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TECHNICAL SPECIFICATION

**User Group;
Quality of ICT Services;
Requirements for Check-up on Metering and
Billing Processes**

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Foreword

This Technical Specification (TS) has been produced by ETSI User Group (USER).

Information and Communications Technology (ICT) standardization is part of the general standardization activities, and contributes to policy objectives to improve the competitiveness of European industry, as specified in the Lisbon strategy. The legal basis for European standardization and standardization policy, including the ICT domain, is Directive 98/34/EC [i.8]. One of its main elements is the formal recognition of three European Standards Organisations (ESOs), CEN, CENELEC and ETSI, active in various degrees in the ICT domain. Standards produced by the three ESOs and resulting from an open consensus building process are by nature voluntary and non-binding technical documents.

The standardization work described in the present document was funded by the European Commission, Enterprise and Industry Directorate-General, as part of the 2009 ICT Standardization Work Programme and executed by ETSI.

The present document has been produced within the ETSI Special Committee USER GROUP (USER) by the Specialist Task Force (STF) 375. Several documents provided by European Telecommunications regulatory bodies have been used to develop the present document. They are detailed in ETSI TR 102 847 [i.7].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The original motivation to produce present document was that a significant difference rate between theoretical and actual bills had been identified by several parties in the current metering and billing processes operated by Service Providers (operators). Several Service Providers, administrations and users associations have intended to reduce this difference rate in implementing rules in order to make users more confident in the reliability of their bills.

The telecommunications industry remains a fast-moving and complex ecosystem. The Service Providers are facing a number of new challenges:

- Smart phone as fast-growing User platform to access applications and all digital services over mobile internet.

- Rapidly evolving new technologies, combining 5G and optical fibres, for migrating ultra-high speed networks.

- An underlying shift taking place: telecom providers are investing in media and content services, while media and content service providers are investing in communications.

- Over-the-top (OTT) services becomes increasingly popular with Users, who demand higher-quality data services and essentially increased traffic requirements on Service Providers.

The convergence of telecom services with media and technologies makes **revenue assurance** for Service Providers as a necessary strategy with many potential opportunities for the substantial amounts of data flowing through their networks by data propositions, pricing and charging mechanisms, in addition to the existing voice and SMS revenues. On the other hand, those challenges increase the risks of billing errors and cause overcharging or undercharging for the Service providers. From the User or Regulator view, overcharging and transparency in a bill are of paramount importance.

Nevertheless, due to the complexity of this issue and in absence of any available formal standard in this area, the current practices are hindered by significant limitations. The purpose of the present document is to fulfil the gaps of the current practices, in order to provide a reference that can be used for a continuous and trustworthy checking up on metering and billing processes. Such a checking is expected to contribute to a continuous quality of service improvement on metering and billing processes.

In order to provide evidence that metering and billing verification is conducted according to the present document, it will be useful for a Service Provider to have its verification process audited by an independent party, that will formally assess the conformity of its checking-up on metering and billing with the technical specification. Therefore, the present document is inevitable not only for protecting User, for assuring revenues of Service Provider, but also for Regulatory Authority in monitoring accuracy of all charges of consumers when using the regulated services.

The purpose of ETSI TS 102 846 [1] is to define when, how and by whom the conformity assessment audit is conducted. Such a conformity assessment is expected to contribute to an increased trust by Service Providers, customers, regulators and other stakeholders that metering and billing processes are reasonably monitored.

1 Scope

The present document has been prepared to provide a model for designing and operating the checking-up on metering and billing processes of Service Providers.

Because the checking-up approach of the present document is end-to-end (i.e. using a "black box" approach from the actual electronic communications generation to the checking-up on their billing), it is intended that these requirements are applicable to the metering and billing of any kind of services offered by the Service Providers.

The goal of the present document is to define a standardized checking process and the test methodology that could be implemented by any stakeholder and is auditable by a third-party, leading to trustworthy performance indicators about the integrity of billing issued by a Service Provider.

NOTE: It is important to note that the present document does not provide any model for designing and operating the metering and billing process itself.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 102 846: "User Group; Quality of ICT Services; Requirements for Bodies Providing Conformity Assessment of Checking-up on Metering and Billing Processes".

[2] BIPM: "The International System of Units (SI)".

[3] ETSI TS 122 115: "Technical Specification Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Service aspects; Charging and billing (3GPP TS 22.115)".

[4] ETSI TS 132 240: "Technical Specification Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Charging management; Charging architecture and principles (3GPP TS 32.240)".

[5] ETSI TS 132 260: "Technical Specification Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging (3GPP TS 32.260)".

[6] ETSI TS 132 295: "Technical Specification Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Charging management; Charging Data Record (CDR) transfer (3GPP TS 32.295)".

[7] ETSI TS 132 297: "Technical Specification Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Charging management; Charging Data Record (CDR) file format and transfer (3GPP TS 32.297)".

[8] IEEE 802.11™-2012: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   ETSI EG 202 057-2: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 2: Voice telephony, Group 3 fax, modem data services and SMS".

[i.2]   ETSI EG 202 057-3: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 3: QoS parameters specific to Public Land Mobile Networks (PLMN)".

[i.3]   ETSI EG 202 057-4: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 4: Internet access".

[i.4]   ETSI EG 202 765-2: "Speech Processing, Transmission and Quality Aspects (STQ); QoS and network performance metrics and measurement methods Part 2: Transmission Quality Indicator combining Voice Quality Metrics".

[i.5]   ETSI ES 202 765-4: "Speech and multimedia Transmission Quality (STQ); QoS and network performance metrics and measurement methods; Part 4: Indicators for supervision of Multiplay services".

[i.7]   ETSI TR 102 847: "User Group; Quality of ICT Services; Standardization and regulation references in the Metering and Billing area".

[i.8]   Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.

[i.8]   ETSI ETR 037: "Network Aspects (NA); Telecommunications Management Network (TMN); Objectives, principles, concepts and reference configurations".

3 Definitions of terms and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

billing error rate: for a set of electronic communications, the ratio of the total number of electronic communications having breached at least one of the billing integrity principles divided by the total number of electronic communications in the set

billing integrity principles: principles that should be fulfilled to state that the billing activity of a Service Provider is correct

Billing Verification Body (BVB): organization that has skills and methods to conduct the checking-up on metering and billing processes of a Service Provider

NOTE: The Billing Verification Body can be internal (i.e. a department of the Service Provider) or external (i.e. a specialized company to which the Service Provider has outsourced the check-up on metering and billing).

Charging Data Record (CDR): Record generated by a Core Network Element for the purpose of billing a subscriber for the provided service. It includes fields identifying the user, the session and the Network Elements as well as information on the network resources and services used to support a subscriber session.

NOTE 1:   In the traditional circuit domain, CDR has been used to denote "Call Detail Record", which is subsumed by "Charging Data Record" hereafter [5].

