

# BC3402

## Financial Service Processes and Analytics

E-Money & Financial Networks (I & II)



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### Instructions (Overview)

- There are 3 types of individuals (you will be assigned to be one type)
- **Type 1:** consumes **Good 1** & in the process of consuming produces **Good 2**
- **Type 2:** consumes **Good 2** & in the process of consuming produces **Good 3**
- **Type 3:** consumes **Good 3** & in the process of consuming produces **Good 1**



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### Before we begin

Two Key Questions:

What are we covering today?

Where are we in terms of the overall “big” picture?



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### When the game begins.....

- At the beginning of the next period, you will again be randomly matched with another participant. You will then decide whether you want to offer to trade the good that you have, in exchange for the good that the other person has.



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## Objective

- To garner as many points as possible at the end of the game

## Benefits and Costs

- For each good consumed (Good 1, 2 or 3), you gained **20** points
- But you have to deduct any associated storage costs (see below)

Good	Storage Costs (in points)
1	-1
2	-4
3	-9

## Outcomes for each round

- You trade for the good you consume. Then you automatically consume your good, and automatically produce the good that your type produces. Then you store your production good until the next period.
- You trade so that you receive some good which is not your consumption good. Then you store that good until the next period.
- You do not trade. Then you store the good you are currently holding until the next period.

## Important Facts

- There is a possibility that do not gain any points at the end of each round
- BUT** you will always have to pay a storage cost after each round

## Discussion Questions

- What trades were you willing to make and why? Did you have a particular trading strategy, and if so, what was it? Was your strategy effective at maximizing your total points?
- Did any item serve as a generally accepted medium of exchange in the experiment?
  - If so, what item was it, why were people willing to accept it, and how was the pattern of trades affected by the existence of a medium of exchange? What were the advantages of having a generally accepted medium of exchange in this economy?
  - If not, why was there no generally accepted medium of exchange?

## Discussion Questions

- What would the effect on trading strategies have been if the storage costs of all the goods had been equal?
- What other characteristics, besides low storage cost, could make an item a good candidate for becoming generally accepted as a medium of exchange?

## Financial Networks

- Consumer based networks
  - E-money and E-payments
- Wholesale payment networks
  - NSS, RTGS, Hybrid Settlement systems, CLS Bank
- Trading networks
  - ECN, Crossing Networks, Darkpools

## E-Money

- Electronic money products are intended to be used as a general, multipurpose means of payment in contrast to the many existing single purpose prepaid card products.
- Needs to be distinguished from so-called access products which typically allow consumers to use electronic means of communication to access conventional payment services

## Which of the following is E-Money?



- 2 traits
- ① ownership of token is holding of money.
  - ② must be general purpose/widely use within a jurisdiction.
  - ③ netlay - synnorage to use 'ch.
- Not designed for e-money security, not backwards compatible (new-b)

## E-money

- Ownership of the token => ownership of the money
- Is it a general multi-purpose or single purpose => Nets Cashcard vs. Electronic credits at your favorite gaming center?
- Card-based products vs. Network/software-based products

2 sided Network problem  
 - Always subsidise the less desperate side.  
 payment networks: Vendors  
 Grab/Gojek: Pay drivers

## Bitcoin

- x e-money.
- High synnorage.
  - Wildfire/Blockchain.

And country, HK.  
 To create e-money.  
 Higher Riskship  
 - Just need to go to the vendors.

## Success Factors in Payment Systems

- Two-sided market externality problem
  - Users vs. producers
- Security
  - Confidence in using
- Compatibility
  - Backward compatible (e.g. credit cards EMV chip)
- Seigniorage - who should bear the costs
  - Minimize costs

High synnorage

ensure backwards compatibility

## Authenticate payments

- ② magnetic strip - overseas
- ③ chip
- ④ > CRC - online payments.
- ① > emboss parts. - swipe the card

## What's different?



## Electronic Money vs. Electronic payments **KNOW THE DIFFERENCE**

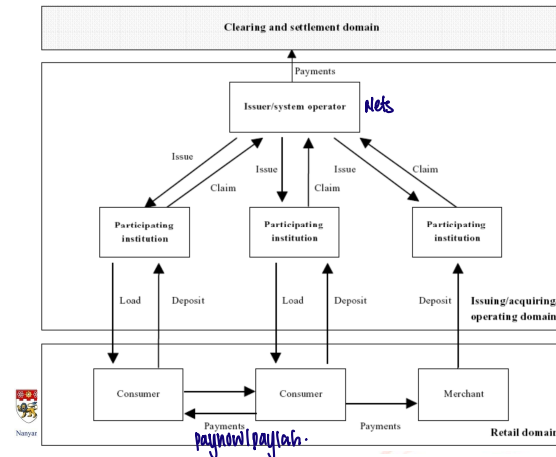
## Electronic Payments

- Mainly through the Internet or mobile phones
- Mobile phones: Two business models are in use - paying from a prepaid balance or paying later along with the mobile phone bill
- More rapid growth here than e-money (esp. via Internet)
- Business-to-business (B2B), business-to-customer (B2C) and person-to-person (P2P) payments
- B2B and B2C e.g. online credit card payment, inter-bank transfer, wire transfer etc.

