Service-Oriented Accounting and Charging for 3G and B3G Mobile Environments

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1 Introduction

Mobile communication networks need an overall holistic concept for their charging and billing processes, independently of the kinds of services in use. All usage data of a single service should finally be summarized in a single **service-oriented complete bill**, which shows the individual components of a service separately. In the case of handover among different access networks at the application or the network level, various costs have to be added depending on the kinds of transport networks. In the final bill, all the individual cost factors should be shown separately. For all the concepts which are to be developed, both pre-paid and post-paid payments need to be considered.

The existing charging concepts are based on distributed and, typically, uncoordinated collections of charging data. These gathered charging data are aggregated by special charging processes into service-oriented data sets. In addition to the high complexity of the method, it is difficult to distribute service identities, which can be deployed by all network layers for identifying their charging data collection. The main related problems are missing correlation identifiers and the large number of datasets. The charging data collected in a distributed manner must then be combined according to these service identities.

It should be pointed out that there are no ready solutions to the problem described above, although partial mechanisms available in the IETF (e.g. RFC 3334 [3]) or in the 3GPP (e.g. 3GPP, TR 32.815 [4]) can certainly be utilized as building blocks. An overview to the IETF architectures is provided by Pras et al. [5]. Koutsopoulou et al. [1] discuss a charging system called CAB. This system reflects the typical centralized accounting and charging architecture used in 2G and 2.5G networks.

In the framework of the "3G Evolving Technologies" (3GET) project[1], which aims at supporting large-scale and sustained success of the 3G and beyond 3G (B3G) mobile networks, the related issue is tackled from the view point of **"Service-Oriented and Convergent Charging"**.

The presented architecture was built for 3G and B3G networks. Therefore, it might partially fit to 2G and 2.5G networks but we did not concentrate on verifying this applicability.

In the context pf this paper, we define accounting as the collection of data about resource consumption. This includes the control of data gathering (via metering), transport and storage of accounting data. Charging derives non-monetary costs for accounting data sets based on service and customer specific tariff parameters. Billing translates costs calculated by the Charging into monetary units and generates a final bill for the customer.

[1] Project homepage http://www.mobile-accounting.org

2 Analysis of Requirements and Processes

The accounting and charging (A&C) system should meet the requirements posed by 3G and B3G mobile environments and should realize the functionality in appropriate A&C processes.

2.1 Requirements

Several categories of requirements must be considered: business requirements, process requirements, technological requirements, etc.

Exemplarily, we are focusing on the business requirements. In the upcoming mobile landscape, the vision is based on the advent of new services, diversified value chains, and competitive business models. All these factors will have direct or indirect consequences on the charging and billing functionality. This applies at mobile systems as well as to unified network structures. Since it is difficult or, at least, unprofitable for any single organization or business entity to cope with the diversity of the service provision in the new landscape, it is expected that different roles will cooperate in various business models to share revenues in the value chain. This leads to several novel requirements. Examples are:

- The charging system must be able to flexibly charge all kinds of services. The charging system must also be easily adaptable to new kinds of services.
- The charging system must be able to accommodate a wide range of pricing models concerning usage, value, and application, as well as tariff options including bonus/loyalty programs in order to meet versatile user needs.
- The charging system must be able to attribute the revenues to participating roles in different business models, especially those involving roaming.

As is also evident for the analysis of other requirements, the key word is “flexibility” with regard to functionality, realization, and utilization.

2.2 Processes

The accounting and charging system is comprised of accounting and charging processes.

To charge a user for the usage of a service, different layers and different aspects have to be considered. Among others, the following pricing factors can apply to a service charge: base fee, transport, content, application/service, time, user type, discounts, etc. Tariff models, and thus the corresponding charging models, are the weighted combination of all possible pricing factors. Different tariff and charging models are in use starting from flat rate to the high dynamic mechanisms. The most popular models are flat rate, access charging, content charging, and application charging. The accounting and charging system, above all its accounting processes, should register those (and ideally only those) dynamic factors that are dependent on the specific instance of service provision as usage data.

3 Service-oriented Accounting and Charging

In the following, we introduce a novel approach for a service-oriented accounting and charging solution.