NOTE 2:   For each party to be charged for parts of or all charges of a chargeable event a separate CDR is generated, i.e. more than one CDR may be generated for a single chargeable event, e.g. because of its long duration, or because more than one charged party is to be charged.

checking-up on metering and billing: activities used to verify how strongly a Service Provider metering and billing activities complies with billing integrity principles

continuous: characteristics of an approach that takes into consideration the constantly evolving nature of communications networks and follows a "back-to-back" principle to verify metering and billing

NOTE: Because metering and billing processes and systems evolve on a continuous basis (incidence and update), the verification of billing has to evolve accordingly and to check the billing integrity on a similar way. "Continuous basis" excludes "one shot audit approach" where verification is performed once a year or once per quarter.

customer: user who is responsible for payment for the electronic communication services

electronic communication: service that helps people communicate

NOTE: Electronic communication types include but are not limited to voice call, video call, conference call, email, SMS, MMS, USSD, web access, instant messaging, content download, TV broadcasting, etc. Electronic communications may involve one or several interconnected networks. An electronic communication may lead to billing of a financial charge to a Customer of the Service Provider.

independent observer: entity which can evidence two characteristics: independency and externality

NOTE: In the context of the present document, the independency clause means that the entity in charge of checking has some level of independence from the entity in charge of operating metering and billing within the Service Provider. The externality means that the checking entity does not have to understand all the complexity of the information systems and network components involved in the metering and billing of a Service Provider.

metering and billing: activity, within a Service Provider, which aims at charging a customer either by producing an invoice or by decreasing a prepaid account

NOTE: Metering and billing usually involve four main types of activity:

- metering is the computation of raw parameters (time, duration, volume, etc.) of electronic communications;

- guiding is the allocation of a specific event to a specific customer;

- rating is the computation of a price of an event according to a rate plan; and

- charging is the imputation of the financial charge to the customer.

metering rules: set of non-ambiguous principles set by a Service Provider to define and meter the electronic communications service it offers to its customers

prerequisites: list of basic principles and statements with regards to metering principles and tariff information that should be available prior to the implementation of checking-up on metering and billing processes

publishing mode: mean by which billing information is provided to the customer of the Service Provider

NOTE: Publishing mode may include but are not limited to paper invoice, electronic invoices, web sites, Call Centres, Intelligent Voice Response Units, SMS servers, USSD servers, etc.

Service Provider (SP): organization that provides electronic communications services to users and customers

Stratified Sample of Electronic Communications (SSEC): sample of electronic communications used to conduct the billing and metering checking process

NOTE: The sample of electronic communications is designed according to statistical method so as to provide a reasonable evidence that the billing integrity is fulfilled.

tariff information: set of principles defined by a Service Provider to price the electronic communications it offers to its customers

NOTE: Tariff information includes the definition of unit price (price for a unit billed quantity) and valuation methods (set of mathematic methods allowing transforming raw quantities into billed quantities).

tariff plan: set of principles defined by a Service Provider to price the electronic communications service it offers to one customer

NOTE: Tariff plan is a subset of tariff information.

Test Charging Generator (TCG): Remotely operated and automated test system that is able to generate test events, emulating the usage of application transactions, each type of services, including voice, messaging, value added services (VAS) and data, etc. The test events, in turn, cause the core networks to generate and collect the corresponding appropriate charging information and transfer it to the billing systems.

NOTE 1: TCG used to denote Test Call Generator in the CS domain. More recently, the term of test Event Generation System (EGS) is also used in the same context of TCG. In the present document, TCG subsumes the term of automated (test) robot in the earlier versions.

NOTE 2: Its main functions comprise:

- electronic communication test planning;

- electronic communication test events generation and execution;

- electronic communication logging as test result.

unambiguous: characteristic of a rule that can be understood and checked by a customer by its own means without having to understand the internality of a Service Provider systems and processes

user: individual, including consumer, or organization using or requesting telecommunications services available on public or private networks

NOTE: The user may or may not be the person who has subscribed to the provision of the service. Without any specific addition this word is used to identify the telecommunication user community in general, e.g. end-users and IT&T managers who use products and services possibly conforming to standards.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

5G	Fifth Generation mobile technology
ADSL	Asymmetric Digital Subscriber Line
API	Application Programming Interface
APN	Access Point Name
BIPM	International Bureau of Weights and Measures/Bureau International des Poids et Mesures
BVB	Billing Verification Body
CDR	Charging Data Record
CSCF	Call Session Control Function
DSL	Digital Subscriber Line
EGS	Event Generation System
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service (2G mobile technology together with GSM)
GSM	Global System for Mobile communications
GW	GateWay

ICT	Information and Communications Technology
IN	Intelligent Network
IP	Internet Protocol
ISUP	ISDN User Part
LTE	Long Term Evolution (4G mobile technology)
MMS	Multimedia Message Service
MNO	Mobile Network Operator
MSC	Mobile Switching Centre
NR	New Radio access
OCS	Online Charging System
OTT	Over-The-Top
RCS	Rich Communication Services
SCEF	Service Capabilities Exposure Function
SGSN	Serving GPRS Support Node
SIM	Subscriber Identification Module
SIP	Session Initiation Protocol
SMS	Short Message Service
SP	Service Provider
SSEC	Stratified Sample of Electronic Communications
TCG	Test Charging Generator
TDD	Time Division Duplex
TV	Television
UE	User Equipment
UMTS	Universal Mobile Telecommunications System (3G mobile technology)
URL	Universal Resource Locator
USSD	Unstructured Supplementary Service Data
VAS	Value-Added Service
VOD	Video On Demand
VoIP	Voice over IP
VPLMN	Visited Public Land Mobile Network
VPN	Virtual Private Network

4   Billing Chain and Risks

4.1   Billing Chain

A telecommunication billing chain consists of three functional areas:

- information management area,

- operational area,

- financial management area.

The information management area is responsible for customer information, pricing model and numerous billing configurations, management of the contract entries and the corresponding service provisions and withdrawals, customer cares.

The operational area captures, collects and records the overall usage of services, resources (creating raw CDR, ETSI TS 122 115 [3], ETSI TS 132 240 [4] and ETSI TS 132 260 [5]), processes, converts and transfers CDR, from raw CDR, mediated CDR, rated CDR to billed CDR, ETSI TS 132 295 [6] and ETSI TS 132 297 [7]. The area comprises online charging and offline charging and billing.

The financial management area covers financial functions such as invoice (bill) production, revenue recognition, accounts receivable and payment tracking, as well as processing, mapping correspondence between payments and consumed services, managing credits and debt collections, calculating company taxes, etc.

4.2   Billing Model in Operational Area

4.2.1   Billing model

The metering and billing verification are mainly performed in the billing operational area. A simplified functional billing model is depictured in figure 1.
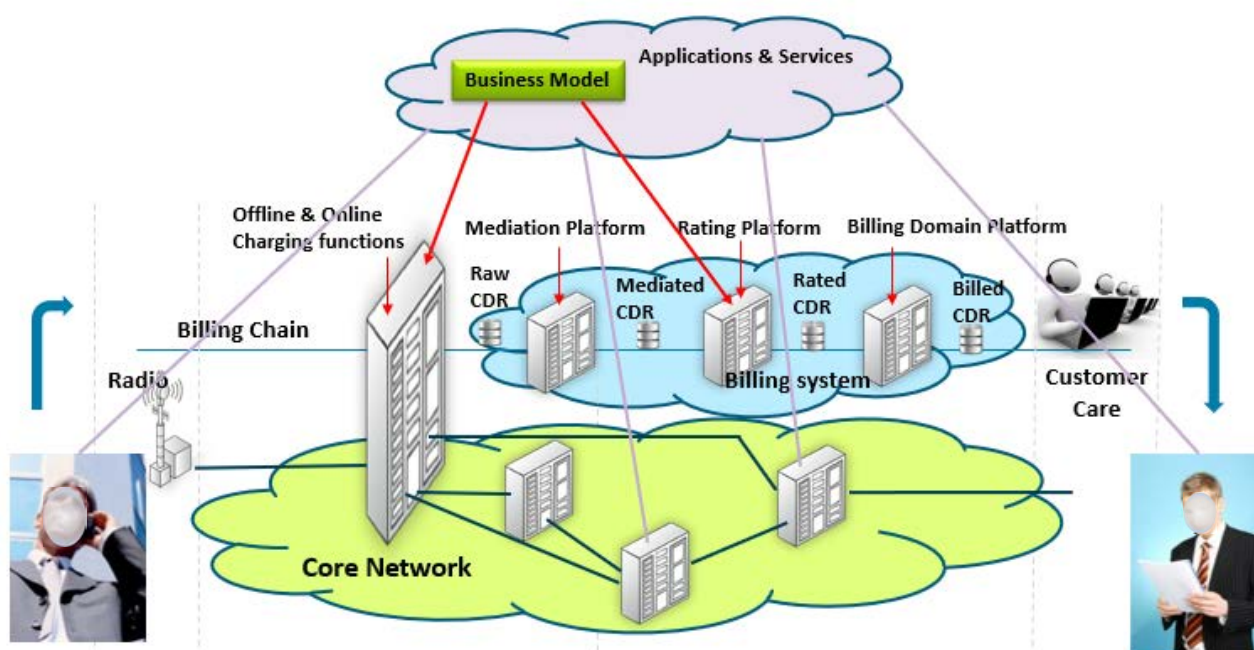
Figure 1: Illustration of a billing model

The model consists of four functional components: Offline and Online charging function, mediation, rating and billing domain system, where the charging function is located in the core network and distributed in the different domains, services and subsystems. The mediation, rating and billing domain system are a part of the operator network known as billing system, and is separated from the core network for the purpose of the revenue assurance.

