GPRS Charging Schemes

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Abstract

This paper studies different charging schemes possible in GPRS networks. The existing and future charging schemes are presented and analyzed and the requirements for charging are introduced. In the comparison among Finnish operators is indicated that by applying block price charging in GPRS networks it is possible to offer an attractive GPRS service for customers while still maintaining the predictability of network usage.

Also the linkage between network level charging and service level charging is researched. It is noticed that the linkage between different charging entities could be done by applying explicit charging IDs for different transactions or by identifying the network traffic targeted into the certain service at the gateway level.

Keywords: GPRS charging, Service level charging, Block price charging

1 Introduction

The purpose of charging is to collect data on the network resource usage and services to enable the billing of the subscriber [1]. The charging should be explicit, effective and flexible.

Charging is required mainly for two reasons: to recover the costs invested in the infrastructure development and to make commercial profits for the stakeholders of the operators. Also congestion can be controlled through different charging models [2].

There are different ways to define charging schemes. This paper examines them through two different approaches: in the chapter two and three there are introduced and evaluated the existing and future charging schemes for voice and data. In the fourth chapter the feasibility of the charging schemes is considered and the prices of the GPRS services offered by Finnish mobile operators are compared. Chapter five researches some of the evolving scenarios of the linkage between network level charging and service level charging. Chapter six summarizes the key features of this paper.

2 Existing and Future Charging Schemes

2.1 Metered Charging

In metered charging [3] the subscriber is charged for the connection to the service provider and in addition for metered usage. The charge for the connection is usually paid on monthly basis and can include a certain amount of free metered units. Three different types of metered charging are described below.

Charging Based on Units of Time

In this model charging is based on the time the connection is open between the user and the service provider. GPRS characteristics produce problems in this kind of situation, because the connection can be left open even if the terminal equipment is turned off. That is one reason why GPRS charging should be based on another session parameters than time [3].

Another problem in time based charging is that during the GPRS session the connection is most of the time in idle state, so the there wouldn't actually be anything to charge for. Charging based on time units is justified in circuit switched connections like GSM telephony, but there isn't any suitable use for it in GPRS network.

Charging Based on Number of Packets

Charging based on number of transmitted or received packets is the proposed method of metering Internet traffic. It gives accurate information of customer's network usage and the absolute usage of the network and

the services [3]. This charging model is also known as charging based on volume.

The problem of this charging model is the implementation of the packet counting systems and the packet data processing systems. Packet based charging requires a complex system, which increases capital expenses. Also operational expenses of packet based charging system rise because of the increased amount of the traffic information in the network. The cost of measuring the sent and received packets can be even greater than the actual value of the packets.

Single Fee Charging

In single fee charging one fixed fee per service is charged from the user. These fees might differ depending on the service used. For example MMS (Multimedia Messaging Service) is based on single fee charging.

Single fee charging might easily produce charging environment that is too complicated for the user. If the network contains a lot of different services with different fees it might be real hard for the customer to keep track of expectable expenses.

2.2 Fixed Price Charging

Charging based on one fixed price [3] means that user is enabled to use all network services provided by a certain operator for a certain time by paying the fee for network operator. Charging model is also known as flat rate charging.

By using fixed charging it is possible to reduce both network and charging system complexity and remove the most traffic generated in charging. Still even with fixed price charging it is advisable to collect some traffic information from network to be able to maintain network effectively.

The downside of this charging method is that it does not offer any additional revenue for the operator when the network is usage is raised over the average. Fixed charging also lacks methods to prioritize network traffic in congestion situations: the only way to affect to a congestion situation in the network is to change the fee charged periodically.

2.3 Expected Capacity Charging

In expected capacity charging [4] a certain amount of network capacity is identified for every user. Subscriber is then charged for this expected capacity. In implementation of this model users' traffic is constantly monitored and all packets that don't fit in to users profile are either dropped or marked with special tag.

