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Billing for IP Content and Services

Internet is gradually moving from academic, information-sharing and leisure spaces to the market place where content and related value-added services are becoming key differentiators for Service Providers. Revenue derived from content and content-related services is expected to be an important part for all actors within the IP industry. A selection of technologies covering micro-billing and IP Billing has been studied with a focus on Swisscom needs. Furthermore, in an international project together with industrial partners from the IP Billing area, Corporate Temnology gaines an inside view of the whole billing chain from data collection to bill presentment.

The Exploration Programme "IP Business Support Issues" deals with technologies, services and support functions for IP networks. In detail these are:
- Content-oriented IP billing; which technologies Swisscom needs to charge for IP services
- Service level assurance; how to enable Swisscom to support an IP-VPN point-to-cloud SLA with end-to-end QoS guarantees
- Fraud; what kind of fraud must Swisscom expect offering services on IP networks and how to prevent it
- Security of mobile devices; GPRS and UMTS will make mobile devices accessible from the Internet; which privacy services can Swisscom offer
- Security services for the massmarket; easy to use security services for Internet users.

With its Exploration Programmes, Corporate Technology is exploring telecommunication technologies and new service possibilities with a long-term view of 2–5 years. Furthermore, the expertise built up in the course of this activity enables active support of business innovation projects.

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Content and usage based billing schemes present big advantages over flat rate: they provide means to remunerate and attract Content Providers according to the actual content value. They are fairer to end customers because currently, the slower the network, the more the customer has to pay. They enable Service Providers to assure ROI for expensive technologies such as UMTS; they allow Service Providers to improve the value of their customer database; and last but not least, they support complex settlements where revenue has to be shared between an increasing number of market players.

The reasons why IP Billing fundamentally differs from PSTN Billing can be summarised in the mnemonic 5 "W":
- *"Who bills and who is billed"* has changed. Internet appears in a deregulated context with an increasing number of business players (ISP, ASP, CP, carriers...) between whom business relationships are not yet stable. Payment safety, a well-known issue in the Internet world, has brought the concept of Trusted Parties.
- *"What should be billed"* has evolved. Transport services are becoming a commodity and the customer's interest is moving to the service layer where the metrics are no longer limited to minutes. Technology has evolved from switched-circuit to routed-packets allowing different QoS according to the delivered service (video-on-demand, browsing, VPN...).
- *"Where should the information be collected"* is unclear. One of the challenges of IP Billing is the gathering and aggregation of the billing information. There is no centralised device providing CDR equivalents and information has to be gathered from very different devices, such as radius servers, web servers, routers etc.
- *"When should the information be collected"* brings new constraints. Internet has to deal with a huge increase in data volume, never seen in the past; e.g. a traditional voice call generates three CDR's on average, whereas Internet services are expected to produce hundreds of IPDR's. Hence, more frequent data collection is required to keep up with the IPDR generation rate. Furthermore, real-time becomes a key requirement for certain services like hot-billing (the ability to produce a bill right after service utilisation), prepaid services etc.
- *"Why moving to new network elements"* is led by new standards (IPDR...), new processes (correlation...) and new Business Models (Third-Party Billing...).

To support content and usage based billing, we have studied various micro-billing solutions and IP Billing architectures. Micro-billing is defined here as a technology which is implemented at the application level and which initiates a dialogue between an Internet Payment Provider (SP who delivers a billing service) and a CP through a transaction protocol. Therefore we have eliminated micro-payment solutions which characterise direct purchases between end customers and the CP without using a tel-

