Flexible Billing for a Personalised Mobile Services Environment

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Abstract

The evolution of network technologies, service types and consumer demands have profound implications for accounting and billing. The application of traditional voice and data accounting methods to the contemporary IP based services of next generation networks have proven too cumbersome and hinder rather than help the process. 3G type services are exhibiting new characteristics that are far removed from their predecessors, leading to new and challenging ways to account for their usage. An alternative mindset is needed when considering the application of accounting principles (mediation, rating and billing) to this new evolution of services. WIT has prototyped a generic ASP based accounting solution that meets some of these emerging requirements. The solution has been trialled in the IST funded AlbatrOSS project. This paper presents a report on the approach used and lessons learned.

Introduction

Billing and accounting are the most critical operational support activities conducted by a provider (network or service) in the telecommunications industry. The ability to effectively and efficiently charge for the consumption of resources represents a critical competency of any telecommunications organisation.

The next generation of the 'communications' environment sees the convergence of the IT and telecommunications industries. This convergence has instigated a profound growth in the number and types of services and acceleration in the emergence of network technologies. This evolution of the communications industry has serious impacts on billing and accounting solutions. Traditional telecommunications billing and accounting systems are proprietary to providers, services and networks and are generally rigid in nature. Accounting and billing for IT services is limited, as the vast majority of services have been delivered free over the Internet while flat rate access fees have been charged.

Background - The AlbatrOSS Project

To support the timely rollout of Next Generation (NG) networks and services, and to fulfil end-user expectations of the associated marketing hype, capable management platforms must be in place. The time to market of these services will be a critical factor in their success or failure and will depend greatly on support from lower operational levels.

The complex communications environments that NG networks and services will introduce, will highlight the inadequacies of current generation Operation Support Systems (OSSs). The limitations of such systems are apparent in the areas of provisioning, billing, integration, service design and subscription management. The rapid emergence of access networks (GPRS, UMTS, WLAN, Bluetooth etc.) and the evolution of services (location based, context aware, customisable) are forcing a paradigm shift in the communications industry. The convergence of the IT and telecommunications industries represents the first step in this progression. IT engineers are focused on providing services to the customer while telecommunications engineers are focused on the network. Hence, on the horizon of convergence, IT people are looking up to the service level while telecommunications people are downward focused on the network level. The key to advancement is the line of convergence. A layer needs to be built to support convergence and seamless integration between the two industries to deliver pervasive services in ambient network environments.

The primary focus of AlbatrOSS was the specification of a Third Generation (3G) OSS architecture framework that represents this layer. This framework provides the essential elements required to build integrated and open OSSs to support the service centric environment of NG service/network operation and delivery.

The objectives of the AlbatrOSS project can be summarised as follows:

- To specify an innovative 3G OSS (3G OSS) architecture framework applicable to an open 3G mobile telecommunications environment.
- To develop a set of OSS building blocks to support rapid service creation, provisioning and maintenance of mobile Internet based services.
- To validate the 3G OSS architecture framework and building blocks through the execution of a set of trial systems.

Since the original conceptualisation of AlbatrOSS there have been shifts in the industry that have lead the project consortium to move its focus from 3G (UMTS) environments to include other network technologies including GPRS, WLAN etc. In order to achieve its objectives, AlbatrOSS has carried out the following work:

1. Capturing end-user, service provider and network provider requirements for 3G services and networks.
2. Specifying an open OSS architecture for managing 3G services based on the requirements capture and on the state of the art as reflected in the current activities of standards bodies and industrial consortia.
3. Identifying and evaluating software technologies to be integrated to support the development of a 3G OSS platform.
4. Integrating and customising open network, service and application components into a 3G OSS platform.
5. Validating the architecture framework through the operation of a set of sub trials based on usage scenarios from the requirements analysis and which support adaptive end-user services on mobile devices.

WIT and UHC conducted extensive research on emerging requirements for OSS Accounting during the project and trialled an innovative online accounting architecture through a series of distributed project trials.

Information Model

The AlbatrOSS consortium adopted the NGOSS™-based Shared Information and Data model (SID) to represent the different components involved in a common information representation. The SID NGOSS principle described in [1] is the result of the application of such model to the AlbatrOSS requirements.

The objectives of the model can be summarised as follows:

- Define a common information and data model that all the consortium members will adhere to
- Promote a common conceptual view that addresses major issues in a 3G environment
- Provide the TM Forum SID working group with feedback.