By using expected capacity charging operators have better possibilities to plan the network usage in long-term situations. In consequence the network capacity can be better optimized to the users. The use of this charging model also enables the users to have a fixed fee that they will pay.

The problem is that network provider has to monitor the actual usage of the capacity and either limit the usage or charge the subscriber for extra in case of over usage of the capacity. At network level this means that all the equipment have to have the ability to monitor traffic and mark the packets or drop out traffic that is out of the profile. The operator also has to have the equipment to handle large amount of user profiles and all access points should be able to monitor and mark traffic based through them.

2.4 Edge Charging

Edge pricing is based on the idea that charging of network usage is made at the edges of the network. This means that the actual charging event is performed at the edge of the user's home network [5]. Charging at the gateway may be produced with help of networks information, but the actual charging ticket is created at the edge.

Usually the edges of the network are congested first. In consequence edge charging can be seen as a method to control network usage and implement existing traffic policies. Collection of charging information at the edges of the network would also remove the need to exchange charging information between networks.

Downsides of edge charging are the cost of the infrastructure (that can be even greater than the value achieved by implementing the charging system) and the lack of visibility of the routing information outside the home network. In edge charging also knowledge about the behavior of the traffic flows is required to be able to avoid cross-charging at the other edges of the network. Also the implementation of edge charging to existing systems could be problematic.

2.5 Paris Metro Charging

Paris Metro charging [6] is based on differentiated levels of service. Charging model combines the idea of travel class with network traffic: charging is based on travel classes as used on public transport system.

In Paris Metro charging subscribers prioritize network traffic by assigning a preferred travel class with an associated cost for their network traffic. Different traffic types (like e-mail, streaming, browsing) may have different priorities and different travel classes. Chosen

travel class can also be changed due to congestion or to reduce costs.

Paris Metro charging scheme is a flexible charging system with self regulative feature in case of high usage. Charging model is however mathematically very complex to implement and the possibility for the user to decide tariff class can create overhead to the network.

Due to the model's multiple traffic classes, effective multiplexing cannot be performed in a Paris Metro charged network [3].

2.6 Market Based Reservation Charging

Market based reservation charging introduces the model of public auction of bandwidth or network recourses. In this model the subscribers place monetary bids that will influence the quality of service they receive from their serving network [3].

In this charging approach subscribers have to maintain a preference profile that defines subscriber's bids for the different services. That way the network operator can use subscriber's profile to route the network traffic. Profiles can be administrated e.g. via a web interface.

An advantage of this charging model is subscriber's possibility to influence their quality of service. This can be done by attaching the chosen value to the service they require. Market based reservation charging may however allow some subscribers to gain unfair advantage if they bid for certain services at the expense of other subscribers. Also the administration of the user profiles can be awkward for some users.

3 Requirements for Charging

It is important to produce a charging scheme that collects all information concerning chargeable events, produces appropriate processing and imposes flexible billing schemes to the users. In addition the system should reuse the existing or proposed network elements and functions involved in the charging process.

To make a productive charging model out of theoretical schemes a generic charging architecture is needed. It has to accommodate various charging models (e.g. time and volume based, fixed price) and be layered approach meaning that the chargeable event should be in two layers (transport and service) and processing of the relevant information should be made uniformly for one service but separately for both layers. Also an open Application Programming Interface (API) is needed between the network operator and service providers for service providers to be able to modify charging configurations for the service part [2].

Users require one-stop billing: users would like to receive a single itemized bill for using voice and data services offered by network operators and service providers. Thus network operator would be responsible for collecting charging data from all players and billing the users [2]. Charging models should also be in a form easily understood by the average user.

All the network usage charged via one channel is however a challenging task. There are multiple players with different working methods at the network operator business environment. Network operators can e.g. charge each others based on different schemes than they charge their customers. Therefore commercial agreements in addition to the automation of procedures concerning the charging and sharing of the revenues will be needed to really benefit from complex charging schemes.