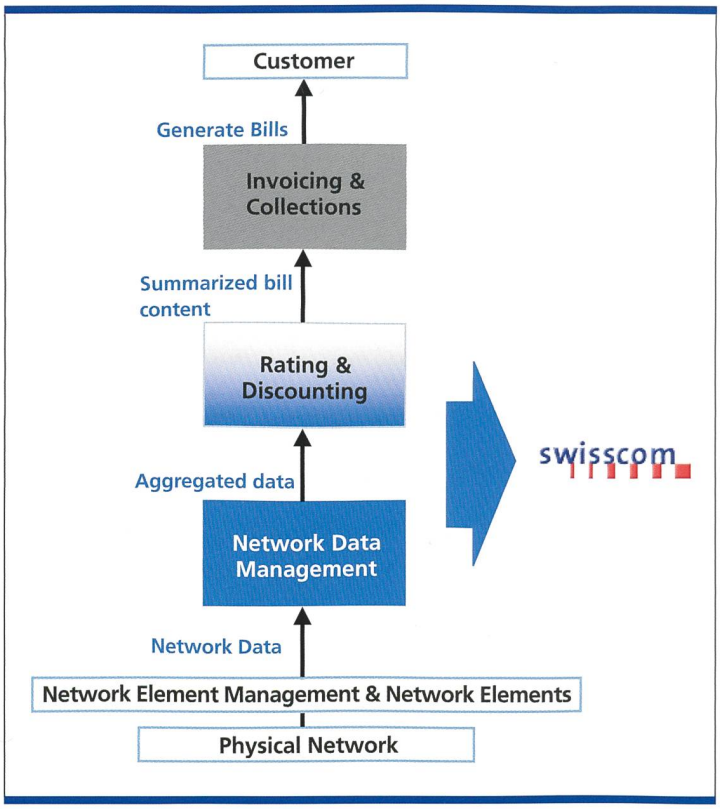

Fig. 1. Billing Processes defined by the TOM Model

ecommunication company as third-party.
IP Billing is characterised by an architecture which is close to the one defined by the TMF model (fig. 1). We distinguish: a mediation layer (Network Data Management) which collects, correlates and aggregates the data coming from either network elements, an application server or the wire itself; a billing layer (Rating and Discounting) where enhanced data coming from the mediation layer is rated according to pricing schemes and business models; and an Electronic Bill Presentment and Payment (EBPP) layer (Invoicing and Collections) where the bill is presented to online end customers.
These technologies find a particular echo in a company like Swisscom which is deploying a new IP backbone and platform to support IP services. Such heavy changes imply that the OSS and IP mediation should be of central consideration.
Swisscom Mobile AG has to deal with the same problem with its future UMTS services. *Bluewin AG* will position itself as an ASP and needs an update rating engine.

Work Completed at Corporate Technology

In the context of micro-billing solutions, companies such as *EHPT* with Jalda, *IBM* with MiniPay, or *Compaq* with Millicent provide technologies which compete with creditcard means of payment. We have tested and classified these products with basic services [1].
In the IP mediation layer, a plethora of companies presents a specific tool. A paper study has enabled us to build a classification of these tools. Three products have been tested with quite complex services [2].
With regard to the billing layer, due to the costs of the software, we have not been able to carry out internal tests. In order to back up our paper analysis we have initiated a TMF catalyst project with *Lucent, HP* and *eDocs* as product vendors.

Anatomy of Micro-billing Solutions

The key element of a micro-billing solution is the Transaction Protocol which represents the way a dialogue with the enduser is handled, e.g. the transaction can be initiated by an elaborate authentication mechanism, monitored through a web page, or transparently by the application itself. The supporting technology may require an electronic wallet installation etc. The transaction protocol is at the crossroads of different elements of the billing chain (fig. 2). First of all, a micro-billing solution has to pass information to a billing system which will then rate them. To supply relevant information, a micro-billing solution has to collect information from the CP application which the end customer is accessing. To pass the data, the transaction protocol has to be supported by a transport layer. Finally, a micro-billing solution must provide a clear management tool for both the Internet Payment Provider and the Content Provider.

