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Re-engineering Payment Systems for the E-world

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Re-engineering Payment Systems for the E-world

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Abstract

Payment systems are undergoing rapid changes stimulated largely by technological progress. Distributed network technology, real-time processing and customers' willingness to use electronic banking interfaces will further reshape payment systems during the coming years. Internet and e-commerce will have a major impact on payment systems.

This paper presents the current developmental trends. It analyses the need to develop payment standards and the content of payment instructions in order to fully automate the payment process. Since interbank settlements comprise an essential part of payments, they should be made an integral part of the payment process within the Internet environment. With cross-border payments increasing in importance, any new developments should take an international perspective.

Payment system development requires cooperation between the banks and other participants involved. In order to build the necessary consensus, banking industry organizations as well as central banks and other regulators will need to work together to re-engineer the present payment systems, making full use of the possibilities created by modern technology.

Key words: payment systems, settlement systems, RTGS, payment system integration

Maksujärjestelmärakenteiden uusiminen kokonaan elektronista ympäristöä varten

Suomen Pankin keskustelualoitteita 17/2000

Harry Leinonen
Rahoitusmarkkinaosasto

Tiivistelmä

Maksujärjestelmät ovat suurien, pääasiassa teknisestä kehityksestä johtuvien muutosten edessä. Hajautetun tietoliikenteen tekniikka, tapahtumien reaaliaikainen käsittely ja asiakkaiden valmiudet käyttää elektronisia pankkiyhteyksiä uudistavat maksujärjestelmiä seuraavien vuosien aikana. Internetillä ja elektronisella kaupankäynnillä on huomattava vaikutus maksujärjestelmien kehittymiseen.

Tässä tutkimuksessa esitetään keskeiset kehityssuunnat. Maksuliikestandardien ja maksutoimeksiantojen sisällön kehittämistarpeita tarkastellaan maksuprosessin automatisoinnin näkökulmasta. Pankkienväliset katteensiirrot ovat oleellinen osa maksamista. Niitä tulisi kehittää niin, että ne muodostavat integroidun osan maksuprosessia Internet-ympäristössä. Kansainvälinen maksaminen lisääntyy, ja uusissa kehittämisaloitteissa tulisi ottaa huomioon kansainvälinen ulottuvuus.

Maksujärjestelmien kehittäminen vaatii yhteistyötä pankkien ja muiden osapuolten välillä. Riittävän yksimielisyyden aikaansaaminen edellyttää, että pankkisektori, keskuspankit ja muut säätelijät keskittyvät yhdessä järjestelmien uudistamiseen käyttäen modernin tekniikan antamia mahdollisuuksia.

Asiasanat: maksujärjestelmät, katteensiirtojärjestelmät, RTGS, maksujärjestelmien integrointi

Contents

PART I: BACKGROUND FOR PAYMENT SYSTEM DEVELOPMENT

1 Introduction

Today's payment systems have emerged over time by building on paper-based processes. Automation has occurred in phases where various parts of the process have been electronified independently, without redesign of the whole process. Now we are in a situation where major benefits can be realized only by re-engineering the entire payment process in order to utilize the new efficient features provided by modern technology.

The major user trends and technology changes that would seem to require this re-engineering are

– the distributed network solutions (ie the Internet and TCP/IP[1]) and the new interactive real-time communication mode based on direct one-to-one contacts
– customers readiness and interest in using electronic interfaces and integrating their internal systems with bank systems for transaction processing
– security infrastructure using modern encryption techniques and secured chip based processors
– decreasing costs of real-time processing and telecommunications
– increase in global cross-border communications, which requires efficient cross-border operability.

The changes have to be implemented in the two different phases of payment processing

– the flow of payment information from paying customer to receiving customer and
– the interbank settlement transfer.

The aim should be to design a completely electronic process straight through the system (=STP), where each phase is automatically linked to the next one. The only intervention needed is to control the correctness of payments against relating agreements and deals. Even this process could be to a large extent automated. This calls for bank-to bank, bank-to-customer as well as customer-to-customer integration of payment processing systems. In the e-world, the ultimate result is a transfer that occurs in real time from end-to-end for all participants. This is already the case in some limited Internet payment environments (eg Internet payments provided by the major Finnish banks).

Interbank settlement systems today consist of large varieties of solutions. Common to all these systems are the heavy costs involved in matching or keeping

[1] Transmission Control Protocol/Internet Protocol (TCP/IP) is the basic communication language or protocol of the Internet.

the payment information transactions synchronized with interbank settlements. Central banks' RTGS systems and some private continuous net-settlement systems have solved the synchronization problem by settling all transactions at a central intermediary point before transferring the payment onwards to the receiving bank. However, in order to support the distributed network process in the e-world, a distributed interbank e-settlement process is needed.

This paper deals mainly with credit transfers, which will probably be the main and basic mode of payment in the e-world. Checks and direct debits can and will generally be separated out of credit risk concerns into a payment request transaction with the credit transfer being made after successful debiting of the payer's account.

Many of the examples cited here are from European and Finnish payment systems, and the paper generally takes a European perspective on payment systems. However, most of the conclusions are general and could be implemented also in other geographic regions. In general, the focus of payment system development should be on designing a general and global payment system infrastructure. The e-world will have no geographic borders.

This paper is organized as follows. The first part contains introductory and background information. The second part presents ways to improve payment system efficiency by system integration. In the third part different settlement alternatives are presented and their efficiencies are assessed. The forth part concludes by presenting some views on the process for change. There are two enclosures analyzing in detail the two main items requiring redesign, ie the payment routing/account numbering convention and the e-settlement process.

2 Developments in payment transfers

The following important technical changes will bring a need for restructuring the current payment processing schemes and will result in increased efficiency

- open network structure in interbank connections
- interactive real-time processing
- electronic customer payment input
- need for end-to-end control in order to enhance service level and security
- general public key security infrastructure (PKI)
- tamper resistant chip processors supporting distributed processing
- generally decreasing costs of real-time processing and telecommunications.

<u>An open network structure in interbank connections</u> enables banks to communicate directly with each other without an intervening centre. An internationally standardized account number code (eg IBAN) will specify unambiguously where a payment should be sent. The need for clearing or other payment sorting centres is eliminated, as the network will automatically transfer a payment to the receiv-

ing bank. SWIFT's Next Generation InterAct services[2] are slated to provide this facility.

Real-time processing will speed up payment execution and will have a profound impact on processing. Today most interbank payment systems work in batch and store-and-forward[3] mode. With real-time functions, the payment process can be kept together as a single interactive entity from end-to-end without separate store and forward phases. This entails faster processing and simpler error correction routines. Incorrect transactions can be attended to directly. Most banks already use real-time processing in internal processes and in interbank debit transfers (EFTPOS and ATM transactions). Extending this to interbank credit transfers enables streamlining of the processes.

Interactive electronic customer payment input means that bank systems are accessed directly via electronic interfaces and even integrated with customers' internal systems. Payments are transferred directly from companies' payables files. Private customers will use home terminals to input payments. Banks' customer interface systems must be able to ensure sufficient data quality also for customer-generated transactions. Corporate customers' electronic payment interfaces for mass transfers are nowadays generally file transfer-based. However, for large value and special transfers, real-time interactive usage is growing among corporate customers.

The need for end-to-end control in order to enhance service level and security is increasing. In a store-and-forward-based system, end-to-end control is problematic. If a transaction is found to be incorrect, it must be traced over a long path consisting of many phases back to the originator, especially if it has been batch processed through many ACHs or other centres. In a system with real-time end-to-end control, the error will be detected immediately and can be corrected at once by the sender. With increasing cross-border traffic, the risk of incorrect and forged account numbers is increasing. In store-and-forward systems, there is a problem in establishing the identity of the receiver. Generally the credit transfers are made on the assumption that the account number given is that of the entitled receiver. With an interactive end-to-end control feature, the receiver's identity can be – when necessary – checked by the sender before completing the payment. This will be important especially in countries where, in addition to the account number, the proper receiver must also be verified by checking the receiver's name. The sender will at the same time receive verification that the payment instruction was processed completely.

General public key security infrastructure (PKI) will provide solutions for identification of counterparties and integrity and security of transfers. The SWIFT

[2] SWIFT FIN services function (from the users' perspective) in bilateral mode. However, all payments are sent to the SWIFT centre, which sorts and redistributes them to receiving institutions. This is a source of additional costs. In the Internet TCP/IP world, routing/redistributing is one of the basic telecommunication network services. The new InterAct services will be based on TCP/IP technology.

[3] Store-and-forward means that messages are sent without interactive control. The message sent is stored in different intermediary phases and is forwarded in separate steps to the end receiver. The sender cannot control the process. The sender can get reception acknowledgments for different phases, but these will be received later as separate messages, after the original process is closed. In an interactive real-time process, the sender can control the entire process, and the original process is closed only when a positive acknowledgment is received from the end receiver. Today's TARGET/RTGS service can be characterized as a fast store-and-forward based payment system, but it lacks truly interactive real-time end-to-end capabilities. For instance, the interbank settlement/payment transfer process is separate from customers' debit and credit processes.

Next Generation offering will most likely provide the commercial solution. To be viable, the decentralized network must include an efficient and robust security solution. This has so far been a general problem with Internet usage. The main problem is how to introduce two strangers to each other in the network so that they can exchange identity codes and initial passwords. The solution is a commonly trusted third party that is able to safely identify both parties. After the introduction phase, the connections can be maintained on a bilateral basis. The new PKI-based products provide efficient solutions even for large networks.

Tamper resistant chip processors will enable the use of efficient encryption techniques and the storage of secret information for distributed usage at user sites.

The generally decreasing costs of real-time processing and telecommunication creates a strong incentive for change. Continuous processing is becoming the norm, and compiling payments into batches will in the future increase costs (compared to real-time solutions) because of congestion, control and delivery time problems. The change will first affect large value payments and urgent payments typically related to different kinds of investment and security transfers. Gradually the trend will extend to all kinds of payments. E-commerce will probably speed up the transition because in e-commerce communications are based on one-to-one real-time connections.

PART II:
IMPROVING PAYMENT EFFICIENCY BY SYSTEM INTEGRATION
(*REACHING FOR COMPLETE STP CIRCLE)*

3 The challenge for integration

In all countries payments are shifting from paper-based to electronic systems. Cross-border payments are increasing, and the EMU will accelerate the trend in Europe. The cross-border integration process will affect general system integration. In order to speed up the development, we need international electronic payment standards. The emphasis will be on electronic credit transfers in a real-time and network based environment because the security issues and processing phases would then enable the most straightforward solutions. This part analyses the main features of an efficient automated credit transfer system. Although many of these systems can be implemented also as paper-based systems, the greatest benefits will be achieved in a completely electronic environment.

