Can Mobile Payments be 'Secure Enough'?

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... / EC/MPS-071025 {.html, .ppt}

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Agenda

1. Mobile Payment Excitement
2. Payment Mechanisms – Pre-Networks
3. Payment Mechanisms – Network Era
4. Security Analysis
5. The Acceptability of Insecurity

Octopus Hong Kong Since Sep 1997

- To pay, wave an Octopus card within a few cm of the reader (even if it's in a wallet/purse)
- Audio-acknowledgement (beep)
- Display of tx amount and remaining balance
- On MTR and KCR transport, read-on-exit causes a deduction based on entry-point

RFID Tags for Road-Tolls

- Car requires a Tag
- Car drives through Control-Point
- Control-Point interacts with Tag
- Toll is deducted automatically
- Fixed display of fees
- Audio-acknowledgement of transaction
- Depends on blind consumer trust

Japanese Osaifu-Keitai / Mobile Wallet

- Many Japanese mobile phones contain an extra chip, which uses RFID/NFC to communicate with payment-related devices
- Services include:
  - eMoney (Edy)
  - public transport (Mobile Suica)
  - credit card?
  - vending machines (Cmode)
  - (loyalty card, id card, ...) Don't lose it!!
- The chip is the Sony FeliCa (as in Octopus ...)
- Sony Viao PCs can interact with FeliCa

http://en.wikipedia.org/wiki/Japanese_mobile_phone_culture
http://en.wikipedia.org/wiki/Osaifu_Keitai

Visa MicroTag
using Visa payWave Technology

- Intended to support 'instant purchase'
- Carried as a key-ring / key-chain
- Requires proximity (1-2 inches)
- Provides a visual indication when it operates
- No confirmation under a threshhold [US$ 25?]

- Not standards-based?
- No independent security testing?
- No public audit and certification?

http://arstechnica.com/news.ars/post/20070930-ready-or-mostly-not-here-come-more-contactless-payment-devices.html – 30 Sep 2007

paybox

- German scheme, with Deutsche Bank
- Type in account no, amount, a PIN
  e.g. in a taxi-cab
- PayBox acts as an Intermediary
- PayBox passes Payment Instructions on to the Bank for processing against the Payer's existing Bank Account

PayPal

- Links an Account with the Intermediary to:
  - an existing bank account; and/or
  - an existing credit card

  but is now becoming a card-issuer as well
- Passes on Payment Instructions sent from:
  - web-browser
  - touch-tone to IVR
  - SMS / text-messages
- Imposes punitive terms and fees

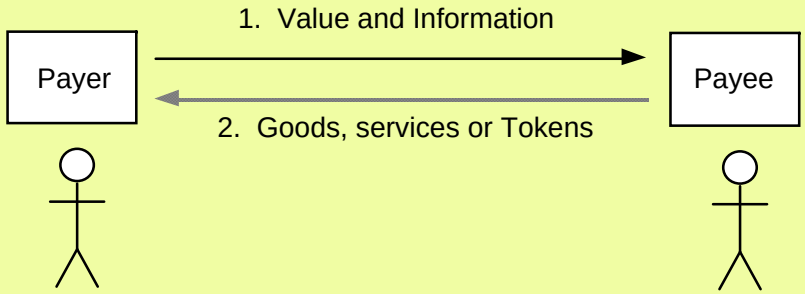
UK Parking Payment

- Customer registers with RingGo and provides (most of) their credit card details
- Customer uses their mobile phone to call a RingGo phone-number displayed in the car-park
- Customer keys the car-park's 4-digit code
- Customer chooses the duration of stay
- Customer keys remaining digits of credit-card
- RingGo processes a credit-card transaction, and makes data available on-line to traffic wardens
- Customer can access the transaction trail online
- [Still pre-paid, so still risk over-run!]