↓  
- EPOS  
- Mastercard.  
- VISA

## Examples of P2P Electronic Payment Networks

- Yahoo! – PayDirect
- Ebay – Paypal™
- Western Union – BidPay (till Dec 31, 2007)
- Citibank – c2it (till February 22, 2004)
- Many e-payment networks have failed. What are the critical success factors for a payment network? Why do you think the banks and FI fail in getting a slice of the market?



## Issues to consider about e-money and electronic payments

- Monetary Policy and Seigniorage
- General legal issues
  - supervision of issuers, the oversight of payment systems, the effect of the issuance of e-money on consumer and data protection
  - In several countries legislation exists which provides the legal context for internet and mobile payments. There are nations where the legal aspects have not caught up with the developments
- Security
  - Encryption? Tamper-resistant? Limits in value?
- Issuer details. Who issues?
  - The EU regulatory framework allows only deposit-taking institutions and authorized electronic money institutions to issue e-money

## Security Risks

- Fraud Risk
  - Duplication of devices
  - Alteration or duplication of data or software
  - Alteration of messages
  - Theft
  - Repudiation of transactions
- Malfunctions
  - Balance cost with robustness of device

## Risk Management: Prevention Measures

- Tamper-resistance of devices
  - security-related processing is performed inside a physically secured module (smart card chip)
  - sophisticated features include both logical (software) and physical (hardware) protection
- Cryptography
  - logical protection of electronic money systems by ensuring the confidentiality, authenticity and integrity

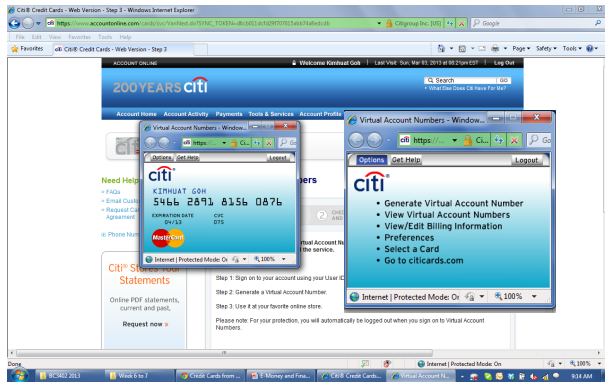
Security  
usually  
physical

magnetic strip → logical protection.

ATM → uses drip.  
(due to big cloning incident)  
↓  
- physical security  
- designed to be fragile

## Risk Management: Prevention Measures (Cont'd)

- Online authorization
  - What you know, who you are, what you have
  - Login ID, Password, Biometrics, MAC addresses, secret questions, two factor authentication, virtual credit card numbers
- Procedural and administrative controls
  - card manufacture, cryptographic key management
  - separated geographically and administratively



## Risk Management: Containment Measures

- Time and value limits on devices
  - Value limits is to contain the magnitude of losses from successful fraud attempts
  - Cloning large number of devices is required for attacker to make the effort financially worthwhile
  - Expiration dates on devices contain the extent of any fraud
- Registration of devices
  - Facilitate investigation of any attempted fraudulent activity

## Risk Management: Detection Measures

- Transaction traceability and monitoring
  - Balance between cost to run the system and the risk management
- Interaction with a central system
- Limits on transferability
- Statistical analysis
  - detect unusual volumes of payments that could be indicative of fraud

## Risk Management: Containment Measures (Cont'd)

- Hot lists and disabling of devices
  - Hot lists are records of the serial numbers of suspect devices maintained by a central system operator
  - disabling of devices can include multiple attempts to enter a PIN or multiple failed transactions
- System suspension
  - implement facilities to rapidly change the cryptographic keys or algorithms used if a wide-ranging fraud is detected

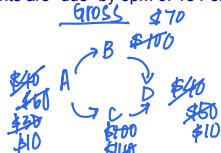
## Risk Management: Organizational

- Manufacturing of devices
  - Manufacturing, initialization and personalization are strictly controlled and carried out by different organizations
  - Separation of staff within organization for different responsibility
- Security evaluation: to be performed by independent 3<sup>rd</sup> party (external audit)
- Background checks for merchants, and staff involved
- Monitoring of financial institutions, due diligence programs.

