



Electronic Payment Systems

Speaker: Jerry Gao Ph.D.

*San Jose State University
email: jerrygao@email.sjsu.edu
URL: <http://www.engr.sjsu.edu/gaojerry>*

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Presentation Outline

- *History of payment systems*
- *Classes of traditional payment systems*
- *Introduction to electronic payment systems*
- *Overview of electronic payment protocols*
- *Types of electronic payment systems*
- *Comparison of payment protocols*

History of Payment Systems

(1) The most primitive payment form:

--> the direct exchange of goods and services for other goods and services.

- The major problem is known as double coincidence of wants

(2) The second form is to use money to exchange for goods and services.

- The earliest money was called commodity money, where physical commodities (such as corn, salt, or gold) whose values were well known were used to effect payment.

- The next step in the progression of money was the use of tokens such as paper notes, which were backed by deposits of gold and silver held by the note of issuer. This is referred to as adopting a commodity standard.

- As an economy becomes highly stable and governments are trusted, money tokens are known as fiat money.

Traditional Payment Systems

Cash payments --> the most commonly used form of payment:

- *simple, portable, no transaction costs*
- *need money to produce money notes (or tokens)*
- *high risk to transfer and store cash money*

Payment by check --> when both parties are stored money in banks.

- *easy, safe, and convenient for consumers*
- *involve transaction costs*
- *time delay*
- *the “returned items” problems*

Payment by giro or credit transfer:

- *Similar to check payment*
 - *the major difference is that the transaction cannot be initiated unless the funds available.*
 - *very popular in European countries.*
 - *Eliminate the return check or bounce check problems.*
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Traditional Payment Systems

Automated clearing house (ACH) payments: (since 1968)

- *An ideal way for mid- to low value transactions.*
- *The ACH system operates in a similar way to paper clearing except that the payment instructions are in electronic form.*
- *Now the ACH system has been used in EDI for direct deposit, direct ordering, direct debits, and direct credits.*

Wire transfer services:

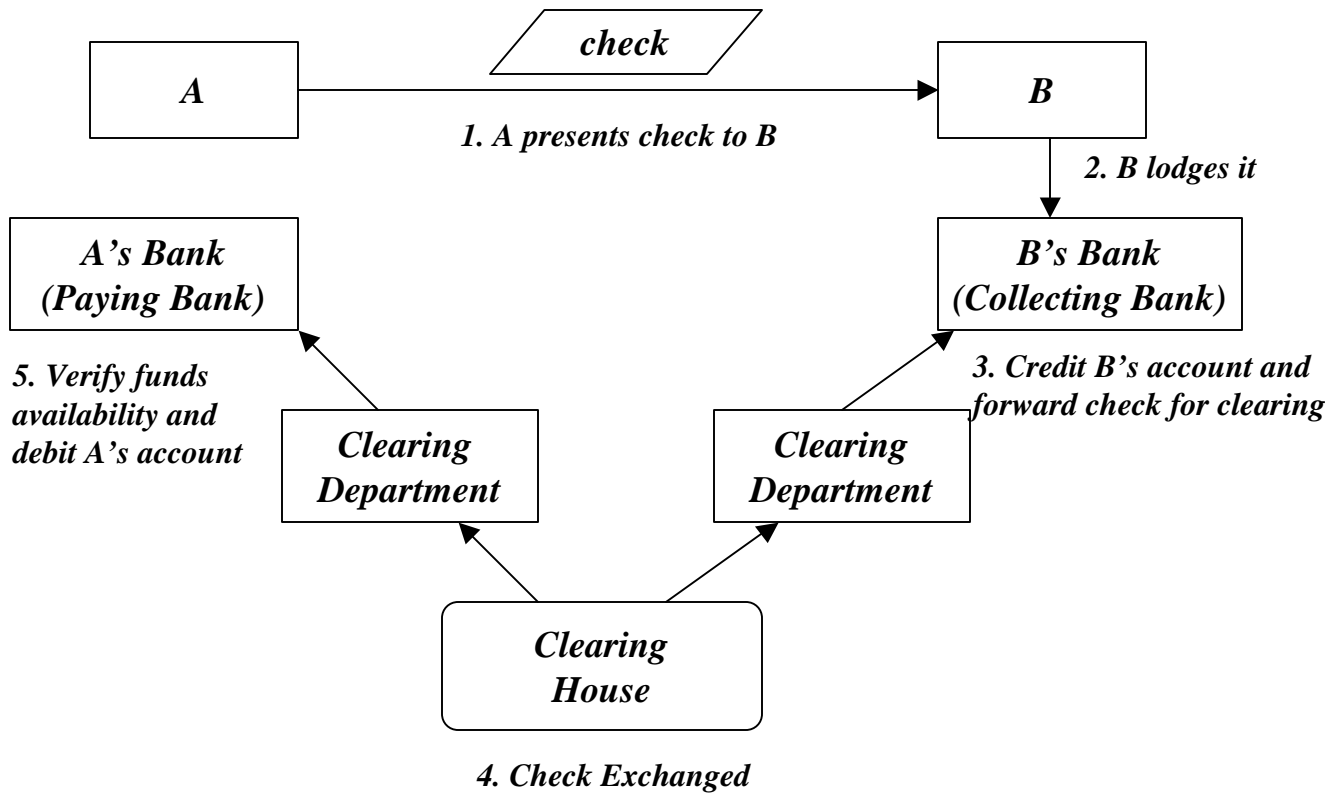
- *Handle the payment transactions between businesses and banks and to and from government.*
- *Involve large value transactions*
- *Higher risk and requirements for security*