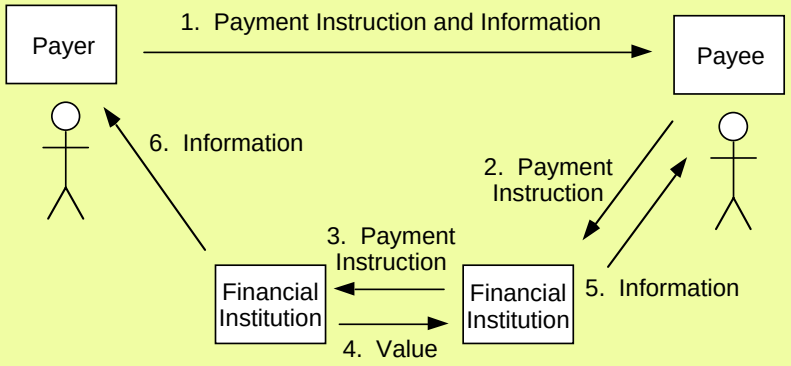
http://www.ringgo.co.uk/

2. Payment Mechanisms Pre-Networks

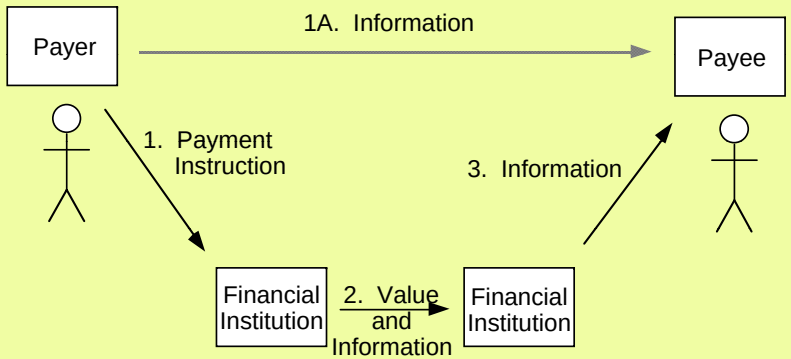
- Cash
- Cheque
- Direct Credit
- Direct Debit
- Credit Cards at Point-of-Sale
- Credit Cards MOTO
- Charging to Telco Accounts