NOTE 1: Online charging function has also rating capability and can have an open interface to the billing domain.

Charging is a function within the telecommunications core network and comprises Offline and Online Charging components. The charging information related to chargeable events is collected from the different Network Elements of the core network (MSC, SGSN, MME/S-GW, P-GW, CSCF, SCEF, etc.). The information is formatted, transferred and evaluated, to make it possible to determine usage for which the charged party (User) may be billed (offline charging) or the subscriber's account balance may be debited (online charging) - ETSI TS 122 115 [3] and ETSI TS 132 240 [4]. In short, the charging function collects charging information and generates raw CDR.

Offline charging is a mechanism where charging information **does not** affect, in real-time, the service rendered.

Online charging is a mechanism where charging information can affect, in real-time, the service rendered and therefore a direct interaction of the charging mechanism with session/service control is required. Online Charging System (OCS) performs real-time Credit-Control. Its functionality includes transaction handling, rating, online correlation and management of subscriber accounts/balances.

Metering means a functionality for both the offline and online charging. The charging-responsible Network Elements have mandatorily a distributed functionality, called Accounting Metrics Collection, to precisely capture the chargeable events and the usage of the consumed resources from the service events or signalling/user traffic.

Mediation is a process within the Telecommunications Management Network which acts on information passing between Network Elements and Operating Systems and provides local management functionality to the Network Elements. Mediation uses standard interfaces and can be realized in a separate Mediation Device or be shared among Network Elements and/or Operating Systems [i.8]. In context of the billing chain, mediation collects and processes charging data (raw CDR) received from the charging functions of the core network and performs the following tasks:

- Collecting and validating raw CDR from core network elements.

- Filtration of non-billing CDR.

- Correlation of different input sources CDR.

- Aggregation of partial CDRs related to the same call, session, event, service.

- CDR normalization transform the raw CDR to the mediated CDR and pass to the rating platform.

Rating function performs both monetary and non-monetary unit determination (rating). It provides the following functionalities:

- Rating for network and external services and applications (session, service, event) before and after service delivery.

- Cross-product and cross-channel discounts, benefits and allowances.

The Rating Function handles a wide variety of rateable instances, such as:

- Rating of volume (in terms of granted units or money, e.g. based on charging initiated by an access network entity).

- Rating of time (in terms of granted units or money, e.g. based on charging initiated by a SIP application).

- Rating of events (e.g. based on charging of web content or MMS).

The Rating Function includes the determination and application of the tariff model or the price of a chargeable event or of multiple chargeable events (correlation scenario); examples include the price of a call minute, data volume, multimedia session, Web content, etc. The rating function converts the mediated CDR to the rated CDR.

Interactive rate function (online charging)**:**

Upon receipt of a rate request (price or tariff request) from the Charging Function, the Rating Function:

- Evaluates the request. Rate requests include various rating parameters such as service identifier, subscriber reference, network identification, user location, service usage time, transferred data volume, etc.

NOTE 2: A rate request may contain multiple service identifiers that reflect the list of active services contained in the context handled by the Charging Function.

- Determines the applicable price or tariff model and returns it to the Charging Function.

Billing Domain (BD) receives and processes CDR files from the rating functions. The rated CDR are transformed as billed CDR in form of bills requiring payment. Except billing, the billing domain includes also the other (e.g. statistical) end applications. BD is only applicable to offline charging.

NOTE 3: Online Charging System can also generate rated CDRs and transfer them to the billing domain system.

4.2.2 Configuration of Charging data and Billing Platforms

It is evident that any errors in the billing chain will cause overcharging or undercharging. Although there are many root causes, the main cause is resulted from a wrong configuration of charging data in the charging and the billing systems.

Charging data is generated and collected either from charging events or charging sessions in accordance with the Core Network domains, services or subsystems. The charging data are essentially constructed from the content of charging events and the parameters of the raw CDR. Many parameters in CDR are operator provisioned and configured to be present in a CDR when the specified conditions are met. In another word, the presence of those parameters is rule-based. If the business model is changed, the corresponding rules are required to be correctly modified and configured to ensure to generate correct CDR.

Similarly, the rating platforms are deployed for monetisation of CDR. How to apply the rates for monetisation is strictly followed the business model and tariff plans which derive the rules to configure the rating platform.

4.3 Inherent risks in tariff plans complexity

4.3.0 Inherent risks

Based on the rules derived from the business model and tariffs plans, the charging data, the mediation and rating platforms in the billing system shall be correspondingly and correctly configured.

Because of the complexity and missing information inherent from the tariff plans, the wrong configuration of the charging system and the various platforms in the billing system often causes the undercharging or overcharging. Several examples are given in the following clauses.

4.3.1 Bundles and bundle plans management

Bundle is a package of services defined through several dimensions, such as volume, quantity, time, etc. Most postpaid and many prepaid tariffs are presented as a bundled packet offer. A bundled offer contains a quantity of minutes of voice service, a quantity of SMS/MMS and a volume of Data. Furthermore, it is a normal way for prepaid plans to add a bonus or additional voice minutes, a number of free SMS/MMS and/or Data after each top-up (upgrade).

Differentiating from a single service, charging and billing a bundle of services require totally different rules for charging data and rating within and out of the bundle. These specific rules need to be configured correctly in the core network and in the billing system.

The bundle included for each tariff plan and the business rules that apply to the bundle offer shall be clearly stated on the website and/or in commercial brochures of the Service provider. The business rules shall be explicitly stated for the service behaviour once the bundle has been exhausted or expired. For example, the following questions from the USER view shall be answered:

- Are all further transactions blocked or charged?

- Are Data transactions blocked?

- Will the allowed services as free of charge be in a reduced speed or totally blocked?

- What charges will apply?

In case of a bonus or additional bundle added after a top-up, the detail of each bonus/bundle shall be clearly displayed via a SMS and/or in the customer care section on the operator's website. When performing billing verification with a third party, it will be critical to confirm the order in which the accounts should be used. Each extraction will include several fields used to match and analyse the metering and billing.

In case of multi bonus/bundles, the operator shall state the order in which each bundle/bonus is applied, to perform thorough verification and highlight any billing errors as overcharging or undercharching.

4.3.2 Value-Added Services

4.3.2.1 VAS billing risks

Value added services are basically services offered by operators - either directly or with a third party - beyond the 'core' services (i.e. above standard voice, SMS, MMS and Data services). Value-added services range from complex products like mobile banking, to over-the-top applications, subscriptions to third-party services (such as music streaming services, media services providers, own operator's TV/VOD applications, storage services, online gaming, etc.).

Two categories of VAS have potential billing risks:

- Premium and content services

- Other VAS, including mobile banking, Voice on demand, Storage services, online gaming, etc.

4.3.2.2 Billing of Premium Rate and Content Services

Premium services are a kind of VAS and concern mainly voice service or SMS. The services usually involve a third party who purchases a premium number to sell contents. A premium call/SMS charge consists of two parts:

- the operator's charge for accessing the network;

- a charge from the third party which can in turn contains two parts:

  - a connection call charge;

  - a price per minute.