4 Feasibility of Charging Schemes

Above mentioned charging schemes are only rough and simplified models of the GPRS charging. In real life the charging is usually based on a combination of two or more charging models.

It is not possible to specify only one, "right" GPRS charging solution for every situation – different users have different kinds of customs, habits and interests to use mobile terminals. Therefore it is good that different GPRS networks can charge their subscribers in different ways. Each operator should know its customers and find the charging schemes most suitable for its customers' needs.

It is however important to find a good and effective charging model. Above mentioned charging models based on differentiated services (Paris Metro charging, market based reservation charging) and limited capacity (expected capacity charging) don't enable effective charging at the radio access network but charging functions are performed in the core network. To make effective resource control possible and to minimize resources wasted on traffic that isn't allowed it is important to place resource control and charging as close as possible to radio access network. In the following example such charging schemes are compared.

Three different GPRS charging models (fixed charging, block price charging and metered charging based on volume) by two Finnish mobile operators are illustrated in figure 1. Block price charging model is a combination of above schemes and consists of a fixed price tariff that includes a certain amount of data up to an agreed limit, plus metered charging for extra blocks (e.g. data volume

blocks). It can be seen that when transferring large amounts of data, fixed price charging is the most cost-effective for the customer. But in a normal use customer can save a lot of money by applying block price charging. Charging based on a monthly fee and megabyte-sized blocks is also according to Nokia [7] the most successful charging strategy for GPRS.

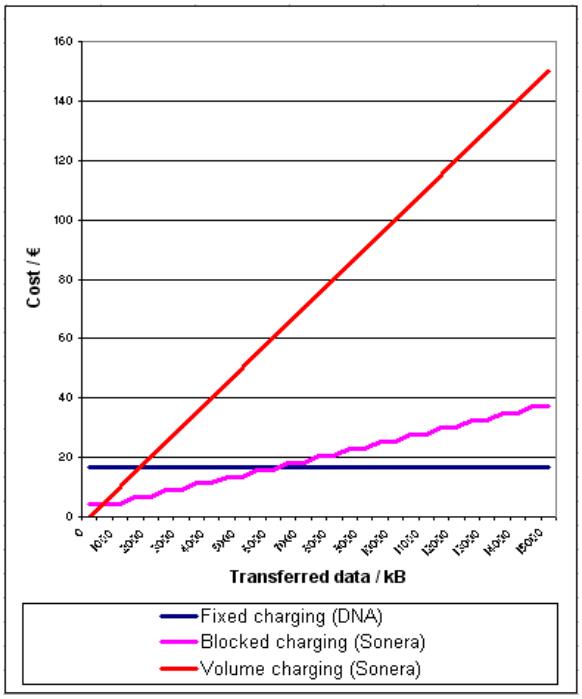

Figure 1 Comparison of GPRS charging models of two Finnish mobile operators [8, 9]

5 Linkage to Service Level Charging

Besides the existing and future charging schemes it is important to see the charging in a wider context. This chapter researches the linkage between network level charging schemes and service (or application) level charging schemes.

Network level charging information of one GPRS session is delivered to the charging system using Charging Detail Records, CDRs. CDRs are created in network's SGSNs and GGSNs. Charging system usually consists of charging gateway and post-processing part [10, 11]. Service level charging information can be collected using CDR:s or Service Detail Records (SDR) and includes data about used service instead of e.g. volume of transferred data. Network and service level charging are illustrated in figure 2.