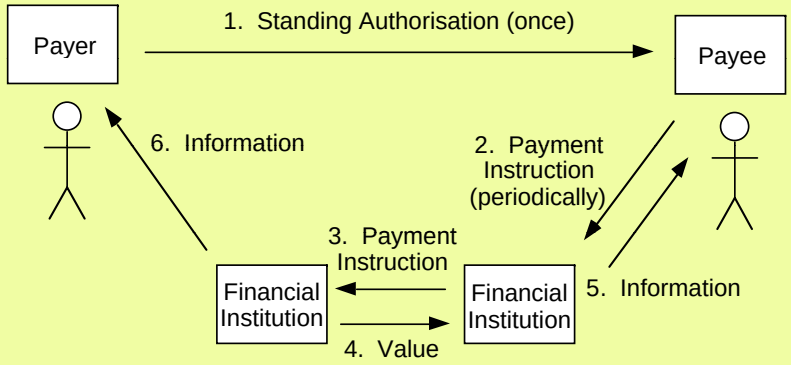
Payment by Cash



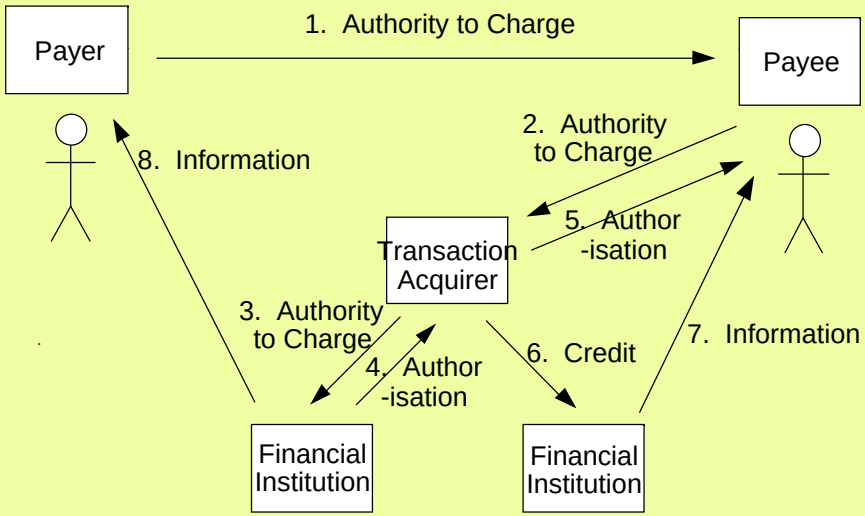
Payment by Cheque



Direct Credit
Giro, 'TT', Salary Payments



Direct Debit
Standing Authorisation



Credit Cards and Charge-Cards
(in 'Meatspace' Transactions)

Credit-Card Details in
Card-Not-Present (MOTO) Transactions

- Changes the ‘have’ factor from ‘have the card’ to merely ‘have credit card details’
- No ‘know a secret’ factor
- Relies on:
  - secrecy of credit-card details [??]
  - general levels of honesty
  - consumers reconciling their accounts
  - self-insurance by merchants (banks issue ‘charge-backs’)

Paying Through Your Telco / Mobile Provider

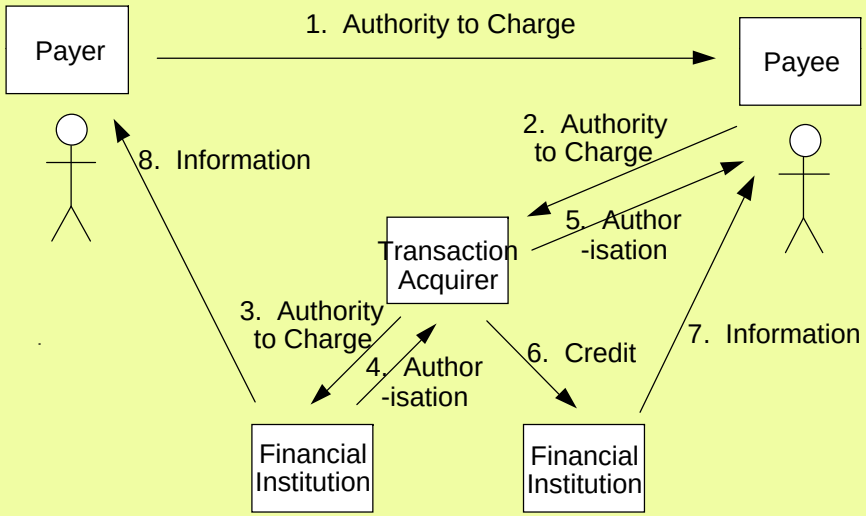
- Top-Ups
- Vending Machines
- Event Tickets
- Public Transport Tickets
- Parking Fees
- ...

3. Payments in the Network Era

- ATMs
- Internet Banking
- Credit Card Tx over the Internet
- Debit Tx over the Internet
- eCash
- ePayment Instructions
- Stored Value Cards

ATMs

- 2-factor:
  - have card
  - know PIN
- PIN keyed into secure PIN-pad, in a manner which makes it difficult to observe [?]
- Hash of PIN transmitted and compared
- So the 'know' part is protected from both physical and electronic observation



Debit Cards (Against Own Account) (in 'Meatspace' Transactions)

Credit Card Tx over the Internet (Very Similar to MOTO)

- The 'have' factor is not 'have the card' but merely 'have credit card details'
- No 'know a secret' factor
- Relies on:
  - an encrypted channel (SSL/https)
  - secrecy of credit-card details [??]
  - general levels of honesty
  - consumers reconciling their accounts
  - self-insurance by merchants (banks issue 'charge-backs')

SET (Secure Electronic Transactions) Processing for Internet Credit Cards

- Card-Holder states that he wishes to make a payment
- Merchant acknowledges
- **Card-Holder provides** payment amount, **digital certificate**
- Merchant requests an authorisation from the Payment-Processing Organisation (via a Payment Gateway / Acquirer)
- Existing EFTS networks process the authorisation
- Merchant receives authorisation
- Merchant sends capture request (to commit the transaction)
- Merchant receives confirmation the transaction is accepted
- Merchant sends Card-Holder confirmation