Premium voice calls/SMS are usually more expensive than a standard voice call/SMS. It is essential to test premium numbers routinely and for the operator to supply the exact pricing structure, as well as the business rules applied (connection charge, price per second or per minute, maximum charge).

Because a premium call/SMS will involve a third party in the price structure, additional business rules are needed to reflect the price structure (against the third party) and to configure the rating platforms accordingly. Any wrong configuration causes possible billing errors.

The information reflecting the price structure shall be made easily accessible for the subscribers either on the operator's website or the third party's website/advertisement. Additionally, the split pricing shall be clearly presented on the invoice or billing extraction.

The test principles described in this clause, in terms of pre-requisites and requirements, are equally valid for any third-party content services.

4.3.3 Temporary mobile offer and real time promotion

For competitive reasons, the operators can provide some temporary offers and promotions that will not be displayed on the website or in the commercial brochures. These promotions may be generated via dynamic tariffing platforms, for example, through the usage analysis at a punctual moment/ geographical location, a number of subscribers will receive a promotion notification via SMS or cell broadcast.

Such promotions are temporary and valid in a short period. For those specific promotions/discounts, the billing platform will need to be configured accurately, including the start and end date/time. Non-accurate configurations with a wrong date/time lead always to the billing errors.

In such instance, operators shall enable the third party to access such information or to receive such notification for Billing Verification or test. If the temporary offer/promotion is applied via a USSD, then the information shall be shared with the third party, together with the plan details, the pricing and the business rules applied so that they are testable.

4.3.4 Zero-rating

Zero-rating (content) is used by service providers to differentiate the tariff offer from a normal tariff for data usage. Zero-rating enables unlimited usage of one or multiple concerned applications, services, or websites for a fixed price. The approach differs from a normal data tariff plan where a User/customer pays a fixed amount (prepaid or postpaid) for a pre-defined, non-guaranteed data speed and a volume quota (an offered Gigabits over a period). A service provider can also provide a combined tariff offer of the zero-rating tariff, e.g. for unlimited social networking or music streaming, with a normal data tariff plan.

Zero-rating requires clear charging rules for the core network policy and charging control, for example application detection, resource usage monitoring control for those applications with zero-rating. The billing systems needs to correctly qualify those application data traffic and rate it as zero. Usage of whitelisting is a typical method for the charging policy rule control. Only the applications, in terms of source IP address or site URL, in the Whitelist are zero-rated.

With each new app added to the zero-rating offer, the Whitelist in the charging system of the core networks or in the billing systems shall be correspondingly re-configured or modified in a timely manner. Similarly, the data bundle shall be verified that the apps usage does not count against it.

Typically, the risks for zero-rated offerings are more related to overcharging. Certain traffic classes (whether determined by source IPs or URLs in whitelists) will be rated with 0, whereas traffic from any other source IP addresses or URLs have to be charged. The risk is that the source IP addresses do not get updated in time, e.g. keeping an old Whitelist or if an applications changes some servers and the Whitelist is not updated in time, the traffic of that app will be charged, although the zero-rate of that app traffic is claimed.

Undercharging can also happen in case any third-party traffic as a plugin app should be charged (e.g. opening an app of the third-party outside of the Whitelist via another app rated as zero-rate in the Whitelist).

4.3.5 Mobile Money

Mobile money is a service in which the mobile phone is used to access financial services. Mobile money transfer is a person-to-person (P2P), remittance service enabled by a Mobile Network Operator (MNO) at either the send or receive ends, or both. The service is typically provided by MNOs in partnership with other ecosystem partners. Mobile money transfer can be international or domestic within a country. The scope of the present clause is restricted to the domestic mobile money transfer service provided by an MNO without involvement of Over The Top (OTT) services. Beyond P2P, mobile payment is another type of the mobile money services. The mobile payment service includes Government-to-Citizen payments (G2C) and vice-versa (C2G), and payments to business such as electricity/water companies (C2B).

The person, as end user participating at the mobile money transactions, is not necessarily to have a bank account. In developing countries mobile payment solutions have been deployed as a means of extending financial services to the community known as the "unbanked" or "underbanked". SIM cards are used as identifier equivalent to the traditional bank account number for the corresponding mobile wallet.

MNO provides different types of mobile money services/transactions:

- Mobile money transfer - send mobile money from subscriber A to subscriber B.

- Cash-in (deposit)/cash-out (withdraw) at an agent - a subscriber credits his mobile money account with cash/deducts cash from his mobile money account, via an agent.

- Mobile payments (buying goods, services including SIM airtime) - payment services operated under financial regulation and performed via a mobile device and deducted from his mobile money account.

- Mobile financial services (paying bills) - financial services operated under financial regulation and performed via a mobile device and deducted from his mobile money account.

In context of mobile money, the metering and billing verification are meant for a completeness of transactions, accuracy of number of transactions, amount of volume and charging fees, correctness of balance of the mobile accounts concerned.

5   Approach for Checking-up on Metering and Billing

5.1   Billing Integrity Principles

By definition, the metering and billing of a Service Provider is correct if it complies with the following five billing integrity principles:

Principle 1:   Electronic communications metering (success status, time, duration, volume, and throughput) is accurate.

Principle 2:   Unsuccessful electronic communications are not billed or are billed at null price.

Principle 3:   Each successful electronic communication is billed.

Principle 4:   Billed electronic communications are metered and priced in accordance with documented metering rules and tariff information.

Principle 5:   Electronic communication billing information details provided to customers are complete, sufficient, timely, unambiguous and correct whatever the publishing mode.

5.2   Process Approach

The present document adopts a process approach for providing evidence measured by an Independent Observer according to a standardized process that a Service Provider complies with the billing integrity principles defined in clause 5.1. The chain of services delivery possibly involves different Service providers, then the Independent Observer as the third party shall segment its approach at the service boundaries to verify each complies with the billing integrity principles defined in clause 5.1.

According to the present document, evidence of compliance of billing integrity principles is based on the actual generation and verification of the billing of a Stratified Sample of Electronic Communications (SSEC), designed according to a predefined statistical method and performed on a continuous basis by connected TCG.

Because of the billing and metering checking continuous process, billing and metering checking reports are produced on a predefined frequency and recorded according to a predefined storage policy.

5.3   Billing Error Rate

In practice, in the history of telecommunications, no Service Provider has ever fully complied with the principles defined in clause 5.1. Moreover, no industry experts would expect any Service Provider to fully comply in the future with these principles because of increasing commercial complexity, technical complexity and speed of changes.

For this reason, the approach taken in the present document is to define a standardized approach to verify how close is one Service Provider of the billing integrity principles defined in clause 5.1. This is achieved by metering a billing error rate which assesses the percentage of electronic communications that do not comply with the billing integrity principles.

By metering the billing error rate on a continuous basis and according to a standardized and auditable method, Service Providers will be able to evidence how strongly they comply with billing integrity principles.

6   Implementation Model

The billing and metering checking process itself can be executed by an internal department of the Service Provider (Full Internalization), outsourced to an external provider of monitoring services (Full Outsourcing) or by a combination of both (Mixed Model). The present document does not recommend any special type of organizational model.

The only organizational requirement is that the entity in charge of checking-up on metering and billing processes shall have an Independent Observer status as defined in clause 3.1.

7   Prerequisites

7.0   General prerequisites

Before implementing the checking-up on metering and billing process described in the present document, the two following prerequisites shall be fulfilled by the Service Provider:

- Prerequisite 1: Metering Rules Definition.

- Prerequisite 2: Tariff Information Documentation.

For the present document, the requirement is restricted to the fact that the prerequisites information is made available to the BVB (Billing Verification Body) prior to the implementation of the checking-up process. This is consistent with the approach of the present document: the checking-up on metering and billing shall be performed by an Independent Observer based on documented information.