The SID domain of interest for accounting is the billing domain. This domain provides all entities and relations that support billing delivery from the mediation of usage records to the delivery of an invoice/bill to the customer (end user or service provider).

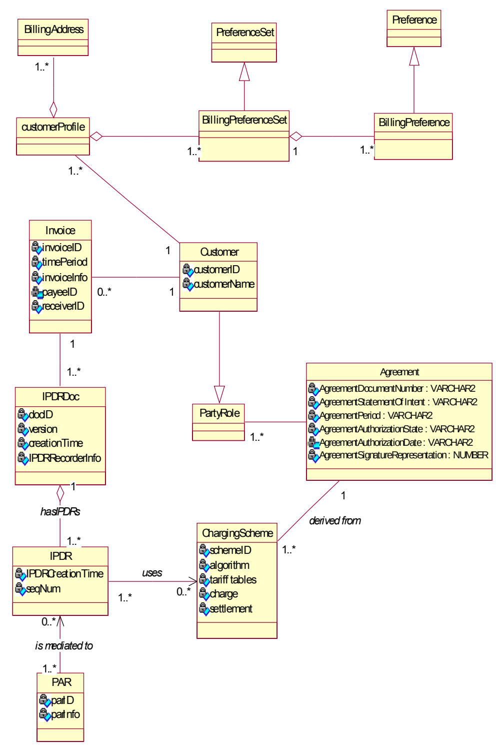

Figure 1 UML Class Diagram for the AlbatrOSS SID Billing Domain

The SID model mainly relies on the TM Forum SID work [2], which was a major resource used in AlbatrOSS. While TM Forum addresses several complex issues and representations, it does not define a general framework to deal with billing. The Billing model is an attempt to fill this gap by bringing together models such as Service Level Agreement (SLA) and preferences as well as information models (PAR and IPDR) to represent the activities of mediation of usage records, charging and production of an invoice/bill.

This new Billing model attempts to cover a large set of requirements needed to capture the relevant information to produce an invoice/bill. The following simplified model focuses on those requirements:

- Mediation of proprietary account records into IPDR
- Correlation and aggregation of those IPDRs
- Rating and Billing of this information based on charging schemes (derived from an SLA)
- Using those rated IPDR documents to produce an invoice depending on the customer and service details provided

Proprietary Accounting Record

The accounting team in AlbatrOSS used the (Internet protocol Detail Record) IPDR.org's Network Data Management-Usage specification (NDM-U) as a base for its information modelling work. In the IPDR NDM-U reference model, the interface between a service element and an IPDR recorder is named the A-Interface. The NDM-U specification does not attempt to constrain file naming, format, transfer protocol, sequencing or any other details of this interface, as the IPDR Recorder is expected to be able to retrieve usage data from service elements in any proprietary form that the service element may provide.

Following the AlbatrOSS architecture concept that all OSS components are using a common communication bus (in the form of web-services interfaces in the AlbatrOSS trials), the project has investigated a common information structure for the information exchanged across this interface.

The PAR (Proprietary Accounting Record) information model is not an attempt to standardise the NDM-U A-Interface but merely to provide a convenient format to be used when the conditions allow it.

The PAR structure (see Figure 2) is defined as a general service usage record capable of covering most service types. It categorises services in three basic types of usage records:

- DurationPAR: Types of services where the charging is based on the amount of time the service has been in use.
- EventPAR: Types of services where charging is based on execution of single events, such as finding a location, performing a search operation, etc.
- VolumePAR: Types of services where charging is based on amount of service usage, such as amount of data transported during a WLAN session.

A PAR thus contains one of these EventPAR, DurationPAR or VolumePAR elements.