Banks' retail payment systems are facing an integration phase with customer IT systems. In some countries much of this integration has already been accomplished. The general trend suggests that soon everyone will be connectable via the Internet. All customers have a PC or other means of electronic bank interface. The rapid development of mobile communications (eg WAP) will bring a lot of new electronic banking customers.

Up to now the focus has mainly been on bank-to-bank communication and to some extent on business-to-bank communication. It is now time to turn toward the huge potential for improved efficiency through the integration of (business and consumer) customer systems with banking systems. Because of the EMU and the general international development trends in payment systems, a number of initiatives in this area have been made, especially in Europe. Eurosystem[4] and the EUCommission[5] have also stated their desired development goals for the European area. There is a need to synchronize and unify these different initiatives for particular parts of the payment flow into a complete functional system. There is also a need to combine the US and European based initiatives in order to achieve global standards.

There are generally four legs in a complete payment circle, all of which can be automated (figure 1). STP (straight-through-processing) is within reach of every unit in the circle. It is important that all legs be analysed simultaneously, since they influence each other.

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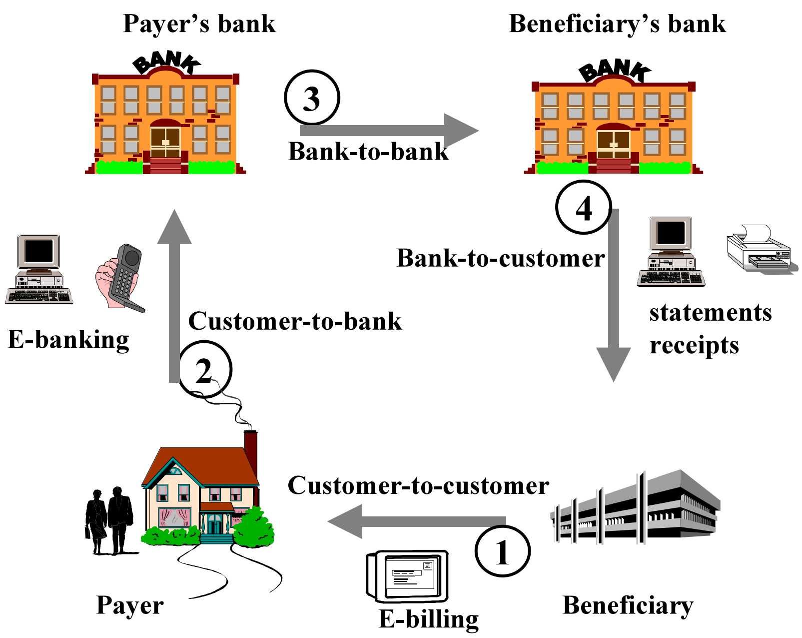
[4] ECB statement: Improving cross-border retail payment services – The Eurosystem's view, September 1999 (www.ecb.int)

[5] Communication from the Commission to the Council and the European Parliament: Retail Payments in the Internal Market, January 2000 (http://europa.eu.int/comm/internal_market/en/finances/payment/2k-108.htm)

4 The payment circle

The general payment circle consists of four parties: payer, beneficiary and their respective banks. The credit transfer makes a circle, with each participator performing its particular tasks. Other payment means such as cheques, credit/debit cards and direct debits often generate more processing legs because of authorizations, announcements beforehand etc.

Figure 1. The payment/credit transfer circle



Leg 1: customer-to-customer. The ultimate beneficiary, most often an invoicer, communicates to the payer on when, how much and to which account to pay. The bill often contains invoicing details, and marketing materials can be attached. The traditional way is to send bills by regular mail, but the more modern way is to use the Internet and electronic bill presentment, ie to use e-billing. In the future the most economic way will be to send invoices by e-mail/Internet.

Leg 2: customer-to-bank. The payer submits a payment instruction to the bank. In the giro-based countries, the banks have generally designed standardized giro forms for this purpose. In order to facilitate automated input, these are printed by invoicers using OCR (optical character recognition) text or special bar-code fields are included. However, there is a rapidly growing trend toward e-banking in which the payer sends his payment instructions to his bank via an electronic telecommunication medium - usually Internet. This makes it possible for the banks to process payments without manual intervention.

Leg 3: bank-to-bank. This leg can include different setups for intermediaries, especially in international transfers (eg correspondent banks or clearing houses). This leg has generally been automated already some time ago in domestic systems. On the international level, STP and automation have not yet been fully attained and so some manual procedures are usually needed. This is mostly due to incompatible standards and especially the lack of international account number standards, routing conventions and settlement procedures. The development needs of the settlement part of the payment process are dealt with in depth in part II.

Leg 4: bank-to-customer. The reception of payments is communicated to the beneficiary after crediting his account. Traditionally banks have sent statements of account on paper and the beneficiaries have been compelled to manually reconcile their receivable files. Electronic statements reduce banks' paper output and help the beneficiary with automated reconciliation when reference data is available.

All technical parts and features are available for automation and electronification of the complete payment circle. The only thing required is to design compatible electronic standards for the different legs, which amounts to making choices among the different possibilities already suggested. Full STP results in benefits for all parties. However, once the technical foundation is in place, there remain the large tasks of implementation and marketing.

4.1 Payer's perspective

Common to all payers is the need to control the payment flow. They have to check that the right amount is paid on the due date to the right beneficiary by verifying the information on e-bills. The payer must also ensure that there is enough cover on his bank account in order to avoid stoppage of payment by the bank. The customer-to-customer leg has to be secured eg with PKI (public key infrastructure) certificates in order to reduce the risk for fake e-bills and forged beneficiary account numbers. The most convenient solution for the customer would be for the e-bill to be forwarded to the bank immediately after implementation of the control procedure, in the form that it is received from the invoicer. The bank account to be debited is normally automatically chosen as a default value related to the paying customer.

For private customers, paying and controlling payments are not inherently interesting activities. These are merely necessary activities in connection with purchases etc. (Nobody sits down at the terminal in order to make payments for fun). After basic checking, a payment can be sent via telecommunication to the bank, especially if the bank can queue not-immediately-payable payments by due date. The basic checks for regular payments could also be done automatically by a (PC) program. The program would check the new payments against previous payments and against limits on value and frequency. If everything is within acceptable limits, the instruction could be forwarded automatically to the bank.

It would also be possible for the invoicer to send e-bills directly to the bank. The payer would then access the bank's computer to check for new incoming e-bills. This alternative would be close to direct debiting. Regarding private customers, it therefore seems that there are two possibilities: the traditional customer orientated bill presentation route or the more bank orientated alternative of sending e-bill information via banks to the payer. It is really a question of customer choice, with the decisive factors being bank dependence, pricing, information usage for accounting and taxation purposes etc.

To corporate customers it is important to get the information in electronic form for integration into their accounting systems. It would be useful to receive the ordering (paying) customer's reference number with the e-bill in order to reconcile it with the orders file. Using pre-established accounting profiles could also help in the automatic transfer of payments to accounting systems[6]. E-bills received from a given invoicer can in most cases be directly booked on the proper cost accounts. For example, electricity bills are paid to the electricity company and gas bills are paid to the gas company. For corporate customers, straight-through-processing directly into general ledger and payable files is a major factor in improving efficiency.

4.2 Perspective of the payer's bank

Input work related to payment instructions is a major factor in banks' operating costs in a heavily paper-based payment environment. With e-banking this can be automated. Customers would do it as self-service and very conveniently in connection with e-billing. Resources could be reallocated to more important customer services.

The customer will make contacts through the Internet, which is a very versatile medium. The bank can at the same time approach the customer with various direct marketing messages. It is easy with an electronic interface to control marketing efforts and customers' reactions to them.

The main task of the payer's bank is to forward the electronic payment instruction to the beneficiary's bank directly or via the proper intermediaries. The information in the payment instruction - essentially the account number convention - should be such that this task is easy to perform (the electronic address of beneficary's bank should be easily established). In national payment systems, this has generally been agreed during the first phase of integration process. However, as regards international use, we lack a clear-cut solution (see appendix 1 for details). Cross-border transactions can be routed through different payment networks, correspondent bank relationships, or clearing centres. A common routing and account number convention must be established before full STP can be attained globally. For settlement information related to specific payments, some kind of codification is needed so that the beneficiary's bank (and possible intermediaries) knows where to anticipate the settlement (when there are several alternatives available). In fact the settlement process needs redesigning in order to support decentralized communications (see appendix 2 for details).

4.3 Perspective of the beneficiary's bank

For STP at the beneficiary's bank, the beneficiary's account number is the most important information. For control purposes the beneficiary's name is helpful, although the name is often difficult to use because of different marketing names/brands, change of names (mergers), factoring services, misspellings, abbreviations and inclusion/order/form of legal attributes, for example 'limited company'.

Transactions received from payers' banks, correspondent banks, clearing houses and other intermediaries must have a clear audit-trail code so that transactions can be traced backwards easily and automatically when problems are en-

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[6] The possibilities of automated accounting is well described in Heli Salmi – Pauli Vahtera: Internet and EDI in Effective Accounting

countered along the way (eg customer remarks and discontinued or non-existent accounts).

Paper-based statements and receipts are costly and slow to print, process and deliver. Customer service can be improved and costs can be reduced substantially by introducing electronic statements and transaction listings. The electronic statements need only be kept available on files so that the customer can obtain them at his convenience. E-commerce companies delivering in real-time will in the future require real-time notifications of received payments.

4.4 Beneficiary's perspective

Receipt of electronic statements and receipts from the bank enables the beneficiary to update receivables files automatically. This can be done faster and at less cost than before.

The most important datum needed is a payment reference number to identify the specific payment. This reference number should be included in the originally sent e-bill and should accompany the payment instruction all the way back to the beneficiary. The individual payment is then clearly recognizable and can be updated.

It is important for corporate customers that all banks have the same standardized electronic statements. Most companies have multiple bank relationships, and common statements make it possible to process all statements with the same program and syntax.

The next step will be real-time notifications of received payments. E-commerce companies delivering services online to large numbers of unknown customers via Internet (eg videos, games, programs, information) will want to receive payment before delivery, because after the shipment it will be difficult to trace the customer via the Internet.

5 Prerequisities for complete STP in the transfer circle

The following prerequisites for speeding up the development toward the full STP goal follow from the description of the payment circle:

1. Standardized global account number supporting automatic routing of transactions
2. Common electronic layouts for e-bills, electronic payment instructions and electronic statements/receipts
3. Standardized payment reference number
4. Standardized order reference number
5. Common due date convention
6. Bank audit-trail code
7. Settlement code
8. Common appearance for the other payment data: amount, currency, beneficiary's name, charges etc
9. Security features to ensure safe transmission and counterparty verification on all legs.

