Realizing real-time charging

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Real-time charging differs from non-real-time charging. Among other things, it is an integral, ongoing part of the service, not an after-service activity; it does not handle the aggregation of information; in converged networks, the subscriber identity is not necessarily the MSISDN; and it must accommodate different classes of service and content. With these differences in mind, Ericsson has defined a real-time charging mechanism and process for assessing charges for specific services.

The author describes the real-time charging network along with its main components (serving elements, charging control, and business support systems). He also briefly describes operator scenarios, a logical evolution of real-time charging, benefits, and standardization.

Background

In the early 1990s, operators in the UK attempted to offer a credit-limiting service (stopping users from spending more than a predefined limit) that processed call detail records (CDR) as they arrived from the network and blocked service when customers reached their credit limit. The service was unsuccessful, however, because processing was delayed (sometimes up to several days) and thereby failed to fulfill user expectations and service providers' objectives.

In 1996, prepaid services emerged as a value-added service (VAS). At that time, many people in the industry saw these as yet another "phase" but in reality prepaid services helped revolutionize the way in which the industry does business. Prepaid services have accelerated growth in the industry and currently account for the main source of new subscribers (75% of net subscriber additions). Analysts predict that prepaid subscriptions will represent 65% of the global mobile subscriber base by 2010. At present, this figure is 59%.[1] The success of prepaid services can largely be attributed to two main factors:

- people need not bind themselves to a 12- or 24-month contract to have access to mobile communications services; and
- users on a limited budget have greater control over their spending (this is the main reason people choose prepaid subscriptions).

Today, prepaid subscriptions are no longer considered a value-added service. Instead they are one of two payment options enabled by an underlying real-time charging environment. This environment, however, has presented the industry with a number of challenges, in particular because no standards had been defined for it. As a result, many different approaches were tried, including SIM-based applications, call-trunking nodes, and intelligent network (IN) implementations. The problem is not only one of standards, however. There is also the issue of how charging is to be handled in real time (real-time charging broke all established rules governing charging and billing before the introduction of prepaid services).

Before the advent of prepaid services, only non-real-time mechanisms had been defined for charging in existing standards. An interim approach was needed. In 2000, the intelligent network approach was adopted as the *de facto* standard for managing real-time, prepaid voice services. This solution fell short for non-voice services, however, and one additional approach emerged: service-charging nodes. The use of service-charging nodes to handle charging on behalf of service nodes in the network introduces other complications, however.

Figure 1
Ericsson's Real-time charging solutions enable service providers to offer services to any subscriber, regardless of payment method or wallet size.

The nature of real-time charging

Real-time charging differs from non-real-time charging:

- It is an integral, ongoing part of the service, not an after-service activity. As such it must be aware of and facilitate all relevant interactions to permit charging and supervision.
- It cannot handle the aggregation of information; that is, one cannot first gather information from multiple network elements and then calculate a cumulative charge.
- In converged networks, the subscriber identity is not necessarily the same as the mobile station international subscriber directory number (MSISDN). Therefore, when a service is to be used, multiple identities must be resolved against one account.
- It was not standardized until 2005 when the 3GPP IMS standard was defined.

- It must accommodate different classes of service ranging from the bearer to service (for example, SMS and MMS) and content. Operators must identify the value of each service. If, for example, operators charge for GPRS data volume, an MMS message, and a just-purchased background image, the subscriber will perceive the service as bad value for money and not use it.

With these differences in mind, Ericsson defined a real-time charging mechanism and a process for assessing charges for specific services. The real-time charging network contains two main components: *serving elements*, which deliver the service to the user; and *charging control*, which identifies the service and user, calculates the charge, and updates the subscriber account according to the service provider's business rules.

Obviously, in this model, a serving element must be intelligent and able to interact directly with charging control over an efficient charging interface – Diameter – which uses the Diameter credit control application for charging (Box A). A third element, business support, invoices postpaid subscribers and performs other, enterprise-specific functions, such as managing the general ledger and accounts receivables. It also logs and stores a history that can be used for data mining (market research) and to provide detailed bills.

The diminishing role of IN

In the IN model, the service control point (SCP) and service switching function (SSF, part of the mobile switching center, MSC) work together to form a serving element. IN was designed for call-completion services, not charging. Although it is the *de facto* charging standard for real-time voice in present-day networks, it is not the mechanism of choice for future networks, such as the IP Multimedia Subsystem (IMS) and broadband access networks. Instead, serving elements interact directly with charging control over the Diameter protocol. Based on the information they receive from charging control, serving elements can thus control the delivery of service including voice service. This real-time-charging-for-all feature gives the mobile MSC the intelligence and ability to communicate and interact with charging control directly in the Ericsson core network, eliminating IN for charging voice calls and freeing up IN switching resources in the network for services like virtual private networks (VPN) and ring-back tones.

