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Interoperable Mobile Payment – A Requirements-Based Architecture

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Summary: Existing payment methods like cash and debit/credit card payments are still predominant in our daily lives. Nevertheless, these methods are not well suited for new payment scenarios as for example e-commerce and TV shopping, resulting in increased fraud and high disputes handling costs. Next-generation payment methods must meet technical, user, and business requirements that cover traditional as well as recent scenarios. This paper presents a mobile payment architecture that combines the security and strong user authentication of GSM networks, the cost efficiency of micropayment, and the flexibility and world wide acceptance of existing macropayment schemes.

Keywords: mobile payment scheme, three domain, interoperable payment protocol

1 Introduction

During the last decades, a continuing trend in the payments market has been the declining share of all payments made by cash. Cash payment volumes in the UK were some GBP 25.6 billion in 1999 accounting for three-quarters of all payments. APACS projects that cash use in the UK will still account for 62% of all payments in 2009, but cash payment volumes are expected to continue to decline [Apacs03]. Migration to on-line debit cards and the electronic purse will be important influences.

Mobile payments, i.e. payments based on your mobile phone, will take their share of cashless payments for various reasons. According to a study of Frost and Sullivan, mobile payment will achieve a volume of USD 25 billion in Europe by 2006 [Frost02].

This paper starts with a brief discussion of advantages and drawbacks of different payment methods. Section 3 presents a list of the most important requirements to a modern payment system and provides the basis for chapter 4 – the architecture of an interoperable mobile payment system, followed by conclusions and an outlook.

2 Payment methods

Paying with cash will remain the predominant payment method, but its share is continuously declining. Users appreciate its ease of use, anonymity, and ubiquitous acceptance. Drawbacks are handling costs, in particular when dealing with foreign currencies, and risk of loss and theft. Furthermore, distant payments as needed for e-commerce are not economically feasible.

Check payments are widely accepted but come with relatively high handling costs. Their importance is constantly decreasing, particularly in Europe.

Credit and debit card payments continue to grow. They are widely accepted, offer good security and come with affordable costs. They allow distant payments and are therefore the preferred payment method for e-commerce and m-commerce. Payments, however, are not anonymous and some consumers are reluctant to use credit cards for e-commerce because of the perceived risk of fraud. Merchant discount (merchant service charge) is relatively high in e-commerce, because the disputes rate is relatively high for cardholder-not-present transactions. Furthermore, person-to-person payments are not always possible and valuta is usually delayed by one or more days.

Enhancements of card payments like SET [SET97] or 3D-Secure [Visa01] try to overcome these drawbacks, in particular by introducing better consumer authentication via chip or digital signature in order to decrease e-commerce fraud. Changes necessary at merchant and consumer side are the major hurdles in deploying these systems.

Token-based methods like the German Geldkarte gained some acceptance, mainly for cashless payments at vending machines, but spread is limited because of the need of card reading devices.

A growing number of other payment methods and trials, e.g. e-cash schemes like CyberCash [Cyb03] and mobile payment systems like Paybox [Pay03], evolved over the last decades but did not yet gain significant market share. One of the main reasons is their limited interoperability and acceptance, i.e. consumers and merchants must both register to the same entity – the scheme does not allow to leverage existing business relationships between consumers, issuers, acquirers, and merchants.

The following chapters describe technical, business, and user requirements to next-generation payment systems and present an interoperable mobile payment architecture that addresses these needs.

3 Requirements to next-generation payment systems

When looking at the advantages and drawbacks of existing payment methods and when learning from the reasons why many payment systems failed, one can derive a set of technical, business, and user requirements:

- Interoperability
  Financial networks follow the three domain model in order to implement interoperability. Brand and business rules are defined in a payment scheme. Issuers hold contracts with consumers, maintain consumer accounts and issue e.g. credit cards. Merchant acquirers deliver services tailored to merchants' needs. The interchange domain ensures interoperability, computes fees and settles funds between issuers and acquirers. Stakeholders are not restricted to a single role, e.g. some banks issue cards and acquire merchants at the same time. Technically, interoperability is achieved by standardized protocols like ISO 8583 [ISO87].

- Wide-spread acceptance
  Every introducer of a new payment system encounters the so-called hen-and-egg problem. Consumers are reluctant to use and subscribe for a new payment method, as long as acceptance is limited to a small subset of merchants; merchants hesitate to accept a new scheme as long as the consumer base is small. Leveraging the existing infrastructure (merchant acquirers, issuers) can overcome this problem.

