An integrated management platform for the support of advanced Charging, Accounting & Billing schemes in Reconfigurable Mobile Networks

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ABSTRACT

The convergence of telecommunications industry and the Internet are about to alter the existing business models creating an open market, where a large number of independent application/service providers will offer their services to the users through a limited number of network providers. Furthermore, new concepts such as network reconfigurability and service adaptability require new advanced and holistic solutions for several technical issues related to dynamic service provision as well as flexible charging schemes.
In that context, we present the involved business players and the prospective business models for flexible service provisioning and we introduce a generic integrated management platform for Charging, Accounting and Billing enabling flexible service provision in an open marketplace.

Keywords: Charging; Accounting; Billing; Reconfigurable mobile networks

I. INTRODUCTION

The charging billing and accounting schemes used in voice and data communication networks have been quite simple until now. Users have been mainly billed with a flat rate, based on their subscription and/or the duration of their connection.
The flat rate model that has been adopted to charge people for accessing the Internet was a simple one and didn't require complex systems for monitoring and billing purposes. Content/service providers' revenues were based mainly on advertisements, since their services and content were usually offered to the users free of charge.
Concerning the mobile communication, revenues were based on the network resource usage. In such networks it was essential to deploy the appropriate components that collect and process charging information. This information was related only to the duration of a call and the number of the SMS exchanged between users.
These schemes are expected to be altered soon as a consequence from the technological convergence of these two worlds. The introduction of the IP in the mobile networks causes the design and adoption of new schemes for QoS provision, that aim to support real time services in a quality acceptable by the users. However, in UMTS networks users can exchange data in a connectionless way and enjoy value added services offered by their operators or independent providers. The deployment of such schemes signals the differentiation among users as well as the service flows and packets exchanged through the network. This differentiation creates the need for new mechanisms that will manage the collection of all information concerning chargeable events and, after the appropriate processing, the application of flexible billing schemes on the users. Moreover, the deployment of advanced charging schemes (e.g., content-based, location-based) requires that the charging records should contain all information related to the chargeable events and in an adequate granularity. We also note that the provision of value added services from independent service providers to the users causes the need for advanced billing and accounting schemes.
The rest of the paper is organized as follows. In Section II, we discuss the arising requirement. While the involved players in service provision process are identified in Section III and the existing and newly introduced business models are described in Section IV. An integrated platform for Charging, Accounting and Billing that aims to cope with the emerging requirements and be compliant with the innovative business models are presented in Section V. Finally, Section VI concludes the paper.

II. CHARGING ASPECTS AND ARISING REQUIREMENTS

In order to improve the comprehension of charging aspects as well as to avoid misunderstanding and misinterpretation it is useful to provide the meaning of these terms according to the telecommunication world.

The Charging function collects information related to a chargeable event from several nodes. The charging information generated by network nodes is structured in the form of Charging Data Record (CDR) and IP Detail Record (IPDR) and transferred via standard charging protocols. The charging function is responsible to further process and store temporarily the generated records, to correlate any partial records and transfer them securely to the Billing System.

The Billing function processes the records coming from the charging functional entity according to the respective tariffs stored in the Home Location Register (HLR) or inside the Billing System, and calculates the charge for which the user will be billed.

In case of roaming users, the Accounting function is responsible to calculate the portion that is due to each operator. The billing record concerning a roaming user is forwarded to its home network operator using the "Transferred Account Procedure (TAP)" and a specific TAP format.

The evolution of reconfigurable mobile networks has created new requirements that are imposed by the involved players. The standardization bodies (i.e. IETF, 3GPP) as well as the UMTS Forum elaborate on these requirements in several internet drafts [1][2] technical reports [3][4] and specifications [5][6]. However, after the development and the introduction of advanced services new requirements have come up from the users, mobile operators, the ISPs and the content/service providers.

From the users/subscribers point of view, their main recorded demand is the provision of "One Stop Billing" for advanced 3G services. Another requirement is that the charging model should be in a form easily understood by the average users. The main demand concerning the internet services is to alter the existing best effort QoS model. A large number of the users are willing to pay additional charges in order to ensure a better quality of the provided services. Also, the users should be constantly aware of the charges to be levied for each chargeable event.