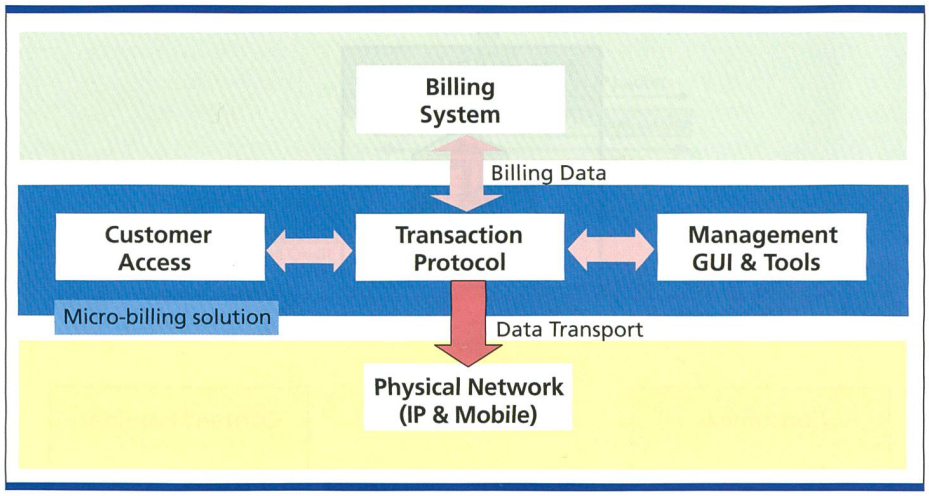

Fig. 2. Micro-billing interfaces.

A Transaction Supporting Technology Classification

The landscape of micro-billing tools comprises lots of different architectures, methods of authentication and security, etc. A good way to distinguish families of tools consists in using the technology supporting the electronic transaction as a discriminator.
This way, three families have been distinguished where an SP can play an active role in the transaction: Some companies use "cash", also called coins or tokens, for transaction. Such electronic coins are independently authenticated from the issuer with the help of encryption or hardware devices. However, fraud is possible by using these coins several times during their time of validity. In order to limit such fraudulent usage, a similar technique, called "cheque", can be used. Cheque authentication is reinforced since cheques are only valid between one end user and one service provider. However, this technique offers less flexibility than the previous one. Figure 3 shows the different steps of the cash & cheque approaches. The third technology is called "account-based". The consumer owns an account at the Internet Payment Provider side which can be pre- or post-paid. As illustrated in figure 4, this technology allows the CP to check the validity of the transaction.

The IP Billing Architectures

The Network Data Management Layer

Mediation platforms are a key element in the IP Billing chain as they directly impact the "what should be billed". However it has to be noted that the mediation platform can also be interfaced to other back-office applications such as fraud management, network planning, financial platforms etc.
IP mediation differs from PSTN mediation platforms in many ways:

- In a typical production IP carrier network, network elements generate millions of transaction records per hour. It is then essential to distribute the collection process and to filter, aggregate and compress the data before sending it.
- There is no single point from which to collect basic network transaction data. The collected data exists in many network devices and application servers such as routers, IP switches, firewalls, mail and web servers, IP telephony gateways, QoS facilitators.
- Each information source has a proprietary log file format, CDR format, and access protocol.
- Basic transaction records generated by each network element are not sufficient for billing. The missing information exists in other information sources and, in most cases, must be correlated in real-time because of the dynamic