NOTE 1:   The exact legal status of Metering Rules and Tariff Information depends on the contract agreed between the Customer and the Service Provider. It is to be noted that, in several cases, such contracts are not in place. The issue of the legal value of the documents quoted in the prerequisite clause is outside the scope of the present document.

NOTE 2:   For residential contract, tariff information should be accessible by anyone by at least one mode (e.g. paper booklet available in retail shops, publication on a web site). For bespoke tariff information (e.g. Enterprise contracts) the mode will depend on an agreement between the different parties. The exact scope of which documents is published or kept confidential by the Service Provider is outside the scope of the present document.

7.1   Metering Rules Definition

7.1.1   Definition of Successful and Unsuccessful Status

[7.1.1.1]   The Service Provider shall define methods and principles to define if an electronic communication is successful or unsuccessful and whether or not it should lead to a chargeable item.

[7.1.1.2]   The principles of [7.1.1.1] shall be differentiated for every type of electronic communication offered by the Service Provider to its customers: voice call, video call, conference call, SMS, MMS, USSD, Web access, Instant Messaging, content download, Value Added Service (VAS), etc.

[7.1.1.3]   The principles of [7.1.1.1] shall include the case of electronic communications spanning over more than one network. If Service Provider has not full management of all involved networks, rules shall be defined, for example based on signalisation exchanged at the interconnect point.

The definition of a successful status requires making assumptions that are arbitrary but shall be clearly defined by the Service Provider. Successful and unsuccessful status definitions are available in several standards for different types of electronic communications. It is up to each Service Provider to make available its own definition or to rely on the standard of its choice but to states which one is used. For information, the list below provides widely accepted definitions of successful or unsuccessful electronic communications:

- Mobile Telephony: In ETSI EG 202 057-3 [i.2], an unsuccessful call is defined as a call attempt to a valid number, while in a coverage area, where neither the call is answered nor called party busy tone nor ringing tone, is recognized at the access of the calling user within 40 seconds from the instant when the last digit of the destination subscriber number is received by the network.

- Fixed Telephony: In ETSI EG 202 057-2 [i.1], an unsuccessful call is a call attempt to a valid number, properly dialled following dial tone, where neither called party busy tone, nor ringing tone, nor answer signal, is recognized at the access of the calling user within 30 seconds from the instant when the last digit of the destination subscriber number is received by the network.

NOTE: The definition of successful and unsuccessful calls should include the cases of busy called party. It is up to the carrier to decide if a call that receives a busy tone leads to a chargeable item or not. Most industry standards hold busy calls as not chargeable.

- SMS: In ETSI EG 202 057-2 [i.1], a successful SMS is defined as a SMS where the Short Message has been successfully sent from a terminal equipment to a Short Message Centre. (i.e. this does not imply that the recipient of the SMS has received it).

- Data transmission: In ETSI EG 202 057-4 [i.3], a successful data transmission is defined as successful if a test file is transmitted completely and with no error. Incomplete download which can be automatically recovered shall be considered as partial successful data transmission.

- TV: In ETSI ES 202 765-4 [i.5], a successful TV channel access is defined as an access where video and audio are accessible.

7.1.2   Definition of Units

[7.1.2.1]   The Service Provider shall use, when available, units that are part of the International System of Units as described in BIPM [2].

[7.1.2.2]   If no unit is defined in the International System of Units (e.g. bit, byte), a clear system of unit shall be defined and used consistently by Service Provider.

[7.1.2.3]   The Service Provider shall use Multiples and Submultiples (e.g. kilo = 1 x 1 000) that are part of the International System of Units as described in BIPM [2].

7.1.3   Definition of Time

[7.1.3.1]   The Service Provider shall define a clear and consistent reference for measuring time of an electronic communication. This method shall be unambiguous to all types of electronic communications delivered by the Service Provider (e.g. international roaming communications).

7.1.4   Definition of Duration

[7.1.4.1]   The Service Provider shall define a clear method to compute the duration of electronic communications charged to customers. The duration shall be determined as the difference of time between two well defined trigger points.

7.1.5   Definition of Data Volume

[7.1.5.1]   The Service Provider shall define a clear method to define volume of data exchanged during an electronic communication.

[7.1.5.2]   Volume metering method, defined in [7.1.5.1], shall define the way electronic communication is exchanged: upload, download, multicast, etc.

[7.1.5.3]   Volume metering method, defined in [7.1.5.2], shall define if protocol overhead information added on top of user information is included or not in the metering.

7.1.6   Definition of Classes of Service

[7.1.6.1]   If Service Provider markets different classes of service (e.g. based on throughput or availability), the Service Provider shall define a clear method to meter the parameter used to define each marketed class of service.

7.1.7   Definition of Rounding Methods

[7.1.7.1]   The Service Provider shall define the different methods used for rounding each type of raw parameters (time, duration, data volumes and classes of service).

7.2   Tariff Information Documentation

7.2.1   Tariff Scope

[7.2.1.0]   Tariff information published by the Service Provider shall be complete, unambiguous and accessible to customers and shall include or refer the metering principles of clause 7.1. The different modes of Tariff Information shall contain this information and shall be consistent.

[7.2.1.1]   Tariff information should cover all rate plans that are used by at least one customer. For the avoidance of doubt a rate plan that is still used by at least one customer shall be available, even if it is not sold any longer.

[7.2.1.2]   Tariff information shall state in an unambiguous way the pricing for each electronic communication type.

[7.2.1.3]   If an electronic communication price depends on the destination or the point of origin, tariff information shall explicitly state:

-       the distinct types of domestic destinations;

-       the distinct types of international destinations;

-       the distinct types of roaming destinations.

[7.2.1.4]   If an electronic communication price depends on when it was generated, tariff information shall state without ambiguity the different periods of peak and off-peak hours and shall specify the applicable days of the week (including the case of bank holidays).

[7.2.1.5]   If an electronic communication price depends on technical profile used during the electronic communication generation, tariff information shall state without ambiguity the distinct types of technical profiles (for example with GPRS traffic: URL, APN, protocol nature, etc.) used for rating purposes.

[7.2.1.6]   Tariff Information shall define without ambiguity the applicable electronic communications that are included in buckets, their unit and how they impact the bucket balance.

[7.2.1.7]   If an electronic communication price depends on an bundled offer: i.e. a bundle description, content, price & max. unit to be consumed, conditions of consumption, consequential service performance once exhausted (barring, data speed reduction, etc.), the bundle shall be clearly detailed, what is included in Voice minutes, SMS, MMS and Data, the conditions of consumption (On net, Off net, Peak, Off Peak, geographical and non-geographical numbers, international), as well as the expected behaviour once the bundle is exhausted (calls/messages blocked, charged out of bundle prices, Data blocked, speed reduced, charged out of bundle price, triggering of an automatic additional bundle).

In case of a bonus or additional bundle added after a top-up, the detail of each bonus/bundle shall be clearly displayed via a SMS and/or in the customer care section on the operator's website. When performing billing verification with a third party, it will be critical to confirm the order in which the accounts are applied. Each extraction will include several fields used to match and analyse the metering and billing. In case of multiple bonus/bundles, the operator shall state the order in which each bundle/bonus is used, to perform thorough verification and highlight any billing errors.

[7.2.1.8]   In case of Premium rate services: all billing information shall be provided, which include the description and price structure, i.e. network charge & unit, third party charge, unit + maximum charge. The Voice service and SMS+ of a Premium rate service shall be testable. The operator shall supply the exact pricing structure, the business rules applied (connection charge, price per second or per minute, maximum charge). This information shall be easily accessible for the subscriber, either on the operator's website, or on the third party's website/advertisement.

7.2.2   Taxes Information

[7.2.2.1]   Tariff Information shall state if taxes are included or not in prices and which rate applies. When applicable, tariff information shall distinguish if taxes are included according to different cases such as domestic vs. international transactions, local vs. roaming transactions, incoming vs. outgoing transactions, etc. If there are other taxes, they shall be stated clearly.

