White Paper

Service charging in the Intelligent Edge

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Contents

Executive summary

Operators have a key relationship with their subscribers – they bill them, or charge their pre-paid accounts, for services consumed and receive payment in return. This document focuses on IP based services, such as mobile browsing, Java game download and Multimedia Messaging. For many such IP services, the service or content consumed originates from a third party, revenues are collected by the network operator and shared between the network operator and the third party.

To gain the acceptance of the end-user, the operators' service machinery must enable pricing models for mobile services that follow those for traditional consumption, i.e. each item or service should have a set price that is known in advance. Additionally, to ensure a zero fraud window for pre-paid subscribers, it is essential that online charging mechanisms are implemented whereby sufficient funds are reserved from the subscriber's pre-paid account before the service is consumed.

The charging capabilities of the Intelligent Edge enhance and unite the current charging mechanisms available to network operators, allowing flexible charging for the increasing variety of mobile services.

Pricing models and charging processes

Charging for IP services in mobile networks is becoming more challenging. In particular:

- The number of Service Enabler elements, such as the WAP gateway, Delivery Server and MMSC, is increasing – each with different charging requirements and functionalities.
- Solutions offering IP flow analysis based charging are being introduced, enhancing the charging capabilities of the standard packet core.
- The IP Multimedia Subsystem will soon be introduced to the network, bringing with it new charging requirements and mechanisms.

The challenge facing operators is to combine the charging capabilities of these three domains, to produce flexible and intuitive service charging.

Key requirements the charging solution should meet are:

- Support for both pre-paid and post-paid subscribers. In particular, ensuring a zero fraud window for pre-paid subscribers.
- Provide the charging mechanism for third party hosted content (from content providers) and for services provided by external Application Service Providers (ASPs).
- The ability to control the access and service or content charging to enable different services to be charged in different ways and at different rates. If required, this should be possible down to the level of an individual piece of content or service.
- The ability to charge the same service differently for different subscribers, and depending on the context in which it is used – for example, roaming/home network, or location.
- Confirmation of delivery before charging for higher value content.
- Support for revenue sharing and sponsoring of services.

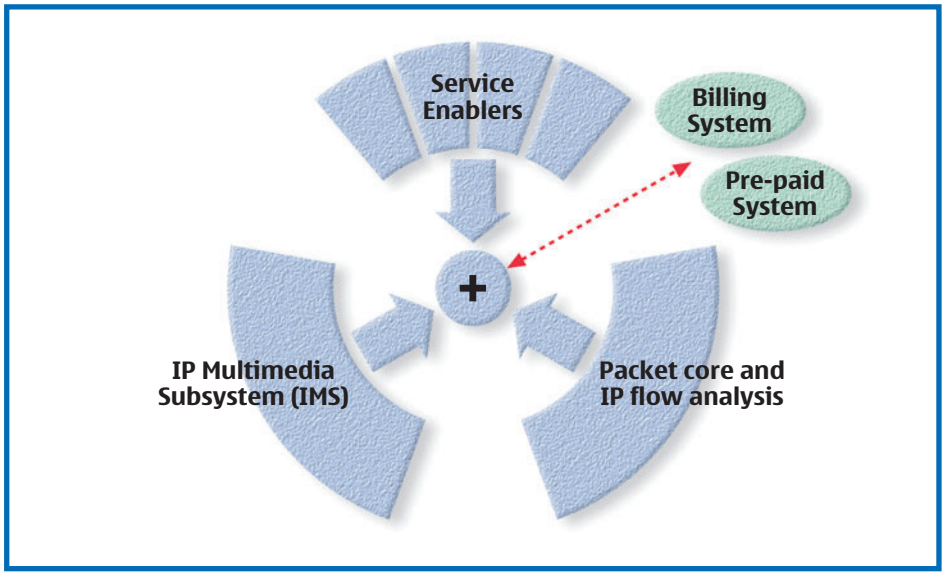

Figure 1. The charging capabilities of three domains must be combined into an integrated charging solution.

	Intuitive pricing model
Infotainment	Subscription fee or price per item
Music	Price per item
Movies	Price per item, or subscription fee
Audio/Video Infotainment	Price per item
Gaming	Price per game download and price per game session
Person-to-person messaging	Sender pays a fixed price per message

Table 1. Intuitive pricing models for various types of mobile service.

Pricing models

Pricing must be easy for subscribers to understand, matching established methods of consumption. For many services in the mobile domain this is currently not the case. Pricing that is difficult to understand is a major barrier to service consumption. Table 1 presents some examples of intuitive pricing for various types of mobile service.