Figure 2
The user communication function in charging control informs users of service costs, bonuses and account balance.

BOX A, DIAMETER

Diameter is an authentication, authorization and accounting (AAA) protocol for applications such as network access or IP mobility. The basic concept is to provide a base protocol that can be extended in order to provide AAA services to new access technologies. Diameter is intended to work in both local and roaming AAA situations. The name Diameter is a pun on the RADIUS protocol (a diameter is twice the radius). Diameter is not directly backwards compatible, but provides an upgrade path for RADIUS:

- it uses reliable transport protocols (TCP or SCTP, not UDP);
- it uses transport level security (IPsec or TLS);
- it has transition support for RADIUS;
- it has larger address space for AVPs (Attribute Value Pairs) and identifiers (32-bit instead of 8-bit);
- it is a peer-to-peer protocol, not client-server : supports server-initiated messages;
- both stateful and stateless models can be used;
- it has dynamic discovery of peers (using DNS SRV and NAPTR);
- it has capability negotiation;
- it supports application layer acknowledgements, defines failover methods and statemachines (RFC 3539);
- it has error notification;
- it has better roaming support;
- it is easier extended, new commands and attributes can be defined;
- is aligned on 32-bit boundaries; and
- it contains basic support for user-sessions and accounting.

Protocol description

The Diameter Base Protocol, defined by RFC 3588, defines the minimum requirements for an AAA protocol. Diameter applications can extend the base protocol, by adding new commands, attributes, or both. An application is not a program, but a protocol based on Diameter. Diameter security is provided by IPsec or TLS, both well-regarded protocols.

Source: en.wikipedia.org/wiki/DIAMETER

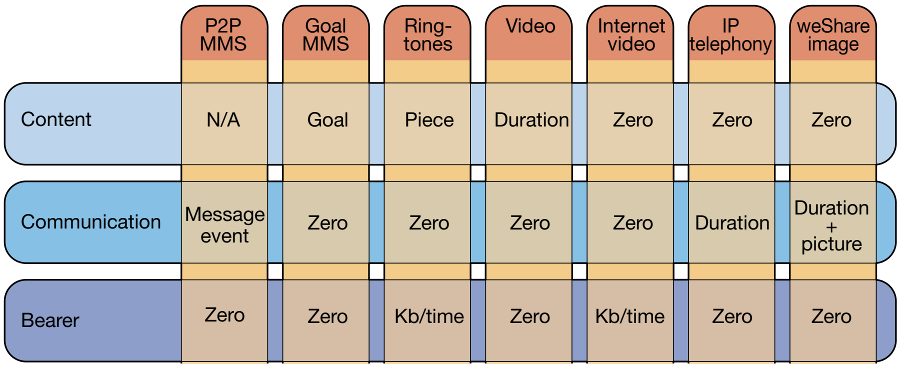

Figure 3
Stacked services.

In the case of VPN, the IN VPN service is considered a serving element that interacts directly with charging control to enable real-time charging.

IN CAMEL (customized applications for mobile network-enhanced logic) is still the most efficient way of handling voice charging when subscribers roam to other networks.

Serving elements, charging control, and business support systems

Serving elements

A serving element, which is a direct link between user and network, monitors quality of service.

Rating function in charging control

When a serving element sends charging information to charging control, a rating function evaluates the information and, based on account type and settings, sets a price for the service. Charging control provides the serving element with details that enable it to control service delivery.

User communication function

When subscribers finish using a service, charging control informs them of

- the actual cost of the service;
- bonuses (if they have received any); and
- current account balance.

In the context of WCDMA and GSM, this communication is typically handled via unstructured supplementary services data (USSD).

Stacked services

In modern networks, different services are stacked on top of each other in order to realize end-user services (Figure 3). Peer-to-peer MMS, for example, requires underlying GPRS. Music services also require underlying GPRS so that users can browse a catalog of available songs. The same GPRS session might be used for sending and receiving person-to-person (P2P) MMS. In addition, MMS can be used as a means of delivering a song when the user has made his or her selection. The charging infrastructure and rating rules must thus know how to identify different services and charge (or not charge) for them. At this point, packet-inspection technology has an integral part in enabling network charging, making it possible to monitor the bearer (which is common for many services) and ensure that data to and from various destinations is, or is not, charged for.

In IMS, the role of the packet-inspection function has been extended to enforce service requirements. The function makes certain that sufficient bandwidth is made available for a particular service, thereby guaranteeing good user experience. Also, because control and payload are separated in the IMS network, the function makes certain that the requested service and actual usage match.