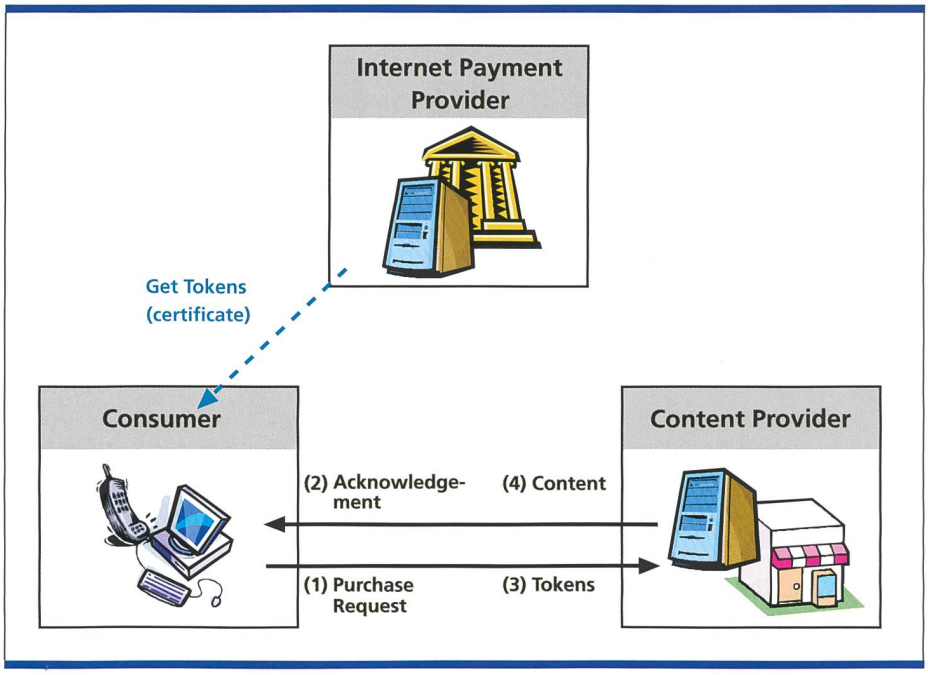

Fig. 3. Token or cheque-based transaction steps.

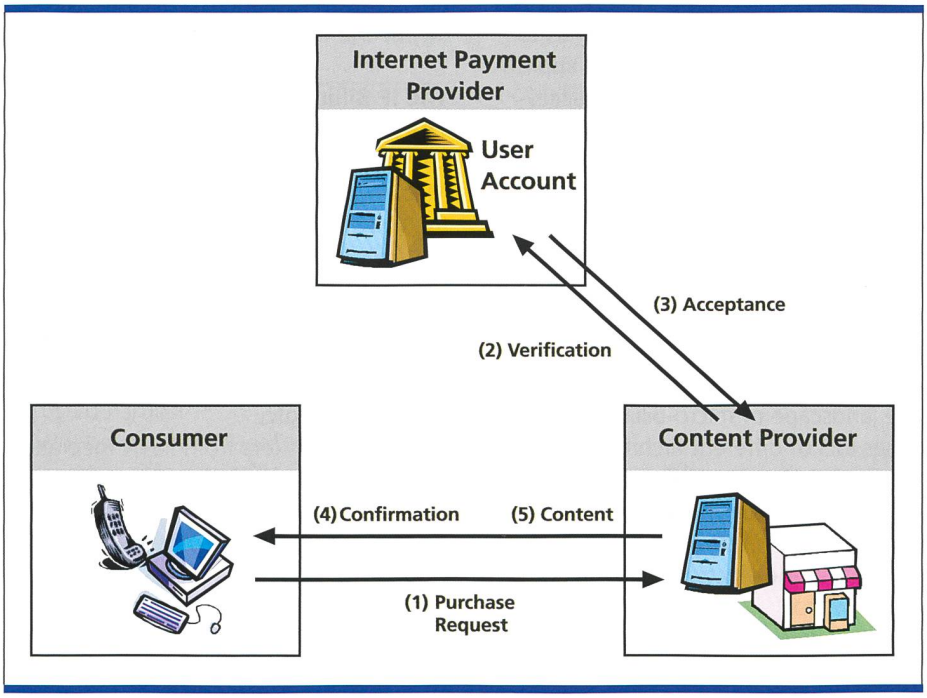

Fig. 4. Account-based transaction steps.

nature of the reference data. For example, IP addresses are often dynamically assigned and the data of a router must then be correlated with the user identity defined in an authentication server.

We have identified three technologies for IP mediation: the log scrapping, the hardware probe and the signalling approaches.

The Log Scrapping Approach
is derived from classical mediation and consists of using hosted agents, also called probes, which "scrap" log files for particular usage data. The advantage of this approach is that this technology has already existed for two years and has proven to be scalable even on high-speed networks. However, Log Scrapping also presents many restrictions: the data present in the log files are not always accurate which usually impacts the performance of the device; log files are not complete as they are not able to capture all transaction information (e.g. two PC's using netmeeting with a non-standard port number can exchange a video without using a H.323 gatekeeper to set up the session; in such a case there is no device to capture usage information); Log Scrapping is device-dependent, i.e. billing systems cannot interoperate with new devices or services as soon as they arrive on the market.