The mobile operators, on the other side, require a generic charging architecture that accommodate various charging models (e.g., time-, volume-, QoS-based, flat rate, one-off charge per service, etc.) in order to fulfil not only the traditional business models but also innovative ones. In addition, the selection of a specific charging model could be possibly based on user and service profile parameters. Another important requirement, imposed by mobile operators, is the support of both pre-paid and post-paid charging mechanisms.

At the same time, the ISPs require the introduction of new charging models that take into account the utilization and sharing of network resources in order to be able to apply efficient network management and to prevent the waste of bandwidth, extending in this way the network capacity. This requirement implies that the network providers should be able to meter the network traffic and the resources consumption.

The content/service providers, on the other side, require charging mechanisms that will be based on service and content usage. This demand imposes the need of an integrated architecture that will enable the providers for user authentication, traffic monitoring and content-based charging. Taking into consideration that these processes could be complex for some of the content/service providers; it is imminent that outsourcing all or some of these processes would be of interest to them. In this case, there is an emerging demand that each authorised player should be able to apply dynamically the desired pricing policy for its services' usage. The independent providers should be able to add or modify tariffs for the service and/or content part.

In reconfigurable mobile networks a number of players has an active role in the service provision process. To bypass a complicated charging architecture, a layered charging architecture approach structured in three layers: transport, service and content should be adopted. The management and processing of the relevant information should be made separately for each layer. Furthermore, different charging models should be possible to be applied on each charging layer.

In terms of sharing the incoming revenue between the players (network operators, content/service providers), it is necessary to introduce an automated process, which apportions the incomes, based on the commercial agreements between them. Till now, only simplified mechanisms have been used for sharing revenues due to practical considerations. However, in reconfigurable networks, complex mechanisms making use of information regarding the resource allocation and usage could and should be possible to be applied.

III.INVOLVED PLAYERS IN SERVICE PROVISION

The evolution of reconfigurable network enables service deployment and content delivery offered by independent providers through the underlined network infrastructure. This evolution leads to the involvement of additional players in the control and sharing of the cost of a provided service. Overall, from an end user's point of view the various players

involved in service provision, that might charge user/subscriber, are presented in Figure 1.

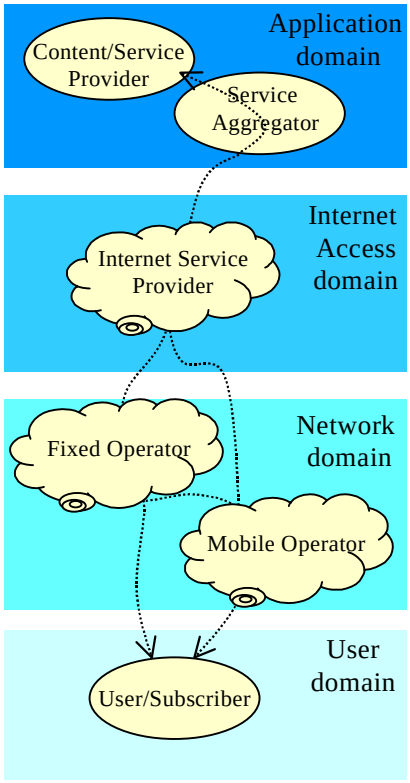

Figure 1. Involved players in service provision

These entities are particularly:
Content/Service Provider deploys services (content or applications) with added value (weather forecast, maps, on line stock exchange etc) to its subscribers.
Service Aggregator is a middleware that enables users/subscribers to be aware of the disposable/available services, categorizes services depending on their content, localization, terminal requirements, etc. As service aggregator can be considered a mobile portal [7].
Internet Service Provider (ISP) provides its subscribers with Internet access.
Mobile Operator offers bearer and supplementary telecommunications services to mobile users.
Fixed Operator provides telecommunications services to stationary (fixed) users but also its infrastructure could be used as transport service by the other providers (ISP, service providers).
Subscriber has contract with an operator and/or provider so that to be authenticated and charged by the operator and/or provider for its services usage. A subscriber could play itself the role of the *user*, or give to a number of different entities the ability to access services making use of the transport service provided by network operators.
The aforementioned players represent roles that are not necessarily mapped into different business entities. For example the service aggregator role could be undertaken by the mobile operator, by the content/service provider or by an independent provider. Moreover, in 3G mobile networks the mobile operator provides GPRS subscribers with internet access, substituting the need for an internet service provider.