A global account number standard has been discussed for many years. The choice has been between designing a completely new account number convention or building on the current domestic systems. IBAN[7] (=international bank account number), which was proposed by the ECBS (=European Committee on Banking Standards), is building on the domestic numbering schemes by prefixing them with a two digit country code and common two digit control number. The idea is basically the same as that of telephone companies in respect of area and country prefixes. This solution would allow for parallel use of the current short domestic account number and the extended international account number conventions. In order to facilitate decentralized and automated routing of cross-border payment transactions, the banking industry needs to establish a common global account number and payment routing scheme (see appendix 1 for details regarding account number alternatives). The credit card and telephone number schemes are examples of efficient international numbering schemes that have enabled efficient communication routing.

Common electronic customer layouts for e-bills, electronic payment instructions and electronic statements have to be specified so as to be compatible with each other. Electronic versions need to be defined from different paper-based standards like IPI[8] (International Payment Instruction). In Internet the layout can be specified using HTML[9], which defines the visual appearance on the screen and at the same time the structure for automated processing. We can look forward to XML-based[10] layout descriptions in the future. EDIFACT-based solutions lacking simultaneous visual appearance features seem outdated compared to HTML/XML-solutions. The OFX[11] standard proposal appears to be gaining momentum, as many large international third party IT providers getting behind it. It is important that IT providers accept the standards because they will be delivering software with which customers will communicate with banks.

A common payment reference number standard needs to be designed so that the beneficiary can efficiently identify received payments. National standards exist in some giro oriented countries (eg Finland, Portugal, Sweden), but a common standard will be needed in order to ensure faultless transportation through the whole payment circle on the global level. Within the IPI (international payment instruction) designed by ECBS, the payment-detail field is such a reference number. Efficiency requires that the common features have numeric character, a given maximum length, and a common control digit algorithm.

A standardized order reference number is perhaps less important than a payment reference number. The former is needed only in business-to-business e-billing. It would be helpful in booking invoices to the proper cost accounts in the general ledger. One could also imagine common standard codes based on a general cost account specification. This kind of code could be accommodated easily in the initial designing phase. The common features should be the same as for the

[7] Information on IBAN can be found at www.ecbs.org

[8] Information about IPI can be found at www.ecbs.org

[9] HTML (Hypertext Markup Language) is the language used to define and build Internet screens.

[10] XML (Extensible Markup Language) is used to create languages for describing data.

[11] OFX (Open Financial Exchange) is an XML-based description and standard of financial transactions for customer and bank interchange of financial information. OFX is supported by major IT vendors such as Microsoft, Intuit and CheckFree, as well as major US banks that provide e-banking. Information regarding OFX can be found at www.ofx.net

payment reference number, but with clear differences so that possible mix-ups can be easily detected.

A common due date convention is needed in order to establish clearly when a payment should be paid. When should a payment instruction be sent to the payer's bank, on the due date or early enough to be credited to the beneficiary on the due date? The EU directive on settlement finality defines it more like the former, but there is still no clear international convention. Some payments (eg down payments, rents) need generally to be made before a clearly defined moment.

The bank audit trail code is important within the bank-to-bank leg in order to make inquiries about and efficiently process incorrect transactions. The code should enable specification of the originating bank, the interbank route, and all possible intermediaries along the route.

The settlement code will be used to define how the settlement of a transaction is handled, especially when payment transactions have been sent directly (bilaterally) to another bank. It would specify settlement institution and time. Such a code would be especially useful when there are several settlement alternatives available. A settlement code is also needed when there is more than one settlement process during the day. In the e-world, the settlement code could include a complete e-settlement stamp indicating that the payment has been settled (see appendix 2 for details).

Common formats for the other payment data, ie amount, currency, beneficiary's name, charges, possible free-format message fields etc, are also important. These are basic data fields for which common specifications are required such as length, type etc. The SWIFT standards cover most of these.

Proper security features are important in customer communication via an open network. The information must be encrypted[12] during transfer, and the customer's identity must be secured. PKI (public key infrastructure)[13] products are available, and certification services can be accessed in most countries. However, we need a general outline of the security solutions for each leg.

The list of prerequisites seems long and some are less important than others. However, in doing a large overall redesign, it is important to include all potential factors, because in most cases these have to be faced during the next updates, when the costs of change will be much higher. The international standard should be comprehensive right from the start, because then it will be easier to achieve the critical mass and all the various IT system vendors can start to implement the standards in the payment processing programs.

6 The power of common standards

The processing of payments is a bulk type of service. It can be done with more or less efficiency and accuracy, but it is very difficult to provide added value to the basic task. Efficiency and accuracy are the main goals, and these are both promoted by common standards.

Common standards, preferably global, for electronic payment lead to certain major benefits:

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[12] For the basics in cryptography see for instance Bruce Schneier: Applied Cryptography

[13] See for instance www.identrus.com for details.

- participating parties are more willing to invest in changes when support of common standards is widespread
- third parties, eg IT companies, accounting system and service providers etc are more interested in integrating the new offerings when these are supported by all the major banks
- the different marketing efforts regarding the new offerings and involving banks, third parties and large invoicers reinforce each other
- the introduction phase will be shorter and the adoption faster
- all parties enjoy sooner the gains from electronification and STP (lower costs, faster processing, greater accuracy and less mistakes).

Payment system integration gains can generally be realized with a small extra investment. All parties have already made their major investments. The additional requirement is to agree on common links between systems.

Different standards can coexist, but this only complicates things. Countries or banking communities that have already established some electronic standards and have been gaining larger domestic usage may have to cope with processing international standards in parallel. The sooner global standards can be achieved, the less the inconvenience and inefficiency of parallel standards. The global debit/credit card standard is a good historic example of efficient cooperation where also initial problems can be pinpointed.

7 The Finnish case

The Finnish market has become a kind of laboratory for new electronic products in banking as well as in other industries. Internet and mobile telephone penetrations are the highest in the world. With a population of five million people, Finland had about three million Internet e-mail addresses and 3.3 million mobile telephones at the end of 1999. A little more than half of the population has access to the Internet. There are 110 computers (hosts/servers) connected to the Internet for each one-thousand Finnish residents, which is the highest among the OECD countries. Usage is still growing rapidly. Everything points to the same kind of rapid growth in the other EU countries and industrialized countries.

Finland has the highest number of e-banking users per capita in the world. At the end of 1999 the major banks reported 1.9 million Internet-based e-banking customers, which is about 25-30% of their total customer base. On average these customers make more than three identified connections per month and altogether some 6.3 million e-banking service calls per month. Corporate customers rely almost completely on e-banking. The penetration level among corporate customers is over 80%, and as a result, 84% of all payment instructions received by banks in 1999 were in electronic form and were executed in STP mode. E-banking is spreading across all kinds of banking services eg domestic and international payment instructions, salaries, direct debits, debit/credit card transactions, statements of account, payment receipts, e-billing, securities' instructions, credits etc. There are domestic standards common to all the banks for all the main banking services[14]. One important standard has been the electronic statement of account,

[14] Statistics and information on Finnish banking technology can be found at www.pankkiyhdistys.fi and major Finnish banks' websites.

which can be automatically integrated with general ledgers and other accounting systems.

One important lesson from the Finnish experiences is the crucial influence of accounting software providers for e-banking for corporate and private customers with bookkeeping requirements. Medium-size and small companies in particular rely on ready-made products, having no software development or in-depth IT expertise of their own.

In addition to customers' own interest in IT technology and telecommunications, banks have been very effective in marketing new electronic banking services. The main marketing elements have been

- common banking standards and conventions
- simultaneous marketing efforts using similar arguments
- tariff incentives for customers (costly manual services are priced higher)
- third party involvement (cooperation with software vendors in order to provide IT solutions employing new standards)
- cooperation with major beneficiaries (eg tax authorities, public utility companies, insurance companies).

The Finnish example confirms that challenging goals and big changes are attainable - even rapidly - in the payment sector when all critical new components are available. Developments will be similar in other countries. It is therefore important to create a common international payment system structure and set of standards that will accelerate the development, increase interoperability and make cross-border transfers more efficient.

8 The way forward

It is clear that in the future the payment circle will be completely automated and Internet-based. The initial steps have been taken and a phase of rapid acceleration can be anticipated. The question is whether banks can speed up this development and whether the transition can be accomplished efficiently.

Regarding technological developments, one must often choose between investing in presently available technology or waiting for the next generation. There are often different standards to choose from (compare this eg with the development of video equipment). From the banking perspective, Internet technology seems to be quite stable, and improved functionality is in the pipeline. SWIFT has also announced a SWIFTnet, which will employ Internet technology (TCP/IP-networks with PKI security).

With the exception of international credit card networks and standards, developments in payment system automation have been mainly limited to domestic systems and SWIFT. Credit transfers, cheques etc. are processed on international level, with few exceptions, according to paper based models with the need for manual intervention. All the requisites are in place to update the credit transfer process to the same automation level as the EFTPOS-based credit card process.

E-banking developments are in some countries driven by banks and in other countries by IT providers and customers. The best result is achieved when developments are supported by both sides. Banks should be actively involved in redesigning and automating the whole payment process, ie all four payment legs. The redesigning should be done so that the different legs support each other and so that all involved parties get full benefits from the automation process and can reach STP within their own systems. An international set of standards would increase the benefits involved.

The preconditions for successful introduction of a completely automated payment process are

- a supporting organization
- an overall coherent design model with detailed specifications
- sufficient commitment by major players
- a credible implementation plan
- marketing names for the new payment standard and its main features (international account number and reference numbers)
- simultaneous marketing efforts.

The network effects in payment systems are so large that you need a large international effort to initiate the process. After that, the ball will roll on its own with accelerating speed.

PART III: DEVELOPMENT OF SETTLEMENT ALTERNATIVES FOR PAYMENT TRANSACTIONS

9 Challenges for settlement systems

The customer interface to payment systems will change and become increasingly based on electronic connections. Customers' demands on their banks will change and banks will also need to enhance interbank payment systems in order to meet the customers' demands. Central bank systems must also change in order to meet banks' expectations for interbank settlement systems. This part analyses the impact of payment system and information technology developments on settlement routines and interbank payment transfers. Different current and future alternatives for improving interbank efficiency are examined. The speed of settlement system development will be determined by the extent of common interest in, and capacity for, such development within the banking/payment industry.

Payment systems are in a period of transition as they become increasingly global. The distinction between domestic and cross-border systems will eventually disappear. There is a need for efficient processing (STP) that will employ standards and completely electronic processing from end to end. IT developments are reducing costs for data processing, storage and telecommunications. Previously important cost considerations that argued for batch processing are disappearing. Payment processing is moving toward continuous real-time processing. Payment transactions will be carried out one-by-one. Banks will be accessible instantaneously in a global telecommunication network via standardized protocols and addressing conventions. In real-time processing, end-to-end control of credit transfers can be interactive and can span from the sending Internet (or other e-banking interface) customer to the account at the receiver's bank. These trends are visible and have already been realized in ATM and EFTPOS environments (because of the risk-management-related need to verify customers' account balances). Everything points to the adoption of these technologies also in credit transfer processes. How soon this will happen depends on progress in standardization and competitive pressures. In credit transfers, banks' float incomes are delaying the development process, as compared to debit transactions, but in an increasingly electronic network-based world it will be very difficult for banks to defend delays when information in other systems (eg e-mail) is delivered instantaneously.

