TAP3.12 Implementation Handbook
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1 Introduction

1.1 Overview

The purpose of this document is to provide additional information for implementing Transferred Accounts Procedure version 3 (TAP3). The TAP3 Implementation Handbook serves as a description manual, which supports TAP3 implementation based on TD.57[7].

1.2 Scope

The document is intended to provide implementation guidance for Transferred Account Procedure (TAP).For detailed examples, see TD.60[8].

Note: The current version of this document supports TAP version 3 release 12 only.

1.3 Definitions

Term	Description
Abstract Syntax Notation One (ASN.1)	It defines the syntax of information data. It defines a number of simple data types and specifies a notation for referencing these types and for specifying values of these types.
Charging Data Record	A formatted collection of information about a chargeable event for use in billing and accounting.
CAMEL	CAMEL is a network feature which help the network operator to provide the subscribers with the operator specific services even when roaming outside the HPLMN.
Evolved Packet Core	It represents a framework for an evolution of the 3GPP system to a higher-data-rate and lower-latency that supports multiple RATs.
Evolved Packet System	It is an evolution of the 3G UMTS.It comprises the Evolved Packet Core together with the evolved radio access network E-UTRA and E-UTRAN.
GPRS session	The period during which the GPRS subscriber is registered to the GPRS data network.
Handover	The process in which the radio access network changes the radio system used to provide the bearer services.
Number portability	A capability that allows a user to retain the same MSISDN when changing from one service provider to another
PDP Context	A transaction for the exchange of data between an MS and a peer entity, which is addressed by the Access Point Name.
QoS class identifier	The QCI is a scalar that is used as a reference to a specific packet forwarding behaviour (packet loss rate, packet delay budget) to be provided to a Service Data Flow (SDF).

1.4 Abbreviations

Term	Description
APN NI	Access Point Name Network Identifier
APN OI	Access Point Name Operator Identifier
ASN.1	Abstract Syntax Notation 1
BER	Basic Encoding Rules
CAMEL	Customised Application for Mobile Enhanced Logic
CDR	Call Detail Record
CF	Call Forwarding
CFB	Call Forwarding on mobile subscriber busy
CFNRc	Call Forwarding on mobile subscriber not reachable
CFNRy	Call Forwarding on no reply
CFU	Call Forwarding Unconditional
CS	Circuit Switched
EPC	Evolved Packet Core
EPS	Evolved Packet System
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
G-CDR	GGSN CDR
GGSN	Gateway GPRS Support Node
GT	Global Title
HPMN	Home Public Mobile Network
HSPA	High Speed Packet Access
HSS	Home Subscriber Server
ICS	IMS Centralized Services
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IOT	Inter-Operator Tariff
LTE	Long Term Evolution
MME	Mobile Management Entity
MOC	Mobile Originated Call
MSC	Mobile Switching Centre
MSISDN	Mobile Station International ISDN Network
MSRN	Mobile Station Roaming Number
MTC	Mobile Terminated Call
OCS	Online Charging System
P-CSCF	Proxy Call Session Control Function
P-GW	PDN Gateway
PCRF	Policy and Charging Rules Function
PS	Packet Switched
PSTN	Public Switched Telephone Network
QoS	Quality of Service

S-CDR	SGSN CDR
S-CSCF	Serving Call Session Control Function
S-GW	Serving Gateway
SAE	System Architecture Evolution
SDR	Special Drawing Right
SGSN	Serving GPRS Support Node
SMSC	Short Message Service Centre
SRVCC	Single Radio Voice Call Continuity
SS	Supplementary Services
TAP	Transferred Account Procedure
TAS	Telephony Application Server
UMTS	Universal Mobile Telecommunications System
USF	Universal Service Fund
VLR	Visitor Location Register
VoLTE	Voice over LTE
VPMN	Visited Public Mobile Network
WLAN	Wireless Local Area Network

1.5 References

Ref	Document Number	Title
[1]	GSMA PRD BA.11	Treatment of Exchange Rates for Billing and Payment
[2]	GSMA PRD BA.12	Transferred Account Procedure (TAP) and Billing Information
[3]	GSMA PRD BA.27	Charging Principles
[4]	GSMA PRD BA.46	Non-Terrestrial Roaming Principles
[5]	GSMA PRD IR.21	GSMA Roaming database,structure and updating procedures
[6]	GSMA PRD IR.33	GPRS Roaming Guidlines
[7]	GSMA PRD TD.57	TAP3 Format Specification
[8]	GSMA PRD TD.60	TAP3 Scenarios
[9]	ITU-T Rec. X.680	ASN.1 Specification for basic notation

2 Physical Implementation

2.1 How to decode a TAP file

It is good practice to decode a TAP file in the following order:

1. Firstly, decode the Batch Control Information, Accounting Information, Network Information and Audit Control Information.
2. Secondly, decode the Call Events Details; each element (Mobile Originated Call (MOC), Mobile Terminated Call (MTC) and so forth). These should be decoded one after the other.

2.1.1 Identifying the TAP release

As specified in TD.57[7], the ASN.1 definition and tag numbers for the data items Specification Version Number and Release Version Number remain the same in all TAP releases from TAP3 onwards. A program with the sole purpose to identify the TAP release of an input TAP file (TAP3 and higher) is therefore feasible. This program must be able to read a sequence of BER encoded TAP3 elements until it has read the ASN.1 elements representing the Release Version Number and the Specification Version Number. This makes it possible to identify these two data items and thereby the applicable TAP release and release version prior to decoding the TAP file.

2.2 Physical Implementation Considerations

2.2.1 Zero Length Elements

The ASN.1 syntax allows production of elements with a size (length) of zero bytes. This is valid according to BER but all parties creating TAP must take measures to avoid such implementations. When such errors are encountered in a TAP file, it is allowed to raise either of the following errors:

- Syntax error for the element that is zero length
- Group structure error applicable to the group that contains the element (this treats it as though the zero length elements were not present in the group)

Note: The severity of the error must be according to the severity of the applicable syntax or group structure error. The group structure error may not always be applicable.

A VPMN cannot treat an element with length zero as an invalid BER encoding, that is Fatal error code 53 (file not encoded according to ASN.1 BER) must not be applied.

For example, where the element Tax Value in Tax Information is present but has no content (length is zero) the HPMN can only raise one of the following errors (no other validation rule is applicable):

- Severe error code 10 (syntax error) on element Tax Value in the Calls context
- Severe error code 31 (tax value missing) on group Tax Information in the Calls context

2.2.2 Elements filled with spaces (blanks)

Like the zero length elements, (see section 2.2.1) elements must not be filled with spaces. Such space filled elements can actually be treated as zero-length when all spaces have been discarded, and the rules in section 2.2.1 must be followed.

2.2.3 Integer size for specific elements

ASN.1 allows the creation of integers with an unlimited size. This means, that the length of an ASN.1 encoded integer value can vary between one and X bytes depending on the containing value. The representation has to be the minimal possible length that is the nine most significant bits of the encoded value must not be identical.

For TAP, there is only the differentiation between the maximum size of four bytes/octets and maximum of eight bytes depending on the element. TD.57[7] contains a list of elements to be encoded with a maximum size of eight bytes (see TD.57[7] chapter 6.1 Abstract Syntax).

2.2.4 ASN.1 extension markers

Extension markers ('…') are added at the group or list levels where possible (within all Choice and Sequence elements). Extension markers must not be used to introduce elements outside of the normal TAP release procedure. All bi-lateral sending of additional elements must use the Operator Specific Information.

Examples:

```
CallEventDetail::= CHOICE
{
  mobileOriginatedCall   MobileOriginatedCall,
  mobileTerminatedCall   MobileTerminatedCall,
  supplServiceEvent      SupplServiceEvent,
  serviceCentreUsage     ServiceCentreUsage,
  valueAddedService      ValueAddedService,
  gprsCall               GprsCall,
  contentTransaction     ContentTransaction,
  locationService        LocationService ,
  newInsertedField       NewInsertedField,
  ...
}
```

In case of a sequence, the three dots for the extension marker may be before any new added element.

First extended release:

```
TransferBatch ::= [APPLICATION 1] SEQUENCE
{
  batchControlInfo       BatchControlInfo           OPTIONAL, -- *m.m.
  accountingInfo         AccountingInfo             OPTIONAL,
  networkInfo            NetworkInfo                OPTIONAL, -- *m.m.
  messageDescriptionInfo MessageDescriptionInfoList OPTIONAL,
  callEventDetails       CallEventDetailList        OPTIONAL, -- *m.m.
  auditControlInfo       AuditControlInfo           OPTIONAL, -- *m.m.
  ...,
  firstInsertedField     FirstInsertedField         OPTIONAL
}
```

Second further extended release:

```
TransferBatch ::= [APPLICATION 1] SEQUENCE
{
  batchControlInfo       BatchControlInfo           OPTIONAL, -- *m.m.
  accountingInfo         AccountingInfo             OPTIONAL,
  networkInfo            NetworkInfo                OPTIONAL, -- *m.m.
  messageDescriptionInfo MessageDescriptionInfoList OPTIONAL,
  callEventDetails       CallEventDetailList        OPTIONAL, -- *m.m.
  auditControlInfo       AuditControlInfo           OPTIONAL, -- *m.m.
  ...,
  firstInsertedField     FirstInsertedField         OPTIONAL,
  secondInsertedField    SecondInsertedField        OPTIONAL
}
```

With this syntax, you are able to support different releases of TAP3 definitions. It allows systems built for the first version (not extended) of the grammar to silently ignore 'firstInsertedField' and 'secondInsertedField'. A system built to support the

first extended release of the grammar will silently ignore the element 'secondInsertedField'.

Decoding of extension marker information:

If a TAP decoding application identifies that a valid (as per the ITU ASN1 standard) and unknown ASN1 data block is present at an extension marker position, all the data contained in this block must be ignored. Further processing of the data contained in this block must not be attempted. The decoder should resume standard processing at the next item following the extension marker data block. For example, let us assume that the following information is received in a TAP3.11 file in the Call Type Group of a MOC event:

```
{CallTypeGroup
      {CallTypeLevel1}
      {CallTypeLevel2}
      {CallTypeLevel3}
      {CalledCountryCode}
}
```

The data item Called Country Code does not exist in TAP 3.11 and therefore the tag of this item will be unknown to a TAP 3.11 decoder; however, the ASN1 grammar contains the extension marker just after item Call Type Level 3 data item. As a result, data item {CalledCountryCode} must be ignored by the decoder and processing must continue with the next data item present in the file.

Notes:

- In this example, warning error 57 can be raised however not fatal error 50.
- The version of ITU ASN.1 standards referenced detailed in TD.57[7](ITU Rec. X.680[9]) supports the extension markers.

2.2.5 Empty Choice Elements Encoding

The tagging type for a tagged choice type is always EXPLICIT.

ASN1 encoded TAP 3.11 file having just the tag and zero length contents is “Incomplete" and will be considered as invalid BER encoding.

Therefore, files with such TAG errors can be rejected using error code 53.

For example:

```
ImeiOrEsn ::= [APPLICATION 429] CHOICE
{
    imei  Imei,
    esn   Esn,
    ...
}
```

could be encoded as

```
ImeiOrEsn   [ TAG "7F832D"H (429) LEN "00"H (0) ]
{
}
```

In other words 0x7F832D00 (encoded)

In case none of the choice elements are present – the whole ‘choice’ construction (tag id and length) should not be present in the encoded TAP3 file.

3 Service Implementation

3.1 GPRS

3.1.1 General

It is not allowed to send S-CDR and G-CDR separately for the same PDP context. If information from both the S-CDR and the G-CDR is used within the same PDP context and time period, they must be combined into one TAP GPRS Call event.

3.1.2 Principles of GPRS Partial Handling

This chapter provides information on how to create and handle partial GPRS call events within TAP files. For information on GPRS partials limits (partial time interval /number of partials) see BA.12[2].

When handling / creating GPRS partials please note that the following applies:

- TAP file partials must not be mistaken for being network-generated partials. In some cases a network partial may be forwarded at the TAP interface as a single GPRS partial. However, since there is a limit of partials (per PDP context per day) that must not be exceeded on the TAP interface, in most cases GPRS partials will be the result of network partials aggregation. A one to one relation between the network and GPRS partial records cannot be expected.
- To allow the HPMN to bill its subscriber based not only on volume, all GPRS partials must be forwarded to the HPMN (for example time generated partials which may carry no charge in the case of operator-to-operator volume charging, must still be transferred in the TAP files as the HPMN may need these for re-rating and/or customer care purposes).
- Only consecutive network partials can be aggregated to a GPRS partial. For example if the VPMN has partials 1, 2, 3 and 5, with partial 4 missing/not available for TAP transfer, then only partials 1, 2 and 3 can be aggregated in an aggregated GPRS Call and a separate GPRS Call for partial 5 made available in the TAP file.
- The HPMN should have in mind that partials may not be received in the correct order (for example because partials were not received in the correct order from the network or because a TAP file has been delayed/rejected).
- An intermediate partial may be received well after the last partial for the same PDP context has been received.
- The only way, to sort GPRS partials in the correct sequence, is by using the date & time information present in each partial (in some cases of course switch manufacturers may offer proprietary data items to assist in partial sequencing). Please note that in case of multi-SGSN partials, clocks on different SGSNs may not be synchronized up to the second.
- Where partial GPRS records are issued on TAP, the partial type indicator must be populated correctly. This data item is vital for the HPMN aggregation of partials for end user billing. In some cases, values in this data item are also necessary to validate charges in TAP records.
- The VPMN must aggregate the GPRS network partials to meet the limit of number of TAP GPRS partials per context and day defined in BA.12[2].

- Inter Operator Tariff (IOT) check for GPRS Partials: GPRS partials in many cases need to be validated independently as not all the partials are always available.

Note: it is not always possible to perform a guaranteed charge validation on GPRS partials. As a general rule, a GPRS partial can only be rejected if it can be guaranteed that it does not meet the IOT.

The first partial can always be validated. However, it is not always possible to validate intermediates or last partials (for example, as for many GPRS IOTs one needs to know the data volume transferred before the intermediate or last partial was generated in order to determine the charge). Intermediate partials and last partials can be rejected if the associated charge is greater than the maximum according to the applicable IOT.

The Partial Type Indicator relates to the creation of the CDR (first partial created, intermediate and last) and does not relate in any manner to the charging method.

Any applicable IOT steps are totally independent from the usage of the Partial Type Indicator.

Please note there are currently no TADIG test cases defined that would allow verification of correct GPRS partials generation for GPRS (for example, a long term GPRS session with duration greater than 24 hours).

3.1.3 Multiple SGSN IP Addresses

There can be multiple IP addresses for a single SGSN.

3.1.4 Data Volume Size Definitions

To prevent invalid calculations and charging the following clarification is made:

- One kByte is not 1000 Bytes, but 1024 Bytes.

The same goes for one MByte, which are 1024 kBytes and not 1000 kBytes.

In the case of rounding up to the nearest kByte, a call with a volume of 1019 Bytes is only one kByte and not two kBytes, whereas a call of 1025 Bytes should be two kBytes.

3.1.5 GPRS Partials relevant to CAMEL usage

VPMN must supply CAMEL information in each GPRS partial on transferring Partial GPRS Events relevant to CAMEL usage in TAP files. The mandatory presence is to ensure successful Tariff validation and HPMN re-pricing. Please see below the example scenario A in section 3.1.6.

3.1.6 Population of Access Point Name (APN) Information for GPRS call event relevant to CAMEL usage

Mapping rules between network level CDR (S-CDR) and TAP CDR in regards to the actual connected/original APN NI & OI relevant to CAMEL usage should be handled according to the description provided in the data dictionary for “GPRS Destination” in TD.57[7].

APN Information (APN NI & APN OI) is mapped one to one between the network CDR (S-CDR) and TAP CDR.

a) APN NI & APN OI from S-CDR:

The Actual connected/or modified APN NI & APN OI are used to populate GPRS Basic Call Information group in TAP. It is mandatory for each GPRS partial call record.

b) CAMEL APN NI & CAMEL APN OI from S-CDR:

The Original APN NI & APN OI as entered by the subscriber are used to populate CAMEL Service Used group in TAP. They are conditional for GPRS partial call records. Thus, they may be available on the first partial but not guaranteed on subsequent partial call records as it will be subject to availability from the network.

Example A: GPRS relevant to CAMEL usage (first partial)

- Actual APN NI as typed in by the subscriber: digitalforum.com
- Modified APN NI as returned by the CAMEL server: corporate.digitalforum.com

The following table shows the contents of the relevant TAP elements:

TAP Element			Comments
GPRS Basic Call Information			
	Access Point Name NI		corporate.digitalforum.com
	Access Point Name OI		mnc009.mcc262.gprs
CAMEL Service Used			
	CAMEL Service Level		0
	CAMEL Service Key		21754
	3G CAMEL Destination		
		GPRS Destination	
		Access Point Name NI	digitalforum.com
		Access Point Name OI	mnc009.mcc262.gprs

Table 1: Example A: Relevant TAP elements (first partial)

Example A: GPRS relevant to CAMEL usage (second partial)

- Actual APN NI as typed in by the subscriber: digitalforum.com
- Modified APN NI as returned by the CAMEL server: corporate.digitalforum.com

The following table shows the contents of the relevant TAP elements:

TAP Element			Comments
GPRS BasicService Used			
	Access Point Name NI		Corporate.digitalforum.com
	Access Point Name OI		mnc009.mcc262.gprs
CAMEL Service Used			
	CAMEL Service Level		0
	CAMEL Service Key		21754
	3G CAMEL Destination		
		GPRS Destination	
		Access Point Name NI	digitalforum.com
		Access Point Name OI	mnc009.mcc262.gprs

Table 2: Example A: Relevant TAP elements (second partial)

3.1.7 Call Type Levels in GPRS Event

Call Type Levels (1, 2, 3) are used to identify the IOT tariff defined by the VPMN to charge for GPRS usage in TAP. It is important that Operators populate Call Type Levels with the correct values that reflect the roaming subscriber usage in terms of the access method to GPRS services, the QoS Type provided and any detailed qualifications of the QoS Type as per the VPMN's IOT.

3.1.7.1 Access to GPRS Services

Call Type Level1 values describe the different GPRS access methods that could be used:

- Call Type Level 1 = 10(HGGSN) means that the roaming subscriber has access to the GPRS Services through the GGSN located at the HPMN side. This currently represents the common implementation access method to GPRS Services by the Operators.
- Call Type Level 1 = 11(VGGSN) means that the roaming subscriber has access to GPRS Services through the GGSN located at the VPMN side as such, indicates Local Access to GPRS Services. This is currently not in use due to the lack of technical feasibility which enables the identification of the service used by the subscriber at the VPMN side.
- Call Type Level 1 = 12(Other GGSN) means that the roaming subscriber has access to GPRS Services through a GGSN which belongs to a third party vendor typically operated on behalf of the HPMN. The GGSN belongs to neither VPMN nor HPMN in this case.