7.2.3   Definition of Rounding Methods

[7.2.3.1]   The Service Provider shall define the different methods used for rounding prices before and after the computation of taxes.

7.2.4   Definition of Publishing Modes

[7.2.4.1]   The Service Provider shall define the different publishing modes that are available for a customer of each tariff plan to access details about its billing information.

8   Checking-up Process

8.0   General principles

The checking-up process of the present document is based on the principle of using appropriate test subscriptions (SIM cards, fixed line, DSL lines, VoIP accounts, etc.) and on connected TCG to verify the compliance of a Service Provider with the billing integrity principles.

The TCG use test subscriptions to generate electronic communications according to a predefined plan (the SSEC).

The Tariff Information published by the Service Provider for the test subscriptions is collected when available and checked, by verifying each charged item against a theoretical item computed based on the TCGlogs, in a manner completely independent from the metering and billing systems of the Service Provider.

8.1 Process Overview

The process used for checking-up metering and billing is made of the elementary tasks described by figure 2.
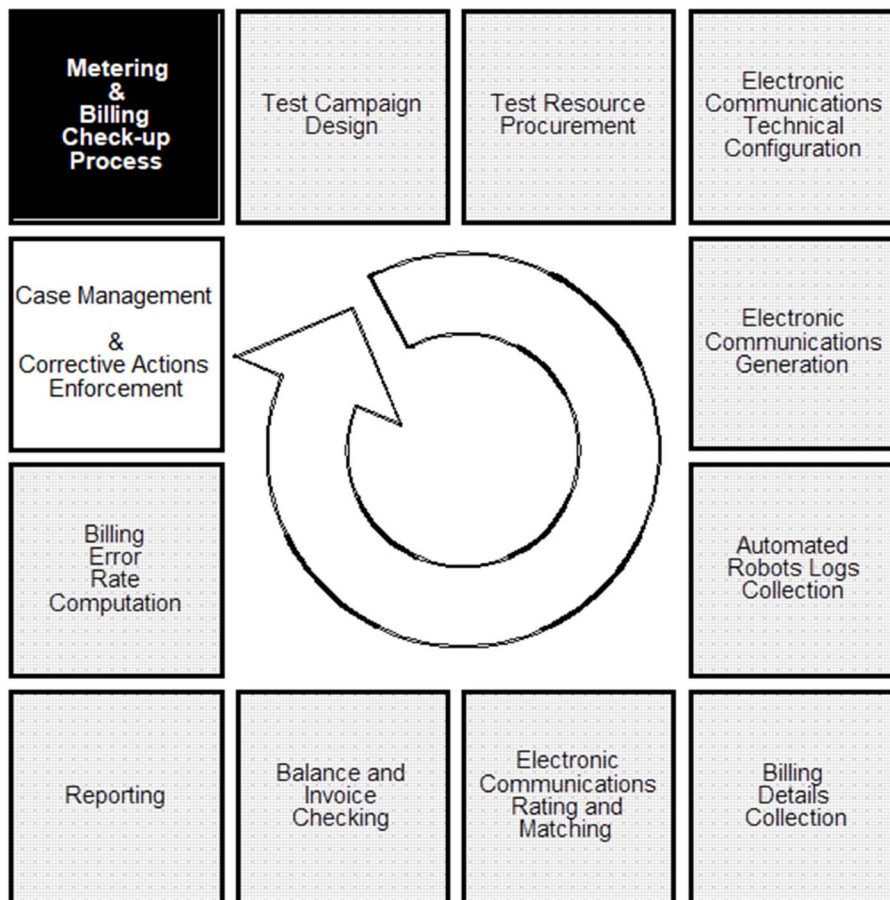

Figure 2: Checking-up Process Overview

Clauses 8.2 to 8.11 describe the clauses a Service Provider shall conform to, to claim compliance with the present document.

> NOTE: The "Case Management and Corrective Actions Enforcement" is outside the scope of the present document which deals only with checking-up on metering and billing. Fixing errors is usually part of the entire process, since the checking-up on billing is usually performed to detect and fix issues. For the avoidance of doubt all clauses for this activity are provided in annex B.

8.2 Test Campaign Design

[8.2.1] The Service Provider shall define a statistical method to design a SSEC that addresses metering and billing verification objectives and respects a set of testing constraints. An example of SSEC is provided in annex A.

[8.2.2] The Service Provider shall document and validate the statistical method of [8.2.1].

[8.2.3] The Service Provider shall use the statistical method to evolve the SSEC used for the billing and metering checking process on a Continuous Basis. The SSEC shall evolve at least on a predefined frequency that will be documented.

[8.2.4] The SSEC shall involve a reasonable number of each electronic communication service types which can trigger a charging item by the Service Provider. The exact granularity of electronic communication types shall be defined by the Service Provider according to the statistical method (see also clause A.4).

[8.2.5]   The SSEC shall include at least one type of each offer type marketed by the Service Provider. The exact granularity of offer types shall be defined by the Service Provider according to the statistical method of [8.2.1].

[8.2.6]   The SSEC shall involve generation of electronic communications from the distinct locations types (switching zone, network geographic zones, etc.) available in the network of the Service Provider. The exact granularity of location types shall be defined by the Service Provider according to the statistical method of [8.2.1].

[8.2.7]   If the Service Provider offers to its customers the possibility to access services from other networks (e.g. roaming in the mobile world), the SSEC shall involve generation of electronic communications from a subset of the different networks accessible by the subscribers of the Service Provider. The exact granularity of networks shall be defined by the Service Provider according to the statistical method of [8.2.1].

[8.2.8]   The different target addresses (called number, URL, SMS recipient, etc.) of the SSEC shall be varied according to the statistical method of 8.2.1. For services that involve interconnection to reach a destination at another SP, the SSEC shall encompass diversity of possible terminating SP (including both off-net and international destinations and premium rate services). In case of Premium Rate Services, the SSEC shall include specific target and possible range of numbers to be tested.

[8.2.9]   The different start time of the SSEC shall be spread over the applicable period according to the statistical method of [8.2.1]. The SSEC shall involve at least one electronic communication for each day of the year.

[8.2.10]   The different durations of the SSEC shall be varied according to the statistical method of [8.2.1].

[8.2.11]   The different volumes of the SSEC shall be varied according to the statistical method of [8.2.1].

[8.2.12]   The SSEC shall include contract lifecycle events like creation, interruption, termination, transfer, suspension, cancellation, address changes, etc. that may lead to billing errors.

[8.2.13]   The SSEC shall include any additional variation that reflects likely customer behaviour that may lead to billing errors.

[8.2.14]   The SSEC shall include testing of temporary offers and promotions limited in time. Such offers are usually not described in proper tariff plan and information is volatile. The SSEC shall involve at least one electronic communication while temporary offers and promotions limited in time is happening.

[8.2.15]   The SSEC shall include testing of bundle management. The SSEC shall involve at least one electronic communication included in a bundle offer and test combination of transactions to evidence the correct depletion of bundles.

[8.2.16]   The SSEC shall include testing of fair usage and speed limitation. The SSEC shall involve at least one electronic communication while mobile offer is fully depleted over a period.

[8.2.17]   The SSEC shall add zero-rating scenarios via specific apps on real devices, where traffic via an IP source on a white list is being-zero rated, and any other traffic (e.g. adds or third-party content such as video-sharing websites, etc.) is being rated (black list).

8.3   Test Resources Procurement

[8.3.1]   The different test resources of the Service Provider (SIM cards, Fixed line, DSL subscription, VOIP Account, etc.) needed to perform the SSEC shall be configured in the networks and information systems of the Service Provider as if they were actual customers of the Service Provider.