- Ease of use
  Consumers and merchants are familiar with use cases like registration, confirming payments with a PIN, transactions (e.g. credit and debit), account statements, etc. Ease of use can be achieved if a mobile payment scheme copies the known payment transaction types, use cases, and business relationships. Moreover, a payment system of international scope is expected to provide foreign currency conversion during the payment flow.

- Disposability
  The need of additional devices or software poses a barrier for introducing a new payment system, in particular to consumers. Furthermore, consumers prefer payment systems that provide ubiquitous access. A method bound to e.g. a PC (like some e-cash schemes) limits usage to web payments and is likely to remain in this niche segment.

- Economy
  Cost for deploying and maintaining a new payment method as well as subscription and per transaction fees must compete with costs of existing payment schemes. On the other hand, fee distribution among the service providers must cover their efforts and risks.

- Security
  Strong payer authentication is the precondition to prevent consumer fraud and to keep the number of disputes low. This is why most schemes that provide a payments guarantee for the payee demand strong consumer authentication. Measures for integrity, non-repudiation, confidentiality, and persistence further reduce the number of disputes and increase consumer trust.
- Anonymity
  The consumer prefers anonymous payments, which is in contrast to fraud reduction and strong authentication. Nevertheless, consumer data can be hidden from the merchant while still keeping strong authentication by the issuer.

The requirements listed above are considered the most important technical, user, and business requirements. Other aspects as for example legal requirements are out of the scope of this document.

4 Mobile payment architecture

We propose an extended three domain model in order to fulfill the requirements listed in section 3. Building on the three domain model allows to leverage the existing banking, card issuing, and merchant acquiring infrastructure (cf. figure 1). In this extended model, payer authentication is performed by the GSM network when the consumer uses his or her mobile phone to confirm a payment. GSM networks provide a strong, chip-based user authentication and almost ubiquitous access [GSM03].

Figure 1 depicts a role-based three domain model, where the traditional macropayment systems are extended by a micropayment system (account management and interchange components), mobile payment handling (mobile payment processing component), and consumer wallet servers. The wallet servers manage consumer data (IDs, account numbers, spending limits, address, preferences, etc.) and is responsible for consumer authentication. The payment processing component handles a mobile payment protocol (“mpp”) between wallet and merchant servers. The merchant acquirer routes authorization requests to the respective interchange network using a micropayment authorization protocol (“map”) designed for micropayment and ISO8583 derivatives or equivalent protocols for macropayment.

A virtual private network provides security (authentication, integrity and confidentiality) for communication between the components.

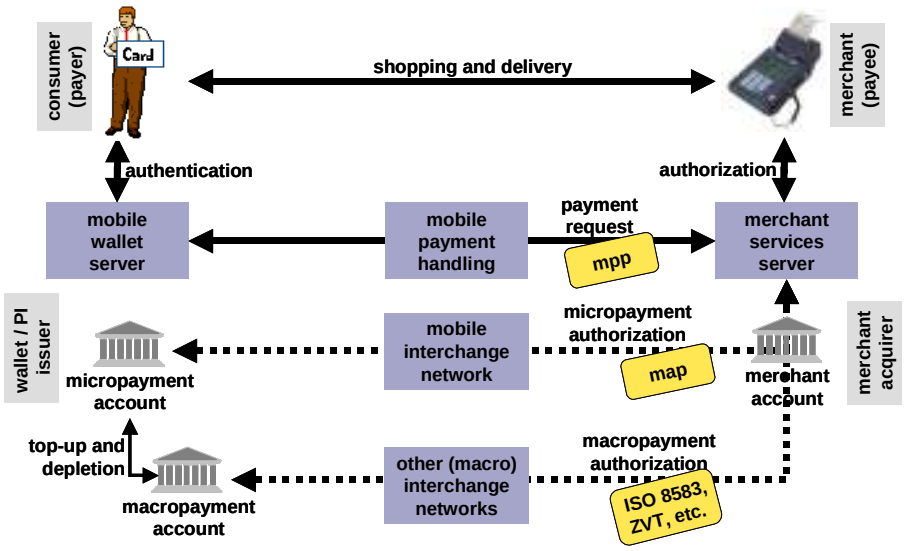

Figure 1: Mobile micro- and macropayment.