The interbank payment process traditionally consists of two parts: the payment information transfer and the settlement transfer. These must be synchronized, eg banks have to check that they receive settlements for specific payments. In real-time gross settlement and continuous net settlement systems, these parts are kept together and synchronization is achieved automatically. Nowadays in batch and bilateral systems banks must create separate synchronization processes in order to verify receipt of final settlement. The automated synchronization is making the process management more straightforward for both sending and receiving banks. This gives a clear advantage to centralized real-time-based systems (RTGS and continuous net settlement systems).

The settlement process is the main distinguishing feature of a payment system vs a pure information transfer system. In the new Internet-based communications world, the most efficient way to send information is by direct virtual connection to the other party whereas, in traditional payment systems, settlement occurs at a common 'settlement bank/centre'. This requires centralized processing, which means the loss of some of the benefits of decentralized processing. The challenge here is to design an efficient settlement convention that supports decentralized payment communications (see the proposal in appendix 2).

10 European consolidation developments

Traditionally most payment systems have processed payments in only one currency. International credit card and forex netting systems are the exceptions. The single-currency limitation has meant that the major payment systems are rooted on the national level. Over time, network effects and economies of scale have in most countries resulted in the emergence of a single dominant payment system in each functional area (retail transfers, credit cards etc). Regional clearing centres can be found in some large countries, especially for paper base processing, but generally processing centres have been merged into a national ACH.

Existing national systems represent a vast diversity of procedures, message/interface standards, timetables, legal constructions etc. These have emerged over time as solutions to common problems in payment systems. The lack of international coordination has led to the present situation with systems on different development/electronification levels, with heterogeneous domestic message standards and different payment structures (eg cheque- vs giro-based). The establishment of EMU has created a new situation in Europe, which will almost certainly lead to systems harmonization. Incoherent and non-standardized systems will only increase costs or defer cost savings in the long run. The basic payment needs are the same in all countries, and domestic features deviating from the most efficient general solution will be difficult to defend in the future. Electronification will enable establishment of new common standards as part of the development process.

The development of payment systems in Europe should also be seen against the general trends toward consolidation and a single financial market. Cross-border trade and payments are increasing, and this will increase the demand for efficient cross-border services. These trends are already clearly discernible in the securities markets, where alliances and other cooperative arrangements are being formed as national markets and systems are merged into EMU/EU-wide entities. The next step will surely be to include retail payments in the process. The solutions established for cross-border communication within the EU context, as well as the experiences gained, will probably be adaptable to wider international cooperation, including multicurrency arrangements.

With the onset of EMU, European-level systems have emerged for large-value payments, eg EBA clearing and TARGET. What will the next steps be? What kinds of harmonization developments are there in the pipeline? How fast will cross-border traffic grow? What will be the driving forces for change?

The need for connecting domestic systems stems from increasing cross-border volumes within the common currency area. Rapid growth will require rapid development of common features and interoperability. The development toward coherent systems can take different routes:

- bilateral conversions between all the different domestic standards
- bilateral conversions between domestic standards through a common standard
- using the same common standard in all systems
- integrating domestic systems into one common system.

The first alternative will be the result if there is a lack of coordination. If the payment/banking industry cannot define common standards, conversions must be made between all systems. This will be the most costly alternative in the long run and therefore progress toward common standards should be promoted. In the long run, systems will converge toward common standards, because it is difficult to argue for parallel standards. It is really a question of what kind of interim solution is needed and how long the interim period will be. An interim period and solution will smooth the change toward common standards. It is difficult and costly to change all systems at the same time and within a short time frame. A common bridge between different systems in the form of a conversion standard could enable an efficient transition process.

In the paper-based world, physical transportation limitations and costs have required a multilevel hierarchical system structure. In the electronic world, transportation limitations disappear and a flat hierarchy is most efficient. This points to Europe-level integration in the long run. Generally new payment developments are seen first in large-value payments and later in small-value payments, which now seems also to be the case for EBA clearing and TARGET.

Generally standardization developments are very slow. The implementation phase is particularly time consuming. A lot of different standards have been developed, but common implementation is lacking, especially regarding international standards. In order to promote common standards within EMU/EU, it will be necessary to have a joint high-level commitment to the chosen standards. Because of the integration/standardization development needed in Europe, the European banking industry has the unique challenge of leading the way to a harmonized international efficient payment process based on common electronic interface standards.

11 Network topologies and hierarchies

Payment networks can be established using different network topologies. The most common are centralized star-type and bilateral networks. In a star-type payment network, there is a clearing centre (eg ACH), which processes and sorts all payments. Every participant sends its transactions to the centre and receives from the centre all payments going to its customers. The clearing centre calculates the net balances for settlement and maintains counterparty limits when so agreed.

With a completely bilateral network topology, each participant establishes connections to all other counterparties and calculates settlement balances and maintains limits according to system specifications.

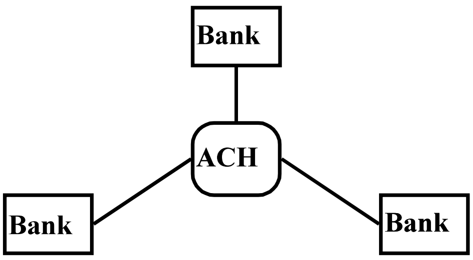
These pure topologies have benefits and drawbacks. The centralized network is convenient, but there are always two telecommunication legs for each transaction, and the centre itself will be a source of congestion, costs and IT system risk. In the bilateral network, telecommunications are effective, but maintaining a large number of connections can be burdensome, especially without common standards.

Modern network technology enables mixing of these basic topologies and selection of the best features of both. Basic transactions are executed through bilateral direct connections, but the system is controlled and supported by centralized functions called upon only at regular intervals or in special circumstances. The traditional SWIFT network can be seen as the first step toward a hybrid network. SWIFT establishes the standards and the addressing tool (ie BIC codes) with which a virtual bilateral network is built, based on an underlying centralized topology. However, in the traditional SWIFT network the store-and-forward process is maintained in SWIFT processing centres.

The SWIFTnet, SWIFT Next Generation initiative, builds on decentralized TCP/IP connections and is thereby moving to a truly bilateral communication environment. Individual payments are communicated directly between participators bilaterally. The new bilateral communications build on general telecommunication standards. In these networks there are centralized administration functions that overcome the problems with completely decentralized communications, and these are accessed only occasionally, as necessary. This is key to the efficiency of the new network structure. The most common centralized routines are participator routing information and security administration (PKI). In payment networks there will also be a need for finding new efficient solutions for risk management and settlement processes.

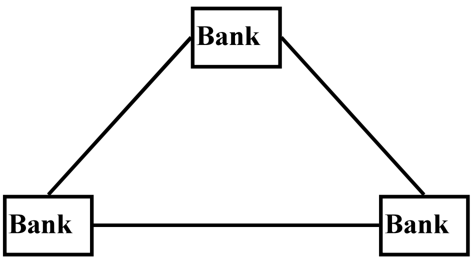
Figure 2. Main network topologies

A. Centralized star



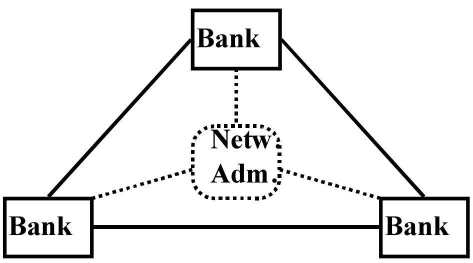
All payments are routed via a centralized clearing centre (ACH). Every participant has one interface and the ACH has as many as there are participants. The ACH maintains the network, security features and risk management process.

B. Decentralized bilateral



Payments are routed directly to other participants. Every participant has n-1 interfaces.
Network details, security features and risk management processes are agreed at bilateral level.

C. Bilateral with supporting centralized functions



Payments are routed directly to other participants. Every participant has n-1 standardized interfaces plus the interface to the centralized network administrator. The centralized network administrator manages the security features (PKI) and may also maintain risk management and settlement processes.

Moving to real-time processing will change the services that a clearing centre will need to provide. When all payments are processed individually, it will no longer be necessary for the centre to sort batches by participant. Participants receive payments and payment confirmations transaction-by-transaction. In a real-time environment, the centralized clearing house/point will function on a pass-through basis and generally update only counterparties' settlement balances and limits.

Today payment systems often have a hierarchical structure with a clearing centre, clearing banks and indirect member banks. This structure can be found in both domestic and international payment systems. This structure has been necessary in manual and paper-based environments with a large number of participating banks. Some larger banks have specialized in functioning as a connection point for smaller banks gathering smaller payment flows to join with larger flows. In the electronic network world, clearing banks will become extra intermediaries, which will increase costs rather than efficiency. In an electronic network, the number of counterparties can be very large without causing an increase in marginal costs. This will result in payment systems with larger numbers of direct, as compared to indirect, members. The underlying reasons for the change are the cost and structural differences between information transfer based on paper vs electronic telecommunications media.

12 Alternative settlement schemes

The alternative settlement schemes can be divided in two main groups: batch-based and real-time-based systems. There is also a hybrid, which could be called real-time settlement of batched payments. In order to get the full advantage of modern telecommunications, the real-time settlement process should be developed to support decentralized communications. The various schemes are analyzed using the frame of reference described in table 1.

Table 1. The analyzed settlement schemes

	Bilateral	**Multilateral Centralized**	**Multilateral decentralized**
Batch	Net settlement **BNS**	Net settlement **MNS**	n.a.
Real-time (continuous)	Continuous net settlement **BCNS**	Continuous net settlement, Gross settlement **MCNS, RTGS**	E-settlement **eCS, eRTGS**
Real-time settlement of batch payments	Net settlement **BCNSbp**	Continuous net settlement, RTGS **MCNSbp, RTGSbp**	E-settlement **eCSbp, eRTGSbp**

12.1 Batch-based settlement schemes

In the batch processing environment, there are two main settlement schemes:

- BNS: bilateral net settlement of payment batches
- MNS: multilateral net settlement of payment batches

In both cases final settlement is generally effected via central bank settlement accounts, usually at the end of the day.

With BNS, participating banks calculate settlement amounts bilaterally. BNS is rarely used in domestic environments, although it is employed in some cases with a smaller and stable number of participants[15]. However, in cross-border transfers, bilateral SWIFT-based relationships prevail. The bilateral scheme can fully utilize the new network possibilities. Before converting to complete real-time processing in the more distant future, the batch-based system will probably be enhanced. BNS schemes could therefore achieve increased volumes if there is agreement on general standards.