Payment using cards: (three types)

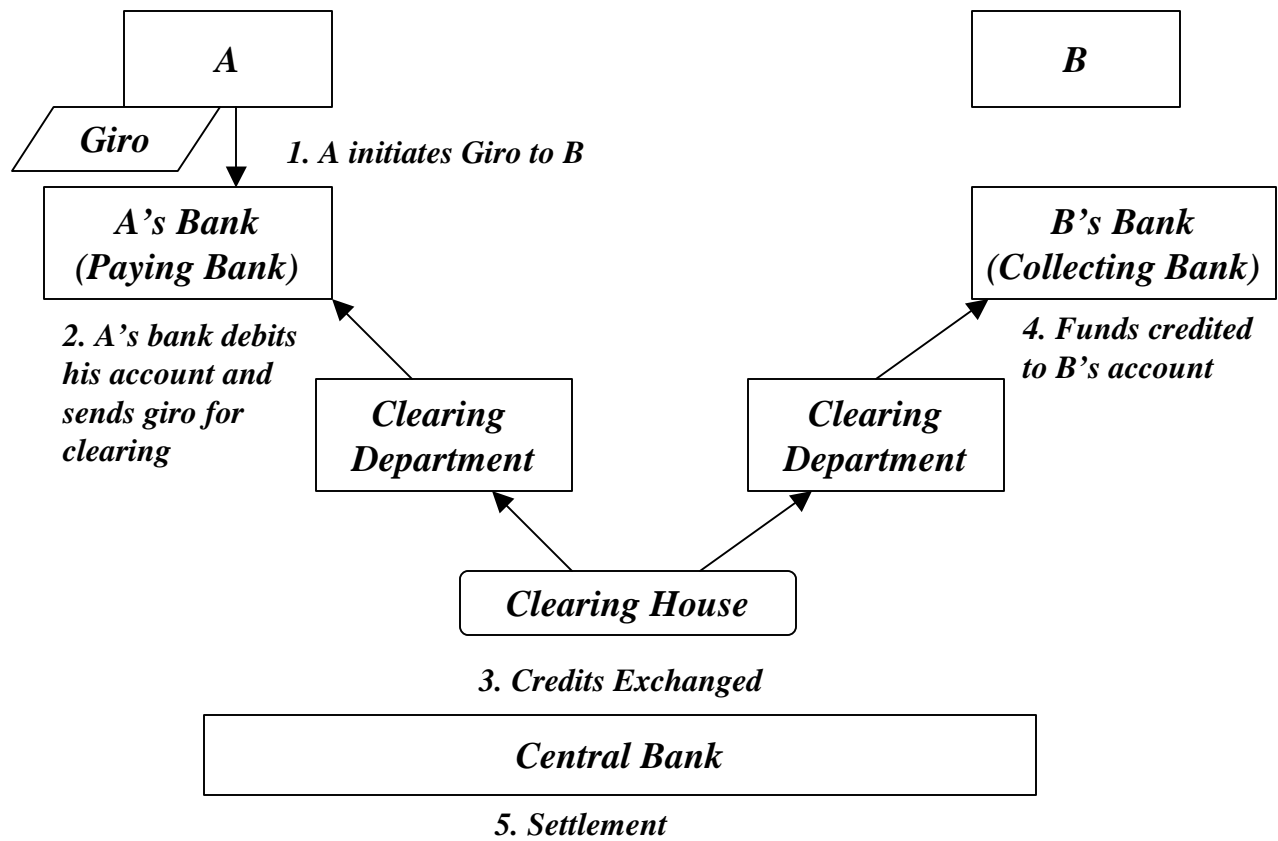
pay before (electronic purse), pay now (debit cards), pay later (credit cards)

- *The idea first arose in 1915.*
 - *In 1947, the Flatbush National Bank issued cards to its customers.*
 - *After 1958, American Express card was born.*
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The Check-Clearing Process