## Financial Networks

### Exercise

- Four banks: A (\$100), B (\$40), C (\$40), D (\$100)
- A series of events occurred on 18 Feb 2010, all figures in millions of dollars
- 12pm
  - A to pay B \$20; A to pay C \$10
- 1pm
  - C to pay D \$40; B to pay D \$30
- 2pm
  - A to pay C \$20; A to pay B \$10
- 3pm
  - C to pay D \$10; B to pay D \$20
- It costs \$10k to wire each transfer
- All payments are "due" by 5pm of 18 Feb 2010



NET  
A → B 20m + 0  
A → C 10m + 0  
B → D 50m unable to pay  
C → D 50m unable to pay  
if not manage properly can turn into credit  
more risky → settlement risk cascades.  
- LOW cost  
- HIGH RISK  
since didn't receive funds from A  
- Herstatt Risk

### Exercise (Cont'd)

- At 1:30pm, A was declared insolvent
- So what happens?
- Compare netting versus grossing settlement arrangements
  - Credit risk % Ratio LT
  - Liquidity risk → short term unable to pay still financially strong e.g. able to liquidate their assets • measured by cash flow



\$100  
\$100  
\$100  
\$100

## Before we begin

Prior to 1974  
- banks do netting to settle payments  
→ Herstatt Risk ⇒ unable to mitigate this problem only until 2005  
→ RTGs.  
→ used collateral

Two Key Questions again:

What are we covering today?

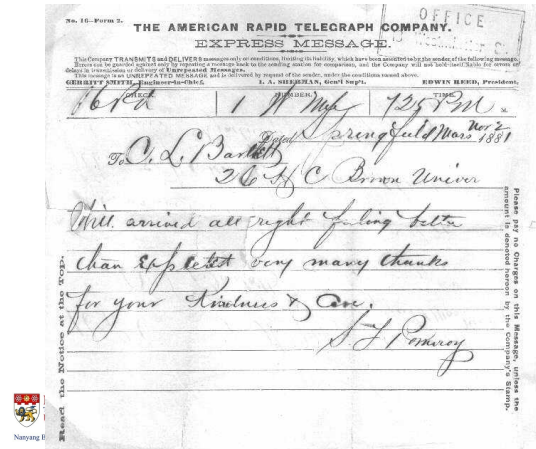
Where are we in terms of the overall “big” picture?

## Financial Networks: What are they?

- Financial industry depends on a wide array of networks.
  - Electric power utilities network
  - Communication lines (e.g. phone, wire transfer etc.)
  - Payment & Settlement networks/systems (credit card payment network) – This session
  - Trading networks (Electronic Communication Networks (“ECNs”), peer-to-peer trading systems, crossing networks and Direct Market Access (“DMA”) – Next Session

## Historic Financial Networks: Physical Delivery to Virtual Delivery

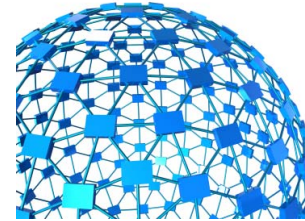
- 1838 onwards – Samuel Morse applied for various patents of technologies that eventually lead to the telegraph.
- Technologies patented included automation in routing of telegrams
- After a series of market upheavals, six organizations throughout US were formed one of them is Western Union
- Price of transmitting a 10-word message for 160 km is \$2.50 (approx. \$500 in 2006). So who can afford telegrams?



## Telegram

- 57% of the initial use of telegrams were related to financial markets. Why?
- Timely information is key in financial trading
- Opportunities of arbitrage across different exchanges (Story of Andrew Carnegie)
- The railroad, and telegram boom in the 1800s help funded the growth, aid financial trading
- Internet boom in the 2000s?

## Settlement & Payment Networks

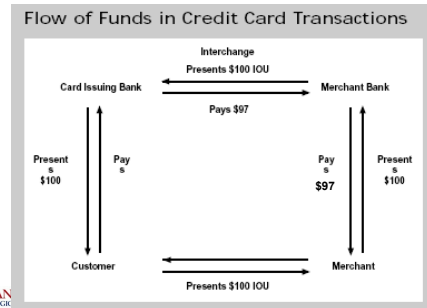


We have seen the past.  
How about the present?