The Hardware Probe Approach
is a more recent approach based on hardware probes that track the relevant information directly in the IP packets. Some hardware probes are able to reduce the amount of data to be transferred by achieving an in-network user correlation (even for dynamically assigned IP addresses). Others are able to catch content data in the IP payload. This approach has several advantages: (1), a hardware probe handles the raw material, i.e. the packets, which makes it conceptually possible to estimate more metrics than by using the log scrapping approach; (2), the technology is device-independent and can be applied in real-time. However, this approach also raises a number of questions: being a younger technology, information on scalability issues is still lacking and the probe location is an important (and perhaps restrictive) issue.

The Signalling Approach
is based on an IP-in-IP encapsulation: original packets are encapsulated in a new IP packet where billable information is added at the beginning of the new packet according to certain rules. This technology is owned by the *Enition* company. The processes are (fig. 5): Step 1, anonymous Toll Tokens are produced by a Toll Factory located in the Service Provider Domain. Step 2, Toll Tokens are stored in the Toll Credit Gateway and, step 3, are inserted together with the user IP request in a new IP packet which is sent to the Toll Debit Gateway using the IP Toll protocol. Step 4, Toll Tokens are extracted and stored in the CP Toll Centre; they can be aggregated and their validity checked. Step 5, they are presented by the CP Toll Centre to the SP Toll Centre; no adaptation is required for user or content, but it is up to the SP's and CP's to adapt their network. However, this solution just fits simple time-based, volume-based and transaction-based (pay-per-URL) payment rules.

Results

The hardware probe approach is much more reliable than data coming from log files. Furthermore, estimation of QoS criteria is managed more efficiently. However, content tracking through hardware probes can be complicated when no mask is provided in the payload. Thus, in this case, a hybrid solution with log-scrapping tools can be chosen. However, the correlation of data is a delicate task which requires intense testing. On the other hand, the signalling approach, if proven to be limited in terms of billable metrics, enables an easy integration of new services; e.g. an online game has been integrated in a few minutes. Furthermore, since IPDR's are accounted by both SP and CP, automatic reconciliation processes are offered to check the validity of the exchanged tokens.

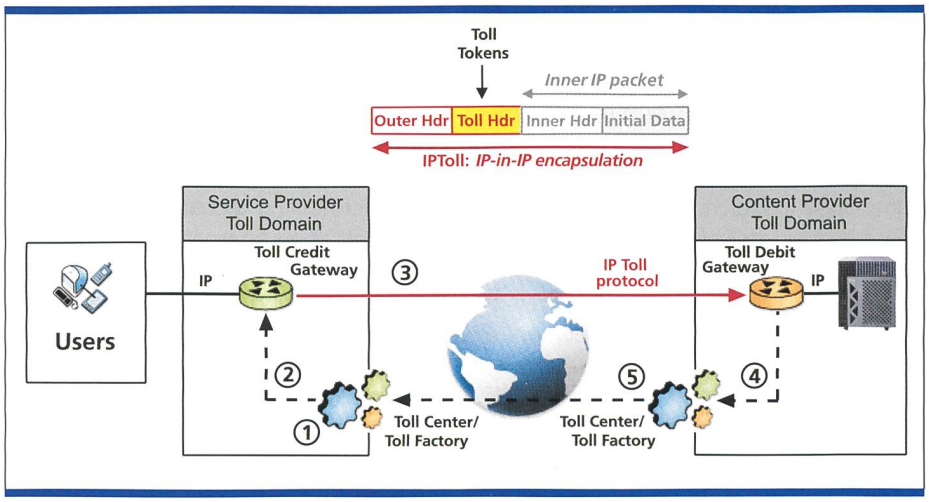

Fig. 5. Signalling approach processes implemented by Enition.