Internet Banking

- 2-factor (or 3-factor):
  - have card
  - know PIN
  - (have or know 2nd authenticator)
- PIN keyed into insecure key-pad, in a manner which makes it difficult to observe
- Hash of PIN transmitted and compared
- So the 'know' part is protected from both physical (but also electronic?) observation

Debit Transactions over the Internet

- Customer is at a merchant's payment page
- **Customer is re-directed to a specialised version of their own bank's online-banking services**
- **Customer uses their own bank's Internet Banking service to authorise the transaction including an encrypted channel (SSL/https)**
- Customer is redirected to the merchant
- Canada's scheme is called Interac Online: http://www.interaconline.com/
- This leverages on a well-trusted infrastructure, but requires careful interfacing from merchants

Other Internet Payment Schemes
1996 – 2000 ??
2007 – 20xx ?

- **Electronic Value-Tokens (cash-like)**
  DigiCash, NetCash
  incl. micropayment schemes
  Cybercoin, Millicent
- **Electronic Payment Instructions (cheque-like)**
  NetCheque, NetBill, BankNet, Netchex
- **Stored-Value Cards**
  Mondex

Wireless Networks

- **Wide Area Networks – Satellite**
  - Geosynchronous (2 second latency)
  - Low-Orbit (Iridium)
- **Wide Area Networks – Cellular** (to 20km per cell)
  1 – Analogue Cellular
  2 – Digital Cellular, e.g. GSM, CDMA
  3 – '3G', e.g. GSM/GPRS and W-CDMA
- **Wide Area Networks – 'WiMax'**, IEEE 802.16; iBurst
- **Local Area Networks – 'WiFi',** 802.11x (10-100m radius)
- **Personal Area Networks** – Bluetooth (1-10 m radius)
- **Contactless Cards / RFID Tags / NFC** (1-10cm radius)

Credit-Card Details in the MCommerce Mobile / Handheld / Wireless Era

- Inherits all weaknesses of MOTO / Internet
- Less Visible Payee, no 'Footprint'
- Less Visible Process, perhaps invisible
- Less Visible Transaction Data?
- Notification Record / Tx Voucher?

Debit-Card Details in the MCommerce Mobile / Handheld / Wireless Era

- Less Visible Payee, no 'Footprint'
- Less Visible Process, perhaps invisible
- Less Visible Transaction Data?
- Notification Record / Tx Voucher?
- **Capture of Authenticators on mobile**
- **Transmission of PIN or hash w/- SSL?**

4. Security Analysis
A Security Model

Vague Threats

Become Actual Threatening Events ,

Impinge on Vulnerabilities,

Overcome Safeguards

& Cause Harm

Security is an (unusual) condition
in which Harm does not arise
because Threats are countered by Safeguards

MPayments – Key Categories of Harm

- **Unauthorised Conduct of Transactions**
- **Acquisition of Identity Authenticators**

  Credit-Card Details (card-number as identifier, plus the associated identity authenticators)

  Username (identifier) plus Password/PIN/Passphrase/Private Signing Key (identity authenticator)
- **Interference with Legitimate Transactions**
- **Use of a Consumer Device as a Tool in a fraud perpetrated on another party**

Unauthorised Transactions Aren't Just Theory

- Design Flaw:
  - Octopus customer started to add value to their card at self-service add-value points located in MTR and KCR stations
  - Customer cancelled the transaction
  - But the bank accounts were debited
- The flaw existed from at least 2000, but was not discovered until 2007!
- HK$ 3.7 million deducted from 15,270 accounts

http://en.wikipedia.org/wiki/Octopus_card#EPS_add-value_glitch
http://www.rthk.org.hk/rthk/news/englishnews/20070204/...news_20070204_56_376306.htm

Second-Party Risks

- Trust Levels:
  - Banks
  - Telcos / Mobile Phone Providers
  - **Intermediaries**
  - **Devices**
- Terms of Contract
- Enforceability
- **Consumer Rights**

Third-Party Risks – Within the System (Who else can get at you, where, and how?)