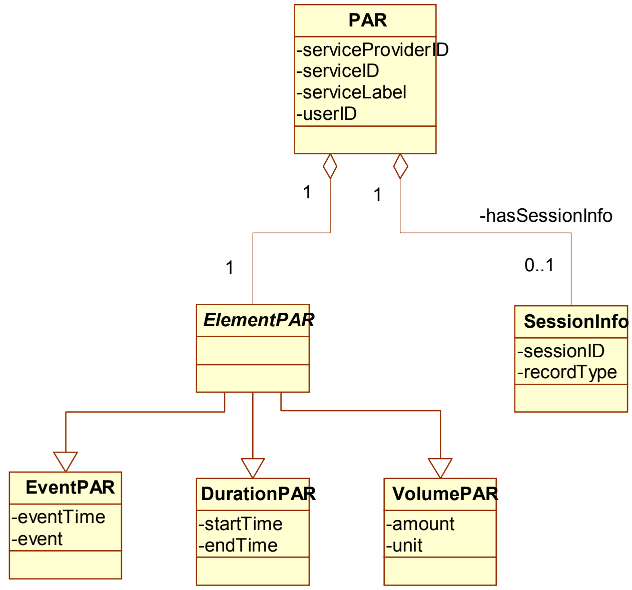

Figure 2 PAR Structure

The serviceProvider, serviceID and serviceLabel are used to uniquely identify the service being reported. The userID uniquely identifies the user who is making use of the service. The sessionInfo element is optional, and may be include for the purpose of performing correlation of PAR records. Correlation of records is performed based on the sessionID attribute within the SessionInfo element. All records pertaining to a session can be aggregated into a single IPDR Document by the mediation function, before forwarding the usage records to a rating and billing function.

IPDRDoc and IPDR

These classes capture the structure of the Internet Protocol Detail Record (IPDR) as defined by the NDM-U for IP-Based Services version 3.1.1 [3]. This structure allows for an IPDRDoc to contain one or many usage records (or IPDRs), which are service specific. The IPDR record is generally described as containing information about the customer, service provider, and metrics or parameters of a particular usage event. The usage represented may be measured as a discrete event, or part of an ongoing session.

Error! Reference source not found. graphically presents the structure of an IPDR Document.

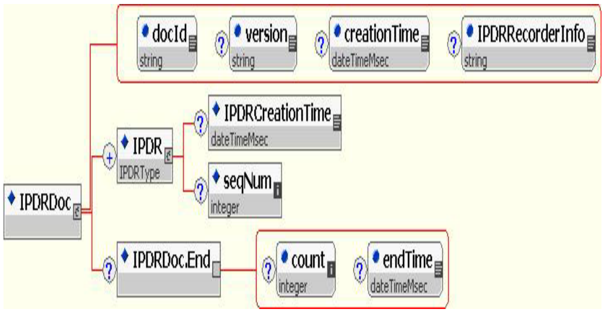

Figure 3 IPDR Document Structure

Charging Scheme

Charging Schemes are spreadsheets that serve as a basis for the Service Rating function of the architecture. A Charging Scheme is the algorithmic representation of a textual SLA. It contains a set of rules applied to a rateable usage record in order to produce a rated IPDR Document.

The Service Rating is responsible for applying such charges to a usage record depending on usage parameters including volume, content and quality type parameters. Discounts will be applied in accordance with parameters specified in the customer SLA. These SLA parameters are captured in service-specific charging schemes. Several charging schemes can be used to generate a rated IPDR document, for instance a service session might be across a peak and off-peak times, hence requiring two different charging schemes.

Service Rating relies on the following process:

- Identify the applicable tariff scheme by extracting the relevant information on the customer, provider and service type from usage records.
- Apply the arbitrarily complex tariffing scheme to the relevant parameters in the usage record to generate a charge.
- Insert the resulting charge into the original usage record and store the rated usage record in the accounting repository.

Common Accounting Architecture

To fulfil the requirements of the AlbatrOSS trials a common ASP based Accounting architecture was required. The chosen architecture is independent of both network and service allowing it to be applied to any conceivable NG accounting domain. The complex nature of NG services introduces new challenges when applying an accounting process. Any number of services may collaborate over multiple sessions to deliver rich content to a user device. Each resource will produce usage records detailing its level of usage in the service delivery, that has to be correlated with usage data from other resources to account and eventually produce a charge for the service. With this in mind a set of requirements for an accounting architecture was devised:

- A common accounting record format to detail service usage.
- Flexible charging scheme generation allowing the capture of complex and granular rating rules.
- Support for inter-domain settlement/clearing
- Flexible end-user (near real-time) bill generation, supporting the need for one-stop billing through the aggregation of service & network charges.
- Generic protocol and supporting interfaces between all entities in the accounting architecture (service/network provider, mediator, rating provider, billing provider).