Additionally, a vital requirement in gaining subscriber acceptance is to make the price of the service known in advance. This is also a legal requirement in many countries. Hence, subscriber preference is for 'event based charging', where one service event incurs a set charge, regardless of the traffic volume or time used in delivering the service. Although a large variety of charging models are possible, Table 2 presents Nokia's view of suitable charging models for each service type. Roaming subscribers are prepared to pay a small premium for service usage, yet this should still adhere to the pricing principles outlined above.

● Recommended method ● Secondary recommendation	Time	Event	Sub-scription[1]	Traffic Volume	Free of charge
Operator Controlled Services					
Person-to-person, real-time (voice, video)	●		●		
Person-to-person, non-real-time (messaging, gaming)		●	●		
Content-to-person, operator portal browsing[2]			●		●
Content-to-person, download (ring tone, Java game)		●	●		
Content-to-person & person-to-person streaming[3]	●	●	●		
Business connectivity, corporate intranet access			●	●	
Non-operator controlled services					
Internet access (used for mobile browsing, e-mail, streaming, intranet access, and so on)			●	●	

[1] Subscription may also be free
[2] It is assumed that operator portal browsing is a discovery method for chargeable downloadable content such as ring tones, logos and games. Hence, to maximize usage the browsing itself is not charged for.
[3] Depending on the type of streaming, time based for a continuous stream or event based for a clip

Table 2. General example for service charging.

Online and offline charging

The charging process employed by the operator should be differentiated from the payment method used by subscribers to pay for service usage, i.e. pre-paid or post-paid. The operator's charging process may be either offline or online, the latter being the only method that can ensure against fraud by both pre-paid subscribers and post-paid subscribers with a credit limit. Online charging replaces the current hot billing solutions for pre-paid and post-paid with credit limit traffic volume based charging. This is illustrated in Figure 2 and terminology is defined in Table 3.

The need for online charging becomes even more acute where high value service content is supplied by a third party. If the operator delivers such third party content but does not secure payment from the subscriber, the third party may still demand payment from the operator according to the revenue sharing agreement.

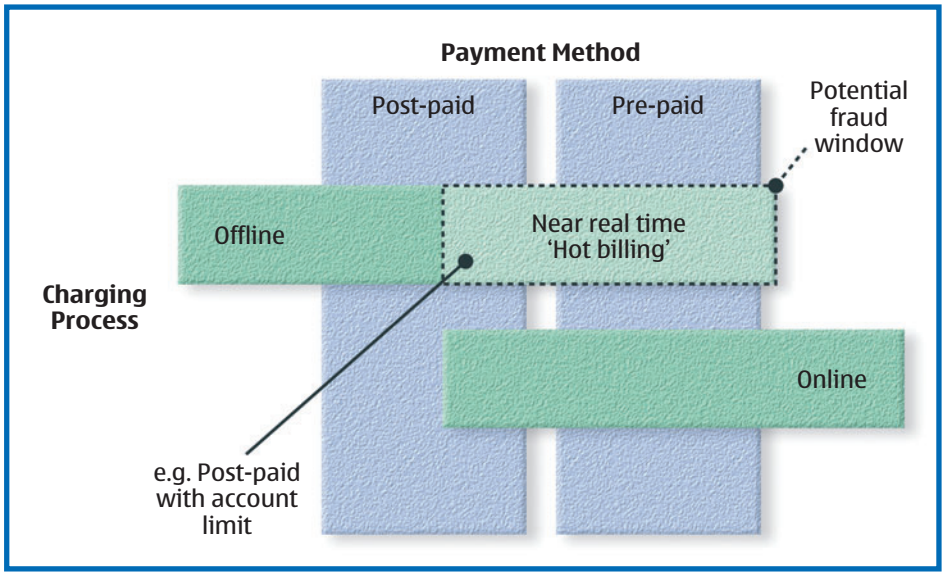

Figure 2. Charging process vs. payment method.

Offline charging	A charging process where charging information does not affect, in real-time, the service rendered
Online charging	A charging process where charging information can affect, in real-time, the service rendered and therefore directly interacts with the session/service control
Post-paid billing	Billing arrangement between customer and operator/service provider where the customer periodically receives a bill for service usage in the past period
Pre-paid billing	Billing arrangement between customer and operator/service provider where the customer deposits an amount of money in advance, which is subsequently used to pay for service usage

Table 3. Definition of terminology.

Service charging in the Intelligent Edge

The Intelligent Edge is the service and business machinery for IP based services. It is built around open interfaces, providing end-to-end interoperability and maximum flexibility in implementation. The Intelligent Edge outlines all the functionalities that are needed to provide a centralized, cost-effective way to deliver services through multiple access networks.

