Electronic Payment Systems

Desired properties of Money

- Universal acceptance
- Transferability, portability
- Safety (unforgeable, unstealable)
- Privacy (no one except parties know the amount)
- Anonymity (no one can identify the payer)
- Work off-line (no need for online verification)
- Divisible into change (pay for $10 item with $100 bill)

[ M. Shamos ]
Payment means

- Cash
- Checks
- Bank transfers
- Credit/Debit cards
- Payment cards, smart card (e.g. CASH, phone cards)
- Intermediaries (e.g. PayPal)
- Loyalty systems (e.g. frequent flyer miles, m-cumulus, …)
- Electronic cash
- …

Payment Model

- A Direct Cash Payment
Electronic payment systems

- Electronic payment systems
  - Credit/debit cards
  - Smart cards (CASH, other independent payment schemes)
  - Bank transfers
  - Digital P2P payments (e.g. PayPal, Paybox)
  - Electronic wallets
  - Electronic checks
- Could be used to pay in the real and digital world
- Digitalization of the payment
  - Cash cost is high
  - Success of e-commerce
  - Number of cards issued

Payment Model

- A Basic Digital Payment Scenario
Payment risks

- Security (unauthorized access)
- Employee fraud
- Counterfeiting (ecash)
- Customer misuse
- Transaction repudiation by customer
- System deficiencies/Security breach
- Money laundering
- Fraud
- Theft
- Kiting (illegal use of float)
- …

*Risk is a factor in all payment processes*
### Different Risks of Payment means

<table>
<thead>
<tr>
<th></th>
<th>credit risk (merchant)</th>
<th>fulfillment risk</th>
<th>payment time (cardholder)</th>
<th>transaction cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>high</td>
<td>high</td>
<td>later</td>
<td>medium</td>
</tr>
<tr>
<td>Pre-paid</td>
<td>low</td>
<td>high</td>
<td>before</td>
<td>medium</td>
</tr>
<tr>
<td>Post-paid</td>
<td>high</td>
<td>low</td>
<td>later</td>
<td>medium</td>
</tr>
<tr>
<td>Debit card</td>
<td>issuer’s low(^b)</td>
<td>low(^b)</td>
<td>now</td>
<td>medium</td>
</tr>
<tr>
<td>Credit card</td>
<td>issuer’s low(^b)</td>
<td>later</td>
<td>high(^c)</td>
<td></td>
</tr>
<tr>
<td>E-Purse</td>
<td>very low</td>
<td>high</td>
<td>before</td>
<td>low</td>
</tr>
</tbody>
</table>

a. Mail Order (MO), Telephone Order (TO).
b. Fulfillment risk for debit/credit is low due to chargeback rights.
c. Credit card transaction cost is high due to commissions.

### Payment security

- Physical protections on bills (e.g. invisible drawings)
- Signature and PIN (and photo ID, 3 numbers on the back) for credit cards
- PIN for debit cards
- For online payment systems
  - Cryptography (keep financial data secret -> privacy)
  - Hash functions (verify that message not altered in transit -> integrity)
  - Digital signatures (prove party’s engagement in a transaction > non repudiation)
  - Passwords, digital certificates (verify identity -> authentication)
- In the future, biometry (fingerprint, retinal analysis, DNA, …) could be used to increase security of payments in the real and digital world.
Electronic Payment Systems: Factors of Success

• Simple
• Convenient
• The merchants have to be involved
• Secure
• Transaction fees have to be reasonable
• Trust
• Respond to a market need

Electronic Payment Systems Characteristics

• Debit cards
  – Issued by financial institutions
  – For proximity payment
  – For macropayments
  – Limit is about 1000CHF/per month
  – Direct paid
  – Very successful in Switzerland (EC/Maestro)
  – Customers: annual fee (price of the card), secure, wide-acceptance, no credit
  – Merchants: cost of the infrastructure, transaction fees (about 30cts), secure

• Credit cards
  – Issued by financial institutions (VISA, MasterCard, Amex, …)
  – For remote (electronic) and proximity payments
  – For macropayments (not efficient for micro due to transaction fees)
  – Limit can vary
  – Post-paid
  – Common payment instrument for e-commerce
  – Customers: annual fee, wide-acceptance, chargeback rights, not secure
  – Merchants: cost of the infrastructure, commissions, risky
Electronic Payment Systems Characteristics

• Electronic Wallet (e.g. CASH)
  – Issued by financial institutions, newcomers
  – For proximity payment only
  – For micropayments
  – Limit is about 300CHF/per card (CASH)
  – Pre-paid
  – Value stored on the smart card or a computer (Digicash-eCash).
  – Customers: reloading issues, very limited use and acceptance
  – Merchants: good for small purchase, system not very used