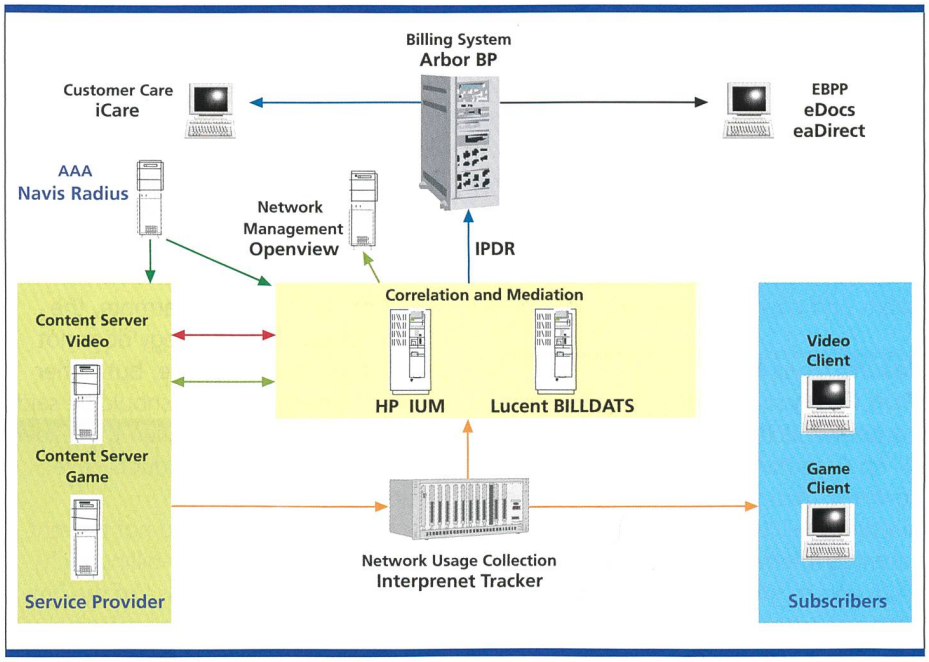

Fig. 6. IPDR Billing Catalyst project.

The Rating and Discounting Layer

At the billing system level, the enhancements proposed by industrial tools are more software-centric. Vendors are numerous in this area. According to an internal survey [3], an attractive billing system should be

- *distributed:* endusers should be able to benefit from easy access to their account and even to self-provide their services. The billing system should also be presented as a service to CP's. It should enable them to access and manage their customer database, personalise the generated invoices, self-activate their services, change their pricing parameters, etc.
- *secure:* all the above features should be enabled in a secure way in order to prevent fraudulent access on the customer's account.
- *flexible:* the billing system should be agnostic regarding future services meaning that it should be able to process and rate any kind of input data. In the context of Third Party billing, it should be able to define numerous accounts and manage revenue sharing.
- *real-time:* hot-billing requires real-time processing of the data.
- *open:* a new billing system should allow to integrate legacy systems and to interface with other BSS such as CRM (Customer Relationship Management) platforms.

The Invoicing and Collection Layer

Electronic Bill Presentment and Payment (EBPP) is the presentation of bills to consumers and the processing of bill payments over the Internet. Today, EBPP describes a broad array of technologies and services that range from the simple scanning and electronic transmission of a paper-bill image to more sophisticated electronic billing services that permit customers to sort and analyse data and offer online telephone or auto-debit payment options.

The key to the growing popularity of EBPP is the ability to transform the information available in the traditional paper bill into a management tool that enables businesses and individuals to analyse costs and operations and make decisions that can significantly reduce expenditure. For example, an EBPP solution for a telecom company may provide customers with a bill that can be sorted according to several parameters, such as time of day calls were made, calls to a single location, etc. Usage analysis is another tool with which customers can analyse their usage by several criteria.

The first and most significant impact of EBPP in a deregulated market is to facilitate the billing process for incumbent players. By their very nature, electronic payments are more efficient, less costly and faster than paper bills. The traditional billing process involves creating and sending a bill in the mail, having the customer receive it, read it, go to a post office to pay the bill, and then receive a confirmation from the bank that the

customer paid the bill. At any stage of the process, a delay on the part of an individual or the postal service means delayed payment. In electronic bill presentment and payment, the bill arrives electronically, the individual selects a payment option, and the payment is processed. No mail delays, no lost paper bills somewhere on the kitchen counter. In addition to reducing costs, Internet billing enhances the customer relationship. With access to their bills, customers can more easily track their billing records and confirm whether payments have been received. If they have a problem with their bill, they can immediately communicate their concerns via email or by phoning a Call Center and speaking with a customer-service representative. Companies also recognise that electronic billing helps to enhance marketing efforts and build brand names. By placing links and banner ads on bills, companies can drive traffic to other parts of their website and use "one-on-one" marketing techniques to sell additional products and services. At the same time, they can learn more about customer buying habits and payment patterns.