3.1.7.2 QoS Type Attributes

Call Type Level 2 values describes the QoS attributes provided to distinguish the level of the service used and the resources consumed to provide the selected service.

The appropriate value corresponding to the QoS Type provided should be populated in Call Type Level 2 upon the availability of the relevant information from the VPMN's network.

Call Type Level 3 provides the means for the VPMN to further specify any detailed qualification of the QoS Type already set in Call Type Level 2.The data item is populated with the appropriate value as defined in the VPMN's IOT.

3.1.7.3 Differentiated data charging by Call Type Level

Where QoS is not an applicable IOT differentiator the value '0' (unknown/not applicable) is used for Call Type Level 2. If the VPMN then wants to further differentiate rates, for example for different rates applicable to 3G and LTE, Call Type Level 3 can be used. If this is done then the full rate plus Call Type Levels 1/2/3 combinations must be defined in the VPMN's IOT and the CTL 1/2/3 values used in the TAP record Charge Information must match those defined in the IOT.

3.1.8 Presence of Both Charged Item 'X' and 'V/W' Within the Same GPRS Event

Telecom operators are advised not to provide more than one occurrence of Charge Information Group where one occurrence has Charged Item value 'X' and another one has Charged Item value 'V' or 'W'.

Although this is not strictly forbidden from a commercial perspective due to freedom of charging principles granted to telecom operators, it is, however, advised that such occurrence of more than one Charge Information, especially where the Charge is greater than zero, in both Charge Information Groups has a severe impact on the majority of the receiving HPMNs' billing systems. This is due to the fact that the HPMN is not able to process the GPRS charges associated with both Charge Items 'X' and 'V' or 'W', so the billing system may consider that the same data volume is double charged within the GPRS Event.

It is more likely that the occurence of more than one Charge Information Group within the same GPRS Event has happened due to an incorrect TAP implementation or a technical error on providing the GPRS Event on the TAP Interface.

The following example scenario shows an illustration of an erroneous GPRS Event provided in the TAP file:

- IOT Charge for data volume is: 5 SDR per 1 MB
- Charge Information group 1: Charged Item 'X' and the Total Volume is 2 MB
- Charge Information group 2: Charged Item 'V' and the Data volume Outgoing is 1 MB

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
GPRS Service Used	
Data Volume Incoming	1065000
Data Volume Outgoing	1025000
Charge Information (1)	
Charged Item	'X'
Call Type Level 1	10 (HGGSN)

TAP Element				Comments
			Call Type Level 2	10 (Broadband)
			Call Type Level 3	According to IOT
			Charge	10
			Chargeable Units	2090000
			Charged Units (optional)	2097152 (2MB)
		Charge Information (2)		
			Charged Item	'V'
			Call Type Level 1	10 (HGGSN)
			Call Type Level 2	10 (Broadband)
			Call Type Level 3	According to IOT
			Charge	5
			Chargeable Units	1025000
			Charged Units (optional)	1048576 (1MB)

Table 3: Two Charge Information Groups with Charged Item 'X' & 'V'

Note: As shown in the example scenario above, the Data Volume Outgoing has been double charged. The first time in association with Charged Item 'X' and the second time in association with Charged Item 'V'.

3.2 SMS

The Short Message Service is independent of the transport mechanism, circuit switched (CS) or packet switched (GPRS), and in TAP, it is reported in a MOC or MTC call event in the case of SMS over CS or GPRS.

In case of SMS over IP (VoLTE), the Messaging Event is used to support SMS Events (SMS-MO & SMS-MT) in TAP.

3.2.1 SMS over GPRS

Because SMS over GPRS does not require an active PDP context, it is not a GPRS call.

The recording entity type distinguishes SMS over GPRS from SMS over CS.

- SMS over GPRS: Recording Entity Type = SGSN
- SMS over CS: Recording Entity Type = MSC

Inspection of the SMS records raised at the SGSN shows that all the necessary data items are present to populate a MOC or MTC call event in TAP.

3.2.2 SMS over IP (VoLTE)

IP-SM-GW (IP Short Message Gateway) is a SIP based application server which is used in the delivery of the SMS over IP bearer. The IP-SM-GW provides protocol interworking between the IP-based UE and the SMSC which uses MAP (Mobile Application Part).The

SMS is routed to the SMSC for delivery to the SMS Destination or the SMS is received from the SMSC for delivery to an IP-based UE.

The successful submission of the SMS will follow the following steps:

- The submitted SMS by the roaming subscriber will use SIP Message method to route the SMS from the visited P-CSCF to the Home S-CSCF in the IMS domain.
- The IP-SM-GW located in the HPMN extracts the submitted SMS from the SIP Protocol and relay it to the Home SMSC using MAP.
- The Home SMSC submits the SMS to the SMS Destination.

The submission of the SMS can be shown in the following diagram:

Figure 1: Submission of SMS-MO over LTE

3.2.3 SMS-MO

Due to the fact that the SMSC may be necessary for billing, the data item Called Number is mandatory and must contain the SMSC address in case of SMS usage. If available, the SMS recipient (destination), exactly as dialled by the subscriber, must be filled in the data item SMS Destination Number.

It should be noted that it is expected to have more than one SMS-MO event created for a long SMS where it exceeds 160 characters. The value of the Call Reference element available in TAP will uniquely identify each SMS-MO event. There is no technical means to enable the aggregation of the SMS-MO events created for the long SMS.

3.2.4 SMS-MT

The data item Calling Number is mandatory and must contain the SMSC address in case of SMS usage. If available, the SMS sender (origination), in international format, must be filled in the data item SMS Originator.

3.3 CAMEL

Currently there are 4 phases of CAMEL implementations with different features. Each phase supports the features of the previous phase plus some additional features. One of the main applications supported by CAMEL service is prepaid billing.

Note: That CAMEL Service Level and CAMEL Phases are not directly related to each other. CAMEL Service Level describes the service logic employed

(Service Type) by the HPMN, for example, VPN Roaming. CAMEL Phases describe the CAMEL features being used by such services.

3.3.1 Camel Invocation Fee

The CAMEL charging construct was simplified in TAP3.11, as no additional Charge Information details were required apart from the CAMEL Invocation Fee, and possible tax, discount and exchange rate information. Therefore, within CAMEL Service Used, the Charge Information has been replaced with Camel Invocation Fee.

The CAMEL Invocation Fee contains the charge (if greater than zero) for the CAMEL invocation after discounts have been deducted (if applicable, see Discount Information) but before any tax is added (if applicable, see Tax Information) and must not contain a negative value.

The charge is in the same currency as all other charges in the TAP file with the number of decimal places from the data item TAP Decimal Places.

All CAMEL Invocation Fees are to be included in the total charge for the file (Audit Control Information) but not in the total charge within the Charge Information associated with each TAP call / event.

Note: The Basic Service Used group is used to charge for the non-CAMEL related charges.

3.3.2 CAMEL in case of Call Forwarding (CF)

The tariff of the call and the content of the Call Type group, in case of a CAMEL modification of the destination, cannot be determined using the Called Number element. In this case, this information depends on the CAMEL Destination Number.

3.3.3 Validation of CAMEL destination presence in case of number or APN modification

In TAP3.11, the Camel Service Used structure was simplified. Camel modification information is not provided. In case Camel Destination Number for MOC or GPRS Destination for GPRS call event is missing, the validation cannot be carried out based on the information in TAP by the VPMN. Only the HPMN can perform this validation and such validation could be based on the knowledge of the applicable CAMEL logic.

3.3.4 The importance of CAMEL Destination Number

CAMEL Destination Number must be represented in the International format on TAP. Where the CAMEL server does not return an international representation, VPMN is obliged to modify the number to be in international format because it represents a billing parameter for inter operator charging. On the other hand CAMEL server implementations should be done in a way that when the dialled number has been modified, the server always returns a number in international format. Failure to provide the number with a valid country code increases the risk of incorrect charging and it is considered bad practise.

Please see Examples P, Q and R for further illustration in section 4.4.2 “Population of Called Number, Dialled Digits & CAMEL Destination Number”.

3.3.5 CAMEL for Video Telephony usage

CAMEL Phase1 supports all Tele Service Codes and Bearer Services Codes related to MOC and MTC activities. Video Telephony can use either the Synchronous Bearer Service code 30 or 37, which depends on the implementation. Thus, Video Telephony can be supported at CAMEL Phase1. Therefore, mobile networks will have the capability to implement Video Telephony in their networks for CAMEL upon launching a 3G network using Bearer Service code 30 or 37.

3.4 Services implementation on top of a Bearer

Currently, all services implemented on top of the same bearer (GPRS, UMTS, CSD) are technically indistinguishable from each other in the visited network. MMS, IM, PoC services are examples of such services where their usage will not be differentiated at the bearer level and hence the VPMN will be able to charge the Home network only for the underlying bearer resources usage. For example, in TAP a GPRS Call is raised for a MMS.

3.5 National Mobile Number Portability (MNP)

3.5.1 Subscriber Identification

Mobile Number Portability allows a subscriber to change from one network operator to another taking their phone number with them to the new network.

Identification by IMSI will ensure the correct identification of the home network operator. If a subscriber switches from one operator, to another he may use his old MSISDN but he uses a new IMSI related to his new operator.

Only for services, which do not use an IMSI for the subscriber identification, there may be a problem (for example WLAN which uses the realm for identification or SMS based on MSISDN only). This will have impact on billing.

3.5.2 Charge Differentiation

VPMNs can have different IOT tariffs for destination networks with-in the same country. In the case of Mobile Number Portability from one network to another network, Call Events charges will be based on the IOT tariff for the destination network which has terminated the Call Event

The IOT Tariff must be clearly identified through the correct population of Call Type Level data items for the destination number as shown below in Example scenarios A and B

The following examples illustrate two calls towards numbers within the same numbering range. In these examples the calls are terminated on different networks due to number portability.

Example A: MOC Call to a ported national number

- Actual dialled digits 01732975235
- VPMN Country Code (CC) 49

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	491732975235
Dialled Digits	01732975235
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	1
Call Type Level 3	4 (An illustration example value for the ported number as per the IOT)

Table 4: Example A: Relevant TAP elements (MOC to ported national number)

Example B: MOC Call to a non-ported national number

- Actual dialled digits 01735146245
- VPMN CC 49

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	491735146245
Dialled Digits	01735146245
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	1
Call Type Level 3	5 (An illustration example value for non-ported number as per the IOT)

Table 5: Example B: Relevant TAP elements (MOC to non-ported national number)

3.6 Optimal Routing

The following diagram should explain the scenario for “optimal routing”.
A subscriber, roaming in network B, makes a call to a subscriber of network A, who is roaming in the network C. Instead of routing the call through the network A to the destination network C, it will be routed directly to the network C.

Note: Network B and C could be the same network.

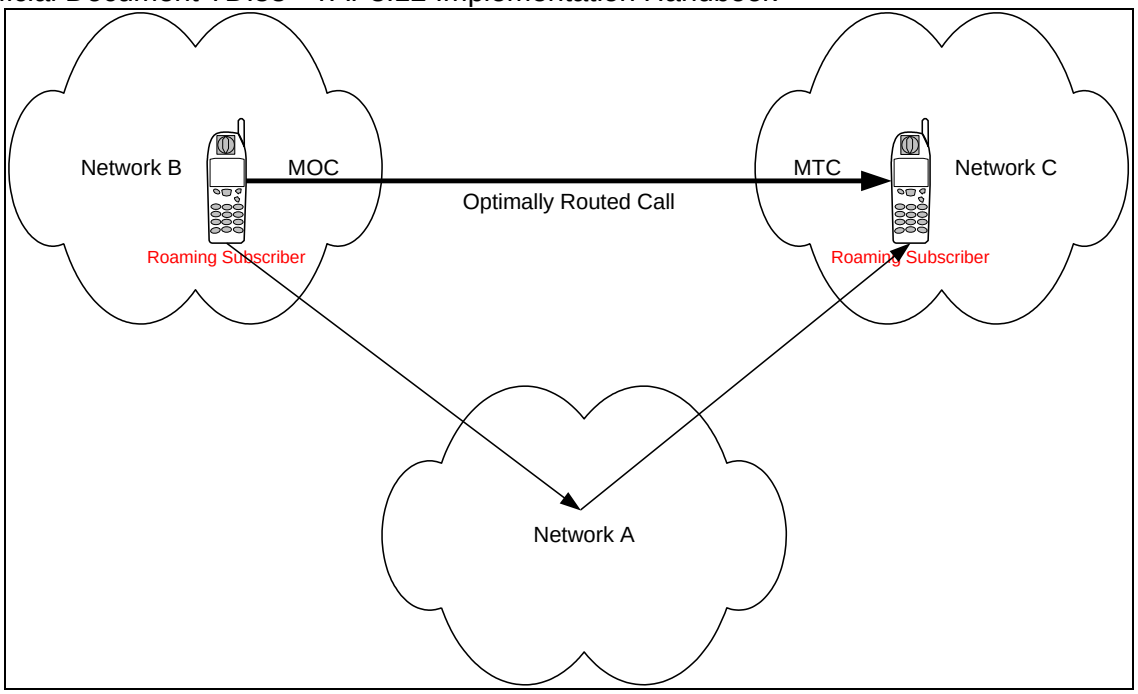


Figure 2: Optimal Routing

MOC:

The element Destination Network must be used in case of optimal routing. It contains the five characters TADIG code (for example EUR01 for Eurognet) and has to be different from the HPMN code of the destination subscriber for optimal routing. In this example, it would be network C. When the optimally routed calls have different charging, the call type levels should be used to indicate the specific rates applied.

MTC:

The element Originating Network must be filled with the 5-character TADIG code of the VPMN that originated the call (in the above example this is network B).

In order to enable the Home Network to validate the TAP charge and/or re-rate the TAP record for retail purposes, they will need to be able to identify optimal routing and the originating and destination networks involved.

Example: Optimal Routing

Assumptions:

- Network A: French Network
- Network B: German Network
- Network C: Belgian Network
- Actual dialled digits +331711234567890
- VPMN International Access Code (IAC) 00
- VPMN Country Code (CC) 49

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	331711234567890
Dialled Digits	+331711234567890
Destination Network	TADIG code of 'Network C'
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	2
Call Type Level 3	As per IOT for optimal routing

Table 6: Relevant TAP elements (Optimal Routing)

3.7 WLAN

WLANs are based on the IEEE 802.11 standard series, and can provide very high data speeds.

Starting from TAP3.10 the billing of WLAN has been defined in TD.57[7] specification. Non-GSM WLAN operators can also use TAP3 to exchange the charging information. In case a non-GSM operator wants to exchange TAP files, a TADIG code must be requested from the GSM Association. The GPRS Call Event Detail in TAP is to be used to cater for the WLAN scenario.

The user of the WLAN service can be identified by IMSI, MSISDN or Network Access Identifier. When using username/password authentication, Network Access Identifier is the commonly used method to provide user identification, however in EAP methods the RADIUS User-Name attribute is not reliable for generating a TAP3 chargeable user identity meaning that only IMSI and/or MSISDN might be available for chargeable user identification.

In a WLAN environment, the primary source of event information is created by a so-called RADIUS (Remote Access Dial-in User Service) Server. How to map between RADIUS and TAP3 is explained in the Data Dictionary of TD.57[7].

3.7.1 Identification of WLAN in TAP

Call Type Level 1 is used to distinguish WLAN from normal GPRS.

3.7.2 Charging ID

For WLAN networks, the derivation is at the discretion of the Sender.

Note: The Charging Id must remain unique (together with the recording entity) for a significant amount of time. A definition of the amount of time must be seen in the normal TAP context, where no call event should be older than 30 days. It is therefore recommended to use a timeframe of 60 days before the Charging ID is repeated.

Currently, there is no standard way to use APNs in the WLAN environment. In the future, APNs will be used in a standardised way as defined by 3GPP Release 6.

3.7.3 Some other topics to observe for WLAN

The following are general observations for WLAN:

- The Recording Entity will contain the identity of the WLAN billing information recording entity.
- Charging Id will contain the needed reference from the WLAN billing information recording entity.
- Serving Location Description will contain a textual description of the Hot Spot.
- Only minor Data Dictionary changes.

3.7.4 Differences to GPRS

The following are differences between WLAN and GPRS events within TAP:

- SGSN and GGSN are not available; instead, only one WLAN Recording Entity is present.
- PDP address will not always be available.
- Use of APN data item is at the discretion of the serving operator.

3.7.5 Similarities to GPRS

GPRS partial rules apply also to WLAN.

3.8 Satellite Destinations

TAP3.11 introduced a new value, “5”, for the Call Type Level 2 element. This value can be used to represent calls to satellite destinations. This makes it possible for the HPMN to verify or recalculate the price for satellite calls.

3.9 Video Telephony

The H.324 protocol is used to identify circuit switched (CS) video telephony, which uses H.223 and H.245 settings at the user protocol level. This means you must set the User Protocol Indicator to 4 (H.223 & H.245), in order to identify the usage of video telephony. Please refer to TD.57[7] Data Dictionary for more detail on how to derive the values.

The element Bearer Service Code contains the values ‘30’ or ‘37’ (depending on the implementation) in the case of video telephony.

3.10 UMTS

Radio access technology cannot be used as a price differentiator.

3.10.1 UMTS Circuit Switched Bearer Services

For UMTS CS Bearer Services the following elements must be filled (where available from the network):

- Bearer Service Code
- Fixed Network User Rate (FNUR) – (see TD.57[7])
- The Guaranteed Bit Rate and Maximum Bit Rate from group Basic Service Group are used to specify the usage of UMTS circuit switched bearer service. These data items were added in the TAP 3.11 release.
- The element User Protocol Indicator will identify the protocol used.

Note: In addition to the 2G bearer service codes the following values can be used to identify UMTS service usage:

- 27 - used for asynchronous services (also used with HSCSD)
- 37 - used for synchronous services, implicates video telephony

3.10.2 UMTS Packet Switched / GPRS Handover

The following time line shows a possible handover scenario between a UMTS packet switched and a GPRS network:

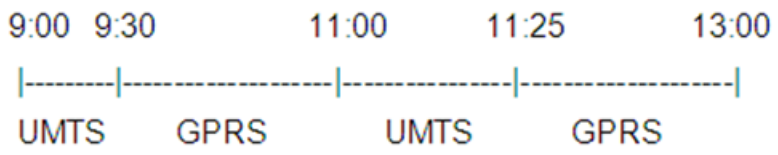


Figure 3: Example: UMTS Packet Switched / GPRS handover

In order to follow the GPRS partial record rules, the different network call detail records (CDRs) need to be aggregated into one GPRS Call. In the example, there are different charges for UMTS and GPRS (different level of Quality of Service), which is illustrated by the Call Type Levels.