Central banks can offer netting services for BNS schemes, which will reduce the liquidity needs. Banks bilaterally calculate settlement amounts for batches sent (or to be sent) to other banks, ie the totals of transferred payments per counterparty bank. These settlement totals are then reported to the central bank before the agreed settlement time. The central bank calculates for each participant the grand net total of all bilateral connections. These totals will be credited or debited to the participants if all 'short' banks have enough liquidity to cover their debits. If some 'short' banks do not have enough liquidity, the settlement time can be delayed for a given extra time to allow them to obtain liquidity. If some participants cannot obtain enough liquidity, they can be partly or completely shut out from the settlement period in question. The system is free of counterparty risk if payments of the failing banks are delayed until successful settlement.

In MNS, there is usually an ACH that calculates net amounts for clearing participants. ACH processing has been cost efficient when the number of participants has been large. In most countries, domestic payments are processed through ACHs. As regards cross-border payments, there are presently no international ACHs for batch processing. Links between ACHs have been tested, but commercial success has not been attained. A worldwide ACH has been proposed by the WATCH[16] initiative, but it seems to be having difficulty in gaining support. EBA (the provider of the Euro 1 payment system) has proposed the STEP1 scheme[17] for small-value euro payments using SWIFT services.

The main difference between BNS and MNS is the latter's need for a clearing centre. Bilateral settlement totals can be settled in a central bank on a total net (ie net-net) basis, which produces the same result as that calculated by the ACH in the MNS case. Thus BNS using network routing services accompanied by a grand total net settlement by the central bank would appear to be more efficient than the MNS alternative. BNS would be an enhanced version of the present cross-border correspondent service. SWIFnet will enable bilateral transfers to all banks in the SWIFT network. These transfers could be settled at the central bank, eg the TARGET network, between all direct participants.

In contrast to continuous real-time systems, batch systems delay payments in order to collect transactions into batches. Having several settlement cycles during the day can speed up the process. There will be no settlement risk if batches are processed only after successful settlement. If final customer credits are made before interbank settlement, a risk is present. Thus to reduce settlement risk, settlement should be effected as close in time as possible to customer crediting.

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[15] For example the Finnish retail payment system PMJ.

[16] See for details www.globalach.org

[17] See for details www.abe.org

12.2 Real-time based schemes

In real-time environments the following settlement schemes are currently employed:

- BCNS: bilateral continuous net settlement of individual payments
- MCNS: multilateral continuous net settlement of individual payments
- RTGS: real time gross settlement of individual payments

In order to support modern distributed networks, one might envisage new settlement processes that could be briefly described as e-settlement:

- eCS: continuous settlement of individual payments in a decentralized private settlement scheme
- eRTGS: a decentralized settlement scheme provided by central banks with immediate finality in central bank money

There is also a general need to speed up the settlement process in order to keep final customer crediting and interbank settlement synchronized when payments are processed in real-time. Settlement risk is present if the customer is credited prior to interbank settlement. If settlements are delayed for a longer time, constantly 'short' banks (eg with surpluses on the payment sending side) are 'living off' structurally 'long' banks (eg with surpluses on receiving side).

In the MCNS and RTGS based systems, settlement synchronization is achieved by establishing a centralized settlement process. In BCNS, eCS and eRTGS, the settlement processes work in decentralized mode.

Bilateral continuous net settlement of individual payments can be found in some real-time based domestic payment systems[18]. Transactions are processed and participants' bilateral net positions are updated on a real-time basis. Risks are reduced by applying limits and requiring collateral. Intraday settlements are typically effected whenever a position reaches an agreed limit. The end-of-day settlement squares the final position. This scheme is especially efficient when there are stable and continuous bilateral flows of payments. In a modern decentralized network, a trustworthy central administrator is employed to maintain security, eg via user identification and key management. Within a decentralized payment/settlement network, the central administrator (PKI certifier) can also oversee participants' bilateral limits and collateral pools. In contrast to an ACH that processes each payment, the central administrator in a BCNS system gets involved only occasionally in special situations. Flexibility is enhanced and collateral can be saved if bilateral limits and related collateral can be transferred during the day from inactive to active payment routes. The sending bank could automatically initiate a change of limits whenever the initial limit is approached, in which case the central administrator would forward the information to the receiving participant.

Multilateral continuous net settlement of individual payments requires a private clearing centre to maintain multilateral net settlement totals for all the participants. This means that all transactions must pass through this central point. In this setup, risks can also be reduced by applying limits and requiring collateral. A bank that approaches its limit must post additional collateral or effect an intraday

[18] For example the Finnish POPS large-value and express payment system.

settlement via the central bank. EBA Euro1 is a typical MCNS system, but it operates with settlement risk because the possible credit positions are not fully collateralized. The CIPS system[19] is another example of MCNS systems. Today it operates with settlement risk, but there is a scheme that aims to eliminate the risk by demanding central bank funds to back the negative settlement balances/limits.

Real time gross settlement of individual payments is provided by central banks' RTGS systems. Each payment is routed via the central bank, which transfers cover across the settlement accounts before forwarding the payment information to the receiving bank.

E-settlement, eCS and eRTGS, would work by employing decentralized settlement balances. Each payment system participant would have a secure e-settlement module in its payment system application, which maintains the settlement balance of the participant. Each outgoing payment includes a settlement stamp with a digital signature, which is used to update the decentralized settlement balance of the receiver. Currently no e-settlement processes are on stream. These should be seen as ideas and proposals of how to build efficient settlement solutions for distributed communications in the emerging Internet world of e-commerce and e-banking. A more detailed description of e-settlement schemes can be found in appendix 2.

BCNS functions well if bilateral payment flows are fairly stable. The usual problem with bilateral continuous systems is that continuous multilateral netting does not occur, in contrast to multilateral netting schemes and RTGS systems. If payment flow relationships are triangular (eg Bank A is paying Bank B, which is paying Bank C, which is paying to Bank A), bilateral limits will soon be reached. This problem can be partly circumvented by changing limits and moving collateral or via intraday RTGS settlements.

MCNS and RTGS operate in very similar ways when both are fully collateralized. The clearing centre and central bank book transactions on accounts, which are limited by available funds and collateral. Payments are queued if there is a lack of funds or collateral. If the MCNS is operating without risk, eg via full collateralization, it could be called a private RTGS system. The main difference compared to RTGS is that participating banks can themselves decide on collateral policy. MCNS can also be run with counterparty risks, eg absent full collateralization. The minimum collateral required is then established by the Lamfalussy requirements[20].

In order to achieve true real-time and end-to-end control, the centres in MCNS and RTGS have to provide pass-through processing with final settlement pending confirmation from the receiving bank. In order to secure final settlement, a cover reservation should be made.

E-settlement schemes, eCS and eRTGS, provide for settlement as part of the payment transaction communicated to the receiving bank directly in one-to-one communication. The one-to-one communication mode is the basic way of communicating in the Internet environment. In order to enhance the settlement process, the next generation of settlement systems will utilize decentralized settlement processing.

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[19] See for details www.chips.org

[20] See www.bis.org/publ/index.htm publication No. 4, Report of the Committee on Interbank Netting Schemes of the central banks of the Group of Ten countries (Lamfalussy Report),, November 1990 (electronic re-release March 1999)

12.3 Real-time settlement of batched payments

Batched payments attached to a settlement transaction envelope can be transferred in a real-time system. Typically this involves a SWIFT MT102 transaction sent from one bank to another. These schemes might be labled RTGSbp, BCNSbp and MCNSbp and eCSbp respective eRTGSbp for the e-settlement versions.

This type of system would apparently be a hybrid between real-time and batch processing. Payments can be received in batches or individually. The main benefit is that payment-settlement synchronization is automatic, in contrast to systems in which settlements are executed separately. Individual interactive end-to-end control and real-time payment processing cannot be achieved, but processing speed can be increased. RTGSbp, BCNSbp,MCNSbp, eCSbp and eRTGSbp could be enhancements to present batch-orientated solutions, but these will not be able to compete with truly interactive real-time processing. Because of the mixture of batches and individual payments, the efficiency is not greatly enhanced, whereas error processing could be more difficult. Especially if batches are processed frequently during the day and the number of participants is large, the process will be close to the processing individual payments. These settlement schemes could perhaps find their own niche in processing regular time designated payments such as salaries and pensions.

In terms of processing fees, systems in which fees are calculated by settlement transaction/payment batch (rather than by individual payment) seem to generate an advantage to large users. In these systems, the bigger banks that are able to batch large volumes of payments into transaction batches can obtain (volume) discounts.

12.4 Assessing the different schemes and anticipating developments

Automated network routing could lead to a gradual shift from multilateral net settlement to bilateral net settlement for non-prioritized retail payments. It would be efficient and convenient to send all payments directly to the receiving bank without using an ACH for sorting and rerouting. In the long run, retail payments will also be processed in real time. The growth of e-commerce will be one of the factors promoting real time processing.

The need for speed and automated settlement synchronization will result in increasing volumes for RTGS and continuous net settlement systems. The change will initially impact large-value payments. One factor that can increase considerably the number of real-time payments is the increase of speed in security settlement processing, ie real-time settlement at T+0 for individual transfers. In order to develop the efficiency of RTGS and MNCS schemes, the next step would be to employ eRTGS and eCS.

Bilateral schemes (BCS) do not introduce extra costs for processing transactions individually at a central point, in contrast to RTGS and MCNS schemes. A bilateral payment system is less dependent on the central point and its processing capacity. The central administrator's services are needed only for adjusting limits during the day and managing participants' collateral pools. End-to-end control is also easier to implement. The incentive to build schemes based on bilateral relationships depends on the comparative benefits, eg in respect of costs of centralized payment processing.

The differences between MCNS and RTGS are completely political, eg in whether private or public payment/settlement services are preferred. In a private MNCS scheme, participants can agree on the main features among themselves, eg on access criteria, system development policy, pricing policy and risk reduction measures such as collateral choice etc. Some limitations are established by public authorities, eg oversight requirements, competition rules etc. In a public RTGS scheme, the participants must adjust to the rules laid down by the central banks.

The new settlement schemes eCS and eRTGS will combine the advantages of decentralized and centralized processing. They will also support the developing decentralized one-to-one communication structures. These are likely to eventually become the general accepted settlement conventions.