• Electronic Checks
  – Issues by banks
  – For remote (electronic) payment
  – For micro/macro payments
  – Limit can vary
  – Direct paid
  – Checks are transmitted over the Internet (NetChex)
  – Advantages: authentication and non-repudiation (digital signature)
  – Disadvantages: not standard, need a specific software or an internet connection

• E-banking
  – Offered by banks
  – For remote payment only (money transfers)
  – For micro/macro payments
  – Need to have a bank account
  – Direct/Post paid
  – Need serious security features
  – Cost of invoice (and risk of non-payment)

• Payments with Card Readers
  – Issues by financial institutions
  – For remote (electronic) payment
  – For micro/macro payments
  – Card readers can be at home or at on a ATM
  – Direct paid
  – Advantages: use credit/debit cards, secure, merchants are guaranteed to be paid
  – Disadvantages: need extra infrastructure (cost of the reader), transaction fee for seller

- **MasterCard in CH**
  - 40.4 million transactions
  - 6.7 billion (CHF) revenue (5.5 billion with Swiss cards, 1.2 billion with foreign cards)

- **EC/Maestro in CH**
  - Number of transactions increased by 14% with 132.9 million transactions
  - 12.1 billion (CHF) revenue

- **CASH**
  - 20.5 million transactions (+4%) = 56’000 transactions per day
Illustration - Purchasing at Amazon.com

- One of the most successful e-business company
  - Famous brand name
  - Variety of goods
  - Good customer service
  - Fast delivery methods (customizable)
  - Easy process of payment (1-Click)
  - Accept most credit cards
  - Secure (SSL - login)
  - Trustworthy
Electronic Peer-to-Peer Payment with PayPal

• Peer-to-Peer Payments
  – Payments “directly” between payer and payee (like cash)
  – Can be a transfer between digital wallets
  – Merchants pay low fees; individuals pay nothing

ACCOUNT HOLDER A
ACCOUNT A
ACCOUNT B
ACCOUNT HOLDER B
ACCOUNT HOLDER B’S BANK
ACCOUNT HOLDER A’S BANK
ACCOUNT HOLDER A’S CREDIT CARD
ACH PROCESSOR
PAYPAL’S BANK
INTERNET

1. A PAYS B VIA PAYPAL (A HAS ENOUGH IN PAYPAL ACCOUNT)
2. OR: PAYPAL CHARGES A’S CREDIT CARD
3. OR: PAYPAL INITIATES ACH DEBIT
4. FUNDS ARE DEPOSITED IN PAYPAL’S BANK
5. PAYPAL CREDITS B’S PAYPAL ACCOUNT
6. PAYPAL NOTIFIES B OF PAYMENT. B CHOOSES PAYMENT METHOD
7. OR: PAYPAL INITIATES ACH CREDIT
8. OR: PAYPAL MAILS CHECK TO B

[Koch & Weber]
Mobile Payments

• **Mobile payments definition:**
  – *Payments carried out wirelessly via a mobile device.*

• **Several statistics:**
  – **Gartner:**
    • Transaction value of mobile payments will expand to $15 billion in Western Europe by year-end 2005
    • 46% of Western Europeans already use a mobile device for making some kind of mobile purchase. (news, logo, ringtone)
  – **Forrester:**
    • Mobile payments will amount €26 billion in 2005.

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Five Ways to Enable Mobile Payment with a Phone

<table>
<thead>
<tr>
<th>Multi-application chip card</th>
<th>SIM and WIM (Wireless Identification Module) combined in a single chip card</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual-SIM phone</td>
<td>Both the SIM and WIM have their own slot inside the mobile phone.</td>
</tr>
<tr>
<td>External WIM card reader</td>
<td>An external card reader can be connected to the handset.</td>
</tr>
<tr>
<td>Dual-slot phone</td>
<td>The mobile phone has a built-in smart card reader. Consumers insert their existing debit or credit card into the smart-card reader slot and type in a four-digit PIN, issued by their bank, in order to authenticate purchases [13].</td>
</tr>
<tr>
<td>Payment software built into the phone</td>
<td>The functionalities of the WIM would be inside the phone memory.</td>
</tr>
</tbody>
</table>
Multi-application chip card (single chip for SIM and WIM)

• Advantages
  – All functions are lodged on a single, multi-application chip card that combines the SIM and the WIM cards
  – Only one card slot is needed in the phones. (advantage for manufacturers (and operators))

• Disadvantage
  – For banks and credit-card companies
    • Their brands subsumed into this merged SIM-WIM card
    • Who will issue the card and thereby manages the relationship with customers?
    • Currently SIMs are issued and controlled by the operator. Understandably, banks are not keen.