The charging functionality within the Intelligent Edge architecture provides centralized charging functions for the service core and service enablers. Charging functionality is implemented once, rather than duplicated, and interconnection to the operator's business support system is simplified by open interfaces.

Online and offline charging

Offline charging in the Intelligent Edge is based on Charging Data Records (CDRs) generated by service enablers and the service core. These are correlated in the Intelligent Edge by the Charging Gateway and then forwarded for rating and billing.

For online charging, the charging functionality of the Intelligent Edge manages the subscriber account balance, usually located in an external balance holder such as IN SCP, by checking the credit availability, making credit reservations, committing reservations following confirmation of the service event and refunding unused reserved credit. This process is applied to traffic volume and time based charging as well as to event based charging. The same master pre-paid balance can be used for both circuit-switched and packed-switched services.

Dynamic subscription based charging

Current mobile subscription plans are static, requiring subscribers to choose between a limited number of packages created by the operator. Plans may include, for example, a number of free MMS messages per month or a volume of free data traffic per month.
The Intelligent Edge brings the possibility of dynamic, self-provisioned per-service subscriptions – once the service is subscribed to, it is instantly available for use. Service subscriptions may be based on time-period, events, traffic volume or a combination of these. Examples are:

- Regular news updates for one month
- Ten ring-tone downloads
- 30 minutes Internet access

IP flow analysis based charging

A key role of the packet core is generation of traffic-volume and time based charging information (i.e. access charging). In the standard packet core, the granularity of charging is limited to per PDP context, i.e. the same charge must be applied to all traffic within the same PDP context. Currently, the industry is beginning to implement IP flow analysis solutions that increase the granularity of volume-based and time-based charging information, and also bring the possibility of event based charging to the packet core. One key advantage of such solutions is that it is not necessary to create a charging interface between the third party and operator domains for third party content – this promises to ease the integration of third parties into the value chain.

By analyzing the information in the IP packets, traffic-volume and time based charging can be based on the source & destination IP address, or on the individual URL/URI for HTTP and WAP traffic, and so on. The particular protocols supported depend on individual vendor product implementations.

Event based charging, i.e. a single event producing a single piece of charging information, regardless of the volume of traffic, is also enabled by IP flow analysis. This functionality enables 'hit based' charging – charging information is created based on the number of 'hits' to defined URL/URIs. For example, each hit to a WAP URI: http://wap.operatorX/StockQuotes/* can be charged at 0.20$.

When the IP flow analysis is based within the packet core it is also possible to use subscriber and session related information such as Quality of Service (QoS) and access network type (e.g. home/roaming, cellular/WLAN) to charge differentially. Although it is also possible to implement IP flow analysis outside the packet core, this solution may face limitations in the long run.

IP Multimedia Subsystem (IMS)

The 3GPP/3GPP2-standardized IP Multimedia Subsystem (IMS) creates charging information related to IP Multimedia sessions and services. Subscribers can be charged based on the duration of a session (time based), number of sent and received messages, service transactions (event based), and additionally volume based charging is also possible. The granularity with which the IP Multimedia Subsystem can create charging information is dependent on the information fields of the SIP headers and Session Description Protocols (SDP).

In addition to the 3GPP/3GPP2 specified IMS functionality, vendor specific Service Execution Environments (SEE) will enable the generation of charging information triggered by service transactions, for example, session redirection and service invocation. This will enable operators to base their charging schemes on service use cases, in addition to using the traditional time and transaction based charging.

Service enablers

Service enablers are the specific functionalities required to support particular services, examples being MMS, Push to talk over Cellular and streaming. Service enabler application servers take care of service specific charging, for example, if the number of subscribers in a group chat session is a charging criterion, then this must be charged by the Push to talk over Cellular application server. To prevent fraud, service enablers must support online charging.

Combining the charging capabilities of IP flow analysis, IP Multimedia Subsystem and service enablers

To provide intuitive and flexible charging models requires the combined charging capabilities of IP flow analysis, IP Multimedia Subsystem and service enabler domains. This is achieved though correlation. Figure 3 shows an example of a service charged using such a combination.

The IP Multimedia Subsystem generates charging information related to the establishment and control of terminal-to-terminal IP sessions. The traffic between terminals does not flow through the IP Multimedia Subsystem, hence when traffic charging is required in addition to the IMS session and event charging, information from the packet core is used.