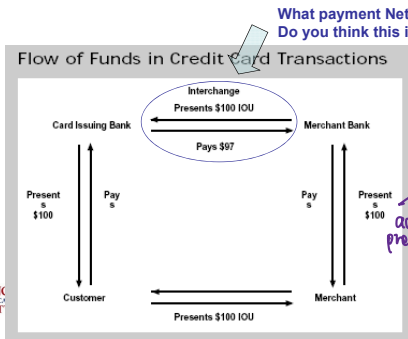
## Upgrading a Financial Network

- Concurrent usage and upgrading
- Backward compatibility and installed base:
  - Compatibility vs. Technology improvements
- Balance between disruptions and upgrades
- Relying on existing externalities for compatibility
  - Europay and MC; Plus and Visa; Discover and AMEX

## Illustration of a Financial Transaction



## Illustration of a Financial Transaction



To allow for immediate settlement

Seq: MEPS &  
maly: MEPS  
us: Fedwire.

MEPS Acc  
UOB  
account  
pre-funded.

### KEY CHARACTERISTICS

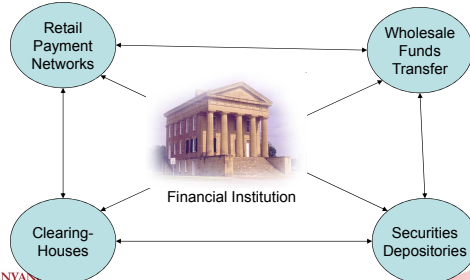
- ① Done Gross NOT Net →  
Realtime & instantaneous
- ② cannot be disputed → one  
you send its final

## What we need to cover

- Payment and Settlement Networks/ System Landscape
- Settlement System Models
  - RTGS/ Net SS/ Hybrid SS
- Settlement System Risks → Network.
- The infrastructure: SWIFT/ Wire room

The term “Network” and “Systems” used interchangeably here.

## Payment & Settlement Systems/ Networks Landscape



### RTGS cons

- ① Transaction cost
- ② Amt of balance you hold  
central bank → possible exposure  
you hold.

## Types of Payment & Settlement Systems

- Funds settlement systems:
  - Wholesale funds transfer service (Fedwire), CHIPS
  - ACH, Check
  - Credit Card, ATM/POS
- FX settlement systems:
  - Funds Transfer Service (Fedwire), CHIPS
  - CLS Bank (Continuous Linked Settlement)
- Securities settlement systems:
  - DTCC (DTC&NSCC)
  - Securities Transfer Service (Fedwire)

## Payment Systems (Wholesale)

- **Large-Value Funds Transfer System**
  - Provides for transfer of large-value payments
  - Primarily used by financial institutions
  - Transfers are typically more time-critical
  - Operates as a clearinghouse
  - System often run by central bank
- **Central Bank**
  - The banker for the banks

## Real Time Gross Settlement (RTGS)

- **Real Time:** not subjected to waiting
  - Processing and final settlement occur on a continuous basis throughout the processing day
- **Gross Settlement:** no netting of positions
  - Each payment is processed individually
- **Payments are final and irrevocable** (“finality”)
  - Payments are irrevocable and unconditional, therefore not subject to reversals

## RTGS (cont'd)

- **Examples:**
  - United States: FedWire & CHIPS (hybrid)
  - CHAPS - **C**learing **H**ouse **A**utomated **P**ayments **S**ystem (Britain)
  - TARGET2 - **T**rans-**E**uropean **A**utomated **R**eal-time **G**ross **S**ettlement **E**xpress **T**ransfer **S**ystem (EU)
  - CHATS - **C**learing **H**ouse **A**utomated **T**ransfer **S**ystem (Hong Kong)
  - SIC - **S**wiss **I**nterbank **C**learing (Switzerland)
  - What about Singapore?

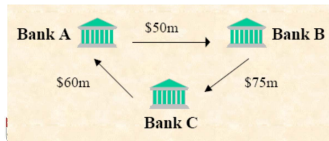
## FedWire

- Started 1913 by connecting 12 Federal Reserve Banks, FS Board, and US Treasury
- Allows netting of position instead of paying for the physical delivery of cash or gold to counterparties
- Eliminate the interest lose due to long wait for physical delivery
- Important participant in providing interbank payment services as well as safekeeping and transfer services for U.S. government and agency securities.
- One of the two primary RTGS for interbank payment, or large-value, domestic, funds transfer payment orders between banks in United States
- If bank A needs to transfer US\$100million to bank B, how will this transaction be performed?