3.1 Architectural Overview

In order to allow a high flexibility as well as functional separation, the functional architecture of our approach was designed as two separate main parts: the accounting domain and the charging domain. Authentication and authorization located in the charging domain are separated from accounting. This is done to enable a service specific configuration of the accounting entities.

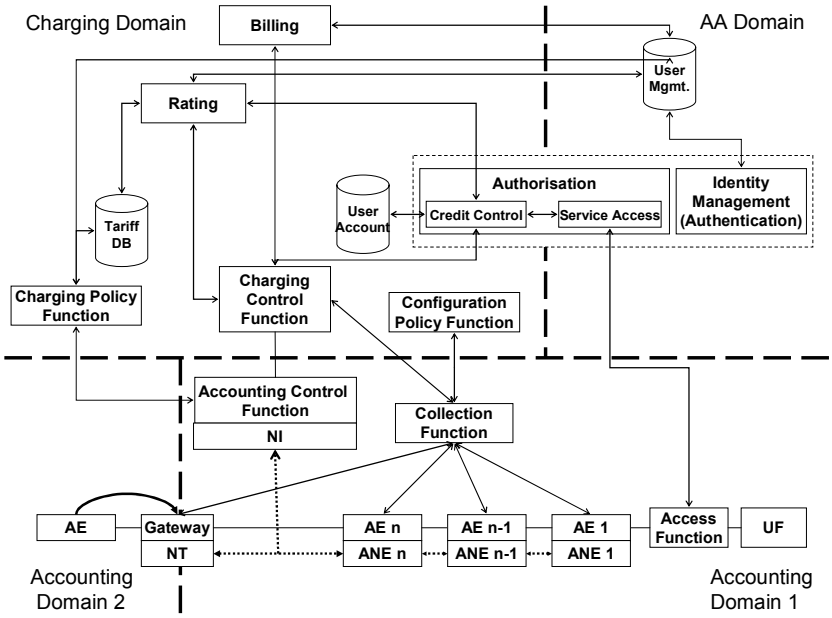

Figure 1. Functional Architecture

All information required by the charging process are gathered within the accounting domain. This task, the accounting, which is controlled by the by the accounting control function (ACF), is done by the accounting entities (AE), the access function (AF), and the user function (UF). Through sending of accounting control messages the ACF configures the AEs involved in a service. All these functions may belong to different accounting domains. In case of inter- domain charging, charging records are exchanged between the involved domains.

The new mechanism introduced with this architecture is the flexible configuration and activation of distributed accounting processes.

3.2 Service-oriented Accounting

Instead of using a static collection of all accounting enabled network functions involved in a service, only those accounting processes are activated which are necessary for the charging for the particular service. This **service-oriented accounting configuration** is done by the accounting control function. The gathered accounting data are transported to central (per domain) collection functions (CF). At this place, they are aggregated, pre-processed and forwarded to the charging function, which is the central control entity of the charging domain.

Using information about the tariff and the user, the accounting data collected by the accounting domain can be rated and, finally, the billing process, which we do not focus on in this paper, can be initiated. Like the accounting domain, the charging domain can be split into several subdomains belonging to different network providers. The synchronization between the domains is provided by the charging function.

Also located at the charging domain is the authorization and authentication functionality. Both functions are employed by the access function in the accounting domain to authenticate users, to authorize them to use a service, and check credit limits.

3.3 Policy Based Management

In order to reduce the complexity and to make it possible to quickly introduce new services, a policy-based management approach is applied. The policy function controls the overall process

and is responsible for the transfer of management and control information among components in the architecture, whether in the accounting domain or in the charging domain.

3.4 Dynamic Configuration by Signaling

Since the accounting domain is expected to cope with versatile accounting granularities and combinations, it should be possible to configure the accounting entities and processes dynamically and efficiently. In this regard, we follow the general approach currently developed by the IETF NSIS working group and advocate the use of a protocol for accounting configuration: NSLP for Accounting Configuration Signaling [2].

4 Conclusions

Accounting and charging system for 3G and B3G mobile environments should cope with various requirements so that flexibility of the system is of paramount importance. Additionally, one of the key problems is how to conduct service-oriented charging efficiently. We tackle the problem by applying a policy-based management approach in the construction of the accounting and charging system and by realizing dynamic accounting configuration through a flexible signaling protocol. Our presented approach for an appropriate architecture includes novel mechanisms and copes with the identified requirements.

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