It seems that current trends in payment processing are as follows:

– BCNS will be applied in the bulk of payments between large retail participants. The number of participants can be quite large because it will in the future be relatively easy to implement decentralized networks as long as there are bilaterally offsetting transaction volumes. The benefits in bilateral retail mass processing are greater than in large-value transfers because of the processing cost of large volumes.
– MCNS will dominate for payments among large and medium size participants that have fluctuating and irregular bilateral payment flows in all types of payments. Smaller banks can get access to MCNS schemes by using clearing bank services, but direct participation will increase. Extra-large-value transfers between large participants will perhaps be excluded because of their limit/collateral impact and non-regular structure. There is also a general trend toward increased collateralization, which will probably reduce future risk levels in MCNS systems.
– RTGS volumes will to a large extent depend on policy decisions of participants and central banks. Final end-of-day net settlements of private BCNS and MCNS schemes will be effected via RTGS systems. Extra large and non-netted large-value payments will be processed via RTGS systems. If the future BCNS and MCNS systems operate openly and efficiently, RTGS systems will find it difficult to compete for the bulk of the transactions and will therefore serve mainly in respect of extra large payments and settlement needs
– eCS will be the next generation of MCNS systems. The technology is available, but the changeover will probably occur only after some years. The implementation of a new scheme will need a large consensus between banks.
– eRTGS in turn will be the next generation of central bank RTGS systems. There will be the same ’competition/substitution’ situation between eCS and eRTGS as between MNCS and RTGS. However, the cost for e-settlement will be very low and the service will be virtually a public good in nature. This could thus lead to a situation with only one system in general use.

SWIFT has already taken the first steps toward providing real-time-based BCNS solutions by introducing the SWIFTnet[21], Next Generation of InterAct-servicies, based on a decentralized network concept. In the first phase, SWIFT is providing centrally only the network security administration. A complete BCNS service will be available when these services are enhanced to incorporate also limits and collateral control or these are provided by another common administration entity.

[21] See for details www.swift.com

EBA clearing (Euro 1) is an operational MCNS system. However, it presently relies on store-and-forward processing and is therefore not fully real-time-based and capable of interactive end-to-end control. SWIFTnet services provided by SWIFT offer the technical platform that could enable Euro 1 to take the leap into full real-time processing.

TARGET is an RTGS system that also relies on store-and-forward processing and hence is not fully real-time-based. Interactive end-to-end control would require pass-through real-time connections to participating banks' customer account systems. Today the sending bank receives no information in TARGET as to when the payment has reached the receiving bank and as to when the beneficiary customer's account has been credited. TARGET provides only information on when the payment has arrived at the receiving central bank. Compared to EBA clearing (Euro1), TARGET provides less information on processing phases. The current RTGS network approach of TARGET is also requiring the use of two co-operative RTGS systems in cross-border credit transfers. The TARGET infrastructure would need a major restructuring in order to provide genuine real-time and interactive end-to-end control.

The concentration of the banking industry is also increasing the benefits of BCNS schemes and the interest in MCNS vs RTGS schemes.

New e-settlement schemes such as eCS and eRTGS will imply major developments and changes in settlement processing. These are not yet available, but the technology is clearly pointing in the direction of decentralized settlement.

13 Diverging paths for settlement systems

Settlement systems seem to be facing two quite different scenarios

- continuing evolution based on small steps using centralized systems
- a large revolutionary change by moving to a completely decentralized solution.

The path of evolution would imply standardization and striving for economies of scale by consolidating the systems and the transaction processing. The payment process itself would remain generally as it is today, but it would be faster and somewhat more efficient.

The path of revolution would lead to a restructuring of the payment process according to a decentralized concept based on direct connections between participating banks. Network features and benefits would be utilized in full. The payment process would be redesigned and the settlement process would be an integrated part of the payment process within the banks' payment systems.

The move to decentralized network solutions seems inevitable in the long run. The open question is the timing. When will the banking community be ready to start making these kinds of large changes?

The general consolidation process will probably also lead to discussions on whether interbank settlement systems should be private or public. Another possible solution would be some kinds of cooperative joint systems. There is no clear answer to the question. However, when costs are decreasing considerably and settlement processing is very clearly defined and standardized, the justification for maintaining parallel systems will diminish and settlement systems will become more like public utilities.

PART IV: THE PROCESS OF CHANGE

14 Striving for the new payment system process for the e-world

Developing payment systems is always a challenge for interbank cooperation. There are different barriers to overcome. The number of counterparties is large. The level of sophistication varies. Banks have vested interests in legacy systems. The main incentive is cost reduction. On the other hand, if the banking industry is not developing common processes, customers have to be content with existing services because there are very few alternatives available. The volumes will probably not increase by lowering costs, because there is little incentive to make more payments just because costs are lower. It is often easier to make changes in small steps than to completely redesign the system.

Against this background it is important that the banking industry find a way of cooperating that is efficient in a rapidly changing environment. It could include different kinds of fora for change and piloting new schemes. The main problem seems not to be finding innovative ideas but rather how to speed up their validation and implementation. The main obstacles seem to be the strong resistance to change that is characteristic of the banking sector as well as customers' usage of banking products. This arises from the strong network externalities in the payment industry. In order for a new feature to be beneficial, large numbers of users and participants have to adopt the change within a short time frame.

It seems that we would have two change scenarios in front of us. In the first scenario the e-world will create its own payment systems, which will have only weak links and interfaces with traditional payment systems. The volumes in e-world payment systems will gradually increase with the growth of e-commerce. The e-world and traditional payment systems will coexist for a long time. In the other scenario the traditional payment systems will proceed to make the changes and rapidly develop the required systems using modern technology that also suits the e-world requirements. The benefits for the whole society will naturally be larger in the second scenario. In order to support the second scenario there is a need to speed up the process of change for traditional payment systems.

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http://europa.eu.int/
The European Union's server. The Parliament, the Council, the Commission, the Court of Justice, the Court of Auditors and other bodies of the European Union (EU).

www.abe.org
The Euro Banking Association (EBA).

www.bis.org
The Bank for International Settlements.

www.bof.fi
The Bank of Finland.

www.chips.org
The Clearing House Interbank Payment System (CHIPS).

www.ecb.int
The European Central Bank.

www.ecbs.org
The European Committee for Banking Standards (ECBS).

www.globalach.org
The Worldwide Automated Transaction Clearing House (WATCH).

www.identrus.com
Identrus.

www.ofx.net
Open Financial Exchange.

www.pankkiyhdistys.fi
The Finnish Banking association.

www.swift.com
S.W.I.F.T.

Appendix 1. The need and alternatives for an international bank account number space/standard

1. The present situation

The prevailing routing practice in cross-border credit transfers employs SWIFT BIC code (bank identification code). This code is assigned to participants in the SWIFT network and serves as the addressing information and routing mechanism in the network. It is in full-length 11 alphanumeric characters, with the 5th and 6th characters comprising the 2-character ISO country code.

Alert beneficiaries inform payers of both the BIC code and the domestic account number on the invoices so that the payer can copy them to the cross-border payment instruction. However, the situation varies across countries. The banking sectors in certain countries have been more active than in other countries in communicating the BICs and marketing their use to the customers. If the BIC code is not transferred to the payer's bank, the BIC code must be looked up in the BIC directory based on the name of beneficiary's bank.

Certain problems have surfaced in respect of BIC-based routing:

– BIC codes are used only by some of the customers
– there is no control mechanism to ensure the correctness of the BIC itself or the domestic account number
– there is nothing that ties the BIC code to the account number
– foreign account numbers are not acknowledged in other countries.

This has resulted in the use of costly manual procedures in the fairly frequent situations of incomplete or erroneous data.

2. The need for a common international account number space and a common account number standard

On the national level, there has generally emerged over time a common account number standard and a single account number space covering the whole banking sector and a common payment system based on this account number convention. A single account number space refers to a given set of available account numbers which are divided among the banks into subsets, each of which is for a specific bank. When a new bank enters the market it is assigned the next free slot in the account number space. The main aim of the defined account number space is to prevent duplicated/overlapping account numbers. Each account number should be assigned unambiguously to one specific customer account. Generally these account number conventions have a hierarchical structure. The first digits identify the bank and/or bank branch and subsequent digits identify the customer account at that bank. Usually the account number standard also contains a check digit for off-line validation.

With the increased volume of international payment flows there is a need to define the total global unambiguous account number space. Each bank should have its own clearly defined subset/subsets of this common account number space. Just as on the national level, there should be some part of the international account number that identifies the bank in question and a common check digit part for off-line validation.

Creating the international account number space and standard is the most important task in advancing cross-border credit transfers and STP efficiency. A good addressing system is the prerequisite for efficient communication. For example without the common card number space and standards, cross-border credit card transactions and EFTPOS usage are not possible. The most popular cross-border ATM usage is also based on this common international card number standard. The same need for a common international number space can be found in telecommunications, eg telephone numbers and IP-addresses. Telephone numbers are based on country prefixes and the small enhancement established by the + prefix has improved the visual comprehension of telephone numbers in international usage. There is a need to create a routing system/number for credit transfers that is as complete and simple as those previously created for card payments and telephone calls. The right number will directly route the payment automatically to the receiver's account.

There are in theory three different structural solutions for bank accounts in establishing a common international bank account number space/standard:

1. a complete new account number standard (the card number approach)
2. use of a country prefix and a check digit before the current domestic account numbers (the IBAN approach)
3. use of the BIC and a check digit before the current domestic account number (the bank identifier approach).

All three solutions are feasible. The main differences are in the cost of change and production costs in the long run. If the international standard is built on current domestic account numbers, the technical changes needed in the implementation face are reduced. On the other hand there will be some overhead carried over into the future.

A complete new account number would in the long run be the most effective solution. As a separate new number, it could be in line with the international card number structure, but it should be clearly distinguished from this if it is implemented as a new separate number, in order to prevent mixing these two. On the other hand, it would also be possible to start to use the card number for credit transfer purposes by assigning card numbers for customer accounts. However, there will be a long lead-time in the implementation of this kind of convention. The new account number standard should be implemented in all systems and the new numbers should be communicated to all customers. There has to be parallel support for new and old numbers because an international 'big bang' implementation is out of the question.

Country prefix and a check digit, the IBAN, is the solution supported by the ECBS[1]. This alternative is in line with the telephone number solution for defining the international unambiguous number space. The current domestic account numbers can be maintained. The country prefix divides the account number space into country slots, and within each country the assigned slot will be further divided between the banks according to present practices. The international check digit will enable a standardized common off-line validation of the total account number, including the country prefix. The drawbacks of the solution are that domestic

[1] The European Committee for Banking Standards (see www.ecbs.org).

account number standards are of varying length and have different kinds of extra signs (eg – and /) in different places. The bank identifiers are structured in different ways. In order to establish the bank to which an account number belongs and to which a payment should be sent, there has to be a cross-reference table based on bank identification conventions used in the different countries (se below for details).

A BIC-based account number space can also be envisaged. The BIC would then identify both the country and the bank and an international check digit would tie it together with the domestic account number. In contrast with IBAN, it would be at least four characters longer and would in most cases include redundant bank identification information. This redundant bank identification information causes extra updating needs. Generally the BICs change more frequently (eg in mergers and acquisitions) than the domestic account numbers (the BIC changes, but the new bank keeps the old subsets of the domestic account number space). This alternative should also have a common international check digit that is covering both the BIC and the domestic account number part in order to make the total account number into an integrated entity which can be validated off-line.