TAP Element	Comments
GPRS Service Used	
Data Volume Incoming	Total
Data Volume Outgoing	Total
Charge Information (1)	First UMTS Part
Call Type Level 1	10 (HGGSN)
Call Type Level 2	10 (Broadband)
Call Type Level 3	According to IOT
Charge Information (2)	First GPRS Part
Call Type Level 1	10 (HGGSN)
Call Type Level 2	11 (narrowband)
Call Type Level 3	According to IOT
Charge Information (3)	Second UMTS Part
Call Type Level 1	10 (HGGSN)
Call Type Level 2	10 (Broadband)
Call Type Level 3	According to IOT
Charge Information (4)	Second GPRS Part
Call Type Level 1	10 (HGGSN)
Call Type Level 2	11 (narrowband)
Call Type Level 3	According to IOT

Table 7: Example: UMTS Packet Switched / GPRS handover (differential charging)

If there is no difference between the Call Type Level 1/2/3, the individual Charge Information groups can be aggregated into one single occurrence of Charge Information.

Operators can choose to aggregate cross over GPRS and UMTS partials (handovers) in one session or not, as long as the rules for GPRS partials are followed (see section 3.1.2 Principles of GPRS Partial Handling).

Note: The aggregation of network partials corresponds to the TAP standard.

3.11 Intelligent Call Assistance Service

A few percent of calls end up as unsuccessful calls because customers do not dial correctly while being abroad, for example the dialled number without the country code. The intelligent call assistance services is able to identify most of these incorrectly dialled numbers by analysing the called number on certain number patterns and applying specific number translation rules for routing the call to the destination desired by the customer. Consequently, the routing of an incorrectly dialled number can be corrected and the call will be connected.

One example of call assistance services is the usage of IN service to correct an incorrectly dialled number automatically. There can be two cases:

Example A: IN service usage for a visitor who is a non-CAMEL Subscriber

The visited non-CAMEL Subscriber has dialled his home national number without the country code in front of it. The connection of this number failed due to an invalid number in the visited country. The IN service corrects the dialled number by adding the visitor's country code and the connection is now successful. The TAP record will be as in the following table:

TAP Element				Comments
Mobile Originated Call				
	MO Basic Call Information			
		Destination		
			Called Number	The IN Connected number used for both IOT and rating
			Dialled Digits	Dialled number by the Subscriber
	Camel Service Used			Not present

Table 8: Example A: Relevant TAP elements (non-CAMEL subscriber)

Example B: IN service usage for own subscribers roaming in VPMN where CAMEL Phase II has been supported

The subscriber will be enabled in the HLR for IN availability by assigning a special CAMEL Service Key for the purpose of Call Assistance Service. If a subscriber visits a VPMN (where CAMEL II is available) and incorrectly dials a home phone number (for example International Access Code and Country Code forgotten or one zero forgotten in the International Access Code, etc.) the call assistance service will correct the dialled digits and the call can be connected successfully. The TAP record will be as in the following table:

TAP Element				Comments
Mobile Originated Call				
	MO Basic Call Information			
		Destination		
			Called Number	If present, Connected number by IN (irrelevant for charging)
			Dialled Digits	Dialled number by the subscriber
	Camel Service Used			
		Camel Service Key		Present
		3G Camel Destination		
			Camel Destination Number	Connected number by IN which is used for charging

Table 9: Example B: Relevant TAP elements (CAMEL subscriber)

3.12 Voice Messaging Service

Voice Messaging (VM) is a deferred message service (store-and-forward messaging), which allows the originator to send a voice message of limited duration to the recipient. The service employs voice circuit switched resources and is represented in TAP by a MOC or MTC event with the Tele Service Code '11' – Telephony. To this extent, the Charged Item value 'E' – Event Based charge cannot be used for the Voice Messaging service due to existing validation rules. Instead, the Charged Item 'F'– Fixed (one-off) Charge will be used for Voice Messaging Call Events

The unique values of Call Type Levels (as defined in the VPMN's IOT for Voice Messaging service) represent the only means to identify and validate the Charge associated with Voice Messaging events in TAP. This is important especially in the case where the VPMN is charging differently between Voice Messaging and telephony services.

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	33567254529
Dialled Digits	*44205764321 ('*' - a prefix used for VM service access)
Charged Item	'F'
Call Type Level 1	2
Call Type Level 2	0
Call Type Level 3	As per IOT (for Voice Messaging service)

Table 10: Relevant TAP elements (Voice Messaging service)

3.13 Universal Service Fund

The Universal Service Fund (USF) is applicable to operators in the USA, and is defined as follows by the US regulator (FCC):

Because telephones provide a vital link to emergency services, to government services and to surrounding communities, it has been our nation's policy to promote telephone service to all households since this service began in the 1930s. The USF helps to make phone service affordable and available to all Americans, including consumers with low incomes, those living in areas where the costs of providing telephone service is high, schools and libraries and rural health care providers. Congress has mandated that all telephone companies providing interstate service must contribute to the USF. Although not required to do so by the government, many carriers choose to pass their contribution costs on to their customers in the form of a line item, often called the "Federal Universal Service Fee" or "Universal Connectivity Fee".

If an operator via TAP wants to recover its contribution to the federal Universal Service Fund (USF) on services that are not exempt from USF assessment, this is done by specifying a charge in relation to a Charge Type value of 21 (VPMN Surcharge).

The following example lists the relevant TAP data items within Charge Information.

TAP Element	Comments
Charged Item	D
Charge Detail (1)	
Charge Type	00
Charge	<Total charge>
Charge Detail (2)	
Charge Type	01
Charge	<Airtime charge>
Charge Detail (3)	
Charge Type	03
Charge	<Toll charge>
Charge Detail (4)	
Charge Type	21
Charge	<USF charge>

Table 11: Relevant TAP elements (Universal Service Fund)

Note: The calculated charge for USF is determined by the charging operator, as specified in its IOT. In the example, a duration-based charge is used however that is not meant to be excluding other ways of charging.

3.14 Supplementary Services

A Supplementary Service (SS) can occur in conjunction with a MOC/MTC event or separately in a non-call related event. Invocation of a supplementary service, for example Call Forwarding, represents an example of a SS occurrence in conjunction with a MOC/MTC

while the administration of SS, for example activation or de-activation, represents a separate non-call related SS event.

Where a SS has been invoked in conjunction with a MOC/MTC, it will be recorded depending on the network configuration either “in-line” in the appropriate MOC/MTC network CDR or in a separate SS event. A non-call related SS transaction is recorded in a SS event.

A Call Forwarding invocation is invoked in conjunction with a MOC event. The inline Supplementary Service Code data item in the MOC will be used to record Call Forwarding SS invocation codes/values for CFB, CFNRc and CFNRy in TAP.

In case several SSs have been invoked in conjunction with a MOC/MTC during a single call, for example Multi Party, it is recommended that each SS invocation be recorded in an individual SS event on TAP.

3.15 Teleservice Category Codes

Teleservice category codes having a description starting with “All” (T10, T20, T60) represent attributes which describe the type of information and technical features of the Teleservice (Telephony, SMS, etc…) being offered to the user through the Telecommunication system.

For example All Speech transmission services (T10) represents the Teleservice category for transmission of the following:

- Telephony (T11)
- Emergency Call (T12)

Teleservice category codes are potentially provided where either the network was not able to obtain sufficient information about the employed Teleservice or where the Teleservice used was not available from the network.

3.16 Long Term Evolution (LTE)

The term LTE has been used to describe the evolution of the radio access network (RAN) into the Evolved Universal Terrestrial Radio Access Network (E-UTRAN). On the other hand, SAE (System Architecture Evolution) has been used to describe the evolution of the core network into the Evolved Packet Core (EPC) as such, the term Evolved Packet System (EPS) has been used to describe the combined E-UTRAN and EPC.

The Evolved Packet System represents an all-IP-Network with more flattened, simple and flexible Network Architecture in comparison with predecessor networks like 3G UMTS networks.

The EPC consists mainly of five Network Nodes: S-GW, P-GW, MME, PCRF and HSS.

3.16.1 Voice and SMS over LTE (VoLTE)

IP Multimedia Subsystem (IMS) has been employed to deliver VoLTE Services. The EPS needs to communicate with the IMS in order to access and control VoLTE services delivered by the IMS.

There are two VoLTE architectures which were initially endorsed by the GSMA for the standard routing of VoLTE calls to the end destination when using the IMS Roaming and interconnect NNI in the roaming environment. The two routing scenarios using local breakout (LBO) are:

1. VoLTE Home Routing
2. VPMN Assisted Routing

With the two endorsed GSMA VoLTE architectures, IMS consists of a whole suite of network entities which are realised mainly in the HPMN with the exception of the P-CSCF which resides at the VPMN side as shown in the below diagram:

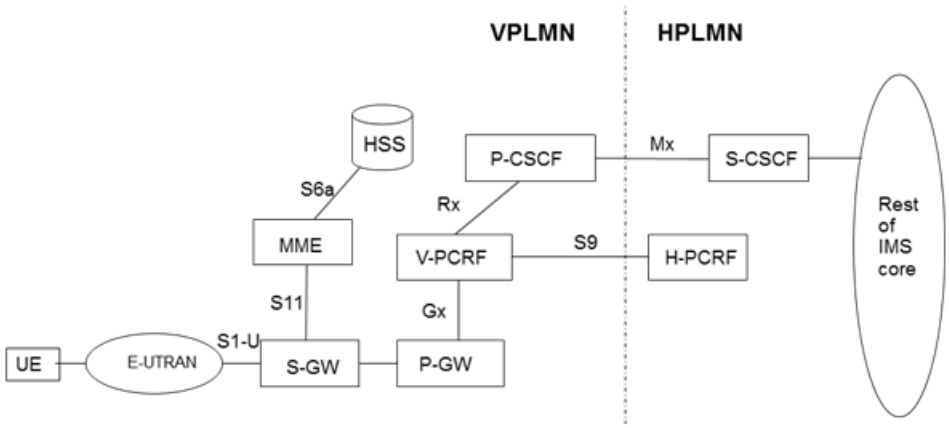


Figure 4: GSMA VoLTE LBO Architectures

The S8 Home Routing (S8HR) represents the third VoLTE architecture which was later endorsed by the GSMA for the standard routing of VoLTE Calls to the end destination. However, S8HR VoLTE calls are home-routed via the S8 interface as data bearer traffic without the use of the IMS Roaming and Interconnect NNI. The IMS UNI is provided directly between the UE and the HPLMN for non-emergency calls.

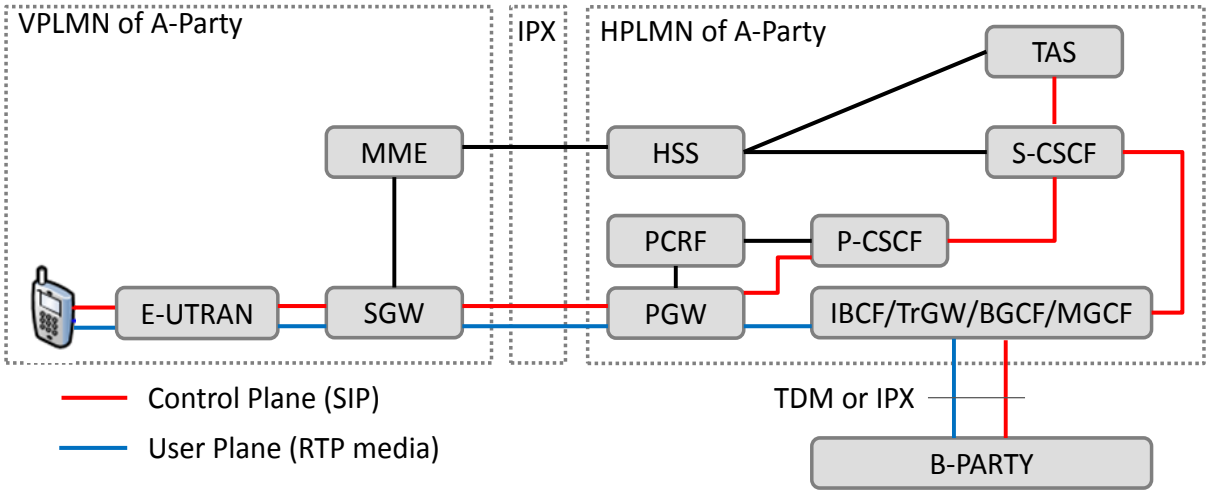


Figure 5: S8HR architecture

On TAP3.12, two new TAP events have been introduced to support VoLTE traffic:

- Mobile Session
- Messaging Event

Mobile Session is used to support voice traffic over LTE (mobile originating & mobile termination) and the Messaging Event is used to support SMS events over LTE (SMS-MO & SMS-MT).

3.16.2 The Representation of VoLTE Handover scenarios in TAP

In a few VoLTE Call scenarios, the VoLTE charging information for a complete VoLTE Call may not be available from a single network CDR where handover has taken place between different RAT like LTE and CS networks. This can be the case for example with VoLTE S8HR where the network CDRs are required to be obtained from MSC-SRVCC and S-GW network nodes for the complete VoLTE Call.

In such a case, the network CDRs from the MSC-SRVCC and S-GW pertaining to the single VoLTE Call are provided in the corresponding TAP MOC Event for Voice over CS usage and in two separate TAP GPRS Call Events for VoLTE usage (1 GPRS = Voice Signalling + 1 GPRS = Voice media) consecutively.

The exchange of a TAP GPRS Call Event for Voice Signalling volume on TAP is subject to the bilateral IOT agreement between the roaming partners.

The Session Transfer Number for Single Radio Voice Call Continuity (STN-SR) is used by the MSC Server to request session transfer of the media path from the PS domain to CS domain.

The STN-SR is populated in the Called Number field on the MSC-SRVCC network CDR where SRVCC handover has taken place from the PS to CS domain. However, it is important to note that the real original Called Number used to setup/connect the VoLTE Call is available only from the IMS domain at the HPMN side.

The STN-SR is a subscription information provided to HSS for each subscriber if SRVCC service is allowed by HPMN. Thus, it can be used by the HPMN to filter out all MSC-SRVCC network CDRs provided in the TAP MOC Event for the CS Call leg usage. This is required to avoid end subscriber’s duplicate charging due to the presence of the complete VoLTE Call (PS + CS) usage from the IMS domain at the HPMN side. On SRVCC handover for VoLTE Calls from E-UTRAN to CS network, the “Cause For Record Closing” element present on the S-GW network CDR is populated with the value "rATChange = 22” to indicate RAT Type Change and the reason for S-GW CDR closure. However, due to the standardization of only abnormal Call release values on TAP, “rATChange =22” is considered normal Call release and therefore this value will not be shown or exchanged on TAP.

A correlation between the network CDRs MSC-SRVCC and S-GW must not be attempted due to the difference of the charging information provided between both CS and PS technologies and the absence of a common correlation Identifier on both Network Events to correlate between both Events. The IMS Charging Id can’t be used to correlate between MSC SRVCC CDR and S-GW because it doesn’t exist on the S-GW CDR. The IMS

Charging Id can be used to correlate CDR transactions shared between IMS Network elements within the IMS Domain only.

The Charging Id can be used for the correlation of the network CDRs on the PS domain (EPC and IMS) as it represents a unique identifier which is present on the SGSN, S-GW, P-GW, P-CSCF, ATCF and TRF.

The Access Correlation Id element on the P-CSCF CDR shall hold the Charging Id generated by the P-GW where LTE has been used as the access network connected to the IMS domain.

For a detailed description on the source network CDRs and the rules on the provision of the TAP CDRs per each VoLTE routing scenario with without eSRVCC please see section 5.9 within TD.57[7].

3.16.3 Support of Voice on CS and LTE

To illustrate the support for voice on CS versus LTE, the below table shows the existing TAP fields for voice over CS and the equivalent TAP fields for voice over LTE.

Existing CS field in TAP	Equivalent LTE field in TAP	Source of LTE field	Comments
IMSI	IMSI	S-GW	
IMEI	IMEI	S-GW	
MSISDN	MSISDN	S-GW	May not always be available
<not available>	Public User Id	S-GW,P-CSCF, ATCF, TRF	May be represented as a SIP-URI or a TEL-URI
Call Event Start Timestamp	Service Start Timestamp	P-CSCF, ATCF,TRF	
UTC Time Offset	UTC Time Offset	P-CSCF, ATCF, TRF	
Total Call Event Duration	Total Call Event Duration	P-CSCF, ATCF, TRF	Zero for SMS
Cause for Termination	Cause for Termination	P-CSCF, ATCF, TRF	Should be same values.
TeleService Code	*<No equivalent>*		
Bearer Service Code	*<No equivalent>*		
Supplementary Service Code	*<Not available>*		Call forwarding occurs in the home network and is not visible to the VPMN
Third Party Number	*<Not available>*		Call forwarding occurs in the home network and is not visible to the VPMN
Dialled Digits	*<Not available>*		
Called Number	Non Charged Party Number	P-CSCF, ATCF, TRF	May be either a Connected Number, or a Called Public User Id (user@domain) therefore is a different format in LTE and preferably

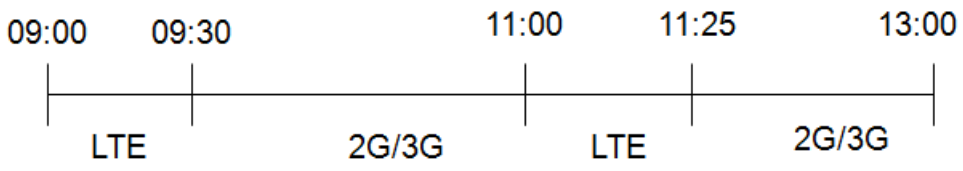
Existing CS field in TAP	Equivalent LTE field in TAP	Source of LTE field	Comments
			2 fields instead of 1 (either or)
Calling Number	Non Charged Party Number	P-CSCF, ATCF, TRF	May be either a Calling Number, or a Calling Public User Id (user@domain), so again 2 fields instead of 1 (either/or)
Recording Entity Identification	Recording Entity Identification	P-CSCF, ATCF, TRF, S-GW,P-GW	This will be the IP address of the Recording Entity. Present 2-3 times in LTE, but only once for CS (MSC). Could put the P-CSCF here, but may be better with the S-GW.
Call Reference	*<Not available>*		A number so not the same as the Call Id (see below)
<Not available>	Event Reference	P-CSCF, ATCF, TRF	Used to uniquely identify a mobile session (call) during an IP session (id@domain)
Location Area Code	Location Area Code	P-CSCF, ATCF, TRF	
Cell Id	Cell Id	P-CSCF, ATCF, TRF	
Charge	Charge	Generated	
Serving Network	Serving Network	Generated	

Table 12: Voice over LTE compared to Voice over CS

3.17 LTE / 2G-3G Packet Switched Handover

In case a data bearer session handover scenario has taken place between LTE / 2G-3G Packet Switched network technologies, the different network call detail records (CDRs) generated for the data bearer session needs to be aggregated into one TAP GPRS Call.