A typical payment flow consists of the following steps:

- Registration
  Consumers must register with a wallet server, providing payment instrument data (e.g. credit card number), personal preferences, and data needed for authentication (e.g. a PIN). Different methods exist, for example sending PIN letters via paper mail, in order to check customer data and therefore improve the quality of the customer data base.
- Shopping
  The consumer shops in a physical shop (point of sale), at a vending machine, or in an online shop. After selecting a basket of products or services, the consumer selects “mobile payment”. The user is routed to his or her wallet (web and WAP technically allow this), actively connects the wallet, or receives a message or call from the wallet for authentication.
- Consumer authentication
  After GSM network authentication, the consumer can additionally confirm the purchase with a PIN or cancel the transaction. In case of confirmation, the wallet triggers the payment transaction.
- Payment authorization
  The payment processing component routes the payment request to the respective merchant server that triggers authorization of the payment via the respective interchange network. The authorization result is indicated to the consumer and the merchant who – in case of success – delivers the product or

service. If applicable, the processing component may convert foreign currencies before authorization.

- Payment capture
  Whereas digital content is usually paid immediately, physical retailers also need deferred and split captures in case delivery is deferred or happens in several tranches.
- Clearing & settlement
  Payment instruments (micro- and macropayment account management systems), merchant servers, and potentially the processing component log transactional data for later processing. In a clearing and settlement (C&S) procedure, the C&S processor computes fees and initiates funds transfer of aggregated amounts between issuers and acquirers.
- Disputes processing
  Disputes processing costs for e-commerce can be decreased through a payment protocol that supports digital content delivery resumption.

The role-based model described above does not restrict a stakeholder to take only one single role. Mobile operators are in a good position to operate wallet servers and to issue micropayment instruments. Banks traditionally take the role as macropayment issuers and merchant acquirers. Nevertheless, the model as well permits a mobile operator to acquire merchants or a bank to issue a micropayment instrument. I.e., the technical architecture supports a whole bunch of possible business setups.

5 Conclusions and outlook

The presented approach combines the security features and strong user authentication of GSM networks, the cost efficiency of micropayment, and the flexibility and world wide acceptance of existing macropayment schemes.

Non-proprietary (interoperable) payment systems are superior to proprietary solutions in the long term and create additional value for all participating parties. Technically, the interchange domain ensures interoperability between independent issuers and acquirers who operate components (wallet server, merchant server, etc.) of various vendors. On the business side, initiatives like the GSM Association and the Mobile Payment Services Association (MPSA) are setting up interoperable mobile payment schemes [ITW03].

However, the introduction of a new and widely accepted mobile payment scheme, in particular the setup of a clear business model and the delay until users get confidence and familiarity with a new brand and scheme, will take considerable time (cf. the introduction of credit card schemes). Nevertheless, the commitment

of mobile network operators to initiatives like MPSA point towards the introduction of interoperable micropayment schemes. Next-generation mobile payment systems are on their way.

References

[Apacs03] Association for Payment Clearing Services: Payments, Facts and Figures http://www.apacs.org.uk/about_apacs/htm_files/figures.htm, as of 2003-01-20, Cash http://www.apacs.org.uk/about_apacs/htm_files/cash.htm, as of 2003-01-20.

[Cyb03] CyberCash, Inc. (acquired by VeriSign, Inc), http://www.cybercash.com/ .

[Frost02] Frost & Sullivan: Mobile Commerce Payments, May 2002.

[GSM03] GSM: GSM Recommendations 02.09, 02.17, 03.20, and 03.21; cf. for example http://www.3gpp.org/ftp/Specs/archive/ as of 2003-01-20.

[ISO87] ISO 8583: Bank card originated messages – Interchange message specifications – Content for financial transactions, August 1987.

[Pay03] Paybox AG, http://www.paybox.de/ and http://www.paybox.net/ as of 2003-01-20.

[SET97] SET Secure Electronic Transaction LLC: SET™ Specification Books, May 1997, http://www.setco.org/set_specifications.html as of 2003-01-20.

[Visa01] Visa International Service Association: 3-D Secure™ Protocol Specification, November 2001.

[ITW03] ITWorld: European operators team on mobile payment scheme, http://www.itworld.com/Net/2613/030226eumobile/page_1.html as of 2003-05-14.