There is also the proposal to use BIC + IBAN (without a check digit) as the account addressing standard in cross-border payments. The problem with this proposal is that the BIC and IBAN are not tied together with a check digit solution. The international account number standard/space need to be an integrated entity. With the BIC and IBAN as separate data fields, there is always the possibility for mixing the different parts. The BIC also lacks a check digit, which makes it very vulnerable to distortion. Most of the current problems would continue with this solution.

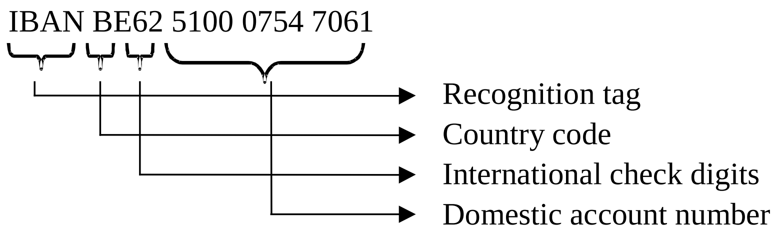
Of the above mentioned coherent account number alternatives, the IBAN has received international support on the European level and has the status of an ISO standard (see ISO 13616 IBAN).

3. The IBAN alternative

IBAN[2] (international bank account number) tries to overcome the weaknesses of the present practice by introducing a coherent international account number standard. The ECBS (European Committee for Banking Standards) made this proposal, and it has won acceptance in Europe. IBAN is based on the same prefix practice we can find in telephone numbers. In IBAN, the domestic account number is prefixed with a country code and an additional 2-digit control number for international usage.

[2] For details, see www.ecbs.org standard implementation guide line SIG 203

Figure 1. **IBAN example: Belgian account number**



IBAN thus works like the international telephone prefixe. It is used in cross-border traffic but can be left out on the domestic level. Customers can recognize the IBAN by the code word IBAN. By using the international check digits, both banks and customers can verify that the account number information and the country code have been inputted correctly. Verification is important because more and more customers, especially corporate customers, will input the information first into their internal systems, from which it will be automatically sent to the bank when due.

4. The IBAN bank cross-reference table

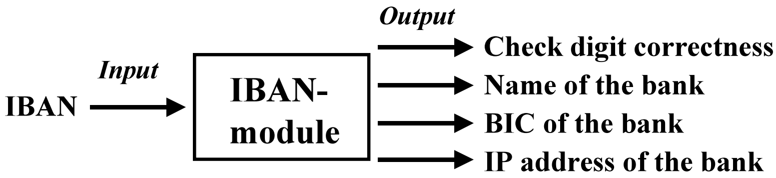
In order to be useful for direct bank-to-bank communication, the IBAN needs to be supported by a cross-reference table from which the receiving bank can be automatically identified. For example, to perform STP on IBANs in the SWIFT environment, banks need a cross-reference table between IBANs and BICs. In most countries the domestic account numbers are hierarchical and contain a unique number sequence, which identifies the domestic participant. This makes it possible to create a cross-reference table for automated BIC retrieval.

Table 1. **Example of the potential Finnish IBAN-BIC cross-reference table**

Bank	**IBAN**	**BIC**
Leonia Bank	FI##8#…#	PSPBFIHHxxx
Mandatum Bank	FI##32#…#	INTKFIHHxxx
Merita Bank	FI##1#…# FI##2#…#	MRITFIHHxxx

In practice this will mean an extension of the BIC directory by one information field. All banks would update the BIC directory with the information on how their account numbers can be 'masked' from IBAN data. It would be the most convenient solution if this directory would be part of the SWIFT directories with automated IBAN 'look-up modules'. The functions of an IBAN-module are described in figure 2. The IBAN-module will output the basic characteristics of the IBAN eg correctness of the check digit, BIC of the account bank, name of the account bank, IP-address etc.

Figure 2. The functions of an IBAN-module



In some countries giro numbers or other customer-specific numbers are used, without reference to the account-keeping bank. In these countries the transactions are routed via a clearing centre or every bank has a table/database, which contains the data needed to establish the account-keeping bank. In these countries the introduction of IBAN has to be done through some kind of a clearing house connection, or the domestic numbering system will have to have an international system in parallel (eg via an extra prefix specifying the domestic bank).

5. The way forward

In order to establish a common international account number space, an agreement has to be reached on global level on which alternative of the possible account number structures should be supported and on the details of the chosen alternative. All alternatives have their benefits and drawbacks. However, the benefits start to accrue only when one of the alternatives is chosen and implemented. Currently the IBAN seems to be gaining support and seems to be the balanced alternative, as it builds on present conventions. The IBAN has the support of the European banking industry, but it would also need the support of other major economic areas and especially the US banking industry. In order to establish the prerequisites for cross-border credit transfers, a global commitment is required. This will be the first stepping stone in all payments, eg retail, wholesale and security market transfers, to efficient STP solutions.

IBAN (or any other scheme) will require implementation in bank systems and communication to the customers. In the beginning the international 'longer' version of the account number can be used only for cross-border payments. Over time it will probably also start to be used domestically because of convenience (the same way as the international + is getting wider acceptance in domestic mobile telephoning). The important thing to tell the customer is that this is the enhanced account number that can be used in all situations, but the 'shorter' version can still be used in domestic transfers. In a completely electronic environment some extra characters will not burden telecommunications but can instead simplify the addressing process.

Technically the data fields in international payment system standards (eg SWIFT standards) have to updated to include the IBAN information. The technical cross-reference table for automatic receiving bank address retrieval should be built. Customers nowadays more and more often send their international payment orders to their banks through electronic channels (eg corporate and home terminals), and these channels should also support the IBAN solution. This in turn will increase the interest of software providers to include IBAN support in international receivables and invoicing applications.

It is important that a clear decision on the international account number standard be made soon. Otherwise benefits will be lost and there is the risk of implementing competing standards in the future and thus generating extra conversion costs.

Appendix 2. Distributed network based central bank money for interbank settlement in the e-world

1. Introduction

Present interbank settlement systems, RTGS or different types of net settlement systems, rely on centralized processing. This is at odds with the decentralized communication method used in modern networks. Internet (TCP/IP) employs direct one-to-one communication, which will be the most efficient way of communicating also payment information in the future, eg via SWIFTnet. This environment requires a new method of final settlement in central bank money that supports direct decentralized communication between sending and receiving banks. This paper describes how such a distributed settlement system could be designed using modern technology. Although the required technology is already available, not all of the elements are as yet in common use. The picture will change rapidly over the next 2-4 years due the rapid progress being made in Internet-related IT.

For simplicity, the system is presented here as a central bank system, which is the predominant model for final interbank settlement. The distributed settlement system described could also be employed by private systems using prepayments in central bank money or general collateral to back up the e-money used for settlement.

2. Basic idea

The new central bank settlement process designed for the e-world can best be described as an e-payment stamp attached to all payments (picture 1). This e-payment stamp will be created by a standardized settlement 'black box' provided by the central bank. This settlement 'black-box' would contain

- an accounting module that manages the balance of the bank's settlement (nostro) account with the central bank, including intraday credits
- an encryption module that generates and validates electronic signatures
- a statistics, reconciliation and audit trail monitoring module
- a central bank interface, eg for liquidity transfers and monitoring
- a bank payment interface (for creating and verifying e-payment stamps)
- a bank liquidity management interface, eg settlement balance inquiries.

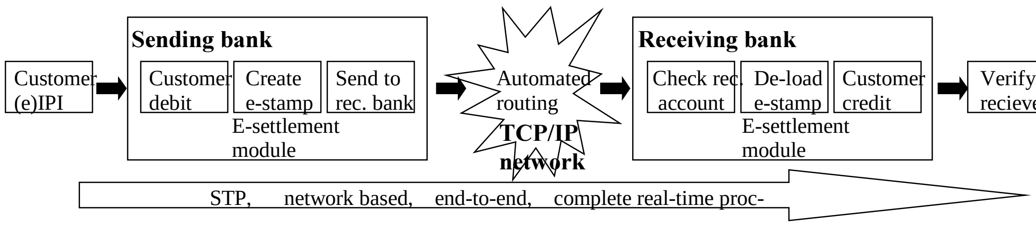
This 'black-box', which might be called an e-settlement module, will attach a digital settlement stamp to each outgoing payment and simultaneously deduct the payment amount from the settlement account balance. At the receiving bank, the corresponding e-settlement module validates the digital stamp and adds the payment amount to the settlement account balance of the receiving bank. In this system, a payment can be viewed as a secure e-mail message, to which the correct amount of final central bank money is attached. Central bank settlement account balances are distributed to e-settlement modules and are maintained on an intraday basis in connection with banks' payment processes. The e-settlement module would reside in a server environment and would use tamper-resistant devices to ensure sufficient security. In this paper the process will be referred to as e-settlement.

Figure 1. E-settlement stamp attached to payment records

IP address	Payment envelope	Payment details …..	Central Bank e-settlement stamp	End of payment

This method of settlement effectively ties the e-settlement information to the payment information process, which allows for distributed/decentralized payment processing and routing among banks in an Internet environment. This is a very efficient settlement solution in that it drastically reduces the settlement cost and facilitates a very straightforward one-to-one decentralized payment infrastructure (figure 2).

Figure 2. The new direct network based one-to-one payment process



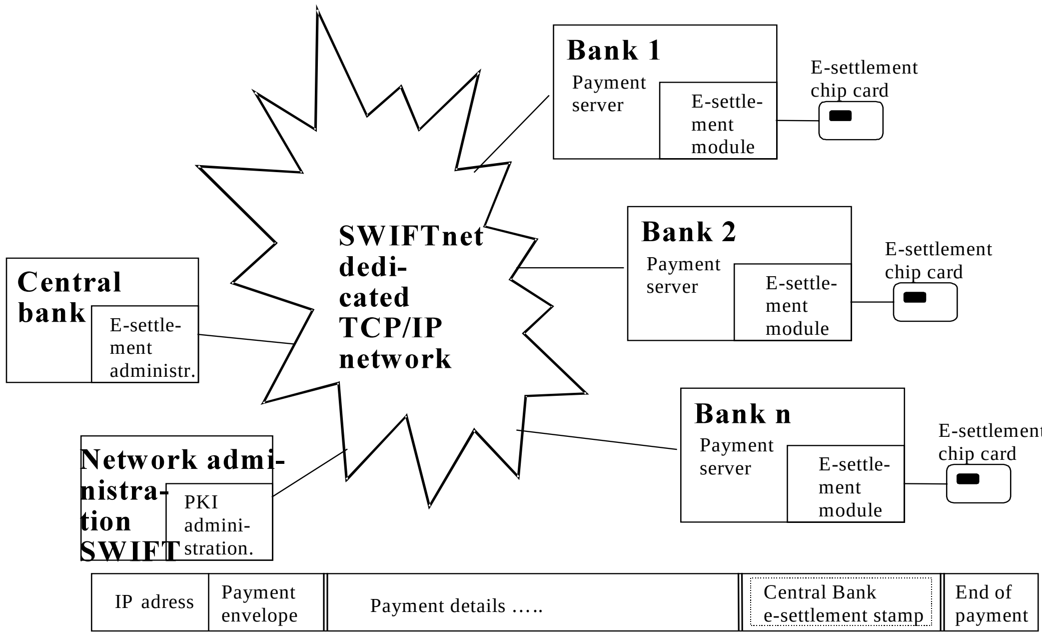
Normal payment transactions with e-settlement stamps move directly between system participants. Central banks are involved in liquidity transactions, eg initial start-of-day balance, intraday changes and end-of-day facilities (see example in chapter 4). The main benefit of the system is that payments can be sent directly, one-to-one, which enables considerable cost savings in processing and communications, and yet central banks control the system and have complete control of total liquidity.