The following time line shows a possible handover scenario between LTE and 2G-3G Packet switched network:



Example: LTE / 2G-3G PS handover

In the below example, there are different charges for LTE and 2G/3G PS (for example for the different bearer technologies, or for different level of Quality of Service), which is illustrated by the Call Type Levels as follows (wherever it says “Bearer” in this section, that could for example be “Technology” or “QoS”):

- Bearer1 with CTL 1,2,3 (10/0/1) is charged at a lower rate
- Bearer2 with CTL 1,2,3 (10/0/2) is charged at a higher rate

Rounding is to 100 KB.

In addition, it is assumed that there are four network CDRs provided for the bearer data session which has traversed between LTE and 2G/3G with different QoS/technology and data volumes as follows:

- Partial 1 contains Bearer1: 345kB
- Partial 2 contains Bearer2: 267kB
- Partial 3 contains Bearer1: 987kB
- Partial 4 contains Bearer2: 123kB

On the aggregation of the four network CDRs, the VPMN can implement any of the following two allowed options on the representation of the network CDRs on TAP in terms of correlation of the data volumes and charging for those data volumes.

Option 1: Chargeable volume total 1722 kB for Bearer1 (that is charged at the lower rate, and rounded up to 1800 kB)

TAP Element	Values (Comments)
GPRS Service Used	
Charge Information (1)	
Call Type Level 1	10 (HGGSN)
Call Type Level 2	0 (Unknown)
Call Type Level 3	1
Chargeable Units	1763328 (1722 kB)
Charged Units (optional)	1843200 (1800 kB)

Table 13: Option 1 LTE / 2G-3G Packet Switched handover (Total Volume for Bearer1)

Note: It is important to be noted that the charging for the total volume of 1800 KB on the higher rate for Bearer 2 is not allowed according to the Charging Principles in BA.27[3].

Option 2: Population of two Charge Information groups:

- Charge Information group 1: Charge the volume 1400 KB for Bearer1 at the lower rate
- Charge Information group 2: Charge the volume 400 KB for Bearer2 at the higher rate

TAP Element	Values (Comments)
GPRS Service Used	
Charge Information (1)	First Bearer1 Part
Call Type Level 1	10 (HGGSN)

TAP Element				Values (Comments)
			Call Type Level 2	0 (Unknown)
			Call Type Level 3	1
			Chargeable Units	1363968 (1332 kB)
			Charged Units (optional)	1433600 (1400 kB)
		Charge Information (2)		Second Bearer2 Part
			Call Type Level 1	10 (HGGSN)
			Call Type Level 2	0 (Unknown)
			Call Type Level 3	2
			Chargeable Units	399360 (390 kB)
			Charged Units (optional)	409600 (400 kB)

Table 14: Option 2 LTE / 2G-3G Packet Switched handover (population of two Charge Information groups)

Note**:** This option 2 could be complicated both for the VPMN to implement and for the HPMN to validate.

3.18 Usage of QoS Class Identifier (QCI) on TAP

The QCI (QoS Class Identifier) is a scalar that is used as a reference to node specific parameters where they have been pre-configured by the operator owning the node. The QCI controls the packet forwarding treatment, for example the scheduling weights, admission thresholds and queue management thresholds.

Each Service Data Flow (SDF) is associated with one and only one QCI. For the same IP-CAN session multiple SDFs with the same QCI and ARP can be treated as a single traffic aggregate which is referred to as an SDF aggregate.

The one-to-one mapping of standardized QCI values to standardized characteristics and example services is described in the below table:

QCI	Resource Type	Priority Level	Packet Delay Budget	Packet Error Loss Rate	Example Services
1	GBR	2	100 ms	10^{-2}	Conversational Voice
2		4	150 ms	10^{-3}	Conversational Video (Live Streaming)
3		3	50 ms	10^{-3}	Real Time Gaming
4		5	300 ms	10^{-6}	Non-Conversational Video (Buffered Streaming)
65		0.7	75ms	10^{-2}	Mission Critical user plane Push To Talk voice (e.g., MCPTT)

66		2	100 ms	10^{-2}	Non-Mission-Critical user plane Push To Talk voice
5	Non-GBR	1	100 ms	10^{-6}	IMS Signalling
6		6	300 ms	10^{-6}	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
7		7	100 ms	10^{-3}	Voice, Video (Live Streaming) Interactive Gaming
8		8	300 ms	10^{-6}	Video (Buffered Streaming) TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.)
9		9			
69		0.5	60 ms	10^{-6}	Mission Critical delay sensitive signalling (e.g., MC-PTT signalling)
70		5.5	200 ms	10^{-6}	Mission Critical Data (e.g. example services are the same as QCI 6/8/9)

Table 15: QCI Values

Note: QCIs 65, 66, 69, 70 are not directly supported by TAP and are for further study. Therefore, if any of those values have been provided from the network, they must be mapped to valid QCI values upon population on TAP based on the following mapping table:

QCI Values Not Directly Supported by TAP	QCI Mapped Value	TAP Call Type Level 2 Value
65 , 66	LTE QCI 1 Conversational	21
69	LTE QCI 5 Interactive (specialised for IMS signalling)	25
70	LTE QCI 6 Interactive	26
	LTE QCI 8 Interactive	28
	LTE QCI 9 Background	29

Table 16: Non-Supported QCI Values Mapping to TAP Call Type Level 2 Values

There are different dedicated bearer data streams for different QoS Class identifiers which are illustrated below by the Call Type Level 2 as described in TD.57[7]:

Call Type Level 2 Value	Description
20	unspecified/default LTE QCIs

21	LTE QCI 1 Conversational
22	LTE QCI 2 Conversational
23	LTE QCI 3 Conversational
24	LTE QCI 4 Streaming
25	LTE QCI 5 Interactive (specialised for IMS signalling)
26	LTE QCI 6 Interactive
27	LTE QCI 7 Interactive
28	LTE QCI 8 Interactive
29	LTE QCI 9 Background

Table 17: Supported QCI Values Mapping to TAP Call Type Level 2 Values

The above described values for Call Type Level 2 are used in the below examples.

Note: The examples have been made to support S8 Home Routing scenarios.

Example 1: QCI bearer data stream for Conversational Voice (IMS Signalling is volume based Charged)

Two bearer data streams are established in order to enable Conversational Voice Call. The bearer data volume is charged at 0.01 SDR per 100 KB. The Voice media and signalling are volume based Charged.

Dedicated Bearer Stream (QC1) for the Voice media

Default Bearer Stream (QCI 5) for Signalling

- Bearer1 with CTL 1,2,3 (10/21/0) is charged for the Voice media
- Bearer2 with CTL 1,2,3 (10/25/0) is charged for the Voice signalling

Voice media for bearer1: Chargeable volume total 1564 kB for Bearer1 and rounded up to 1600 kB.

TAP Element	Values (Comments)
GPRS Call (1)	
Charging ID	25487
GPRS Service Used	
Charge Information	
Charged Item	X
Call Type Level 1	10 (HP-GW)
Call Type Level 2	21 Conversational (Voice)
Call Type Level 3	As defined in the IOT
Charge	160 (0.16 SDR)
Chargeable Units	1601536 (1564 kB)
Charged Units (optional)	1638400 (1600 kB)

IMS Voice Signalling for Bearer 2: Chargeable volume total 250 kB for Bearer1 and rounded up to 300 kB.

TAP Element	Values (Comments)
GPRS Call (2)	
Charging ID	25488
GPRS Service Used	
Charge Information	
Charged Item	X
Call Type Level 1	10 (HP-GW)
Call Type Level 2	25 (IMS Voice Signalling)
Call Type Level 3	As defined in the IOT
Charge	30 (0.03 SDR)
Chargeable Units	256000 (250 kB)
Charged Units (optional)	307200 (300 kB)

Example 2: QCI bearer data streams for Conversational Voice (IMS Signalling is zero Charged)

Two bearer data streams are established in order to enable a Conversational Voice Call. The bearer data volume is charged at 0.01 SDR per 100 KB. The Voice media is volume based Charged and the Voice Signalling is set to duration based zero charged.

Default Bearer Stream (QCI 5) for Signalling

Dedicated Bearer Stream (QC1) for the Voice media

- Bearer1 with CTL 1,2,3 (10/21/0) is charged for the Voice media
- Bearer2 with CTL 1,2,3 (10/25/0) is charged for the Voice signalling

Voice media for bearer1: Chargeable volume total 1564 kB for Bearer1 and rounded up to 1600 kB.

TAP Element	Values (Comments)
GPRS Call (1)	
Charging ID	25487
GPRS Service Used	
Charge Information	
Charged Item	X
Call Type Level 1	10 (HP-GW)
Call Type Level 2	21 Conversational (Voice)
Call Type Level 3	As defined in the IOT

TAP Element				Values (Comments)
			Charge	16 (0.16 SDR)
			Chargeable Units	1601536 (1564 kB)
			Charged Units (optional)	1638400 (1600 kB)

IMS Voice Signalling for Bearer 2: The Charge for the Chargeable Duration is set to zero

TAP Element				Values (Comments)
GPRS Call (2)				
Charging ID				25488
GPRS Service Used				
		Charge Information		
			Charged Item	D
			Call Type Level 1	10 (HP-GW)
			Call Type Level 2	25 (IMS Voice Signalling)
			Call Type Level 3	As defined in the IOT
			Charge	0 (Zero Charge)
			Chargeable Units	267
			Charged Units (optional)	300

Example 3: QCI bearer data streams for Conversational Voice Call including Video service (IMS Signalling is duration based Charged)

Two bearer data streams are established in order to enable a Conversational Voice Call. A conversational Video service has been added during the ongoing conversational Voice Call. The bearer data volume is charged at 0.01 SDR per 100 kB. The Voice signalling is duration based charged at 0.02 SDR per minute, unitised per 60 seconds.

Three bearer data streams are established in order to enable the Conversational Voice Call and the conversational Video service.

Dedicated Bearer Stream (QCI 1) for the Voice media

Dedicated Bearer Stream (QCI 2) for the Video media

Default Bearer Stream (QCI 5) for Signalling

- Bearer1 with CTL 1,2,3 (10/21/0) is charged for the Voice media
- Bearer2 with CTL 1,2,3 (10/22/0) is charged for the Video media
- Bearer3 with CTL 1,2,3 (10/25/0) is charged for the Voice signalling

Voice media for bearer1: Chargeable volume total 1922 kB for Bearer1 and rounded up to 2000 kB.

TAP Element	Values (Comments)
GPRS Call (1)	
Charging ID	25489
GPRS Service Used	
Charge Information	
Charged Item	X
Call Type Level 1	11 (VP-GW)
Call Type Level 2	21 Conversational (Voice)
Call Type Level 3	As defined in the IOT
Charge	20 (0.20 SDR)
Chargeable Units	1968128 (1922 kB)
Charged Units (optional)	2048000 (2000 kB)

Video media for bearer2: Chargeable volume total 2050 kB for Bearer1 and rounded up to 2100 kB.

TAP Element	Values (Comments)
GPRS Call (2)	
Charging ID	25490
GPRS Service Used	
Charge Information	
Charged Item	X
Call Type Level 1	10 (HP-GW)
Call Type Level 2	22 Conversational (Video: Live Streaming)
Call Type Level 3	As defined in the IOT
Charge	21 (0.21 SDR)
Chargeable Units	2099200 (2050 kB)
Charged Units (optional)	2150400 (2100 kB)

IMS Voice Signalling for Bearer 3: rate is 0.02 SDR per minute, unitised per 60 seconds.

TAP Element	Values (Comments)
GPRS Call (3)	
Charging ID	25491
GPRS Service Used	
Charge Information	
Charged Item	D
Call Type Level 1	10 (HP-GW)
Call Type Level 2	25 (IMS Voice Signalling)

TAP Element				Values (Comments)
			Call Type Level 3	As defined in the IOT
			Charge	80 (0.08 SDR)
			Chargeable Units	222
			Charged Units (optional)	240

3.19 CS Voice Partials Aggregation

Network Partial Voice Calls are not allowed to be provided as separate MOC Events on TAP. The Network Partial CDRs must always be aggregated and provided in a single MOC Event with the complete duration of the customer's call before submitting it on TAP.

Due to the possible occurrence of various types of network activities or actions by the network during an ongoing voice call connection; Voice Network Partial CDRs can be generated as the result of such network activities.

The following represents some examples of network activities or actions which can occur during a voice call connection:

- expiry of the partial record timer
- change of location during a connection
- radio link failure and subsequent call re-establishment

The generated Network Partial CDRs belonging to the same call connection are identified by the same Call Reference Identifier.

The same principle also applies to all the Network Partial CDRs resulting from radio link failure with subsequent call re-establishment activity. This is due to the fact that such call re-establishment is transparent to the subscriber and the call is not considered ended in this case.

The radio link failure may occur due to poor coverage, overloaded site or signal quality issues. Further radio link failures during the re-establishment of the call may result in generation of additional partial records.

Since the Call Reference Identifier is a mandatory field on the Network Partial CDR as per the standard 3GPP Specifications; the Call Reference Identifier shall always be present on all Network Partial CDRs generated as a result of all types of network activities or actions.

On the termination of Network Partial CDR ,the table below shows some case scenarios on the Cause for Termination value which can be presented on a Network Partial CDR as follows:

Case Scenario	Cause for Termination Value	Comments
Call Ends Successfully	Normal release	
Network Activity Intervention	Partial record	A new Network Partial CDR shall be opened after the

		closure of the current one
Attempt to re-establish the call was successful	Partial record call re-establishment	A new Partial CDR shall be opened for the new call re-establishment and closure of the current one
Attempt to re-establish the call was not successful	Stable call abnormal termination	

Table 18: Cause of Termination Values

Based on the above mentioned, the VPMN shall aggregate any network partial records belonging to the same call connection into a single TAP CDR based on the Call Reference Identifier.

An example scenario has been described in the following table for the establishment of a single call connection to the destination number (+4524576831) where six Network Partial CDRs have been generated by the network due to the intervention of the following two different types of network activities:

- expiry of the partial record timer for CDR Sequences # 1,2:
- radio link failure with subsequent call re-establishment for CDR Sequences # 3,4,5:

CDR Seq. #	Call Event Start Time	Duration in Sec	Call Reference	Destination	Cause of Termination Value
1	20131201142050	1800	242526	+4524576831	Partial record
2	20131201145050	1800	242526	+4524576831	Partial record
3	20131201152050	150	242526	+4524576831	Partial record call re-establishment.
4	20131201152320	4	242526	+4524576831	Partial record call re-establishment.
5	20131201152324	2	242526	+4524576831	Partial record call re-establishment.
6	20131201152426	10	242526	+4524576831	Normal release

Table 19: An Example scenario of Network Partials CDRs

Notes:

- As shown in the table above, the Call Reference value remains the same unique identifier on the generated Network Partials CDRs # 4 ,5 & 6 (due to radio link failure with subsequent call re-establishment) because the call is not considered ended in such a case.
- Where a new Call Reference identifier value is provided per each of the generated Network Partial CDRs #4,5,6, or where the Call Reference identifier is absent, this would not be considered inline with the 3GPP technical specifications. In addition, it would lead to non-compliance with BA.12[2] rules as the Network Partial CDRs would be presented as single and separate MOC Events on TAP without aggregation in such a case.

All the six Network Partial CDRS generated from the described example scenario shall be aggregated and presented in a single MOC Event on TAP as follows:

CDR Seq. #	Call Event Start Time	Duration in Sec	Call Reference	Destination
1	20131201142050	3766	242526	+4524576831

Table 20: TAP MOC Event

3.20 Treatment of Conditional CF SS within ICS

With the introduction of VoLTE IMS Centralised Services (ICS) deployment Scenarios, Conditional CF SS in association with ICS is invoked by the Telephony Application Server (TAS) at the HPMN IMS network side.

As for example, the invocation of Conditional Call Forwarding (CFB, CFNRy, CFNRc) where A calls B and the Call is forwarded to C, the forwarded Call B to C represents an Originated Call which has been triggered by the TAS at the B-HPMN side

Consequently, there will be no media resources utilised by the VPMN and the Visited MSC will generate no Charging CDRs for this call.

Note: This is in contrast with the treatment of the legacy CS Voice Call where Conditional CF SS is invoked and a Charging CDR is generated by the VMSC at the VPMN side.

3.21 Potential TAP Records of VoLTE Call Scenarios

3.21.1 VoLTE Local Breakout

Call Type	TAP Record
VoLTE (MO, MT)	Mobile Session
SMS over LTE (MO, MT)	Messaging Event

Table 21 VoLTE Calls (Local Breakout with VPMN or HPMN Routing)

Call Type	TAP Record
VoLTE MO	Mobile Session
VoLTE MT	Mobile Session

Table 22 VoLTE Calls (Local Breakout with VPMN or HPMN Routing) in handover case

Note: though the handover in place a VoLTE is always anchored in VoLTE/IMS and the mobile session is recorded in P-CSCF and in BGCF/SBC respectively. There is an additional CDR recorded in CS system (MSC), which should not be generated as MOC in TAP.

3.21.2 VoLTE S8HR

When charging is not differentiated by QCI or other CTL2 values, CTL2 can still be populated in TAP in line with the QCI but will not be used for charge validation.

A S8HR session is a data session and the direction of a S8HR call is not available to the VPMN in the network CDRs.

Call Type	TAP Record	QCI	Call Type Level 2 (CTL2)	Note
Signalling	GPRS Call	5	25	If signalling is charged
VoLTE	GPRS Call	1	21	
ViLTE	GPRS Call	2	22	
SMS	GPRS Call	5	25	Cannot normally be distinguished from signalling

Table 23 Calls by S8HR (QCI based charging)

Call Type	TAP Record	QCI	Call Type Level 2 (CTL2)	Note
VoLTE MO	GPRS Call + MOC	1	21	
VoLTE MT	GPRS Call + MOC	1	21	
Signalling	GPRS	5	25	If signalling is charged

Table 24 Calls by S8HR in handover case (QCI based charging)

4 Common Elements Implementation

4.1 General Rules

The following are a collection of general implementation rules:

- Only the rules of the TAP release exchanged over the public interface apply.
- TD.57[7] defines the maximum level of validation. Regarding the implementation phase and bilateral agreements it is not necessary to implement all existing validations.
- Use a tolerant validation for those TAP elements where there is no impact to your billing system. Use a strong validation when creating a TAP file.