Gross: large payment → High Risk  
 vice versa.  
 → e.g. Giro → Nets after a few days

## Multilateral Net Settlement Systems

- Banks continually send payment instructions to system; system continually “nets” participants’ positions
- What is netting?
  - Offset participant obligations such that a single net position is produced for each participant



Net Settlement Amounts

Bank A: owed \$10m (net creditor)  
 Bank B: owes \$25m (net debtor)  
 Bank C: owed \$15m (net creditor)

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## Multilateral Net Settlement Systems

- Settlement occurs at 1 or more pre-specified times during day, usually at the end of the processing cycle
- Participants with net debit positions make payments;
- System makes payments to participants with net credit positions
- Finality is achieved upon completion of settlement
- Examples: old CHIPS

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## Hybrid Settlement Systems

- Combines features of RTGS and Net settlement systems
  - For example, a hybrid settlement system may *net* participants’ positions (thereby achieving liquidity savings)
  - and provide for settlement throughout the processing day such that *intraday finality* is achieved (thereby limiting payment system risk)
- Examples: New CHIPS

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## Clearing House Interbank Payments System (CHIPS) and other systems

- CHIPS is the other Hybrid/ RTGS system within US
- Privately owned by a consortium of FI
- Payments transferred over CHIPS are often related to international interbank transactions, including the dollar payments resulting from foreign currency transactions
- Payment order processing follows the predefined rules and operating procedures of the large-value payment system. Typically, large-value payment system operating procedures include identification, reconciliation, and confirmation procedures.

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FAST  
 - CHIPS system.

- NOB, other DBS need to have 3 pre-allocated account

- facilitator network that holds your collateral

CHIPS



- Netting i.e. IOUing → then transfer.

## Payment Systems (Retail)

to be able to  
net off the  
payment

- **Small-dollar payments made in goods and services market**
  - **Cash** (anti-counterfeiting devices, distribution networks, high-speed sorter processors etc.)
  - **Checks** ( Clearinghouses; e.g. Federal Reserve)
  - **Credit Cards** (Operators/Processors; e.g. Visa)
  - **EFT** (ACH Operators: e.g., Federal Reserve, NYACH)
  - **Debit Cards, E-Money** (Smart Cards, Digital Cash, Electronic Bill Payment)
- **National Settlement Services (NSS)**

## NATIONAL SETTLEMENT SERVICE (NSS) – United States

- Participants in private clearing arrangements to settle their net obligations with same-day finality using participant's reserve or clearing account balances maintained at the Federal Reserve Banks
- Participants include check clearinghouse associations, automated clearinghouse (ACH) networks, credit card processors, and automated teller machine (ATM) networks

## Settlement System Risk

- **Settlement Risk:** the risk that the completion of individual transfers does not take place as expected
  - Can be attributed to credit risk, liquidity risk, operational risk, systematic risk
- **The push towards RTGS instead of net settlement systems**

## Types of Risk (FYI)

- **Credit Risk:** risk that a party to a trade does not meet an obligation when due or at any time thereafter, i.e. default
- **Liquidity Risk:** risk that a party to a trade will not settle its obligation for full value when due, but at some unspecified time thereafter
  - its counterparty meanwhile may have other obligations to complete and thus may need to cover/finance the shortfall (e.g. borrow, liquidate assets)
  - source of risk: usually temporary in nature

## Types of Risk (FYI)

- **Operational Risk:** risk of problems associated with operational factors in the settlement process
  - Sources: natural disaster, human errors, fraud, failure in computer systems, infrastructure
- **Systemic Risk:** risk that the failure of 1 participant to meet obligations when due may cause other participants to fail to meet their obligations
  - 1 institution's failure may lead to a domino effect
  - the disruption of a large number of payments may lead to broader effects on economic activity

## Funds Transfer Operations (Wire Room Security Measures)

- Hardware and software components to control access and support effective monitoring
- Strong user authentication
- Support user entitlement (information access and function controls) administration
- Presence of audit trails in sufficient detail to support the analysis or investigation of specific transactions
- Enable funds transfer activity logs
- Designate independent staff members to monitor operations, applications support, system administration, and security administrators' activities

## Society for Worldwide Interbank Financial Telecommunication (SWIFT)

- The International financial messaging network
- Transmit payment instructions for both domestic and international financial transactions
- SWIFT operates as a messaging system, transmitting instructions to move funds
- Still needs the domestic systems discussed before accomplish the actual funds movement
  - OCBC – SWIFT CODE: OCBCSGSG
  - Citibank Singapore – SWIFT: CITISGSG; CHIPS UID: 033180
  - Check out swift codes and CHIPS ID: [www.chips.org](http://www.chips.org)

## Funds Transfer Operations (Wire Room Security Measures)

- Information security program include access, authentication, and transmission controls surrounding wire room activities and all terminal connections
- Presence of strong physical controls (sabotage)
  - Secured room (ID passes, Pin, Logbook)
  - Fire and flood management
- Encrypting data during transmission