Common infrastructure

Central charging control functions are common for all access networks, resolving for example, user identities provided by the access networks. Therefore, the serving elements need only be able to charge in real time and communicate with charging control over Diameter.

Real-time charging example

Below follows a real-time charging example. A subscriber, "Carola," decides to watch video on demand on her mobile phone (Figure 4). The service provider charges a nominal fee (a few cents per hour – just enough to deter customers from staying connected indefinitely) for the connection to the portal.

VoD charges are based on time (duration for which the service is used).

The service provider does not charge for GPRS data volume when the subscriber is browsing the portal or watching the video. Specifically, the VoD service is realized and charged for as follows:

1. Carola clicks on the link to the portal in her terminal.
   The terminal opens a GPRS session.
2. The GPRS support node (GSN) sends a charging request to *charging control,* which returns a set of data that enables the GSN to manage data flows for Carola.
   Carola will not be charged for the GPRS data volume to the specified destination. Instead, the GSN merely monitors the flow of data. In other words, this session does not result in charges to her account.
3. When Carola hits the portal, it sends a charging request to charging control. Charging control, in turn, makes a reservation for Carola and returns charging information about Carola. Using information from charging control, the portal then begins policing access (to itself).
   This is the first session that results in charges to Carola's account. Carola may now browse different options and select a video. The price of the video is displayed on Carola's terminal.
4. Carola selects a video; her session is redirected to the streaming server.
   The streaming server sends a charging request to charging control.
5. Charging control makes a reservation against Carola's account and returns charging information to the streaming server.
6. The streaming server begins streaming the video and polices the stream according to the information from charging control.
   This is the second session that results in charges to Carola's account.

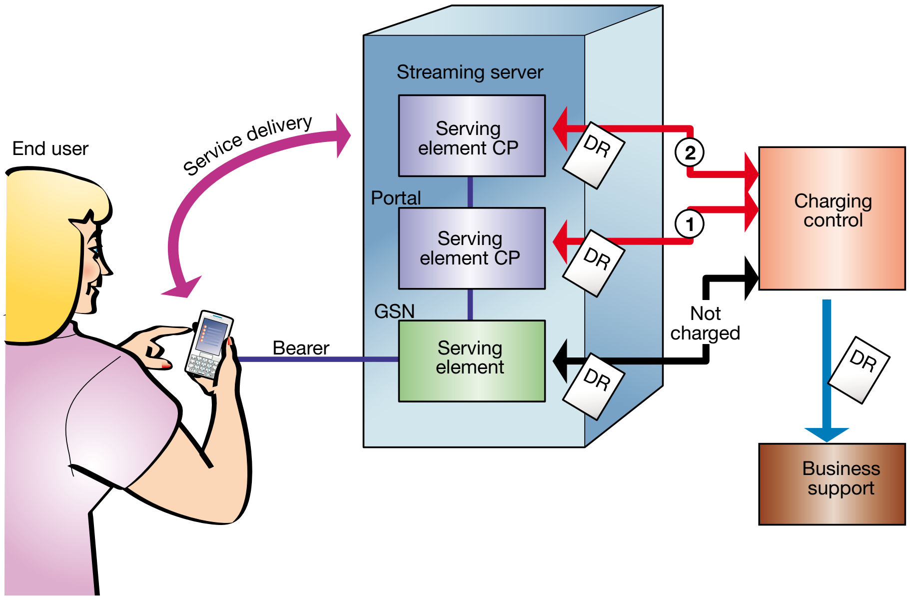

Figure 4
Example of charging for video streaming applications.

The GSN guarantees a minimum amount of bandwidth between the streaming server and Carola.

7. When Carola has finished watching the video, the streaming server redirects her to the portal and sends charging information to charging control, indicating that the session is over.
8. Charging control updates Carola's account, generates a detail record (DR), and passes it to business support.
9. The streaming server also generates a DR and sends it to the mediation function in charging control. Charging control forwards the DR to business support.
10. Carola closes the browser on the terminal, ending the GRPS session.
The portal sends final charging information to charging control. Steps 8 and 9 are repeated for the portal. The GSN sends final charging information to charging control. Steps 8 and 9 are repeated for the GSN.

Operator scenarios

A clear trend in the industry is to employ real-time charging for high-value services in order to limit operators' risk of financial exposure to third parties. More and more operators are thus migrating their charging infrastructures toward convergent, real-time charging. IMS is the first solution to integrate real-time charging from the outset (real-time charging was a main requirement of IMS design).