4.2 Taxation

4.2.1 General

Tax Information is a group detailing the applicable tax elements for the associated Charge. Where there is no tax associated with the charge then there should be no group Tax Information present within the Charge Information group. For example, TAP files and invoices between members of the European Community do not contain VAT by treaty agreement and, therefore, any tax information can only reference a ‘non tax’ zero (either rate or fixed value), this is obviously redundant data which can be misleading and is wasteful both in implementation efficiency and TAP file volumes.

4.2.2 Handling of tax on tax

The taxable amount in some cases can be larger than the charge amount due to some operators applying tax on a charge that already includes additional tax (tax on tax). This means that in order to validate the taxable amounts within TAP, external data detailing the tax rules of the PMN is required. For an example, see section 4.2.3 Tax breakdown, Example E.

4.2.3 Tax Breakdown

Tax Information is a repeating group containing the Tax Rate Code and the Tax Value and, where applicable Taxable Amount. Each occurrence of Charge Information may have several tax elements associated with it, for example national tax, regional tax, local tax. There must be one occurrence within Charge Information for each tax element associated with the Charge Information.

The total Tax Value for a call is the sum of all the Tax Values specified in the Tax Information group. Please note that a summary element shall not be present.

Taxable Amount shall not be specified if it is equal to the Total Charge, however it is not a severe error to do so.

The below examples will clarify the rules on a call having the following Charge Details:

- 00 (Summary Total)
- 01 (Airtime)
- 03 (Toll)

There is no differentiation between multiple rate periods. It also assumes that the Tax Rate Codes present in the file are as follows:

- 1 (for example VAT @ 17%)
- 2 (for example VAT @ 20%)
- 3 (for example VAT @ 18%)
- 4 (for example VAT @ 21%)

Note: The examples below show different ‘valid’ ways to breakdown the tax details to different taxable amounts. The detail level provided for tax breakdown is at the discretion of the sender. The only requirement is that the tax value must reconcile with the taxable amount and applicable tax rate and that no redundant tax information is provided so that the sum of all tax values, irrespectively of the charge type, gives the total (invoiceable) tax amount for the whole record.

The Charge Type mentioned in the examples is specified under Taxation and referred to by the Tax Rate Code.

Example A - Air and Toll subject to the same tax (Tax Rate code 1)

The corresponding tax breakdown section would be as follows:

TAP Element		Comments
Tax Information (1)		Summary Total
	Tax Rate Code	1
	Tax Value	Total amount of tax on this call for this Tax Rate Code

Table 25: Example A: Relevant Tax Information section (AIR & Toll subject to same tax)

The Charge Type element is not required, as the tax is not being applied to a particular Charge Type. Similarly, the Taxable Amount element is not required, as the associated Tax Value and Tax Rate Code relate to the total Charge within Charge Information.

Example B - Air and Toll subject to different taxes

The corresponding tax breakdown section would be as follows:

TAP Element		Comments
Tax Information (1)		Airtime
	Tax Rate Code	1
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (17% of the Airtime charges, across both rate periods)
	Taxable Amount	Amount of this Charge Type that is subject to this Tax Rate Code (Total Airtime charge)
Tax Information (2)		Toll
	Tax Rate Code	2
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the Taxable Amount for this Charge Type.
	Taxable Amount	Amount of this Charge Type that is subject to this Tax Rate Code (Total Toll charge)

Table 26: Example B: Relevant Tax Information section (Air & toll subject to different taxes)

Example C - Air and toll subject to different taxes, and different rate periods of the call are subject to different tax rates

This could happen, for example, on a long call that crossed midnight on a day when tax rates change.

The corresponding tax breakdown section would be as follows:

TAP Element		Comments
Tax Information (1)		Airtime for first rate period
	Tax Rate Code	1
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (17% of the Airtime charge for the first rate period)
	Taxable Amount	Taxable Amount - Amount for this Charge Type charge that is

TAP Element		Comments
		subject to this tax rate (Air charge for the first rate period).
Tax Information (2)		Airtime for second rate period
	Tax Rate Code	3
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (18% of the Airtime charge for the second rate period)
	Taxable Amount	Amount of the Charge Type charge that is subject to this tax rate (Air charge for the second rate period).
Tax Information (3)		Toll for first rate period
	Tax Rate Code	2
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (20% of the Airtime charge for the first rate period)
	Taxable Amount	Amount of the Charge Type charge that is subject to this tax rate (Toll charge for the first rate period).
Tax Information (4)		Toll for second rate period
	Tax Rate Code	4
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (21% of the Airtime charge for the second rate period)
	Taxable Amount	Amount of the Charge Type charge that is subject to this tax rate (Toll charge for the second rate period).

Table 27: Example C: Relevant Tax Information section (Air & toll subject to different taxes & rate periods also subject to different taxes)

Example D - Air and toll is not specified, the rate is independent of time of day. However, After Midnight calls have no tax applied.

The corresponding tax breakdown section would be as follows:

TAP Element		Comments
Tax Information (1)		Total Charge for first tax period
	Tax Rate Code	1
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (17% of the Total Charge for the first period)
	Taxable Amount	Amount of the Charge Type charge that is subject to this tax rate (Total Charge for before midnight period)

Table 28: Example D: Relevant Tax Information section (Rate independent of time of day. Tax not applicable after midnight)

Example E – Tax on tax

The corresponding tax breakdown section would be as follows:

TAP Element		Comments
Tax Information (1)		Province
	Tax Rate Code	1
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (17% of the Total Charge, for example 17.00 SDR)
	Taxable Amount	Amount of this Charge Type that is subject to this Tax Rate Code (Total Charge, for example 100.00 SDR)
Tax Information (2)		National
	Tax Rate Code	2
	Tax Value	Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code and the charge amount for this Charge Type (20% of the Total Charge and the Province Tax, for example 23.40 SDR)
	Taxable Amount	Amount of this Charge Type that is subject to this Tax Rate Code (sum of Total Charge and Province Tax, for example 117.00 SDR)

Table 29: Example E: Relevant Tax Information section (Tax on tax)

4.2.4 Fixed tax based on duration

Some countries' tax legislations require a fixed tax based on the duration of the call, instead of being based on the Charge of the call. This rare situation is not directly supported by TAP; however, a workaround can be used.

This should be done by defining a fixed tax and then specify a tax value at the call detail level. As the Tax Value for fixed taxes is only specified within Tax Information at the call event level, there can be no cross validation of this Tax Value with the Accounting

Information. There is also no validation of the Tax Value in relation to the Taxable Amount for fixed taxes.

Example: Fixed tax based on duration

5 minute call with 0.1 SDR tax per minute, charged at 0.50 SDR per minute. TAP Decimal Places = 3.

The following would result in TAP:

TAP Element		Comments
Taxation		
	Tax Rate Code	1
	Tax Type	01 (national tax in this example)
	Tax Rate	Not present as this is a fixed tax
	Charge Type	Not present as this is applied to the total charge
Charge Detail		
	Charge Type	00
	Charge	2500
	Chargeable Units	300
Tax Information		
	Tax Rate Code	1
	Tax Value	500
	Taxable Amount	Not present as this is a fixed tax

Table 30: Relevant TAP elements (Fixed tax based on duration)

4.2.5 Tax and Charge break down per Charge Type

There are Telecom Operators which breakdown taxes per charge Type in TAP to be inline with the Tax regulation in their countries. In this case, Taxation information will consist of Tax Rate code, Tax Type, Tax Rate and Charge Type. A breakdown of the Charge Detail information per Charge Type should be implemented in a similar manner within Call Events in order for the HPMN to achieve a successful Tax validation based on the applicable Charge Detail information with in Charge Information Group.

An example of Taxation breakdown and the corresponding Charge Detail breakdown would be as follows:

TAP Element		Comments
Taxation (1)		
	Tax Rate Code	1
	Tax Type	01 (national tax in this example)
	Tax Rate	17%
	Charge Type	‘01’ Air Time Charge

TAP Element		Comments
Taxation (2)		
	Tax Rate Code	2
	Tax Type	01 (national tax in this example)
	Tax Rate	19%
	Charge Type	'03' Toll Charge
Charge Detail (1)		
	Charge Type	00
	Charge	4500
	Chargeable Units	240
Charge Detail (2)		
	Charge Type	01
	Charge	2500
	Chargeable Units	240
Charge Detail (3)		
	Charge Type	03
	Charge	2000
	Chargeable Units	240
Tax Information (1)		
	Tax Rate Code	1 (Airtime)
	Tax Value	425 [Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code (17%) and the Taxable Amount for this Charge Type.]
	Taxable Amount	2500 [Amount of this Charge Type that is subject to this Tax Rate Code (Total Airtime charge)]
Tax Information (2)		
	Tax Rate Code	2 (Toll)
	Tax Value	380 [Total tax amount for this Charge Type, based on the rate associated with the Tax Rate Code (19%) and the Taxable Amount for this Charge Type.]
	Taxable Amount	2000 [Amount of this Charge Type that is subject to this Tax Rate Code (Total Toll charge)]

Table 31: Relevant TAP elements (Tax and Charge per Charge Type)

Note: Sufficient information needs to be provided to support validation of the Tax Value. The Tax Value must correspond to the Tax Rate and Taxable Amount (or Total Charge where no Taxable Amount is present). For the purpose of tax validation, there is no cross-validation between Taxation, Charge Detail and Tax Information. If no Taxable Amount has been populated within Tax Information then the validation of the Tax Rate is always against the

Total Charge (Charge Type 00), even if the used Tax Rate Code has been defined for another Charge Type in Taxation.

4.3 Separation of charges within a call

The Charge Information group is used to provide the details of the charges relating to Basic Service usage within a call. Charges related to CAMEL must be separately represented using the CAMEL Invocation Fee and related tax, exchange rate and discount groups and elements.

The aim of this section is to provide examples demonstrating the separation of charges within call events where CAMEL is used. To avoid confusion on how to provide the CAMEL charges, the following examples clarify that the charge within the CAMEL Service Used group relates to the CAMEL invocation fee only. Where the CAMEL invocation fee is charged within mobile originated or mobile terminated calls, the charge for the basic service used must not include the CAMEL invocation fee. The same applies for CAMEL services used within a GPRS call, for example, CAMEL invocation fee must not be included within the charge of the GPRS service used and vice versa.

Example A
Visitor subscriber dials short code '1122'. CAMEL translates the called party number to 352000001 and the call lasts 2 minutes. The applicable charge according to the VPMN's IOT is 2 SDR. The VPMN operator charges 0.1 SDR per CAMEL invocation regardless of the 'level of CAMEL service'.

The VPMN operator will create a MOC event including the following TAP elements to separate the IOT and CAMEL charges:

TAP Element	Comments
Dialled Digits	1122
Basic Service Used	
Teleservice Code	11
Charged Item	D
Chargeable Units	120
Charge Detail	
Charge Type	00
Charge	2000 (2 SDRs)
CAMEL Service Used	
CAMEL Invocation Fee	100 (0.1 SDR)
CAMEL Service Level	0
3G CAMEL Destination	
CAMEL Destination Number	352000001

Table 32: Example A: Relevant TAP elements

Example B

Visitor subscriber calls a number dialling the short code '2510'. CAMEL translates the called party number to 352000001. The call is answered and lasts for 2 minutes. The called party then releases the call and a follow on call is made for the visitor subscriber to the number 352000002. The call lasts for 1 minute. The applicable charge according to the VPMN's IOT for the two minutes call to 352000001 is 2 SDR. The applicable charge for the one-minute call to 352000002 is 1 SDR. In addition, the VPMN operator charges 0.1 SDR per CAMEL invocation regardless of the 'level of CAMEL service'.

The VPMN operator will create two MOC events in the TAP File. The first MOC will include a basic service used group for the telephony service and a CAMEL service used group for the CAMEL service and the called party number modification. The second MOC will include a basic service used group for the telephony service and a CAMEL service used group for the CAMEL service and the initiated call forward.

It is important to note that each basic service used group will include the charge information for the telephony service used but as it is one single CAMEL call, only one occurrence of the CAMEL service used will include a CAMEL Invocation Fee.

The VPMN operator will create a first MOC event including the following TAP elements to separate the basic service and the CAMEL service used and the corresponding charges:

TAP Element	Comments
Dialled Digits	2510
Basic Service Used	
Teleservice Code	11
Charged Item	D
Chargeable Units	120
Charge Detail	
Charge Type	00
Charge	2000 (2 SDRs)
CAMEL Service Used	
CAMEL Invocation Fee	100 (0.1 SDR)
CAMEL Service Level	0
3G CAMEL Destination	
CAMEL Destination Number	352000001

Table 33: Example B: Relevant TAP elements (first MOC)

The VPMN operator will create a second MOC event including the following TAP elements to separate the basic service and the CAMEL service used and the corresponding charges:

TAP Element	Comments
Dialled Digits	2510

TAP Element	Comments
Basic Service Used	
Teleservice Code	11
Charged Item	D
Chargeable Units	60
Charge Detail	
Charge Type	00
Charge	1000 (1 SDRs)
CAMEL Service Used	
3G CAMEL Destination	
CAMEL Destination Number	352000002

Table 34: Example B: Relevant TAP elements (second MOC)

As explained earlier, the second CAMEL service used does not include a charge as it is the same CAMEL call and that the invocation fee is included in the CAMEL service used within the first MOC event.

4.4 Dialled Digits

4.4.1 Dialled Digits definition

The element Dialled Digits is used to identify the real numbers the user has pressed on his mobile to make a call before pressing the send key. This means that all characters from '0' - '9', '+', '#' and '*' can be transferred in this element. It is not allowed to modify this number during transfer or TAP conversion. Dialled Digits can be used to identify the usage of short numbers.

4.4.2 Population of Called Number, Dialled Digits and CAMEL Destination Number

The Called Number, Dialled Digits and CAMEL Destination Number are crucial for the proper identification of the called party in a mobile originated call. Where the VPMN does not populate these data elements or populates them incorrectly, the HPMN could not be able to re-rate the call accurately.

As in some instances, (hopefully rare) the Called Number and Dialled Digits may not be available from the network, TD.57[7] provides corresponding conditionality rules.

In the case of an unsuccessful call attempt, it is allowed to omit the Called Number if the Dialled Digits are filled correctly.

In the case of CAMEL Call Forwarding, Dialled Digits data item is omitted. The called number has to contain the forwarded number in international format (that is the international representation of the forwarded number as keyed in by the subscriber). In the CAMEL general case, the camel destination has to contain the 'connected number' provided by the CAMEL server represented in international format.

For HPMN re-pricing purposes it is important the VPMN populates the CAMEL Destination Number on TAP3 as received from the CAMEL server. In particular, this implies:

- The VPMN shall not exchange the CAMEL Destination Number by default with the CAMEL Server address for TAP3 creation
- The CAMEL server address will rarely represent the number actually connected. For widely spread prepaid roaming implementations based upon CAMEL phase 1 which re-route the call at call set-up back to the home network, for example, the connected number typically will be the address of a gateway MSC in the home network.

International format number

TD.57[7] references international format number. An ISDN number is said to be in international format where its format is as follows:

Country Code	National Destination Code	Subscriber number
CC	NDC	SN

Table 35: International format

For example, “33” is the country code for France. “6” is a national destination for mobiles in France. “33600120045” is a number represented in international format to call a mobile in France.

Dialled Digits

The Dialled Digits are the digits as dialled on the roamer's mobile. The Dialled Digits must always be present where available from the network.

4.4.2.1 Examples

Below are some examples, please note that this is not an exhaustive set but they are demonstrating population of the various elements. The examples assume that the actual dialled digits are available from the network.
Example A: MO call to international number (not known whether mobile or PSTN)

- Actual dialled digits = +441234123456
- VPMN International Access Code (IAC) = 00
- VPMN Country Code (CC) = 33

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	441234123456
Dialled Digits	+441234123456
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	0
Call Type Level 3	As per IOT

Table 36: Example A: Relevant TAP elements (MOC to international number)

- Example B: MO call to international number (known to be a mobile number)

- Actual dialled digits = 00436641234567
- VPMN IAC = 00
- VPMN CC = 33

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	436641234567
Dialled Digits	00436641234567
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	1
Call Type Level 3	As per IOT

Table 37: Example B: Relevant TAP elements (MOC to international mobile number)

Example C: MO call to national number (known to be a PSTN number)

- Actual dialled digits = +421249551234
- VPMN IAC = 00
- VPMN CC = 421

The following table shows the contents of the relevant TAP Elements:

TAP Element	Comments
Called Number	421249551234
Dialled Digits	+421249551234
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	2
Call Type Level 3	As per IOT

Table 38: Example C: Relevant TAP elements (MOC to national PSTN number)

Example D: MO call to national number (known to be a mobile number)

- Actual dialled digits = 0011614141234
- VPMN IAC = 0011
- VPMN CC = 61

The following table shows the contents of the relevant TAP Elements:

TAP Element	Comments
Called Number	614141234
Dialled Digits	0011614141234
Charged Item	As per IOT
Call Type Level 1	1

TAP Element	Comments
Call Type Level 2	1
Call Type Level 3	As per IOT

Table 39: Example D: Relevant TAP elements (MOC to national mobile number)

Example E: MO call to national number (known to be non geographic number)

- Actual dialled digits = 08001234123456
- VPMN IAC = 00
- VPMN CC = 45

The following table shows the contents of the relevant TAP Elements:

TAP Element	Comments
Called Number	458001234123456
Dialled Digits	08001234123456
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	3
Call Type Level 3	As per IOT

Table 40: Example E: Relevant TAP elements (MOC to non-geographic national number)

Example F: MO call to national short code (no CAMEL redirection, long number equivalent not known)

- Actual dialled digits = 111
- VPMN IAC = 00
- VPMN CC = 41

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	41111 (recommended) or 41
Dialled Digits	111
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	3
Call Type Level 3	As per IOT

Table 41: Example F: Relevant TAP elements (MOC to national short code)

Example G: MO call to international short code (CAMEL redirection to long number of unknown type)

- Actual dialled digits = 121
- VPMN IAC = 00
- VPMN CC = 39

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	Not present
Dialled Digits	121
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	0
Call Type Level 3	As per IOT
CAMEL Destination Number	447836123456

Table 42: Example G: Relevant TAP elements (MOC to international short code)

Example H: MO call to national short code (no CAMEL redirection, long number equivalent known, of type non geographic)

- Actual dialled digits = 100
- VPMN IAC = 00
- VPMN CC = 44

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	447836000100
Dialled Digits	100
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	3
Call Type Level 3	As per IOT

Table 43: Example H: Relevant TAP elements (MOC to national short code & long number known)

Example I: MO call to emergency services (using local access code)

- Actual dialled digits = 911
- VPMN IAC = 011
- VPMN CC = 1

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	Not present
Dialled Digits	911 (may not be present if Teleservice Code is '12')
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	3

TAP Element	Comments
Call Type Level 3	As per IOT

Table 44: Example I: Relevant TAP elements (MOC to emergency services via local access code)

Example J: MO call to emergency services (using GSM standard access code)

- Actual dialled digits = 112
- VPMN IAC = 001, 008
- VPMN CC = 62

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	Not present
Dialled Digits	112 (may not be present if Teleservice Code is '12')
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	3
Call Type Level 3	As per IOT

Table 45: Example J: Relevant TAP elements (MOC to emergency services via GSM standard access code)

Example K: MO call with CAMEL re-direction

- Actual dialled digits = +447879706543
- Number returned by the CAMEL server = 436641234020
- VPMN IAC = 00
- VPMN CC = 44
- HPMN CC = 43

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	447879706543
Dialled Digits	+447879706543
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	1
Call Type Level 3	As per IOT
CAMEL Destination Number	436641234020

Table 46: Example K: Relevant TAP elements (MOC with CAMEL re-direction)

Note: the CAMEL Destination Number is the relevant element for charging and billing even when the called number is available here.