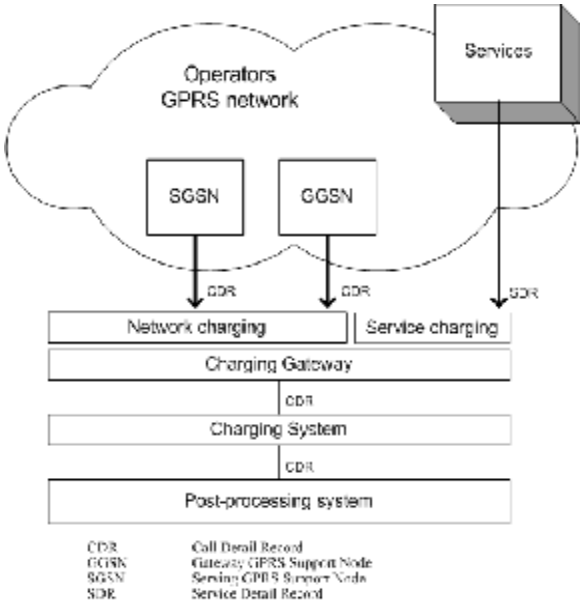

Figure 2 Network and service level charging

5.1 Bundling Schemes

Possible schemes to combine the charging at the network level and at the service level are described in the following:

1. Customer is charged only for the data transmission and only the network level data is used for charging.
2. Customer is charged at different rates for different services. This rate can be defined in GPRS CDR, so there is no need to collect service charging information.
3. Customer is charged only for the service, thus network charging information is not needed or needed only for the statistics.
4. Customer is charged both data transmission and service. Both network level and application level charging information are needed.

To enable charging based on both network level and service level information, different level charging information should be combined to get a general view about charging related to different parties. One solution to link these two types of information could be to add a combination key, GPRS charging ID (C-ID), to the service level charging information [10]. PDP context specific Charging IDs are generated in GGSN and delivered to the SGSNs. They could be delivered further to the service element providing the application to be charged. With the help of this key all the charging

information related to one session could be combined and the traffic related to one service event could be handled as an entirety Also the possibility of double charging can be eliminated by using the combination key to bundle the network level and the service level charging.

The combination of these two types of charging information can be done in network system's mediation device, charging gateway or in the post-processing system depending on the operator's billing system.

One possible way to create service level SDRs could be to identify the traffic targeted to a certain service at the specific gateways of the GPRS network. However in this way it might be problematic for the customer to know when the charging is done. One method to explicitly create SDRs is to pass all requests for the services to be charged through a specific server in operator's network.

There could be many ways to link service and network level charging to the utilized services, but to provide a simple and feasible bundled charging solution for network operator there should be a selected straightforward method that offers generic interface for service operators. This kind of solution could be the above mentioned case where network operator forwards the chargeable transactions into service provider's network.

5.2 Case MMS

Let us consider GPRS charging in case of a Multimedia Messaging Service (MMS) message as an example of the linkage between service level and network level charging. When a MMS message is sent the GGSN will generate a unique GPRS Charging ID that is combined with the charging data linked to the sent message. With the help of this GPRS Charging ID charging gateway is able to combine traffic linked to one message and user can be charged according to it.

An alternative way to combine the MMS message service level charging to the network level charging is to divide the charging into different gateways. This way MMS messages could be charged at WAP (Wireless Application Protocol) gateway, charging based on MMS Center Access Point number. Using this kind of an arrangement it is possible to combine the network charging information with the services in a node where the service traffic can be separated with an adequate accurateness. Of course this increases the complexity of the charging system.

6 Conclusions

To develop effective and feasible charging models it is significant to find the balance between the complexity of the charging system and the advantage the network provider will receive for having the system in place. It is also important to be able to offer to the customers such services that there is enough control over the way they are charged and the quality of service they receive but the services and charging are not too complicated.

Among Finnish GPRS operators block price charging seems to offer the most feasible way to produce a flexible service environment to an average customer. Block price charging also enables operator to predict the network usage of potential new customers. By using large unit of measurements (blocks) it's possible to get more accurate numerical information on future network usage.

Linking of service level charging and network level charging can be combined in various ways, but in all cases the result will be multivariable environment that requires highly organized charging structures to enable operating in an effective and profitable way. While combining service level charging with the network level charging it is crucial to define just a few different methods to combine tariffs, because otherwise the complexity of the charging system will expand.

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