- Points-of-Payment Physical:
  - Observation
  - Coercion
- Points-of-Payment Electronic:
  - **Rogue Devices**
  - **Rogue Transactions**
  - **Keystroke Loggers**
  - **Private Key Reapers**
- Network Electronic
  - **Interception**
  - Decryption
  - Man-in-the-Middle Attacks
- Points-of-Processing
  - Rogue Employee
  - Rogue Company
  - **Error**

Consumer Device Vulnerabilities

- The Environment
  - Physical Surroundings
  - Organisational Context
  - Social Engineering
- The Device
  - Hardware, Systems Software
  - Applications
  - Server-Driven Apps (ActiveX, Java, AJAX)
  - The Device's Functions: Known, Unknown, Hidden
  - Software Installation
  - Software Activation
- Communications
  - Transaction Partners
  - Data Transmission
- Intrusions
  - Malware Vectors
  - Malware Payloads
  - Hacking, incl. Backdoors, Botnets

Consumer Device Threats

- **Physical Intrusion**
- **Social Engineering**
  - Confidence Tricks
  - Phishing
- **Masquerade**
- **Abuse of Privilege**
  - Hardware
  - Software
  - Data
- **Electronic Intrusion**
  - Interception
  - Cracking / 'Hacking'
    - Bugs
    - Trojans
    - Backdoors
    - Masquerade
  - **Infiltration by Software with a Payload**

Infiltration by Software with a Payload

Software (the 'Vector')

- Pre-Installed
- User-Installed
- Virus
- Worm
- ...

Payload

- Trojan:
  - Documented or Undocumented
  - Bot / Zombie
- Spyware:
  - Software Monitor
  - Adware
  - Keystroke Logger
  - ...

Key Elements of a Secure Approach

- Two-Sided **Device Authentication**, i.e.
  - by Payee's Chip of Payer's Chip
  - **by Payer's Chip of Payee's Chip**
- **Notification to Payer** of:
  - Fact of Payment (e.g. Audio-Ack)
  - Amount of Payment
- At least one **Authenticator**
- Protection of the **Authenticator(s)**
- **A Voucher** (Physical and/or Electronic)
- Regular **Account Reconciliation** by Payers

Contactless / RFID / NFC Technologies

- No Notification At All
  Surreptitious Payment Extraction
- Real-Time Notification Provided (no record)
  Octopus, Drive-Through eTags for Road-Tolls
- Receipt Provided (or at least Offered)
  UK RingGo Parking Payment Scheme
- Act of Consent Required
  e.g. Tap the Pad in Response to Display of Fare
- Provision of Partial (Non-Secret) Details
  UK RingGo Parking Payment Scheme
- Provision of a Secret Authenticator
  PIN for Telstra/NAB/Visa payWave above US$ 25?

Can Mobile Payments be 'Secure Enough'?

Things We Need To Know

- What does the public want?
- What's the price of convenience?
- What security-levels will the public accept?
- How will we know where
  the threshhold of acceptability is?
- If we exceed it, will we harm adoption?
- How long do people remember stuff-ups?

Some Factors to Consider

- Apparent Risk
  - Apparent Size of Payment
  - Monetary Value in Wallet/Purse
  - Monetary Value in Account / Cr Limit
  - Identifiers
  - Authenticators
- Frequency of Payment
- Context of Payment
- Fit to Life-Style:
  Quick, Simple, Intuitive, 'In'/Style/Fashion
- Confidence in 'the System', 'the Parties'

Possible Public Reactions

- Sullen Acceptance
- Habituation
- Scepticism
- Opposition / Non-Adoption / Rejection

Consumer Rights as an Enabler of MPayments

- Architecture (e.g. Device Authentication)
- Audit and Certification
- Education and Awareness
- Liability Assignment
- Complaint Handling
- Recourse

But NZ Banks have just reduced Consumer Rights, and Aust Banks are lobbying for it!!

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Conclusion

Mobile Payments can be

- Faster
- More Convenient
- Less of an Obstacle

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For the Thief Too