• In 2000, Swedish mobile operators were considering replacing existing SIMs with SIM-WIMs.

Dual-SIM phone (one slot for SIM and one slot for WIM)

• Advantages
  – Enables the bank to retain strong control over the credit and payment applications
  – Opening the door to other actors like supermarket chains through the dual slot

• Merita Bank (Finland) implemented a dual-chip system in 1999 (Using a Nokia 7110 dual-band GSM phone: WAP&Bluetooth).
External WIM card reader

- **Advantages**
  - Secure
  - Easy to use
- **Disadvantage**
  - One additional device

Dual-slot phone (built-in smart-card reader)

- Consumers insert their existing debit or credit card into the smart-card reader-slot and type in a four-digit PIN, issued by their bank, in order to authenticate purchases

- **Advantages**
  - Makes sense in countries such as France, where credit cards already incorporate a smart microprocessor to authenticate payment, rather than using a customer’s signature
  - Consumer is using a proven and trusted payment method (secure)
  - Consensus between the bank and the telecom operator
  - Open the door to other organizations, such as supermarket chains, to step in with their own card (loyalty points, co-branded credit cards…)
- **Disavantages**
  - Consumers need to buy a new phone

- France Telecom launched a dual-slot phone scheme with CB cards in 2000.
Payment software built into the phone

- **Advantages**
  - Simplest solution for handset manufacturers

- **Disadvantages**
  - Serious security issues - a software-only solution would be the most open to attack by hackers.

Current solutions in Switzerland

- **Premium SMS**
  - Train schedule
  - Contest
  - Poll
  - Ringtones
  - MMS

- **Reverse-billed SMS**
  - News
  - Alerts (Radar, E-mail, ...)

- **USSD (Unstructured Supplementary Service Data)**
  - Vending machines, Quick&More (press articles)
The Mobile Payment Arena

Mobile Payment Service Providers’ Capabilities

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Banks</th>
<th>Credit card firms</th>
<th>Mobile operators</th>
<th>Payment start-ups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Fear of staying behind</td>
<td>Add a new channel</td>
<td>New revenue and services</td>
<td>Business opportunities</td>
</tr>
<tr>
<td>Mobile services skills</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Financial services skills</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Micro billing capabilities</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Macro billing capabilities</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Large end-user base</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Large merchant base</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Move quickly</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Able to expand quickly</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Sample company</td>
<td>SEB</td>
<td>Visa</td>
<td>Orange</td>
<td>Paybox</td>
</tr>
</tbody>
</table>

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Université de Lausanne
Four Mobile Payment Models

A. Carriers are « storefront » for merchants.

B. Carriers accept payment from financial networks to reduce the risk.

C. Merchants use any carriers and any financial networks.

D. Intermediary becomes the « glue » that facilitates commerce between the parties.

Position of the Telcos

- **Attractive Market**
  - Generate extra traffic
  - Enable m-commerce and other services
  - Target the most valuable customers
  - Enter the micro payment market

- **Want to collaborate with financial institutions**
  - Need expertise in the payment market (risk management)
  - Offer a new channel for micro/macro payments
1. The customer gives his or her mobile phone number to the merchant
2. The merchant transmits to Paybox the phone number and the price
3. Paybox calls the customer and a voice message asks for authorization of payment
4. The customer authorizes the payment by entering his or her PIN
5. Paybox informs Deutsche Bank to settle the payment via the traditional payment system (direct debit)
6. The transaction is confirmed by an automated voice or SMS.
Position of the banks

- Wait & see strategy
- Not very concerned (for now)
- Return on investment too low
- Participation in start-ups (e.g. Paybox)
- Would like to keep their dominant position on the payment market
- In CH, transaction volume too low
- Have to train employees to the new systems
- Have to educate their customers (merchants and consumers)

Case study - Exercise

- A company wants to enter the m-business market in 2005. The main market will be mature by 2007. They planned to sell digital goods. Today, they need to decide on the payment scheme they would use.

- Case I.
  - Target customers: Young people
  - Target market: National
  - Frequency of purchase: once a week
  - Size of payment: micro

- Case II.
  - Target customers: Business people
  - Target market: National and International
  - Frequency of purchase: few times a day
  - Size of payment: micro/macro
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