IV. EXISTING AND PROSPECTIVE BUSINESS MODELS

Nowadays, to access a service a user/subscriber has first to come in an agreement with a network provider. This agreement enables the user to access telecommunication and value added services provided by the specific operator. Furthermore, till now for Internet access additional contract between a subscriber and an ISP is required. This of course has been partially altered with the introduction of GPRS since mobile users can access the Internet directly through their Mobile Operator. Moreover, the usage of services provided by independent entities either is free of charges or is tied to an operator or an ISP. Alternatively, the user has to charge his credit card providing its credit card details to non-trusted entities.
The latest technological developments in the telecommunications have enabled the introduction of new contracting models. These models enable users to access various networks and services independently of the owner of the underlying network or the provider of a service.
Three basic business models can been identified [7]:

- *Network Operator Centric Model* where the user has to come into agreement with an operator, which is responsible to provide its subscribers with telecommunication services, and value added services offered by any of the involved players. In this model the mobile operator incorporates the service aggregator role and is also responsible for collecting charging information and generates a single bill for all charges incurred. This model is close to the business model that has been followed for many years.
- *Service Aggregator Centric Model* where the service aggregator is responsible to provide its subscribers with its advanced services (lookup service, terminal capabilities negotiation, etc.) and access to content and services offered by independent providers. The user should have subscription with the service aggregator and with a network provider but for service execution the service aggregator defines the prices, collects the charging information and charges the user for the transport part as well as for the service and content parts. Another option would be the network operator to charge separately the user for the transport part but this is not compatible with the One-stop billing requirement. The apportioning of revenues between the network provider, the content/service provider and the service

aggregator is performed by the former based on their commercial agreements.

- *Content/Service Provider Centric Model* where the content/service provider comes directly into agreement with a network provider for delivering its content and services. This model is similar with the service aggregator centric model but in this case the content/service provider takes up the service aggregator role. The users/subscribers are charged directly by the content/service provider, which also defines the pricing and payment policy. Taking into consideration the difficulties introduced by the billing process in case of the usage based charging model and the necessity of a subscription with each content/service provider, this model can be adopted only in parallel with another one in case of the most popular services (e.g. MMS images or MP3) [7].

The involvement of new players in the service provision process and the introduction of new models that enables the service provision without the necessity of many contracts and many different bills impose the aforementioned requirements regarding the calculation of the charges as well as the apportioning of the incoming revenues.

V. AN INTEGRATED PLATFORM FOR CHARGING, ACCOUNTING AND BILLING

With the evolution of next generation mobile systems, the concept of reconfigurability, as the mean to achieve adaptability, has been heralded as potentially offering a pragmatic solution for the provision of a wide range of sophisticated services to mobile users [8]. Although reconfigurability is a key enabler to support the convergence of heterogeneous and generalised access, it creates the need to consider additional requirements for managing flexible service provision and charging in reconfigurable environments.

Issues related to the management of the overhead and complexity required by reconfigurability, service adaptability, protocol/service downloading, intelligent network and service provision need more detailed consideration and impose the introduction of additional parameters, policy provision mechanisms, functionality and appropriate Application Programming Interfaces' (APIs) specifications. These will be the means for taking into consideration charging events related to protocol and service component downloading (tailored to the user needs and profile), the terminal, network, security and user profiles, etc.

We propose a holistic solution for all management aspects related to charging for flexible service provision in reconfigurable mobile networks. To this end we introduce an integrated platform that will cater for all the involved players, in order to avoid any duplication of functionality and enable the efficient handling of these new tasks.