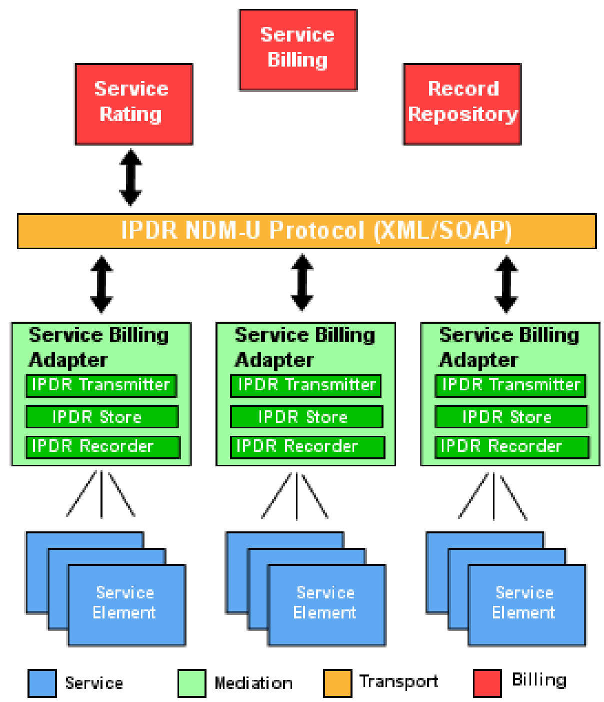

Figure 4 Service Accounting Architecture

Figure 4 depicts the overall layered architecture that was developed to support the accounting of IP based services in the Albatross trials. The Service Element layer represents the resources consumed during the service/network provision activity. These entities are capable of producing usage data in standard or proprietary record formats. Usage data may originate from specialised network nodes through an OSA/Parlay gateway [4] or from customised interfaces incorporated at the service level.

For the architecture to be effective in serving such a wide array of service types the usage data generated from the mediation layer must be captured in a predictable format. The IPDR NDM-U specification [3] defines a common XML based usage record format to capture the intricate details of IP based services. This information is then used by an accounting system to create charged records that support bill preparation and subsequent analysis.

The structure and usage attributes of an IPDR are captured in a service definition XML Schema [5]. This schema forms a contract between the producer and consumer of IPDR records and enables validation of incoming records for verification of their content. The encapsulated resource usage information may serve more than just the billing processes where activities like performance analysis, fraud detection, Customer Relationship Management (CRM) etc. also benefit from the record payload.

The complexities of the data presented by the underlying Service Element layer are abstracted through the use of a set of Service Billing Adapters. These adapters are responsible for collecting and converting the Service Element usage data into IPDR record format. The Billing Adapters provide an abstraction of the actual type of service, which may be anything from raw network transport to sophisticated location based services. The Billing adapters are made up of a set of sub-components: IDPR Recorder (IR), IPDR Store (IS) and IPDR Transmitter (IT) [3]. The IR acts as a mediation device and is responsible for producing IPDRs from the many proprietary data formats (PARs) of the underlying Service Elements. The IPDR Store provides persistence to the generated IPDRs from the IPDR Recorder. The IS correlates the various independent service records using a predefined algorithm and packages them into higher level IPDR Document containers. The document container represents an entire service usage and is the smallest unit of correlated data. Finally, the IPDR Transmitter provides a mechanism for the timely and reliable delivery of IPDRs to the supporting layers above.

The IPDR NDM-U specification also defines a document transfer protocol. The D interface [3] defines a set of messages and related parameters for the negotiation of a reliable transport session between the mediation and billing layers for the delivery of IPDRs. Using the IT Push model of delivery the Service Rating component in the above architecture subscribes to a specific group of IPDRs maintained by the IPDR Transmitter in the Service Billing Adapter component.

Typically the Service Rating component will advertise its willingness to accept usage records from the mediation layer during its lifetime and this is achieved through the formation of a SubscribeReq primitive.

```
<SubscribeReq>
    <versionId>3.1</versionId>
    <requestorId>www.foobar.com:1234</requestorId>
    <groupId>WLAN_unrated_correlated</groupId>
    <beginSeqNum>0</beginSeqNum>
    <idOnly>FALSE</idOnly>
</SubscribeReq>
```