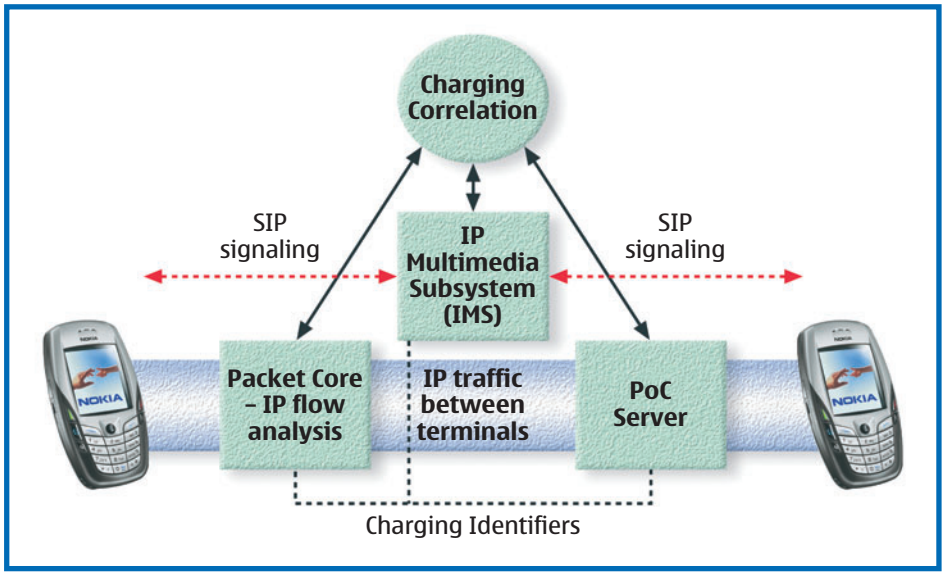

Figure 3. Example of charging an IP Multimedia based Push to talk over Cellular service by combining the charging capabilities of the IP Multimedia Subsystem, IP flow analysis and the PoC service enabler server.

Although SIP signaling passes through the packet core, no analysis (and hence charging) of SIP signaling messages is possible by IP flow based analysis, as the SIP signaling is compressed between the terminal and IP Multimedia Subsystem (IMS). Such analysis is not required within IMS charging as the IMS is specifically designed to analyze SIP signaling.

In addition to the charging capabilities provided by IP flow analysis and the IP Multimedia Subsystem, service enabler application servers can provide additional, service specific, charging granularity.

Correlation of charging information is performed in the Intelligent Edge, using charging identifiers to identify the control plane and user plane traffic related to a single SIP session. It should be noted that if IP flow analysis is implemented outside the packet core then such correlation may be difficult to achieve.

Conclusions

The mechanisms available to operators in the Intelligent Edge for charging IP services offer a huge range of flexibility. It is clearly possible to abuse this flexibility and create complex pricing structures in an attempt to reach a precise ‘production cost-plus’ service tariff. However, it is proposed that instead, this flexibility is used to produce simple pricing models that are intuitive for subscribers, ensuring services are accepted and usage is maximized.

Glossary

3GPP/3GPP2
Third Generation Partnership Program/2

ASP
Application Service Provider

CDR
Charging Data Record

CG
Charging Gateway

Event based charging
Charging is based on subscriber understandable events, e.g. downloading a game costs 2$, playing a game costs 0.10$ per game. The charge is regardless of the traffic volume (kBytes) used in delivering the event.

Granularity
The criteria and level of detail with which charging can be made. For example, being able to use the access network used by the subscriber (home network or roaming) as a charging criteria is one element in the charging granularity.

Hit
A hit is a request for a file from a web server. This includes requests for web pages, but also includes requests for graphic elements on a web page.

HTTP
Hypertext Transfer Protocol

IMS
IP Multimedia Subsystem

IN SCP
Intelligent Network Service Control Point. Generally the location of the balance holder for pre-paid subscribers

Infotainment
Media form combining information with entertainment

MMS
Multimedia Message Service

MMSC
Multimedia Message Service Center. The service enabler application server for MMS

Offline charging
A charging process where charging information does not affect, in real-time, the service rendered

Online charging
A charging process where charging information can affect, in real-time, the service rendered and therefore directly interacts with the session/ service control. In practice this means the subscriber balance must be checked before the service is delivered.

PDP Context
Packet Data Protocol Context

SEE
Service Execution Environment

Service Core
Built around the packet core network, the service core provides the fundamental elements required to connect subscribers to services, control the session and charge for it.

Service Enabler
Functionality required to support specific services, for example MMS, streaming etc. Usually consists of a terminal client plus a network based application server.

SIP
Session Initiation Protocol

URI
Universal Resource Identifier, used in WAP

URL
Universal Resource Locator, used in HTTP

WAP
Wireless Access Protocol

WLAN
Wireless Local Access Network (e.g. IEEE 802.11 standards)

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