[8.3.2]   The different test resources of other Service Providers (SIM cards, Fixed line, DSL subscription, VOIP Account, etc.) needed to perform the SSEC shall be procured in standard market conditions.

8.4　Electronic Communications Technical Configuration

[8.4.1]　　The different electronic communications of the SSEC shall be updated on a Continuous Basis to a set of connected TCG.

8.5　Electronic Communications Generation

[8.5.1]　　The TCG shall execute the electronic communications according to the predefined plan (SSEC) with an appropriate level of accuracy according to the Metering Principles defined in clause 7.1.

8.6　TCG Logs Collection

[8.6.1]　　The TCG shall report about the executed electronic communications with an appropriate level of traceability. The TCG shall use Packet Capture trace (pcap) for network tracing, and define the appropriate information to be metered.

8.7　Billing Details Collection

[8.7.1]　　The SP shall publish Billing Details Information. For each publishing mode, the collection of Billing Details from the test resources shall be retrieved following the process used by actual customers wishing to know about their charging.

For example, if the Service Provider offers a web site where customers can download their electronic invoices, the billing and metering checking process shall download the electronic invoices of the test resources in the web site. For the avoidance of doubt, a billing verification performed based on more upstream information extracted directly from an internal information system (e.g. CDR of the network) should not be regarded as compliant with the present document.

It is a frequent practice for operator to aggregate data sessions per day in a final invoice. Therefore, the SP shall provide additional billing source such as extraction from Data Warehouse or BSS (Business Support System) platform most commonly. If an invoice does not include all the required information, i.e. individual data sessions, individual SMS sessions, the operator shall share an extraction, in addition to the invoice, that includes the details missing, so that thorough metering and billing analysis can be performed. In case website information is not up to date or not the prime source of info for subscribers, official marketing catalogues shall be considered as reference to be used to collect pricing information & business rules that apply. In such cases, the operator's internal marketing catalogue can also be suitable if it contains all tariff plans, the bundles, international and roaming pricing, as well as the business rules and taxes that apply.

[8.7.2]　　Billing Details shall include electronic communication start time, duration or volume, context of transaction (SIM connected in local or roaming context), destination (called party, SMS address, email address, URL, etc.) and any complementary data needed for the unique identification of the electronic communication.

[8.7.3]　　Billing Details shall include price and, if applicable, the bucket impacted by each electronic communication. If multiple buckets apply, the operator shall explain the order in which the buckets are impacted so SP can reconcile in the correct order. The extraction will contain multiple fields with a main account and dedicated accounts, these may be numerous whenever multiple bundles and bonuses applied. The operator will be required to describe the order in which the bundles are used.

[8.7.4]　　In the case no publishing mode is available with sufficient details for some specific offer (e.g. prepaid data), a mechanism based on more upstream data should be set up to collect sufficient billing details to perform the rating and matching described in the following step of the billing and metering checking process.

8.8 Electronic Communications Rating and Matching

[8.8.1]   Electronic communications shall be re-rated (charged) based on TCG logs and according to published Tariff Information.

[8.8.2]   Electronic communications shall be re-rated (charged) in the chronological order of generation (i.e. after being sorted according to electronic communication start time).

[8.8.3]   Re-rated TCG logs produced by the billing and metering checking process should be matched with the rating details produced by the network and information systems of the Service Provider.

[8.8.4]   The matching of [8.8.3] should be performed individually for each and all electronic communications.

[8.8.5]   In the case of an electronic communication yielding more than one bill item (e.g. a premium SMS that is billed through a content item and a transport item) each item of the TCG logs should be matched with each item of the billing details.

8.9 Balance and Invoices checking

[8.9.1]   On the basis of the re-rating and matching performed in the previous step, every discrepancy between the theoretical bill and the real bill shall be spotted for every electronic communication of the SSEC. A discrepancy may be:

- a missing invoice item;

- a duplicate invoice item;

- an unexpected invoice item;

- a discrepancy in time;

- a discrepancy in duration;

- a discrepancy in number of transactions;

- a discrepancy in data volume;

- a discrepancy in price before tax;

- a discrepancy in price after tax;

- a discrepancy in tariff plan application;

- wrong or missing tariff information.

[8.9.2]   Every discrepancy shall be analysed through a contradictory process to ensure that the billing difference is an actual billing error and not an artefact.

[8.9.3]   The analysis shall be performed for each available publishing mode.

8.10 Reporting

[8.10.1]   Reporting about the billing and metering checking process shall be produced according to predefined templates.

[8.10.2]   The reporting shall indicate the distinct types of billing differences identified between the theoretical bill and the actual bill that have been identified (e.g. unbilled item, item billed multiple times, item billed with a wrong price, item billed with a wrong name, etc.) in the SSEC.

[8.10.3]   At least the following reports shall be produced for each applicable period:

- Report N°1: Detailed list of all executed electronic communications;

- Report N°2: Detail list of all billing discrepancies;

- Report N°3: Summary of billing discrepancies, in which similar discrepancies are grouped together.

[8.10.4]   Reports shall be archived during a period equal to the legal requirement of invoice archiving in the country of the Service Provider.

8.11   Billing Error Rate Computation

[8.11.1]   For each period (e.g. day, week, month, quarter) and for each types of electronic communications, the SP shall compute the Billing Error Rate as defined in the present document (see clause 3.1).

9   Test Methodology

9.1   End-to-End Active Test

9.1.0   End-to-end active test methodology

The metering and billing verification is targeted to the charging and billing system for voice, messaging, value-added services, data connectivity. The end-to-end active test methodology is used for billing assurance test which complements with the existing revenue assurance system at the operator side.

The end-to-end test methodology ensures to emulate the User behaviours with possible involvement of different type of devices, as well as various applications installed in the handsets. The active test methodology enables generating the referenced test CDR to be compared with those in the billing chain for metering and billing verification.

9.1.1   Test Charging Generator

Based on the end-to-end active test methodology, The Test Charging Generator (TCG) is the most popular, reference test system for metering and billing verification. TCG repeatedly emulates USER behaviours on devices when consuming the subscribed services, and generates application transactions, sessions, voice calls, messages causing the usage of the network resources and the services. TCG can follow automatic approach.

During the consumption of the services subscribed in the test, the TCG:

- monitors and measures the usage in the different network layers at the corresponding network interfaces or Application Programming Interfaces (API);

- generates in real time the test Charging Data Record (CDR) as reference in a controlled way;

- rates test CDR in accordance with the concerned tariffs plan;

- tries to match the test CDR with the corresponding CDR recorded in the billing system in the operational networks;

- compares the test CDR with the matched CDR in the billing system;

- reports the comparison result with unmatched, redundant or missing CDR.

9.1.2 User devices connected to TCG

With massive smart phone deployment, the billing verification for mobile data traffics generated by mobile applications shall be tested using end user equipment (UE), in particular, via real smart phone devices which are connected to the test system TCG.

9.2 Test interfaces

9.2.0 TCG interfaces

TCG test system can be connected to different type of interfaces while performing the metering and billing verifications, air/wired interfaces or core interfaces.

9.2.1 Air interfaces

In the end-to-end test approach, the test system TCG can be directly connected to the radio, wireless or wired interfaces, for example, at the reference point:

- Um for GERAN/GSM

- UMTS-Uu for UTRAN/UMTS (FDD or TDD)

- LTE-Uu for LTE

- NR-Uu for 5G NR

- U for CDMA2000

- IEEE 802.11™ [8] wireless interface

- ADSL line connection

- Optical fibre connection

- Gm/Ut for VoLTE, RCS, VoIP

- S2b VoWiFi

9.2.2 Core interfaces

The test system TCG can also be plugged onto the core network interfaces (such as SS7/ISUP, Gb, IUcs, IUps, S1, etc.), since the checking-up on metering and billing processes is starting from the core Network elements responsible for charging, such as MSC, SGSN or MME/S-GW, etc.