Example L: MO international call with special characters

- Actual dialled digits = 0039*3492222
- VPMN IAC = 00
- VPMN CC = 44

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	39 or 393492222 (both representations are allowed)
Dialled Digits	0039*3492222
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	0
Call Type Level 3	As per IOT

Table 47: Example L: Relevant TAP elements (International MOC with special characters)

Note: In the above case it is allowed to send the called number only with the country code or with the number from the dialled digits international format without the '*' and/or '#'.

Example M: MO call with CAMEL international format conversion

- Actual dialled digits = 0664331354 (National numbering plan of home operator - no short code)
- VPMN IAC = 00
- VPMN CC = 44
- HPMN CC = 43

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	43664331354
Dialled Digits	0664331354
Charged Item	as per IOT
Call Type Level 1	2
Call Type Level 2	1
Call Type Level 3	as per IOT
CAMEL Destination Number	43664331354

Table 48: Example M: Relevant TAP elements (MOC with CAMEL international format conversion)

Note: In the above case, the subscriber dials a national numbering plan of the HPMN without the HPMN's CC. The CAMEL Service allows the subscriber to dial any national numbering plan without HPMN's CC (CAMEL Destination Number is the translation of dialled digits to international format - translation made by the HPMN and International format of Camel Destination Number Returned by CAMEL Server). The CAMEL Destination Number is the

relevant element for charging and billing even when the called number is available and same as the CAMEL Destination Number.

Example N: MO Call Forwarding with CAMEL re-direction

- Actual number keyed in by subscriber for call forwarding = 087543412 (National numbering plan of visited Operator - no short code)
- VPMN IAC = 00
- VPMN City Dial Prefix = 0
- VPMN CC = 44
- HPMN CC = 43

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	4487543412
Dialled Digits	Not present
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	1
Call Type Level 3	As per IOT
CAMEL Destination Number	43664331354

Table 49: Example N: Relevant TAP elements (MO Call Forwarding with CAMEL re-direction)

Note: In the above case (CAMEL Call Forward), only the Called Number will be present and not the Dialled Digits. The Called Number will contain the number before modification by CAMEL and the CAMEL Destination Number will contain the modified number. This makes it clear that CAMEL has modified the called number. The CAMEL Destination Number is the relevant element for charging and billing even when the called number is available here.

Example O: MO call to local short code not accessible by dialling in international format

- Actual number keyed in by subscriber 123 (National numbering plan of visited Operator - short code)
- VPMN IAC = 00
- VPMN CC = 44

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	44123
Dialled Digits	123
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	3
Call Type Level 3	As per IOT

Table 50: Example O: Relevant TAP elements (MOC to local short code not accessible in international format)

Example P: MO call with CAMEL Home Routing

- Actual number keyed in by subscriber = 004487543123
- Number returned by the CAMEL server = 436641234020
- HPMN IAC = 00
- HPMN CC = 43
- VPMN CC = 44

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	49487543123
Dialled Digits	0049487543123
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	1
Call Type Level 3	As per IOT
CAMEL Destination Number	436641234020

Table 51: Example P: Relevant TAP elements (MOC with CAMEL Home Routing)

Note: CAMEL server's implementations should return 436641234020. If it would return 6641234020 and the call was successfully routed by the VPMN locally and the VPMN does not format the number in international representation in TAP, there is the danger that HPMN will assume that the call was routed to a country with destination code 66. In other words, the VPMN has to support the formatting of the CAMEL destination in the international format. The CAMEL Rerouting Number should be available in RAEX IR21 of HPMN.

Example Q: MO call with VPN Service

- Actual number keyed in by subscriber = 837031
- Number returned by the CAMEL server = 393356337031
- VPMN IAC = 00
- VPMN CC = 44
- HPMN CC = 39

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	Missing
Dialled Digits	837031
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	0
Call Type Level 3	As per IOT
CAMEL Destination Number	393356337031

Table 52: Example Q: Relevant TAP elements (MOC with VPN service)

Note: Should the VPMN populate the Camel Destination Number with 39837031, the call can be rejected because the number is different from what the HPMN Camel Server returned even if the Charge is correct.

Example R: MO call to international short code with CAMEL re-direction

- Actual number keyed in by subscriber = 2267
- Number returned by the CAMEL server = 2267
- VPMN IAC = 00
- VPMN CC = 44
- HPMN CC = 39

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	Missing
Dialled Digits	2267
Charged Item	As per IOT
Call Type Level 1	2
Call Type Level 2	0
Call Type Level 3	As per IOT
CAMEL Destination Number	392267

Table 53: Example R: Relevant TAP elements (MOC to international short code with CAMEL re-direction)

Example S: MO call to international short code that has experienced ‘Default Handling’ by the Visited Network due to inability to establish the Call Event through the CAMEL Server in the Home Network

- Actual number keyed in by subscriber = 2241
- Number returned by the CAMEL server = No routed number returned by the HPMN’s CAMEL Server.
- VPMN IAC = 00
- VPMN CC = 44
- HPMN CC = 39

The following table shows the contents of the relevant TAP elements:

TAP Element	Comments
Called Number	442241
Dialled Digits	2241
Charged Item	As per IOT
Call Type Level 1	1
Call Type Level 2	0
Call Type Level 3	As per IOT

TAP Element	Comments
Default Call Handling Indicator	0
CAMEL Destination Number	Not present

Table 54: Example S: Relevant TAP elements (MOC to international short code with 'Default Handling')

Note: CAMEL Destination Number data item will not be present in case the Call Event has experienced 'Default Handling' as indicated by the presence of the Default Call Handling Indicator in the TAP record.

4.5 Population of Calling Number on MTCs within TAP

The calling number is the number from which the call was originated in the case of mobile terminated calls. For SMS MT this item must contain the SMSC address. The calling number must be presented in international format within group Call Originator where available from the network. For technical reasons the calling number is sometimes not available from the network. In this case the calling number must not be populated with a default number. In some other cases the calling number can be delivered by the network or carriers incorrectly. The HPMN may opt to use a home CDR for retail billing purposes and not use the TAP MTC record.

4.6 Population of call duration and timestamps for charging (MOCs and MTCs)

Where call charges only relate to the call answer time then the Call Event Start Timestamp will normally be populated with the call answer time and not the channel seizure time.

Due to certain technical constraints this may not always be possible or cost effective to implement so, to support these exceptional cases, TAP has been configured to allow for the population of Call Event Start Timestamp with channel seizure time even where this does not relate to the start of charging. It should be noted that this usage could lead to some TADIG testing completion difficulties with a few potential roaming partners where they may not be able to accommodate this exception in TAP files received.

Where a call has any charges relating to the channel seizure time then the Call Event Start Timestamp must contain the channel seizure time. This is true even where there are other charges within the call that relate to the call answer time, for example where a call set up charge is made for channel seizure and then duration is charged from call answer.

The Total Call Event Duration must always contain the call duration calculated from the call end time (channel release) minus the Call Event Start Timestamp.

For the same call scenario it is the charging model (IOT) that will determine which values are valid for which data items.
Example A:

VPMN X charges for duration from call answer to the end of the call. There is no other charge for the call. The duration is chargeable at 2 SDR per minute, unitised per 30 seconds.

- Channel Seizure Timestamp 20090517152130
- Call Answer Timestamp 20090517152141

- Call End Timestamp 20090517152703

The following table shows the contents of the relevant TAP elements:

TAP Element	Value	Comments
Call Event Start Timestamp	20090517152141	
Total Call Event Duration	322 seconds	Calculated from Call End Timestamp minus Call Event Start Timestamp
Basic Service Used		Group
Charging Timestamp	Not present	
Charge Information		Group; only 1 occurrence
Charged Item	D	
Charge Detail		Group; only 1 occurrence
Charge Type	00	
Charge	11 SDRs	
Chargeable Units	322	
Charged Units	330	This item is optional and is provided at the discretion of the Sender.
Charge Detail Timestamp	Not present	

Table 55: Example A: Relevant TAP elements (Duration charged from call answer to end of call)

Example B:

VPMN X charges for duration from call answer to the end of the call. There is no other charge for the call. The duration is chargeable at 2 SDR per minute, unitised per 30 seconds.

- Channel Seizure Timestamp 20090517152130
- Call Answer Timestamp 20090517152141
- Call End Timestamp 20090517152703

VPMN X implementation uses the exceptional case (see above)

The following table shows the contents of the relevant TAP elements

TAP Element	Value	Comments
Call Event Start Timestamp	20090517152130	
Total Call Event Duration	333 seconds	Calculated from Call End Timestamp minus Call Event Start Timestamp
Basic Service Used		Group
Charging Timestamp	20090517152141	
Charge Information		Group; only 1 occurrence
Charged Item	D	
Charge Detail		Group; only 1 occurrence

TAP Element	Value	Comments
Charge Type	00	
Charge	11 SDRs	
Chargeable Units	322	
Charged Units	330	This item is optional and is provided at the discretion of the Sender.
Charge Detail Timestamp	Not present	

Table 56: Example B: Relevant TAP elements (Duration charged from call answer to end of call)

Example C:

VPMN X charges for duration from channel seizure to the end of the call. There is no other charge for the call. The duration is chargeable at 2 SDR per minute, unitised per 30 seconds.

- Channel Seizure Timestamp 20090517152130
- Call Answer Timestamp 20090517152141
- Call End Timestamp 20090517152703

The following table shows the contents of the relevant TAP elements:

TAP Element	Value	Comments
Call Event Start Timestamp	20090517152130	
Total Call Event Duration	333 seconds	Calculated from Call End Timestamp minus Call Event Start Timestamp
Basic Service Used		Group
Charging Timestamp	Not present	
Charge Information		Group; only 1 occurrence
Charged Item	D	
Charge Detail		Group; only 1 occurrence
Charge Type	00	
Charge	12 SDRs	
Chargeable Units	333	
Charged Units	360	This item is optional and is provided at the discretion of the Sender.
Charge Detail Timestamp	Not present	

Table 57: Example C: Relevant TAP elements (Duration charged from channel seizure to end of call)

Example D:

VPMN X charges a fixed charge for call set up and duration from call answer to the end of the call. The call set up is charged at 0.50 SDR, fixed charge. The duration is chargeable at 2 SDR per minute, unitised per 30 seconds.

- Channel Seizure Timestamp 20090517152130
- Call Answer Timestamp 20090517152141
- Call End Timestamp 20090517152703

The following table shows the contents of the relevant TAP elements:

TAP Element	Value	Comments
Call Event Start Timestamp	20090517152130	
Total Call Event Duration	333 seconds	Calculated from Call End Timestamp minus Call Event Start Timestamp
Basic Service Used		Group
Charging Timestamp	Not present	
Charge Information		Group; 1st occurrence
Charged Item	F	
Charge Detail		Group; only 1 occurrence
Charge Type	00	
Charge	0.50 SDRs	
Chargeable Units	Not present	
Charged Units	Not present	
Charge Detail Timestamp	Not present	
Charge Information		Group; 2nd occurrence
Charged Item	D	
Charge Detail		Group; only 1 occurrence
Charge Type	00	
Charge	11 SDRs	
Chargeable Units	322	
Charged Units	330	This item is optional and is provided at the discretion of the Sender.
Charge Detail Timestamp	20090517152141	

Table 58: Example D: Relevant TAP elements (Fixed charge for call set up and duration charged from call answer to the end of the call)

Example E:

VPMN X charges a fixed charge for call set up attempt when the call is not answered. The call set up attempt is charged at 0.25 SDR, fixed charge.

- Channel Seizure Timestamp 20090517152130
- Call Answer Timestamp not applicable, call not answered
- Call End Timestamp 20090517152204 where Call End Timestamp is the channel release time

The following table shows the contents of the relevant TAP elements:

TAP Element	Value	Comments
Call Event Start Timestamp	20090517152130	
Total Call Event Duration	34 seconds	Calculated from Call End Timestamp minus Call Event Start Timestamp
Basic Service Used		Group
Charging Timestamp	Not present	
Charge Information		Group; only 1 occurrence
Charged Item	A	
Charge Detail		Group; only 1 occurrence
Charge Type	00	
Charge	0.25 SDRs	
Chargeable Units	Not present	
Charged Units	Not present	
Charge Detail Timestamp	Not present	

Table 59: Example E: Relevant TAP elements (Fixed charge for call set up when call not answered)

Example F:

VPMN X charges a fixed charge for call set up and duration from call answer to the end of the call. The call set up is charged at 0.50 SDR, fixed charge. The duration is chargeable at 2 SDR per minute, unitised per 30 seconds.

- Channel Seizure Timestamp 20090517152130
- Call Answer Timestamp 20090517152141
- Call End Timestamp 20090517152703

The following table shows the contents of the relevant TAP elements:

TAP Element	Value	Comments
Call Event Start Timestamp	20090517152130	
Total Call Event Duration	333 seconds	Calculated from Call End Timestamp minus Call Event Start Timestamp
Basic Service Used		Group
Charging Timestamp	Not present	
Charge Information		Group; only 1 occurrence
Charged Item	D	
Charge Detail		
Charge Type	00	
Charge	11.50 SDRs	
Chargeable Units	322	
Charged Units	330	This item is optional and is provided at the discretion of the Sender.

TAP Element	Value	Comments
Charge Detail Timestamp	20090517152141	

Table 60: Example F: Relevant TAP elements (Fixed charge for call set up and duration charged from call answer to the end of the call)

Note: The Fixed call set up charge has been included within the duration call charge in this valid example scenario. It is also possible to populate the call set up charge within Charged Item 'F' and the duration Charge within Charged Item 'D' in two separate Charge Information Groups.

4.7 Population and Validation of Exchange Rates

Exchange rate information is populated in the TAP file to document the exchange rate used to convert monetary amounts from the Sender's local (IOT) currency to the currency used in the TAP file. BA.11[1] specifies detailed rules for determining the exchange rate to be used. TD.57[7] includes several validation rules to confirm the exchange rate applied to the call event is correct. In the TAP, the exchange rate is expressed as the number of units of Local Currency to one unit of the currency used in the TAP file.

The GSMA offers a GSER (GSMA Standardised Exchange Rates) tool in support of the BA.11 rules. Most exchange rates used in the industry are published by GSER. BA.11 lists the currencies that are published by GSER, and also lists the known currencies that are using fixed rates (including what those fixed rates are).

GSER is the official source of exchange rates from 1 May 2016 for those currencies that are published by the tool.

4.7.1 Currencies Published by GSER.

Both GSER and IMF (International Monetary Fund) publish exchange rates to 6 significant digits.Historically, some operator systems have been developed to support only 5 decimal places for exchange rates and a tolerance has therefore been introduced to allow operators who can not support the full number of significant digits published by GSER to round either up or down from the more accurate GSER exchange rate.

Note: This is needed as not all operators are able to support more than 5 significant digits. Operators who can support all digits as published by GSER must,of course,not round the exchange rate in TAP and must populate TAP with the full GSER published exchange rate.

Exchange rates in TAP must be expressed as a minimum with five significant digits. It is however allowed to exclude trailing zeroes in TAP (although that could strictly speaking mean that less than five significant digits are present).

For example (not conclusive), if the exchange rate published by GSER is 2,938.570000, the TAP fields can be populated in the following ways:

- Exchange Rate: 293857, Number of Decimal Places: 2
- Exchange Rate: 293850, Number of Decimal Places: 2
- Exchange Rate: 29385, Number of Decimal Places: 1
- Exchange Rate: 293860, Number of Decimal Places: 2
- Exchange Rate: 29386, Number of Decimal Places: 1

- Exchange Rate: 293857000, Number of Decimal Places: 5

4.7.2 Currencies Not Published by GSER

For currencies not published by GSER a tolerance of two units on the 5th significant digit of the calculated Exchange Rate is required to avoid operational problems when validating the Exchange Rate on different systems.

Note: This is needed due to inaccurate values of calculated exchange rates used in the industry.

The exchange rate must be expressed in minimum five significant digits in TAP. It is however allowed to exclude trailing zeroes in TAP (although that could strictly speaking mean that less than five significant digits are present). For validation purposes, a minimum tolerance of two units on the fifth significant digit must be allowed by the recipient, to allow for differences in how the exchange rate is reduced to the five significant digits (for example, rounding or truncating).

For example the Bulgarian Lev (BGN) does not have an SDR exchange rate published by GSER. It is fixed to the EUR at 1.95583 BGN to 1 EUR.

The exchange rate would be calculated by taking the fixed EUR to BGN rate and then multiplying with the SDR to EUR rate published by GSER.

Example:

- EUR to BGN exchange rate = 1.95583 (1 EUR = 1.95583 BGN)
- SDR to EUR exchange rate = 1.27131 (1 SDR = 1.27131 EUR)
- Exchange rate for TAP is calculated as:
- 1.95583 x 1.27131 = 2.4864662373
- The result can be reduced to five significant digits by rounding or truncating:
- 2.4865 (rounded)
- 2.4864 (truncated)

When validating the exchange rate in the TAP, when the recipient calculates the exchange rate and compares it to the exchange rate in the TAP file, the recipient must allow at least two units of variance on the fifth significant digit.