Results from the IPDR Catalyst Project

Corporate Technology initiated the IPDR Billing Catalyst project [4] whose main goal is to demonstrate the effectiveness of using the IPDR standards for the accounting interfaces between the network and business management layers. IPDR is used to describe new IP services and support sophisticated billing schemes. The main process flow is as follows (fig. 6): IP usage data is collected by a network probe in real-time and then sent to two mediation platforms for processing, i.e. Billdats from Lucent and IUM from Hewlett Packard. This data is correlated to other data coming from AAA servers and two application servers (online game and video streaming) and then transferred to the Lucent ARBOR/BP billing platform for bill generation. Finally, invoices generated by the billing platform are sent to the EBPP vendor, eDocs, for web-based presentment and payment.

The results of this project are quite convincing since the IPDR formats we defined have been implemented by the mediation platforms and are supporting sophisticated pricing schemes such as cross-service pricing. On the upper layers, the EBPP module is able to customise the bills on the fly thanks to a rule-based language.

Conclusions

On the one hand, Swisscom can profit from micro-billing techniques if it positions itself as an Internet Payment Provider. Micro-billing techniques answer the content-billing requirements in the sense that they can bill all kinds of services or contents from small-value electronic documents to high-value hard goods. Furthermore, they can provide accurate billing with various metrics: payment rules can be time-based, volume-based, transaction-based or event-based and there is no limit in defining billing events. Finally, since these solutions are located at the application level, their deployment impact on the architecture is quite limited and should be expected to be less cost-effective than an IP Billing architecture deployment.

On the other hand, these solutions do not enable an NSP to differentiate according to the QoS implemented in its network since no transport metric is taken into account. Furthermore, the success of such a technology does not rely on technical excellence, but rather on market penetration. It should be said that no product has yet taken the leadership, although various products have existed for years.

In conclusion, NSP's should not prevent the development of micro-billing technologies even if the increase of the network traffic is considered as marginal. Micro-billing will allow end users to get accustomed to paying for services over the Internet.

Compared to micro-billing solutions, IP Billing architectures target more ambitious goals by addressing both content and usage-billing requirements. IP Billing techniques can be considered as a following step in the Internet commercial development. However, the impact on the existing infrastructure of a SP is tremendous. Very often these upgrades also imply a cultural change where in-house BSS are replaced by on-the-shelf products. Therefore, integration with legacy systems, analysis of fraud scenarios and scalability are issues that must be carefully analysed against market potential. In an implementation scenario it is generally prudent to first acquire a new rating engine which rates the first few services through dedicated Application Programming Interfaces (API) and, in a second step, integrate a mediation layer.

CIBILL's web page:
http://ctep/ep34/projects/projects_cibill-en.htm
(close user group)

IPDR.org:
http://www.ipdr.org

TMF Catalyst project:
http://www.telemanagementworld.com/catalyst/ipdr.htm

Billing World:
http://www.billingworld.com

Abbreviations

AAA	Authentication, Authorisation and Accounting
ASP	Application Service Provider
BSS	Business Support Systems
CDR	Clock and Data Recovery
CP	Content Provider
EBPP	Electronic Bill Presentment and Payment
IPDR	Internet Protocol Detail Record
ISP	Internet Service Provider
NSP	Network Service Provider
QoS	Quality of Service
SLA	Service Level Agreement
SP	Service Provider
TMF	TeleManagement Forum
TOM	Telecommunications Operations Map
VPN	Virtual Private Network

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[2] David Watrin, "An overview of IP mediation platform vendors", CIBILL Deliverable, September 2000

[3] Urs Haller, Valerie Bauwens, Jesus Roy Solanas, Urs Röthlisberger, "IP Billing: Business opportunities, a first overview", CIBILL Deliverable, February 2001