Many operators will probably continue to run existing networks with existing charging and billing systems but will implement modern, convergent, real-time charging systems for their IMS networks. Initially, they will invest in and deploy a scalable and flexible charging-control function, integrating it with northbound business support systems. They will then evolve the serving elements in the service network and connect them to charging control.

Evolution

When operators are able to charge the majority of their subscribers in real time an obvi-

BOX B, ERICSSON CHARGING SOLUTIONS

Ericsson's Revenue Management solutions, which handle all aspects of consumer-to-business and business-to-business services, are based on Ericsson's charging and mediation portfolio, catering for convergent charging and billing, wholesale, prepaid charging, payments, adjunct rating and promotions, and mediation solutions. The solutions include business consulting, systems integration, and worldwide support, enabling operators to make their operations more cost-efficient, and to optimize their revenue-management business processes end-to-end.

Ericsson Charging System is the key part of Ericsson's comprehensive portfolio of convergent real-time charging solutions for content, data, and voice services. It is the most widely deployed real-time charging solution for telecom networks, serving more than 115 operators and 300 million subscribers.

Ericsson Multi Mediation is more than a traditional mediation system – it is an end-to-end, convergent mediation solution that handles files, events and online mediation. With more than 280 customer installations, Ericsson is the leading software supplier of convergent and online mediation solutions.

Ericsson Convergent Charging and Billing Solution is an end-to-end, real-time revenue management environment for customer management, charging and billing. The solution supports post-paid as well as pre-paid subscriptions and gives operators a great deal of flexibility with respect to their service offerings, segmentation, pricing, and promotions.

ous next step will be to enable them to use their subscriptions to pay for physical goods of any kind (as is already being done in the Philippines). This evolution will broaden the scope of the service provider to include the role of financial provider, paving the way for service providers to become full-fledged financial institutions.

Benefits

Regardless of payment method, end users will benefit from up-to-date information on charges and fees for communication and media services. In other words, they will have vastly improved control over spending.

At the same time, service providers can protect their bottom line by limiting service (voice as well as third-party content) to users who can afford it. Operators thus have greater control over credit.

Real-time charging makes it possible to inform users of service costs and, more importantly, the bonuses they have earned. This kind of customer intimacy, which is unrivaled in other industries, is an extremely powerful asset that can be used for building trust and closing the gap between service providers and subscribers.

Standardization

Many different approaches to real-time charging have been tried since 1996, but most have failed because the standard on which they were based had not been designed with real-time charging in mind – it was added as an afterthought. The only standards existing for authentication, authorization and accounting (AAA) purposes are

- RADIUS (non-bidirectional protocol);and
- Diameter (bidirectional protocol that enables online real-time charging).

Ericsson pushed for the specification in IETF of a Diameter credit-control application (DCCA) that runs on top of the Diameter base protocol. The idea is to make the application flexible enough to allow service-specific specifications, in order to accommodate real-time charging.

The Third Generation Partnership Project (3GPP) has adopted Diameter and DCCA (RFC 4006) as the base for all charging standardization. Numerous service-specific specifications have since been defined to cover 2G network services, such as MMS, and every conceivable IMS service.

Conclusion

The mechanism for managing charging in real time differs fundamentally from non-real-time charging, which is to say the old rules for charging no longer apply.

Real-time charging has come to stay, enabling service providers to offer all-new services to any subscriber, regardless of payment method or wallet size. Convergent charging and billing solutions must thus function in real time.

The end-user experience can be greatly enhanced, for example, through real-time account information on charges and cross-service bundling and promotions.

Standards have been defined and are being improved to enable charging for all kinds of services, even in an all-IP network.

An obvious next step is payment for physical goods, eliminating the need for cash and associated risks. From there, the evolution will lead toward micro-financing.

REFERENCES

Global Mobile Prepaid Strategies - 6th Edition, January 2006, by Informa Media and Telecom.

TERMS AND ABBREVIATIONS

3GPP	Third Generation Partnership Project
AAA	Authentication, authorization and accounting
CAMEL	Customized applications for mobile network-enhanced logic
CDR	Call detail record
DCCA	Diameter credit control application
DR	Detail record
GPRS	General packet radio service
GSN	GPRS support node
IETF	Internet Engineering Task Force
IMS	IP Mulitmedia Subsystem
IN	Intelligent network
MMS	Multimedia messaging service
MSC	Mobile switching center
MSISDN	Mobile station international subscriber directory number
QoS	Quality of service
RADIUS	Remote access dial-in user server/ service
SCP	Service control point
SIM	Subscriber identity module
SMS	Short message service
SSF	Service switching function
VAS	Value-added service
VoD	Video on demand
VPN	Virtual private network