If the recipient used rounding when determining expected exchange rate (2.4865) it must consider any exchange rate between (and including) 2.4863 and 2.4867 as valid.

If the recipient used truncation when determining expected exchange rate (2.4864), it must consider any exchange rate between (and including) 2.4862 and 2.4866 as valid.

In practice this means that all exchange rates between (and including) 2.4862 and 2.4867 are valid.

For example (not conclusive), if the recipient has calculated the exchange rate to 2.4864662373, TAP files containing the following values cannot be rejected:

- Exchange Rate: 2486466237366, Number of Decimal Places: 12
- Exchange Rate: 24863765, Number of Decimal Places: 7

- Exchange Rate: 24864, Number of Decimal Places: 4
- Exchange Rate: 248669, Number of Decimal Places: 5

4.7.3 Significant Digits and Decimal Places

Significant digits and Decimal Places are used on defining the accuracy and precision of the pegged exchange rate value as described in BA.11[1] and on populating and validating the Exchange Rate in TAP as defined in TD.57[7].

In order to avoid misinterpretations this section explains the meaning of Significant digits, Decimal Places and the difference between them.

4.7.3.1 Significant digits

In the context of TAP, the significant digits of a number are defined as follows:

Starting from left to right, the first non-zero digit is the first significant digit. Leading zeroes are not counted as significant digits.

The last significant digit is the last digit in the number. Trailing zeroes to the right of the decimal point are not significant digits on validating by TAP although this is not in line with the mathematical definition of significant digits.

For example:

- 6.000 is one significant digit
- 0.057 is two significant digits
- 11.90 is three significant digits
- 01600 is four significant digits
- 1.0456 is five significant digits

4.7.3.2 Decimal Places

The Decimal Places indicates the number of fractional digits following on the right side of the decimal point.

For Example:

- 0.075 has three decimal places
- 1.08300 has five decimal places
- 1.257646 has six decimal places

4.7.3.3 Significant Digits vs. Decimal Places

Several examples are shown below in order to clearly distinguish between Significant digits and Decimal Places:

- 0.123456 is 6 significant digits and also 6 decimal places
- 123.456 is 6 significant digits but only 3 decimal places
- 123.450000 is 5 significant digits and 6 decimal places

4.8 Updating the Local Currency in TAP

The Local Currency present within Accounting Information Group must be the same as the one defined in the VPMN's IOT. In case an Operator decided to change the Local Currency in its IOT, the Local Currency data item in TAP must be updated and become effective on the same corresponding date as the new VPMN's IOT.

Operators should maintain a clear split in the TAP-OUT traffic stream between the old and the new Local Currency used by the TAP-OUT files. An appropriate cut off date (for example, midnight time) can be set up in the billing system in order to enforce the separation between the old and new Local Currency usage. This is important as only one Local Currency is allowed per TAP file where all Call Events within a TAP file must be related to the defined TAP file Local Currency.

In the event where the Local Currency in the TAP file does not match with the Local Currency defined in the VPMN's IOT, the Call Events will be subject to rejection as the Call Event Charges (based on the exchange rate calculations between the Local Currency and TAP Currency as set in the TAP File) will not match with the defined IOT's Tariff in this case.

It is essential that any late received Call Events made on dates in relation to the old Currency (based on the Call Event/Partial date & time) should be provided in a separate TAP file where the Local Currency element is populated with the old Local Currency as defined in the old IOT. On the other hand, all Call Events made on dates in relation to the new Currency (based on the Call Event/partial date & time) will be provided in a separate TAP files stream where the Local Currency element is populated with the new Local Currency as defined in the new IOT.

4.9 Population of high and low values in Charge and Total Charge elements

The Charge and Total Charge elements may contain very high or low values due to the extensive (for example LTE) or low (for example M2M) usage of services. It is recommended that the TAP Sender does not use a large number of TAP decimal places. For high values a large number of TAP decimal places could potentially cause the charge to exceed the maximum positive integer value that can be encoded within the defined element sizes. Where the maximum positive integer value is exceeded this may result in a negative value on decoding the content of the elements where the left most bit is set to 1. For low values a small number of TAP decimal places could cause sessions with low traffic usage to be zero charged if truncation is used instead of rounding.

It is generally recommended to use 3 TAP Decimal Places.

The table below shows the highest and lowest possible values for Charge (4 bytes) and Total Charge (8 bytes) given the number of TAP decimal places used.

TAP Decimal Places	Lowest Amount (Charge and Total Charge)	Highest Amount (Charge)	Highest Amount (Total Charge)
2	0.01	21474836.47	$> 9 \times 10^{16}$
3	0.001	2147483.647	$> 9 \times 10^{15}$
4	0.0001	214748.3647	$> 9 \times 10^{14}$
5	0.00001	21474.83647	$> 9 \times 10^{13}$
6	0.000001	2147.483647	$> 9 \times 10^{12}$

Table 61: Highest and lowest possible values for Charge and Total Charge by TAP Decimal Places

Where the roaming relationship allows both very high and very low charges the above model may not support accurate charge representations within a single TAP file. In these cases,there are two recommended options:

- Put the charge records into separate TAP files, one file with low charges and one file with high charges.Each TAP file could then be configured to have the appropriate number of TAP Decimal Places to allow for accurate charge representation.This option will work for all services,voice,SMS,data,etc.
- Create more than the allowed two TAP partials per data session per 24 hours to handle the high charges within the same TAP file as the low charges.This option will only work for data, but it is very likely that it is only data charges that could take extreme proportions.

Note: This option could mean more rounding issues when charges are rounded up, so it is only allowed to create more than two partials when it is actually needed because of the size of the charge.

4.10 Discrepancy of Calculated Tax values between TAP and Invoice

It is very likely that the sum of all taxes from TAP files (which is the sum of applied taxes to each single charge) will not match the invoice tax value if this is applied to the overall charge. This can occur due to various reasons as for example due to rounding rules, tax jurisdiction or currency conversion reasons.

In order to reduce discrepancy and reach a more precise value between the calculated tax on TAP and the invoice, the TAP Sender may choose to use more than 3 TAP Decimal Places.

4.11 IOT Validation Examples

This section provides examples for IOT validations. It is related to validation rule 200 on Charge.

The given IOT validation examples are in line with section 5.8 of TD.57[7], defining the Charge Validation Procedure.

Note: Although this TAP Implementation Handbook refers to TAP 3.12 the given IOT validation examples within this section as well as section 5.8 in TD.57[7] is applicable to all TAP 3 releases.

Note: Error 20 on Call Type Level 2, is not IOT related, however examples are given in this section.

IOT Example 1 is from a VPMN with Country Code 99, charge independent on call time. The IOT includes the following information (subset), included fully defined Call Type Levels:

Call Scenario	Service	CTL 1-2-3	Charge
National (destination 99)	Voice	1-0-1	100 per min
National Freephone (destination 99800)	Voice	1-3-1	0
International Zone 1 (destination 49)	Voice	2-0-1	200 per min
International Zone 1 (destination 49)	Video Telephony	2-0-1	400 per min
SMS-MO	SMS-MO	Not present	50 per SMS
Incoming Calls Forwarded	Voice	0-6-1	0
Incoming Calls Not Forwarded	Voice	0-7-1	60 per min
Packet Switched Data	3G	10-0-1	100 per MB
Packet Switched Data	LTE	10-0-2	50 per MB

The following table shows call scenarios and possible CDR rejections due to the IOT related error codes mentioned above, if appropriate. All duration based examples assume a call duration of 60 seconds. All volume based examples assume a transferred volume of 1 MB.

Call Scenario	CTL 1-2-3	Charge	Possible Rejections
Voice call to 991234567	1-0-0	100	Ok, no rejection
Originated SMS to SMSC 491234567	1-0-0	50	Ok, no rejection
Originated SMS to SMSC 491234567	1-0-0	100	200 on Charge
CAMEL Voice call with Called Number 491234567 and CAMEL Destination Number 991234567	1-0-0	100	Ok, no rejection
Voice call to 998001234	1-0-0	0	Ok, no rejection
Voice call to 998001234	2-0-0	100	200 on Charge
Voice call to 998001234	1-0-0	100	200 on Charge
Voice call to 491234567	2-0-0	200	Ok, no rejection
Video call to 491234567	2-0-0	200	200 on Charge
Terminated Call	0-6-0	0	Ok, no rejection
Terminated Call	0-7-0	60	Ok, no rejection
Terminated Call	0-7-0	0	Ok, no rejection (zero charged MTCs must not be rejected)

Terminated Call	0-0-0	60	200 on Charge
Terminated Call	0-5-0	60	200 on Charge or 20 on Call Type Level 2
Terminated Call	0-6-0	60	200 on Charge
Terminated Call	0-0-0	55	200 on Charge
GPRS Session	10-0-1	100	Ok, no rejection
GPRS Session	10-0-2	50	Ok, no rejection
GPRS Session	10-0-0	100	200 on Charge
GPRS Session	10-0-1	50	200 on Charge
GPRS Session	10-0-2	100	200 on Charge

IOT Example 2 is from a VPMN with Country Code 99, charge independent on call time. The IOT includes the following information (subset), but does not include Call Type Levels.

Note: This second IOT is an example of an invalid IOT as the Call Type Levels have not been defined. It is however a common scenario and the purpose is to explain what can be rejected in TAP, not what IOTs should be accepted. As the IOT does not include Call Type Levels it must not apply differential charging for MTC and GPRS scenarios unless technical parameters are used for the differentiation.Thus an IOT like Example 1 is not applicable. Parties issuing IOTs without Call Type Levels, but with differential charging for MTC and GPRS scenarios take a risk to get rejections for all MTC (except zero charged) and all GPRS CDRs (except where verification is possible by pure technical parameter usage, for example by APN).

Call Scenario	Service	CTL 1-2-3	Charge
National (destination 99)	Voice		100 per min
National Freephone (destination 99800)	Voice		0
International Zone 1 (destination 49)	Voice		200 per min
International Zone 1 (destination 49)	Video Telephony		400 per min
SMS-MO	SMS-MO		50 per SMS
Incoming Calls	Voice		60 per min
Packet Switched Data	N/A		100 per MB

The following table shows call scenarios and possible CDR rejections due to the IOT related error codes mentioned above, if appropriate. All duration based examples assume a call duration of 60 seconds. All volume based examples assume a transferred volume of 1 MB.

Call Scenario	CTL 1-2-3	Charge	Possible Rejections
Voice call to 991234567	1-0-0	100	Ok, no rejection
Originated SMS to SMSC	1-0-0	50	Ok, no rejection

491234567			
Originated SMS to SMSC 491234567	1-0-0	100	200 on Charge
CAMEL Voice call with Called Number 491234567 and CAMEL Destination Number 991234567	1-0-0	100	Ok, no rejection
Voice call to 998001234	1-0-0	0	Ok, no rejection
Voice call to 998001234	2-0-0	100	200 on Charge
Voice call to 998001234	1-0-0	100	200 on Charge
Voice call to 491234567	2-0-0	200	Ok, no rejection
Video call to 491234567	2-0-0	200	200 on Charge
Terminated Call	0-6-0	0	Ok, no rejection (zero charged MTCs must not be rejected)
Terminated Call	0-7-0	60	Ok, no rejection
Terminated Call	0-7-0	0	Ok, no rejection (zero charged MTCs must not be rejected)
Terminated Call	0-0-0	60	Ok, no rejection
Terminated Call	0-5-0	60	20 on Call Type Level 2
Terminated Call	0-6-0	60	Ok, no rejection
Terminated Call	0-0-0	55	200 on Charge
GPRS Session	10-0-1	100	Ok, no rejection
GPRS Session	10-0-2	200	200 on Charge
GPRS Session	10-0-0	200	200 on Charge

4.12 Network Node Sharing

The Network Node Sharing in relation to different services, geographical areas or countries is a common practice for some Operators. It supports Telecom Operators to reduce CAPEX/OPEX expenditure in network infrastructure and equipments.

Since Network Node Sharing may represent an impact on Wholesale and Retail billing, the purpose of this section is to describe the different scenarios affected by Network Node Sharing and the possible solutions to avoid any operational problems on Wholesale or Retail billing.

4.12.1 MSC Sharing for MOC/MTC Voice Calls and SMS Events

4.12.1.1 MSC Sharing between Terrestrial / Non terrestrial network

Where a Host Operator (Terrestrial or Non-Terrestrial Operator) extends its network coverage into International Zones e.g. International Waters or International Airspace, the extension of the network is known as the Client Operator where it can be considered a Non-Terrestrial Network Extension.

In such cases, MSC nodes must be identified using independent E.164 addresses or ranges of MSC / VLRs. This means that separate ranges of MSC Global Titles and Mobile Station Roaming Numbers (MSRNs) must be used for each independent non-terrestrial network

extension and must be different from the host network MSC Global Titles and MSRN ranges. Please refer to PRD BA.46[4] for further details on Network Extensions rules and regulations.

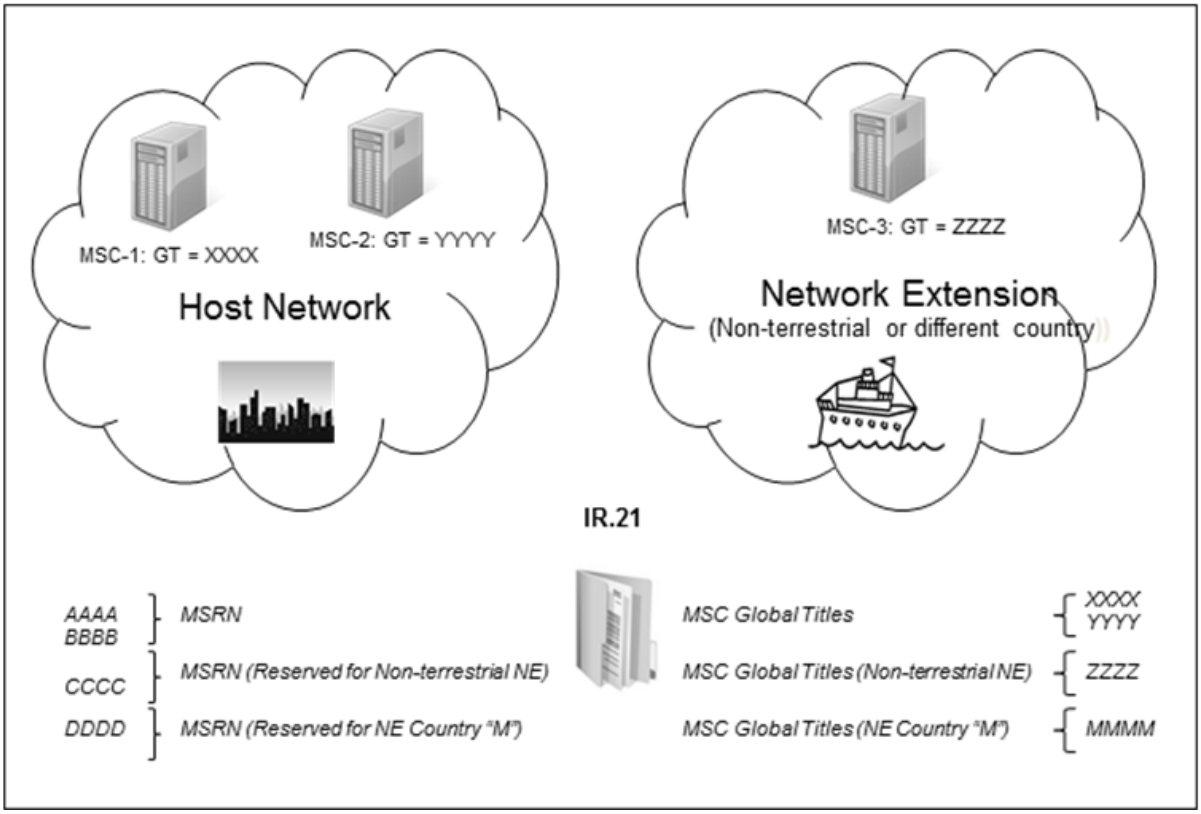


Figure 6: Split of MSC GT and MSRN ranges

4.12.1.2 MSC Sharing between different geographical zones / areas

There are some GSM Operators offering services in different areas that could be different countries or different zones within the same country.

Where the extended network extensions belongs to different countries, a distinct TAP code, MSRN ranges and MSC Global Titles must be completely independent per each network extension.

On the other hand, where the area differentiation is within the same country only, the Serving Location Description within the TAP Events represents the only means to differentiate the traffic at the Wholesale level as the TAP codes, MSRN ranges and Global Titles could be the same in such case.

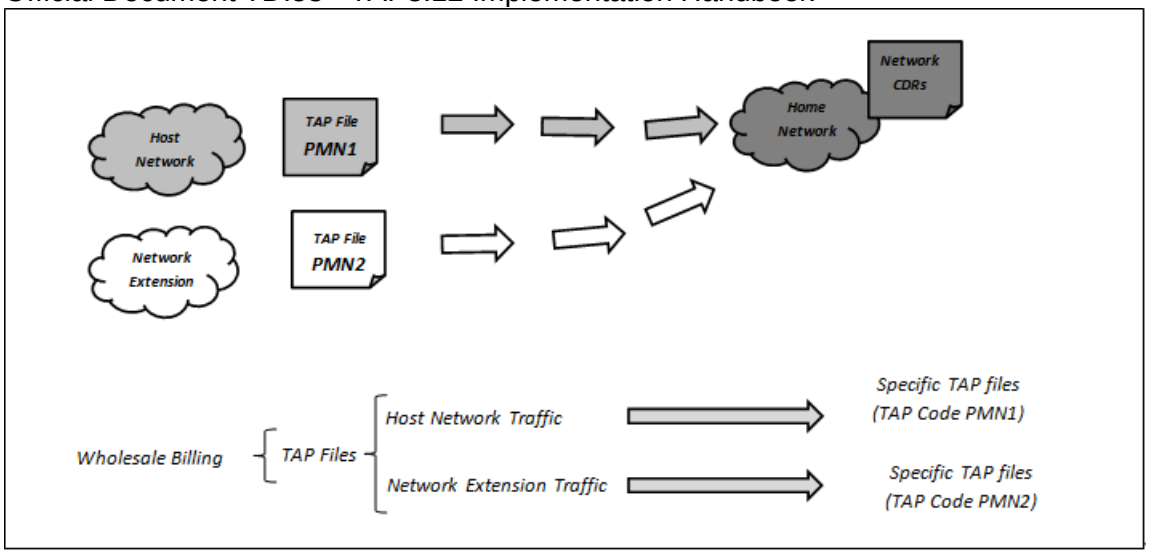


Figure 7: Split of TAP Traffic Stream per each PMN

4.12.2 SGSN Sharing between two or more Network Operators

SGSN sharing represents the sharing of the same SGSN IP Address among more than one Operator or between a Host Operator and its Client network extension. In such case, a severe impact is highly expected on the wholesale and Retail billing operational processes.