[4] TMF, "IPDR Billing Project Charter", December 2000

Outlook
A follow-up of the TMF Catalyst project is expected to take place. This opportunity will depend on the TMF and new partners' acceptance. Its scope would be a natural extension of the present project, the goal being to examine how *IPDR.org,* in an e-world context, can help SP's to support inter-SP settlements and billing scenarios. Another axis will be to study the GPRS and UMTS specificity regarding IP Billing. Finally, collaboration with another project from the same Exploration Programme will focus on the risk in fraud scenarios. [1, 6]

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Zusammenfassung

Mehrwertdienste wie Virtual Private Networking, IP-Fax, IP-Telefonie und Streaming-Multimedia werden immer häufiger über das Internet übertragen. Damit entsteht das Bedürfnis, nicht nur ein Gebührenmodell mit Pauschalen anbieten zu können. Vielmehr sind innovative Gebührentarife für neue Services zu entwickeln und umzusetzen, die auf einer beliebigen Kombination von Messwerten beruhen, die vom Kunden abhängig sind. Micro-billing-Techniken sind auf der Stufe Applikation implementiert. Sie ermöglichen Content Providern verschiedenste Arten einer flexiblen Verrechnung von Diensten und Inhalten in allen Preiskategorien. Die Verrechnung kann auf einzelnen oder auf einer Kombination mehrerer Metriken (zeit-, volumen-, transaktions- oder ereignisabhängig) basieren.
IP-Billing-Architekturen erweitern die Möglichkeiten von Micro-billing um netzwerkbezogene Kriterien wie Service Qualität (QoS), weshalb IP-Billing-Systeme stärker in das Netzwerk integriert sind. Auf der Netzwerkebene werden vom Mediation Layer Daten und Ereignisse aus verschiedenen Quellen zusammengefasst und an die Verrechnungsschicht/Rating Layer weitergegeben. Neben der klassischen Rechnungsstellung per Post besteht die Möglichkeit via "Electronic Bill Presentment and Payment" (EBPP) Rechnungen per Internet zu präsentieren und dem Kunden zu verrechnen.

Ein neuer Supraleiter

Magnesium-Diborid wird man sich merken müssen: Japanische Wissenschaftler hatten im Januar 2001 entdeckt, dass MgB2 supraleitende Eigenschaften bei Temperaturen von 39 K annimmt – was deutlich «wärmer» ist als die meisten, heute bekannten Standard-Supraleitern, aus Keramik. An der Universität von Wisconsin in Madison hat man jetzt noch eins drauf gesetzt: Die so genannte Stromtragfähigkeit, eine der kritischen Grössen für technische Anwendungen, ist erheblich höher als bei den bisher bekannten keramischen Supraleitern. Das liegt nach den vorliegenden Forschungsergebnissen daran, dass die Kornbindung zwischen den einzelnen Kristallen den Stromfluss nicht behindert. Der Grund dafür könnte darin zu suchen sein, dass nur zwei Atome am Aufbau des Supraleiters beteiligt sind und man nicht gezielt an einem bestimmten Verhältnis des Mischkristalls arbeiten muss. So hat man bereits supraleitende dünne Filme und Drähte herstellen können, die mit bemerkenswert hohen Strömen belastet werden konnten.

Ein Mobilfunkchip, der GSM, GPRS und UMTS versteht

Texas Instruments Japan hat eine 1-Chip-Lösung für den Hochfrequenzteil von Mobiltelefonen vorgestellt, der drei verschiedene Mobilfunksysteme direkt konvertiert: das GSM (Global System for Mobile), das GPRS (General Packet Radio System) und das künftige UMTS (Universal Mobile Telecommunications System). Da es gegenwärtig eine Weltnorm auf dem Mobilfunkgebiet nicht gibt, werden solchen Allround-Chips grosse Chancen eingeräumt. Der neue Baustein reduziert die Chipkosten im Handgerät um etwa 30% und das benötigte Volumen auf der Platine um 15%. Der Chip braucht noch zwei externe Filter und einen externen VCO (Voltage Control Oscillator). Muster sind schon zu haben. Die Serienfertigung wird im Herbst 2001 anlaufen.

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