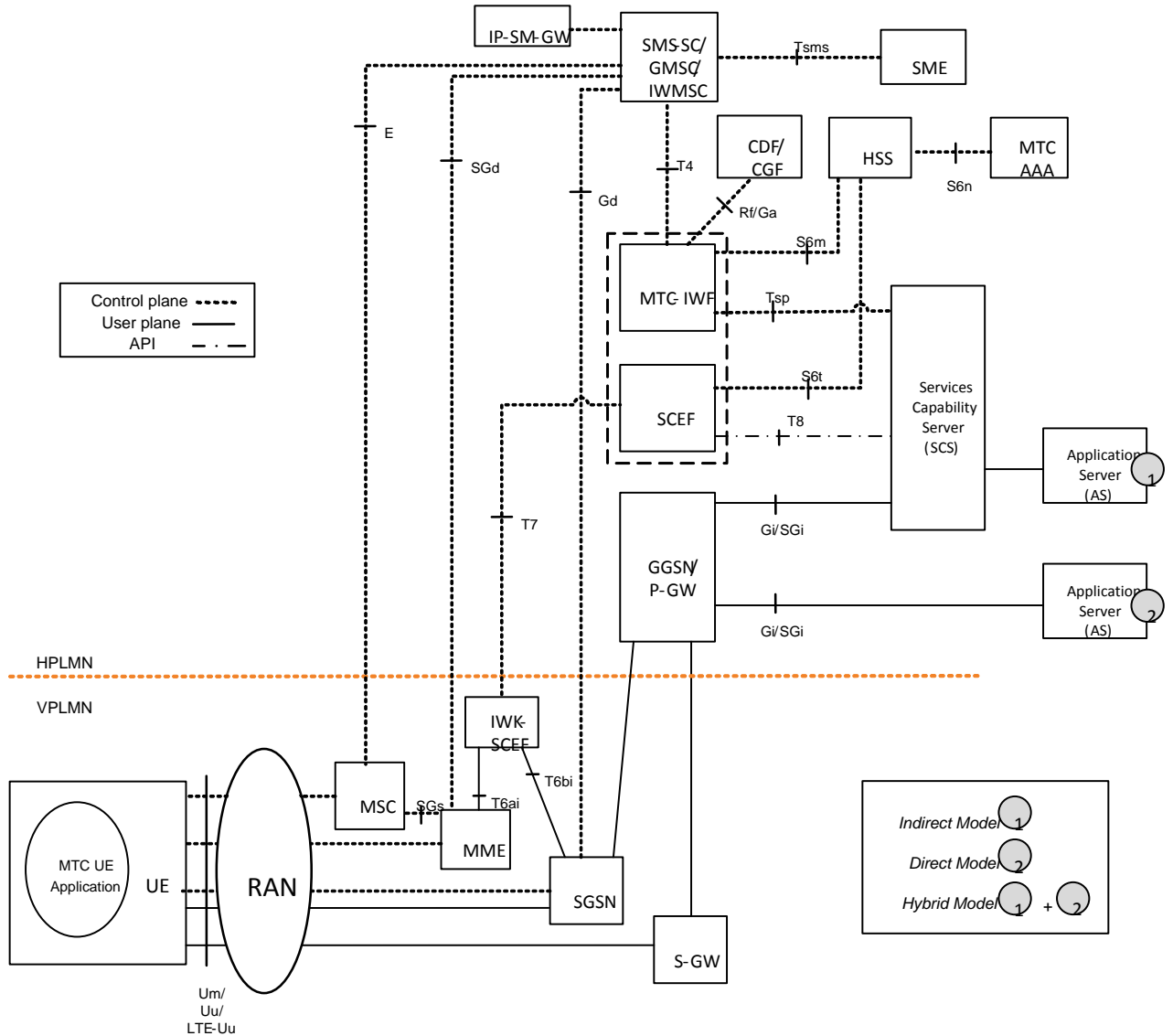


Figure 43 MTC/MIoT SMS Architecture

## Annex G Global architecture

Current

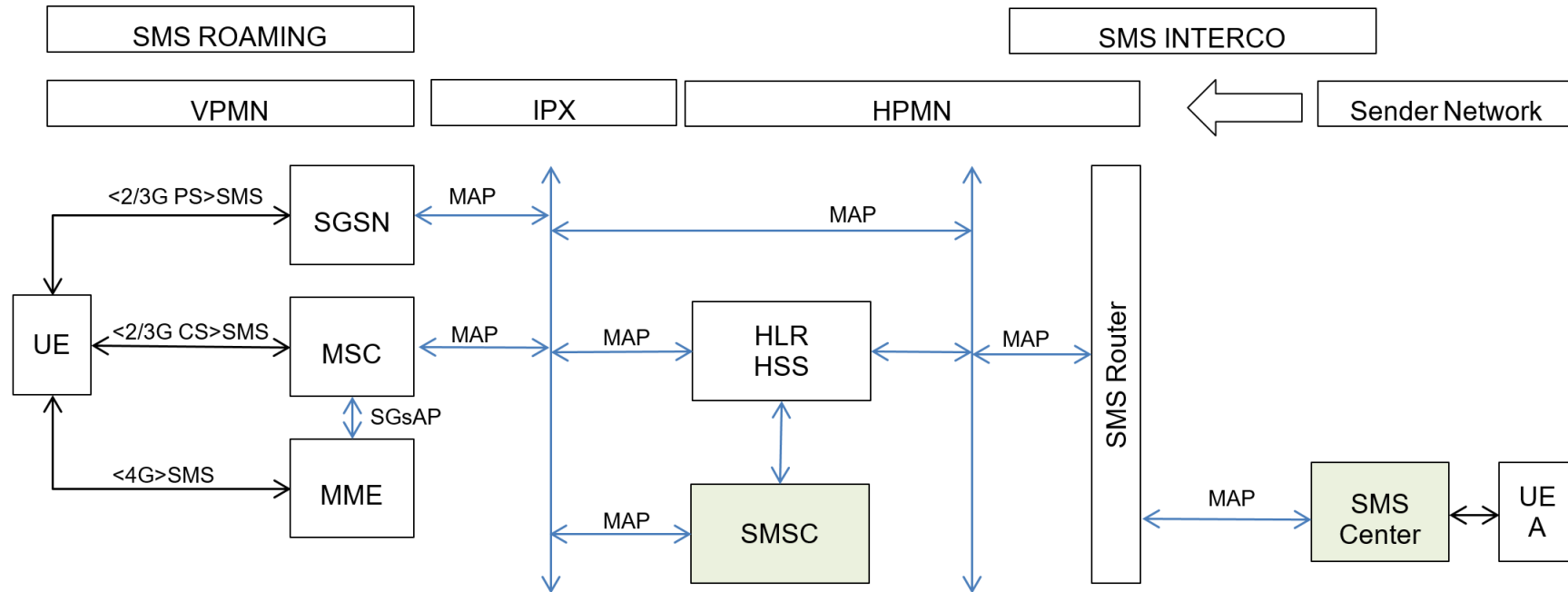


Figure 44 Global Architecture

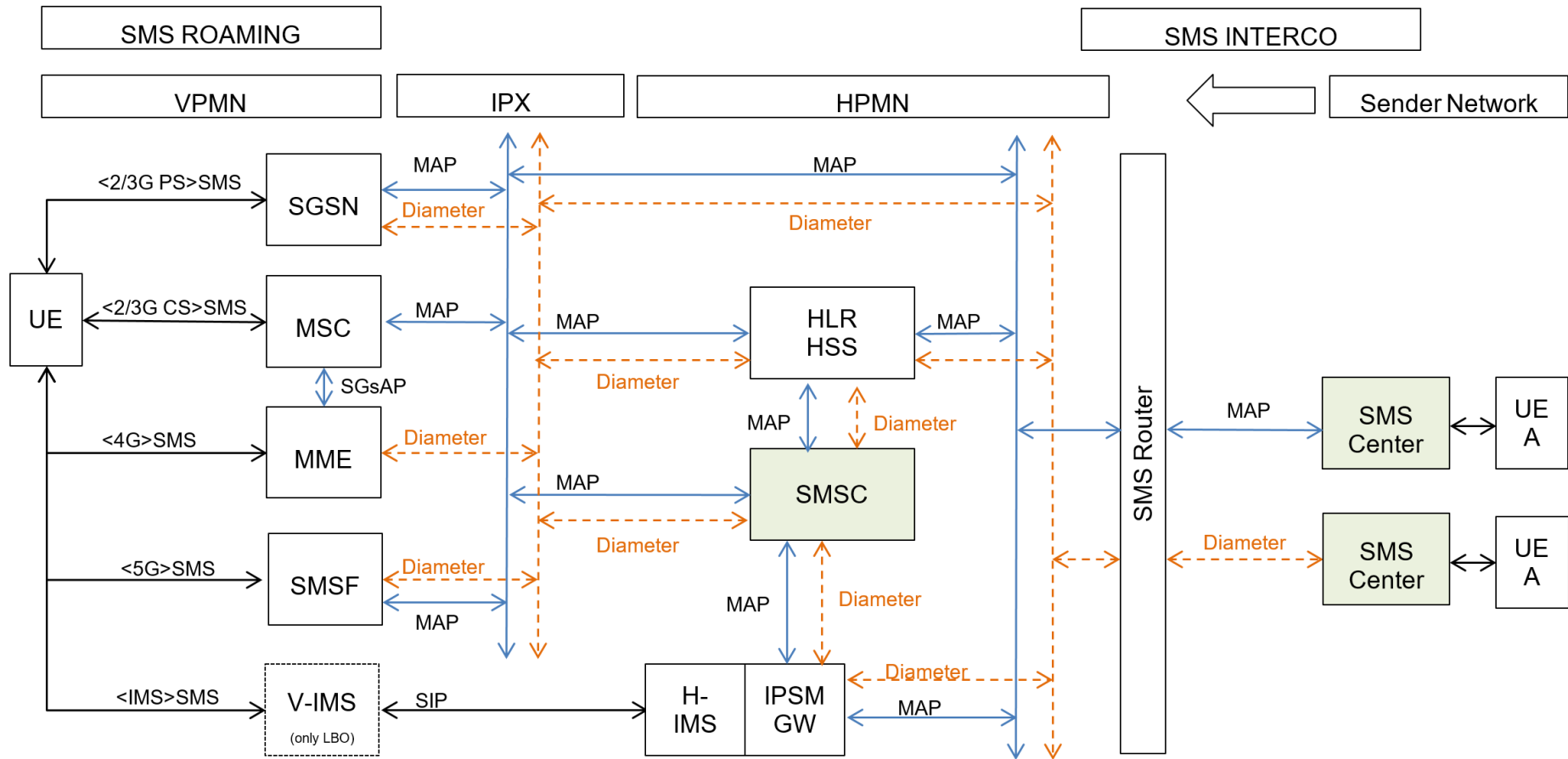


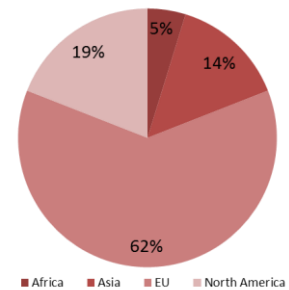
Figure 45 Global Architecture over Diameter



## Annex H GSMA\_Survey SMS Evolution Result summary

### H.1 Survey participation.

- Participants
  - 12 fully completing the survey
  - 6 partially completing the survey
  - 5 operators registering the survey but without providing information
  
- List of countries (partly/fully answers)
  - Africa: Somalia
  - Asia: Japan, Sri Lanka, Turkey, Fiji
  - Europe: Austria, France, Germany, Italy, Netherland, Sweden, Switzerland, UK, Belgium
  - North America: USA, Canada
  - Oceania: Fiji



### H.2 Survey result summary

<4G> SMS over Diameter use case (Home).

A small number of operators have already chosen to move SMS on Diameter. The first deployments are limited to SGd however, their intent is to also migrate on Diameter for GGd and S6c interface within the 3 next years.

The picture below summarise responses related to this topic.