9.3 Benefits of end-to-end test

An operational billing chain consists mainly of two parts:

- Core network is responsible for charging policy and control, determination of charging characteristics and collecting charging information in form of raw CDR.

- Billing system converts the charging information received from core network to USER bills for monetization of services provided.

The billing system, possibly integrated in the entire revenue assurance system, assumes that all charging information provided from core network is correct. It cannot verify, nor tolerate fault in the charging information. The fault can be caused by the responsible nodes update (software or hardware), e.g. replacement, new roaming partner or a new interconnect DRX/IPX added with different QoS affecting prices, etc.

The end-to-end test verifies the entire billing chain, e.g. for:

- incorrect rating - error in billing system,

- metering issues - error in charging information from the core network,

- lost CDR (causing undercharging) or redundant CDR (causing overcharging) - error in the core network.

The end-to-end test is particularly useful e.g. for:

- Billing verification for multiple services mixed with value added services (from the 3rd party).

- Billing verification for billing plans with inherent error risks, such as bundles, Premium rate, temporary offer, etc.

- Real time (< 1 s) billing test (e.g. gaming, video on demand).

- Zero rating when changing number of applications integrated.

- Verification testing of new tariffs.

- Call rating validation for interconnect or roaming and retail billing.

- Regulatory compliance testing.

- Validation of new network components for charging.

Annex A (informative):
Example of a Stratified Sample of Electronic Communications

A.1   General information

The SSEC of this annex is provided as an example for understanding of the requirements of the present document. This is especially targeted at explaining the requirements of clause 7.1 about the design of a SSEC.

The SSEC of this annex should be regarded as informative and not as a formal requirement of the present document. It is up to the management of the Service Providers to:

- select a statistical method to design a Stratified Sample of electronic communication that takes into account the probability of identifying billing differences while respecting a set of testing constraints;

- apply regularly this method to update the SSEC to be used by the billing and metering checking process.

The SSEC of this informative annex has been designed using a theoretical Service Provider, which has the following characteristics (the words and figures in brackets {} will be adapted for each Service Provider):

- The Service Provider is a {mobile operator} based in {Poland} offer {convergent} services.

- It has {10} millions of customers that generates {60} electronic communications per {months}.

- It offers the following service types to its customers: {voice}, {SMS}, {MMS}, {email}, {Web access}, {TV channels}, {music download}, {movie download}.

- It operates {2G and 3G mobile} networks in {Germany}. The switching network is separated in {5} regional zones that are operated by {5} network regional operating centres.

- {It has roaming agreements with 400 other GSM operators. All roaming rates are broken down into 4 roaming zones with different prices}.

- It operates {DSL} networks and sells {"access boxes"} that allow a fixed access to Internet.

- It markets {20} prepaid mobile offers, {30} residential postpaid mobile offers and {10} Enterprise mobile postpaid offers and {5} convergent access box offer.

The SSEC is described in the following dimensions:

- Locations.

- Networks.

- Offers.

- Services.

- Durations.

- Volumes.

- Spreading.

- Additional Variations.

A.2   Locations

The SSEC should involve the generation of electronic communications in {5} cities in {Poland} ({1} in each regional zones):

- {Warszawa
- Lodz
- Krakow
- Wroclaw
- Poznan}

The SSEC should involve the generation of electronic communications in {6} countries in roaming ({3} top countries in zone 1, {1} top country of each other zone):

- {Germany
- France
- Italy
- USA
- Russia
- Egypt}

The method for a statistical distribution of locations described in ETSI EG 202 765-2 [i.4] could be used.

A.3   Networks

In {Poland}, the SSEC should involve the {GSM, GPRS and 3G} networks.

In each of the {6} foreign countries, the SSEC should involve {all VPLMN that are open for roaming}.

A.4   Offers

The SSEC should involve the {65} offers marketed.

> NOTE: This means that {60} SIM cards and {5} DSL lines of the Service Providers require to be provided.

A.5   Services

The SSEC should include the following services for {mobile} subscriptions. The test is based on a risk assessment approach rather than a call volume approach. Each tariff plan is reviewed, and all risks are evaluated.

A typical example is given for understanding. A postpaid tariff plan, with 100 voice minutes, 500 SMS and 5GB Data allowance are tested by using table A.1.

Table A.1

Services
Voice call to on-net destinations
Voice call to VPN destinations
Voice call to all mobile networks in Germany (see note)
Voice call to major fixed networks in Germany (see note)
Voice call to international destinations (50 countries) (see note)
Voice call to premium services (08xx)
SMS to on net-destinations
SMS to all mobile networks in Germany (see note)
SMS to international networks (50 countries) (see note)
SMS to premium services (short number)
MMS to on net-destinations
MMS to all mobile networks in Germany (see note)
MMS to international networks (10 countries) (see note)
MMS to premium services (short number)
Email
Web browsing session
TV reception
Movie download
Music Download

- More than 100 minutes of voice calls are performed, 100 minutes should come out of the bundle, the subsequent minutes should be charged as the out of bundle price.

- More than 500 SMS are transmitted, 500 SMS should come out of the bundle, the subsequent SMS should be charged as the out of bundle price.

- More than 5 GB Data transactions are consumed, 5 GB should come out of the bundle, the subsequent Data transactions should be charged as the out of bundle price.

A risk-based approach does not define the number of transactions per tariff plan. The approach is based on a risk assessment which results in a risk list (test scenarios). All risks in the list need to be covered in the test.

A.6   Durations

In the SSEC, durations of electronic communications charged on a duration basis {voice call, TV on mobile} should include the durations detailed given in table A.2.

Table A.2

Durations
5 seconds
30 seconds
1 minute
2 minutes
5 minutes
30 minutes
1 hour
2 hours

A.7   Volumes

In the SSEC, volumes of electronic communications charged on a duration basis {Web, MMS} should include the volumes detailed in table A.3.

Table A.3

Volumes
5 kilobytes
50 kilobytes
200 kilobytes
1 Megabytes
10 Megabytes

A.8   Spreading

The electronic communications of the SSEC should be equally spread across the different offers.

The electronic communications of the SSEC should be generated at 80 % from the {German} network and 20 % from the roaming networks.

The electronic communications of the SSEC should be equally spread across the various locations.

The electronic communications of the SSEC should be equally spread across the different networks.

The electronic communications start times of the SSEC should be equally spread over the day.

The electronic communications durations of the SSEC should be randomized so as to cover the maximum types of different durations.

The electronic communications volumes of the SSEC should be randomized so as to cover the maximum types of different volumes.

A.9   Additional Variations

The postpaid offers of the SSEC should be spread across the {12} different bill cycles of the postpaid offers.

The prepaid offers of the SSEC should be spread across the {2} different IN platforms.

The subscriptions used for the SSEC should receive a tariff changes every {3} months.

Annex B (informative):
Case Management & Corrective Actions Enforcement

This annex provides guidance for Service Providers implementing "Case Management & Corrective Actions Enforcement" when "billing differences rate" shows the need to enhance the metering and billing process.

B.1   Billing errors identified by the billing and metering checking process should go through a formal Case Management process agreed with the management of the Service Provider, in order to enhance the process.

B.2   The Case Management process should include the necessary steps to perform billing differences verification, impact analysis, correction design and correction planning so as to warrant that corrective actions are enforced within the right network components and information systems.

B.3   The efficiency of the Case Management process should be reviewed on a recurrent basis (e.g. once a year) so as to review number of errors detected, number of billing errors corrected and other appropriate performance indicators.

B.4   The Service Provider should correct the billing errors detected by the billing and metering checking process within the service level agreed with management.

B.5   The Service Level Agreement for billing differences corrections should be documented and reviewed on a regular basis (e.g. once a year).

B.6   The SSEC should include any additional variation that is considered necessary by the Service Provider to lead to the detection of potential billing errors.

History

Document history		
V1.1.1	November 2009	Publication
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