Figure 5 SubscribeReq Primitive

The requestorId attribute defines the protocol specific identifier of the entity instigating the request and could map to a HTTP URL [6], SIP address [7] or any other applicable application level protocol. The groupId attribute identifies the particular IPDR grouping that is to be received by the requesting entity.
After receipt of the SubscribeReq request the IPDR Transmitter of the serving Service Billing Adapter will initiate a transfer of available IPDRs using the PushReq primitive.

```
<PushReq>
    <version>3.1</version>
    <requestorId>http://www.mediation.com:5434</requestorId>
    <groupId>WLAN_unrated_corelated</groupId>
    <docId>WLAN_20030704130826+0200_698166383_1</docId>
    <groupSeqNum>0</groupSeqNum>
    <IPDRDoc docId="WLAN_20030704130826+0200_698166383_1"
             version="3.1" creationTime="2003-5-11T15:18:00Z">
        <IPDR>
            <!-- Contents omitted for brevity -->
        </IPDR>
        <IPDRDoc.End count="1" endTime="2003-5-11T15:18:00Z"/>
    </IPDRDoc>
</PushReq>
```

Figure 6 PushReq Primitive

This time the requestorId attribute represents the identifier of the IPDR Transmitter within the mediation domain. An IPDR document containing IPDRs from the requested group is sent in the body of the message along with a document and group identifier.

The distributed nature of the trial components (Ireland, Spain, Denmark, UK) provided by the consortium members of the AlbatrOSS project imposed a modular structure on the functional architecture design. Simple Object Access Protocol (SOAP) [8] was chosen as the messaging protocol between the service, mediation and billing components because of its versatility in message capture and its simple structure. The Push and Subscribe interfaces of the respective billing and mediation components were implemented as a set of web service endpoints facilitating invocation from any remote location. Web services exploit the ubiquity of the Internet as means to solve the common interoperability problems of many middleware technologies [9]. By placing a lightweight XML based veneer over the existing middleware layer it is possible to attain a level of interoperability that was difficult to achieve using other frameworks.

The Service Rating component offers the functionality to support the massaging of rateable events contained in IPDRs with applicable tariffing schemes, into a final charge presented in an end user bill. The rules for rating each service are encapsulated in spreadsheet based charging schemes that match specific parameters within the IPDR (e.g.. startTime, bytesIncoming, operationType) with their corresponding algorithms for calculating the resulting charge. It should be noted that the tariffing schemes exist completely independently of the rating engine that applies them to IPDR usage records. Hence, tariffing schemes can be updated and initiated without any recompilation of the rating engine. Furthermore, the Spreadsheet nature of the schemes allows them to be manipulated by non-technical staff e.g. accounts/pricing and marketing type staff without any direct involvement of technical programmers etc. Flexible customisable Billing was achieved by using eXtensible Stylesheet Language Transformation (XSLT) [10] technology. Network and Service independent style sheets have been defined for Portable Document Format (PDF), HTML, Wireless Markup Language (WML) and for device dependant screen sizes.

Conclusion

The tier 1 and 2 billing market is today dominated by five product vendors: Amdocs, Convergys, CSG Kenan, Portal and ADC, with Amdocs and Convergys being in a dominant market position due to their relatively larger revenue earnings. A large number of additional vendors compete for specific market niches such as adjust rating, inter-connect rating, content rating and pre-paid services support.

The ongoing rollout of 3G networks and increasing deregulation of the wired telecommunications market is fostering a very dynamic services and application market place involving a large number of creative and innovative SMEs. Such SMEs require billing solutions to allow them to capture their share of the revenue and to break down existing entry barriers to markets. Hence, WIT along with its project partners have identified a significant underserved market – provision of online, outsourced billing solutions for tier 3, 4 and 5 mobile and wired operators, content providers, service aggregators and other genres of service providers. The lack of effective, affordable outsourced solutions has prohibited a lot of these entities from entering the market on their own terms and has, in a lot of cases, allowed them to be exploited by the larger network operators who perform billing on their behalf.

WIT has recently spun off a start up company to exploit an ASP based billing solution resulting from the work described in this paper. This robust online billing service can be shared by these entities, hence making their billing systems more affordable. The solution is being assembled using Application Service Provider (ASP) technologies founded on the third generation of distributed component technologies – HTTP based transport, XML interchange using SOAP and contract based management using WSDL, as used by the AlbatrOSS [11] Accounting Architecture [12]. These technologies together provide an infrastructure for a mature automation of business-to-business information exchange. The ASP billing service will be made accessible to large numbers of customers on a subscription/rental basis. This approach is gaining widespread acceptance, as demonstrated by the phenomenal success of ASPs like SalesForce.com.

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