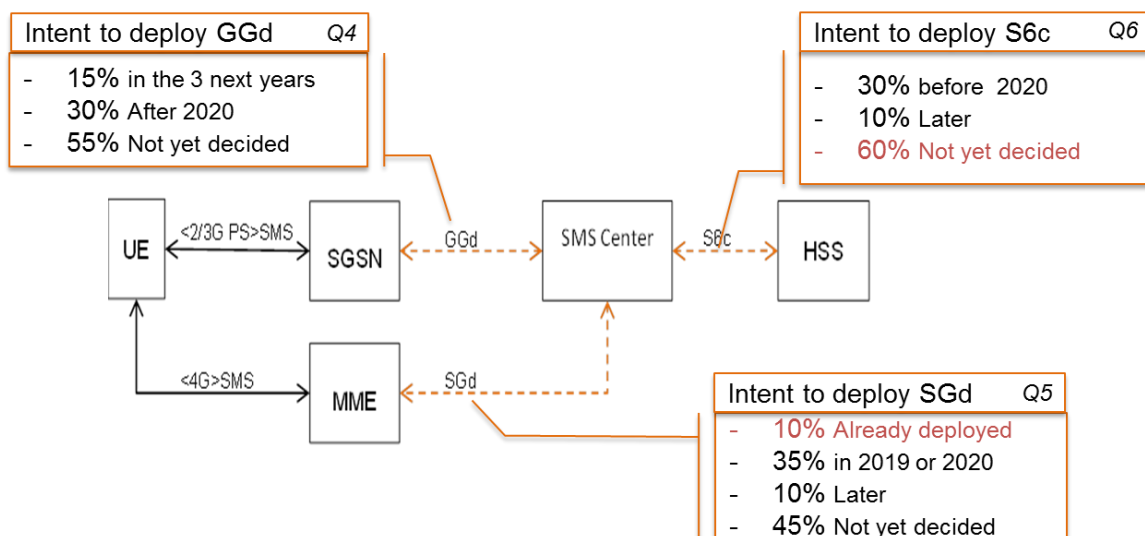


Figure 46 Survey Responses

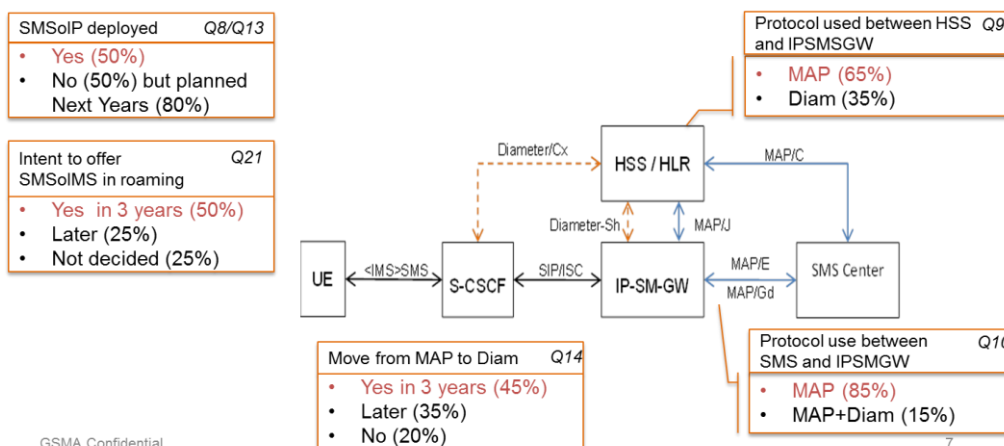
Regarding the possibility to use Diameter for roaming and interconnection, it seems too early to plan a migration from SS7 to Diameter. Moreover, usage of Diameter for roaming could not be taking into account before a secure Diameter able to prevent spoofing for example.

<IMS> SMS over SIP use case (Home/Roaming)

SMS over SIP for IMS customers is planned for next year, for a large number of operators on the Home network. Extension to roaming is also planned within the next three years.

It is also important to note that if Diameter can be used between IP-SM-GW and SMS Center, MAP is the preferred option.

The picture below summarise responses related to these topics.



**Figure 47 SMS over SIP responses**

<MloT> SMS MT use case (Home)

SMS is still an important technical enabler in the MloT context for operators. Two important use cases have been identified in this context: OTA and Wake up IP session.

In this MloT context, it is also mandatory for operators to be able to deliver SMS to Objects without double attachments on CS and PS. SMS delivery must be done without CS.

The picture below summarise responses related to these topics.

Intent to use SMS for MIoT	
• Yes (80%) – Not clear today (20%)	Q15
Use cases foreseen:	
• OTA (60%)	
• Wake up IP session (25%)	Q16

Solution to deliver SMS without CS	
• Yes (85%)	Q17
How	
• 4G SMS Transfer without combined attach (75%)	
• 2/3G: PS Only, using SMS via SGSN (full diameter) (25%)	Q18

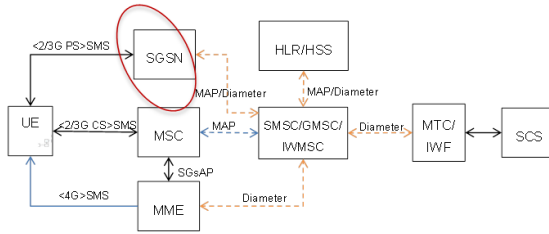


Figure 48 SMS MT responses

### H.3 Conclusions and survey lessons

- SMS is a mandatory technical enabler for MIoT (OTA / Wake up IP) and need solution to deliver SMS without CS.
- SMS will move progressively to Diameter. SGd is the first interface.
- SMSoIMS is a reality on home network and will be opened in roaming soon. Interworking with IP-SMS-GW remains mainly based on MAP.
- It is too early to anticipate the migration of SMS roaming / interconnection to Diameter.
- Diameter vulnerability is still an important concern for operators to move SMS on Diameter.

## Annex I Document Management

### I.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor/Company
V1.0	05/06/2018	Initial version	SIGNAL/TG	Eddy Goffin(Orange)
V2.0	21/10/2020	CR1002 Remove LBO	NG	Eddy Goffin(Orange)

### Other Information

Type	Description
Document Owner	Eddy Goffin / Marc Balon (Orange)
Editor/Company	Orange
Contributors	Erich Zillinger (Telekom Austria) Kwok Onn Looi (Anam Technologies) Pradeep Bhrardway (Syniverse Technologies, Inc)

It is our intention to provide a quality product for your use. If you find any errors or omissions, please contact us with your comments. You may notify us at [prd@gsma.com](mailto:prd@gsma.com)

Your comments or suggestions & questions are always welcome.