3. The network environment

The communication network should be based on Internet technology ie TCP/IP network. The network should be a dedicated network with PKI-based identification (public key infrastructure) for security reasons. The system would have especially in cross-border context an advantage if its implementation were based on SWIFTnet (SWIFT next generation network, based on TCP/IP). SWIFT will provide for direct interactive communications and PKI-based security features. In SWIFTnet, all SWIFT banks can communicate directly which each other. SWIFT will provide automated routines for finding network (IP) addresses, based on BICs and other customer-supplied receiver information. All transactions would be authorized and encrypted by PKI processes, which means that messages can be opened (decoded) only by the proper receivers.

The system should be designed for extra high security using temper-resistant technology. The system should also have a high overall availability, which requires mirrored devices (see chapter 6 for details).

Figure 3. Overview of system participants



Participants are connected in real time with each other throughout the business day via the network. Incoming and outgoing transactions are continuously reflected in updated e-settlement balances in the banks' systems/e-settlement modules.

A bank's e-settlement balance is always available for making payments. If the e-settlement balance is too low for making the next payment, the bank must acquire more money from the central bank (eg via an intraday credit) or wait for incoming payments.

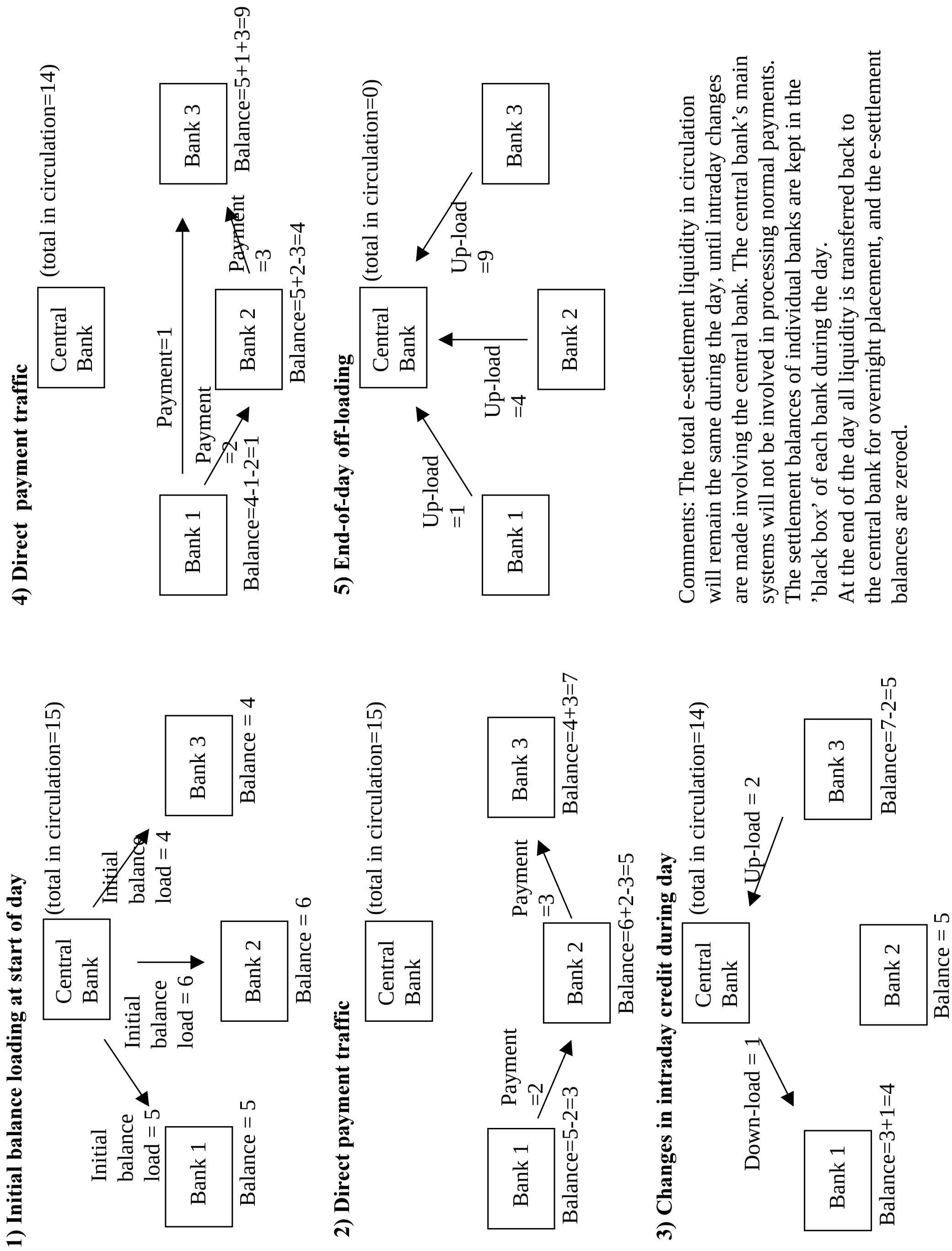
The e-settlement system would support only credit transfers. If a bank wants to make a debit transaction, this must be done separately in an information-only-based debit request transaction, which would be returned by the paying bank as a credit transfer with proper references to the debit request.

If the receiving bank cannot accept the credit transfer (eg due to an incorrect customer account number), the credit transfer will be returned directly as a non-accepted item.

4. Example of the e-settlement process

Figure 5 presents a schematic example of the e-settlement process.

Figure 5. Example of payment traffic in an e-settlement system



Comments: The total e-settlement liquidity in circulation will remain the same during the day, until intraday changes are made involving the central bank. The central bank's main systems will not be involved in processing normal payments. The settlement balances of individual banks are kept in the 'black box' of each bank during the day.
At the end of the day all liquidity is transferred back to the central bank for overnight placement, and the e-settlement balances are zeroed.

5. Liquidity management

Liquidity is transferred by the central bank to the system (ie e-settlement modules) at the start of the day. It can be increased during the day by the central bank via credit transfers or increases of in credit lines (intraday credit). At the end of the day, liquidity is transferred back to the central bank.

In a true real-time environment, there is generally little room for different types of advanced liquidity saving features, which are based on delaying payments. Customers are waiting for direct confirmation of their payments. A bank that is often obliged to inform its customers that payments are queued - waiting for liquidity - will loose its customers. In the real-time environment, customers expects direct delivery.

Still, the e-settlement module could contain basic queuing facilities for situations in which the available liquidity is not sufficient. These would be decentralized queues, managed by the banks themselves. Such facilities can be designed for different levels of complexity, depending on the extent to which banks want to use central bank-provided added-value facilities and the extent to which they want to design these facilities themselves vs using third-party vendors and standardized interfaces.

The system could eg contain different sub-settlement accounts in order to reserve funds for critical payments. The bank would be able to move liquidity between these sub-accounts via the liquidity interface.

Bilateral netting could be accomplished in the distributed e-settlement system through bilateral netting requests to check whether there are transactions also queued at the other end. These could then be netted against each other.

Multilateral netting requires a centralized netting agent. Banks could send the netting agent queued payment orders and liquidity available as e-settlement balances for multilateral netting. When successful netting lots are found, the netted payments would be stamped with an e-settlement stamp and sent to the receiver.

Different types of netting and advanced liquidity saving features would complicate the system. It is advisable to keep the basic system very simple and possible add-on services should be provided separately, possibly by third-party vendors. It is important to keep all interfaces clearly defined and standardized.

6. E-settlement security and availability requirements

<u>The system's security features</u> must be carefully designed. The settlement balance and all security keys have to be in tamper-resistant environments and all the encryption algorithms must be highly reliable. There should be no possibility of intruding in the system. All kinds of 'hackering' should be immediately detectable. The system will be a closed circulation of settlement money with a limited amount of trustworthy users. There will be very little incentive for banks to try to misuse the system, because any attempt would be directly detected.

The basic corner stones of the security of the e-settlement system should be

- tamper-resistant chip cards for maintaining the e-settlement balance, for storing PKI and PIN keys and for encrypting all confidential information
- complete audit trail of all transactions
- automated processes for detecting audit trail breeches immediately (continuous bilateral transaction numbering and turnover totals)

– complete distributed logs of all transactions, which can be accessed by central banks when needed
– digital signatures on each transaction
– reconciliation procedure at the bank-to-bank level at the end of the day and when required during the day
– user profiles for rapid detection of abnormal traffic.

The design should use advanced cryptography to ensure that payment and settlement information is not tampered with. Because there are always two banks involved, all transaction data will be stored at two different places in the system and mirrored at both places. Because of the reconciliation and full audit trail features, every attempt to falsify transactions would be directly detected and traced to the source.

High availability must also be ensured in the distributed system.

The basic cornerstones for high availability should be
– mirrored chip cards at bank level
– mirrored log devices at bank level (write-once device)
– back-up servers at bank level
– back-up communication lines/ports to all participants.

The distributed system in itself will mean that a malfunction will generally affect only one participant at a time and only those payments to be sent from or received by this participant. In order for the participant to re-establish normal operations quickly, there should be back-ups and mirrored devices for all critical components. Because most of the equipment needed will be very low cost compared to the risks involved, spare parts could also be available in almost all banks.

7. Benefits

The benefits of the e-settlement system are the low processing costs of adding the e-settlement stamp for providing instantly final settlement in central bank money. The extra processing costs of adding the e-settlement stamp will be close to nil. It will be an integral part of payment process itself. Banks are only required to invest in low cost equipment (cards, card reader and commonly shared e-settlement module for server type equipment). The very low transaction costs for the e-settlement function will enable banks also to transfer payment flows from ACH-environments to more efficient direct bilateral communications. E-settlement could be a solution for integrating the euro-area payment systems.

Central banks or other settlement system providers have to develop the chip card logic, reconciliation logic and the e-settlement module. A large bank community will share these costs and the total development costs will be much lower than those of a centralized RTGS because of the simpler one-to-one based structure. The costs for sending and settling an interbank payment in the Internet-environment should approach that of sending an e-mail. The central bank production costs will be very low because these will mainly constitute of monitoring, statistics and reconciliation, which compared to processing millions of transactions in a centralized site will be in a completely different costs range.