In case the SGSN is shared between two Operators PMN1 and PMN2, the VPMN's billing system must be capable of distinguishing the PS data traffic generated by each network in order to insert the raised CDR Events in two separate TAP files streams per each TAP Code. The wholesale billing could be performed without any problems where such requirements are fulfilled by the visited network.

SGSN IP address sharing could cause some operational billing problems at retail level for those cases in which Home network uses real time charging as for example DIAMETER or uses its own network GGSN CDRs to charge its end Subscribers. The real problem is more evident if the SGSN is shared between operators belonging to different countries. This is due to the fact that real time charging platforms or retail billing systems uses SGSN IP address to identify the origin of the PDP context where it identify the country in which the roaming subscriber was connected to the PS network.

In case the HPMN is not capable of differentiating the IP Address where a single IP range is used, there will be no way to differentiate whether the PS traffic is originated from one visited network or another. As a result, the retail billing would not be performed in a proper way and it could raise customer claims where it could ultimately leads to revenue reduction for the home operator.

Therefore, SGSN IP Addresses ranges must be differentiated for host network and for each network extension. In addition, the IP Address ranges per each PMN must be described in the corresponding IR.21[5] document.

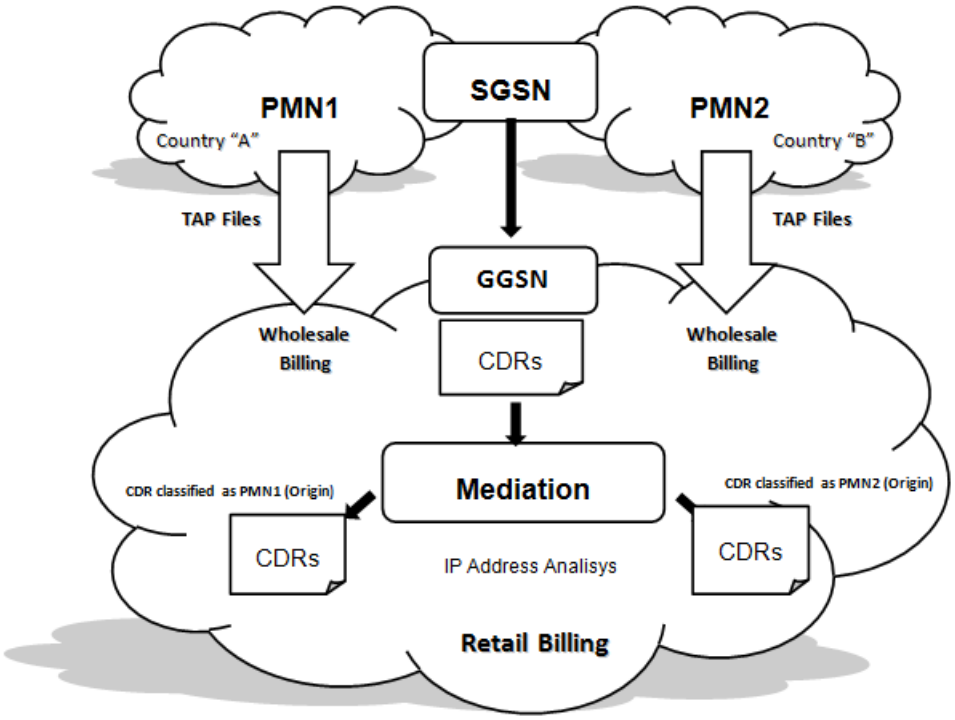


Figure 8: Split of SGSN IP Address ranges per each PMN

4.12.3 IR.21 Information Required

IR.21[5] Document is necessary for the proper retail billing. There are many situations in which IR.21[5] is updated with new relevant information for retail billing but the billing systems themselves are not updated because it is difficult sometimes to coordinate all the relevant changes for all the roaming partners.

TADIG billing teams within the Organization at the HPMN side could analyze the IR.21[5] Information in order to find the relevant information required for the wholesale and retail billing and to inform the corresponding IREG/Network teams at the VPMN side about the correction of any information within the IR.21[5] that would have an impact on the billing processes. With the introduction of GSMA InfoCentre2, it provides the means to alert TADIG/billing teams at the HPMN side when a relevant parameter of IR.21[5] is updated or modified and thus it serves as a very helpful means in maintaining data synchronization and in improving the communication between the IREG and TADIG teams within both the VPMN and HPMN Organizations.

- Relevant Information contained in IR.21[5] document for wholesale / retail charging:
- MSC / VLR Global title ranges
- MSRN Ranges
- SMSC GT Address
- CAMEL Re-routing numbers (CAMEL Destination Number in TAP)
- SGSN IP Address ranges

All these technical parameters contained in the IR.21[5] could be critical for Wholesale/Retail billing systems. Therefore, the presence of working procedure to inform about all IR.21[5]

updates to the “Billing Team” of each Operator could be very useful to prevent severe impact on the Wholesale/Retail billing.

4.12.4 Usage of Location Information for Serving Network Identification

As described in PRD IR.33[6], the Routing Area Identity (RAI) and User Location Information represents an alternative way to identify the serving Operator in case of SGSN IP Address Sharing but it is less likely to be employed by the HPMN for the following reasons:

- It represents more work and complexity on the HPMN’s billing system to perform further analysis of the RAI and ULI in case there is no VPMN’s SGSN IP Address range split.
- The RAI and ULI are not mandatory parameters according to the 3GPP specification so it could be risky to use them for retail billing.
- SGSN IP range identification represents a more simple method to identify the visited network

While SGSN IP Sharing represents a simplified implementation method for the visited network, it produces an increased complexity on the Home Operator’s retail billing system to separate the PS Data traffic according to the Serving network.

4.12.5 Identification of Host/Network Extension for Retail Billing Process

The following table lists the different options of billing solutions that the HPMN can employ for Retail Billing and the Network elements that can be used to identify the VPMN’s traffic streams whether it belongs to the Host Network or Network Extension per each Option.

Billing Solution	MOC Voice Calls	MTC Voice Calls	SMS-MO	PS Data
TAP files	TAP Files can be used for retail billing for all scenarios. No problems to differentiate Host / Network Extension MOC voice calls because different TAP codes are used for each type of traffic.	TAP Files can be used for retail billing for all scenarios. No problems to differentiate host / network extension MTC voice calls because different TAP codes are used for each type of traffic.	TAP Files can be used for retail billing for all scenarios. No problems to differentiate host / network extension MOC SMS calls because different TAP codes are used for each type of traffic.	TAP Files can be used for retail billing for all scenarios. No problems to differentiate host / network extension GPRS calls because different TAP codes are used for each type of traffic.

Real Time Billing	For Real Time billing using CAMEL, the MSC GT can be used by SDP/OCS platforms as criteria to identify the visited host/network extension. Therefore, the MSC GT must be different for host/network extension.	For Real Time billing using CAMEL, the MSRN can be used by SDP/OCS platforms as criteria to identify the visited host/network extension. Therefore, the MSRN must be different for host/network extension.	For Real Time billing using CAMEL, the MSC GT can be used by SDP/OCS platforms as criteria to identify the visited host/network extension. Therefore, the MSC GT must be different for host/network extension. Real time billing is supported under a CAMEL and non-CAMEL environment when Home SMSC is used.	For Real Time billing using CAMEL, the SGSN IP Address can be used by SDP/OCS platforms as criteria to identify the visited network. Therefore IP Address ranges must be different and independent for host/network extension in order to successfully identify the visited network.
Network CDRs	Network CDRs obtained from the CAMEL Server could be used for retail billing as an alternative to TAP CDRs for non-online Charging CAMEL scenarios. The criteria followed by the HPMN's billing system to identify the visited host/network extension should be the MSC GT. For this reason, MSC GT must be different for each host network/network extension.	Network CDRs obtained from the CAMEL Server and Gateway MSC could be used for retail billing as an alternative to TAP CDRs for CAMEL non-online Charging scenarios and non-CAMEL scenarios consecutively . The criteria followed by the HPMN's billing system to identify the visited host / network extension should be the MSRN range. For this reason, MSRN must be different for each host / network extension.	Network CDRs obtained from the SMS Centre could be used for retail billing as an alternative to TAP CDRs for all scenarios when home SMSC is used. The criteria followed by the HPMN's billing system to identify the visited host/network extension should be the MSC GT. For this reason, MSC GT must be different for each host / network extension.	Network CDRs obtained from the Home GGSN could be used for retail billing as an alternative to TAP CDRs for home routing data sessions scenario. The criteria followed by the HPMN's billing system to identify the visited host/network extension should be the SGSN IP Address. For this reason, the SGSN IP Address range must be different for each host / network extension.

Table 62: Options of Billing Solutions for Retail Billing

4.13 TAP calculations and IOT rates in the same unit

It is recommended that the IOT rates and the calculations in TAP are implemented in the same measurement unit to avoid unnecessary TAP rejections, disputes and potential revenue losses.

The below examples illustrate the impact of mismatches between the defined rates in the IOT and the calculations in the billing system for the TAP Charge. There are other examples where rounding at various stages of charge calculation can cause discrepancies.

Note: If a small number of TAP decimal places are used, there could be even larger discrepancies between the expected IOT rate and TAP.

Example 1: Voice rates

- Voice rate: 0.10 EUR per minute, charged by second
- 10 minute call (600 seconds)
- Billing system carries 4 decimals

    - Billing in line with IOT:
        - Use 0.10 per minute as the rate:
        - 0.10 / 60 * 600 = 1.00
    - Billing not in line with IOT:
        - Calculate the per second rate and use that: 0.10 / 60 = 0.001667, rounded to 0.0017 (or 0.0016)
        - 0.0017 * 600 = 1.02 (or 0.0016 * 600 = 0.96)
        - Difference: +0.02 (+2%) (or -0,04 (-4%))

Example 2: Data rates

- Data rate: 0.05 EUR per MB, charged by kB (1MB=1024kB)
- 100 MB data session
- Billing system carries 5 decimals

    - Billing in line with IOT:
        - Use 0.05 per MB as the rate:
        - 0.05 / 1024 * 1024 * 100 = 5.00
    - Billing not in line with IOT:
        - Calculate the per KB rate and use that: 0.05 / 1024 = 0.000048828125, rounded to 0.00005 (or 0.00004)
        - 0.00005 * 1024 * 100 = 5.12 (or 0.00004 * 1024 * 100 = 4.096)
        - Difference: +0.12 (+2.4%) (or -0.904 (-18.1%))

If the billing cannot be made in line with the IOT, it is recommended that the IOT should state the rate as 0.0017 (or 0.0016) per second instead of 0.10 per minute or in the data charging case as 0.00005 (or 0.00004) per KB instead of 0.05 per MB. Alternatively, a manual settlement process could be implemented between roaming partners at agreed intervals.

Annex A Document Management

A.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	30 Nov 2004	Approved document. Includes editorial changes to bring inline with GSMA Style Guide.	TADIG #58	Klaus-Dieter Döll / EDS
1.1	20 May 2005	CR01 to TD.58 CAMEL scenario correction CR02 to TD.58 Optimal Routing Correction CR03 to TD.58 Destination information for CAMEL call forward CR04 to TD.58 Release Specification CR05 to TD.58 CAMEL Service Levels	TADIG #59	Haitham El-Ghannam / EDS Germany
1.2	1 Oct 2005	CR06 Non Geographic Dialled Digits CR07 Empty Choice TAGs CR08 Removal of references to X.208-X.209 CR09 Clarification of CAMEL Destination Number validation CR10 CAMEL Destination Number population CR11 Extensibility Markers	TADIG #60	Haitham El-Ghannam / BSG Germany
1.3	1 Jun 2006	CR013 to TD.58 – APN Info in CAMEL CR014 to TD.58 – CAMEL Destination Number CR015 to TD.58 – Population of fixed tax variable by duration CR016 to TD.58 – Re-work Called Number scenarios CR017 to TD.58 – Called Number in CAMEL	TADIG #61	Haitham El-Ghannam / BSG Germany
1.4	24 November 2006	CR018 to TD.58 – Add Information about Exchange Rates	TADIG #62	Haitham El-Ghannam / BSG Germany
1.5	7 June 2007	CR019 to TD.58 – CAMEL for Video Telephony usage CR020 to TD.58 – CAMEL Call Scenarios for Short Codes and Default Handling CR021 to TD.58 - Services Implementation on the top of a Bearer CR022 to TD.58 – Add new Scenario for Intelligent Call Assistance	TADIG #63	Haitham El-Ghannam / BSG Germany
1.6	26 December 2007	CR023 to TD.58 - Voice Messaging service CR024 to TD.58 - Universal service fund CR025 to TD.58 – Corrections	TADIG #64	Haitham El-Ghannam / BSG Germany
1.7	22 May 2008	CR 026 (TADIG Doc 65_041) Clarification of GPRS partial handling in IOT checks CR 027 (TADIG Doc 65_042) Identification of Call Charge for Number Portability CR 028 (TADIG Doc 65_043) Recording	TADIG #65	Haitham El-Ghannam / Syniverse Technologies

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
		Supplementary Services in TAP CR 029 (TADIG Doc 65_044) SMS-MO Events created for a single SMS message CR 030 (TADIG Doc 65_045) Clarification about Teleservice category codes		
1.8	22 December 2008	CR 031 (TADIG Doc 66_051) Clarify Charge Detail breakdown per Charge Type	TADIG #66	Haitham El-Ghannam / Syniverse Technologies
1.9	4 June 2009	CR 032 (TADIG Doc 67_041) Clarification on populating Charge with large number CR 033 (TADIG Doc 67_042) IOT Currency Change CR 034 (TADIG Doc 67_043) Clarify Call Event Duration regarding channel seizure	TADIG #67	Haitham El-Ghannam / Syniverse Technologies
1.10	26 November 2009	mCR035 (TADIG Doc 68_033r1) CTL usage for validation mCR036 (TADIG Doc 68_034) Extension Markers	TADIG #68	Haitham El-Ghannam / Syniverse Technologies
1.11	28 May 2010	mCR037 (TADIG Doc 69_017) Clarification to Voice Messaging	TADIG #69	Haitham El-Ghannam / Syniverse Technologies
1.12	18 June 2010	mcr039 (TADIG Doc 70_004) Clarification on exchange rate tolerance in TAP	TADIG e-vote	Haitham El-Ghannam / Syniverse Technologies
1.13	16 December 2010	mCR040 (TADIG 70_017) Options for small and high amounts in TAP mCR041 (TADIG 70_018) Exchange rate clarification	TADIG #70	Haitham El-Ghannam / Syniverse Technologies
1.14	02 June 2011	mCR042 (TADIG 71_053) Clarification on the significant digits usage in TAP	TADIG #71	Haitham El-Ghannam / Syniverse Technologies
1.15	15 December 2011	mCR044 (TADIG 72_050) Correction on examples for CAMEL home routing mCR045 (TADIG 72_051) Add new section population of calling number mCR046 (TADIG 72_052) Discrepancy of tax values on TAP and Invoice level	TADIG #72	Haitham El-Ghannam / Syniverse Technologies
2.0	28 December 2011	MCR043 (TADIG 72_049rev1) First version for TAP3.12 Inclusion of VoLTE.	TADIG #72 EMC #99	Haitham El-Ghannam / Syniverse Technologies
2.1	24 May 2012	mCR047 (TADIG 73_032) Add new section IOT validation examples	TADIG#73	Haitham El-Ghannam / Syniverse Technologies

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
2.2	22 November 2012	mCR048 (TADIG 74_026) Add MTC and GPRS scenarios to IOT validation examples mCR049 (TADIG 74_024) Clarification on a list tag with one occurrence mCR050 (TADIG 74_025) Clarification on validation of Exchange rate	TADIG#74	Haitham El-Ghannam / Syniverse Technologies
2.3	23 May 2013	mCR1001 (TADIG 75_016) Add MTC and GPRS scenarios to IOT validation examples mCR1002 (TADIG 75_017) Network Node Sharing mCR1004 (TADIG 75_019) Usage of standard terms for GPRS Partials in TAP mCR1006 (TADIG75_039) Differentiated GPRS Charging by CTL3	TADIG#75	Haitham El-Ghannam / Syniverse Technologies
2.4	05 December 2013	mCR1007 (TADIG76_017Rev1) Differentiated charging of data in handover scenarios	TADIG#76	Haitham El-Ghannam / Syniverse Technologies
2.5	15 May 2014	mCR1008 (TADIG77 Doc 004_Rev1) Guidelines on the aggregation of CS Voice Partials in TAP mCR1009 (TADIG77 Doc 021_Rev1) Presence of both Charged Item 'X' and 'V' or 'W' within the same GPRS Event	TADIG#77	Haitham El-Ghannam / Syniverse Technologies
2.6	4 June 2015	mCR1011 (IDS79 Doc 013) Recommendation for Small and Large Charges mCR1012 (IDS79 Doc 016) Remove Change Request Impact Classification mCR1014 (IDS70 Doc 025) Treatment of Conditional CF SS in ICS	IDS#79	Haitham El-Ghannam / Syniverse Technologies
2.7	31 July 2015	mCR1016 (E-Vote) Inclusion of Fixed Charge in Charge Item 'D'	E-Vote	Haitham El-Ghannam / Syniverse Technologies
2.8	18 November 2015	mCR1015 (IDS80 Doc 056) Abbreviations Section in TD.58 mCR1017 (IDS80 Doc 063) Clarification on QCI usage mCR1018 (IDS80 Doc 075) Clarification on S8HR VoLTE and SRVCC roaming architecture	IDS#80	Haitham El-Ghannam / Syniverse Technologies
2.8	03 February 2016	PRD aligned to standard GSMA template	Editorial change	Haitham El-Ghannam / Syniverse Technologies
2.9	25 May 2016	mCR1019(IDS81 Doc 030) The rates in the IOT and calculations in TAP must be in the same unit mCR1020(IDS81 Doc 023) Clarification on mandatory Taxable Amount in tax breakdown case mCR1021(IDS81 Doc 041) Introduction of GSER	IDS #81	Haitham El-Ghannam / Syniverse Technologies

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
3.0	08 December 2016	Added new section 3.21 Potential TAP Records of VoLTE Call Scenarios (IDS82 Doc 050_Rev1_TD-58 CR1022_v15-0)	IDS#82	Yuemei Chen T-Mobile Austria

Other Information

Type	Description
Document Owner	IDS
Editor / Company	Haitham El-Ghannam / Syniverse Technologies

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