This platform introduces sophisticated management and reconfigurable support for charging, accounting and billing procedures as a discrete service [9]. This architecture is presented in Figure 2, and the CAB platform can be under the administrative domain of one of the involved players. According to the adopted business model the charging, accounting and billing procedures are offered as a discrete service by the responsible business entity. This model assumes that the proposed platform belongs to an independent third trusted party that will have the responsibility and authorization for the overall charging procedure.

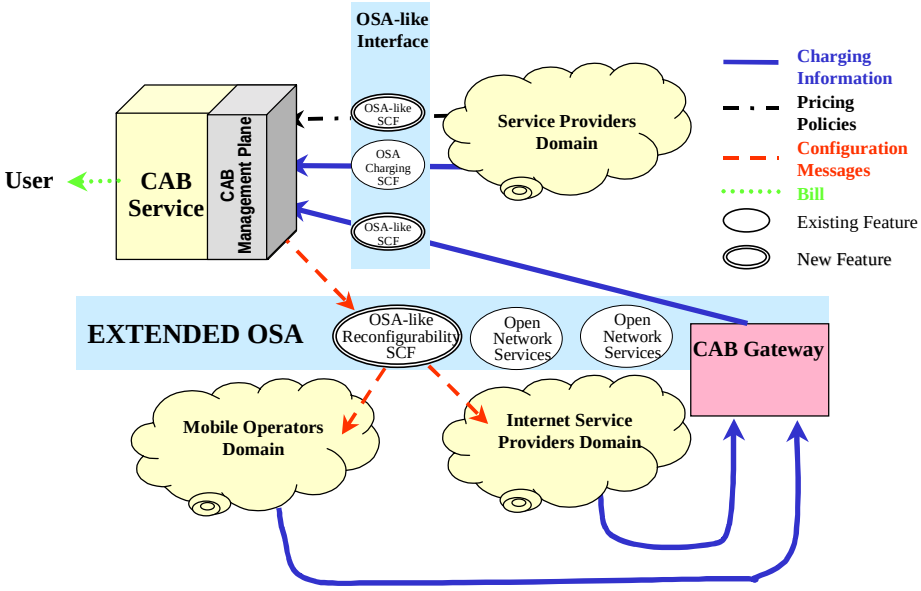

Figure 2: Integrated Holistic Architecture for Reconfigurable Mobile Networks

The platform is able to incorporate the various approaches in charging and the requirements of all the involved players. Furthermore it is able to maintain both post-paid and pre-paid users. It supports one stop billing schemes for the end users as well as the separation of charging events based on content, service and transport usage information. Moreover, it enables the automatic apportioning of incomes among the players.

Note that a charging, accounting and billing management plane provides for the coordination of charging approaches to be applied and for appropriate policy provision. In order to enable charging requirements, policies and schemes to be applied, the use of open APIs among the players that will enable the configuration of network entities for the collection of all required information becomes necessary [10]. For example, the standardized OSA can be used enabling independent players to add application and content charges via the OSA SCF [11]. Furthermore, the introduction and provision of a set of open APIs for the support and management of charging related reconfiguration actions (e.g., pricing policies updates) and the deployment of advanced charging services (location-based charging, on-line charging indication, current balance of user billing) are essential [12]. Finally, this platform takes advantage of existing network components and their functionality and is inline with the latest proposals.

A well defined Charging Gateway could have the responsibility for collecting all the charging information concerning the network resources usage as well as the services' usage using standard protocols and interfaces. This gateway is able to handle charging information, related to content plane, coming from independent content/service providers through standard interfaces (i.e. extended OSA interface).

VI.CONCLUSIONS

By summarizing, this paper discusses the evolution of the Charging, Accounting and Billing aspects for the support of the forthcoming business models in reconfigurable mobile networks. In addition, a generic integrated architecture for Charging, Accounting and Billing with the objective to cope with the increasing requirements and to be compliant with the possible business models was outlined.

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