Payment by Credit Transfer or Giro

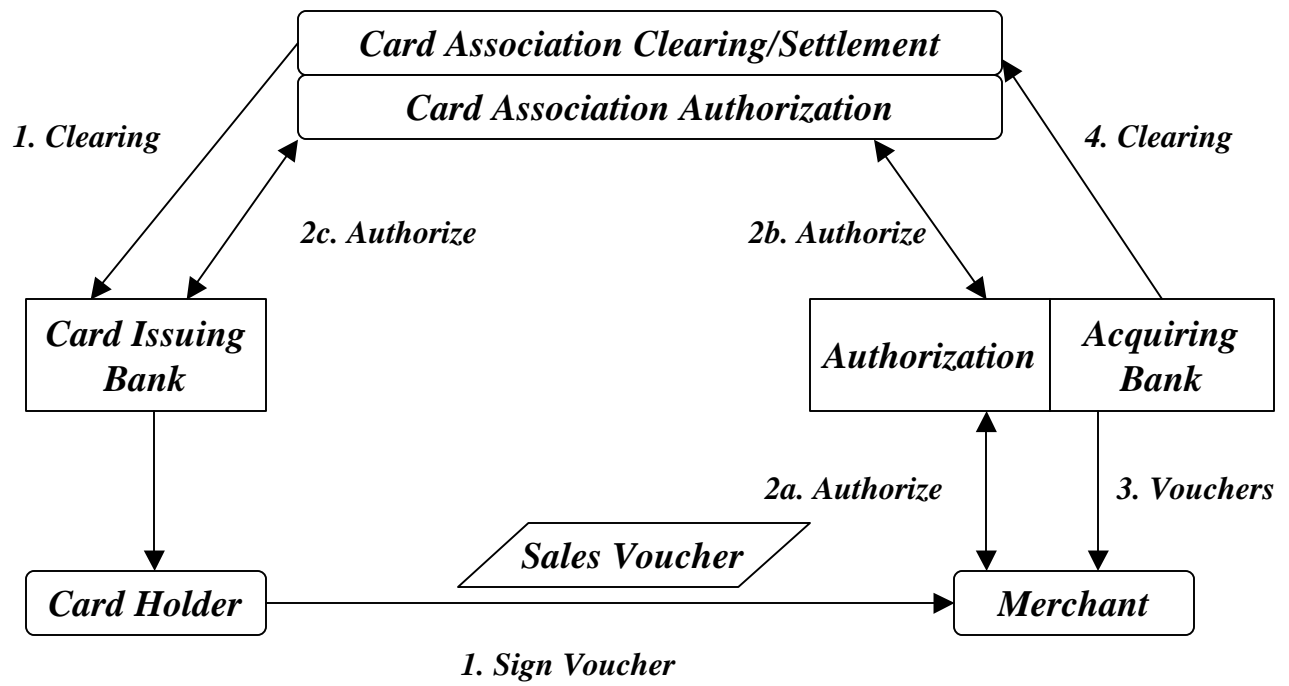


Payment by Credit Cards

Table 2.1 Volumes and Values of Noncash Payments in the United States in 1993

<i>Payment Instrument</i>	<i>Transaction Volume</i>	<i>Transaction Value</i>	<i>Average Value</i>
<i>Check</i>	<i>80%</i>	<i>13%</i>	<i>\$1,150</i>
<i>Credit Card</i>	<i>16%</i>	<i>0%</i>	<i>\$45</i>
<i>Credit Transfer</i>	<i>2%</i>	<i>1%</i>	<i>\$2,300</i>
<i>ACH</i>	<i>2%</i>	<i>1%</i>	<i>\$5,000</i>
<i>Wire Transfer</i>	<i>0%</i>	<i>85%</i>	<i>\$4,100,000</i>

Payment by Credit Cards



Consumer Preferences in Payment Systems

Table 2.2 Consumer Preferences in Noncash Payment Methods by Country in 1992

<i>Country</i>	<i>Checks</i>	<i>Giros</i>	<i>Payment Cards</i>	<i>Direct Debits</i>
<i>U.S.</i>	<i>81%</i>	<i>2%</i>	<i>17%</i>	<i>1%</i>
<i>Netherlands</i>	<i>12%</i>	<i>61%</i>	<i>3%</i>	<i>15%</i>
<i>U.K.</i>	<i>45%</i>	<i>21%</i>	<i>19%</i>	<i>15%</i>
<i>Germany</i>	<i>9%</i>	<i>50%</i>	<i>1%</i>	<i>39%</i>
<i>India</i>	<i>99%</i>	<i>0%</i>	<i>1%</i>	<i>0%</i>
<i>Thailand</i>	<i>26%</i>	<i>7%</i>	<i>65%</i>	<i>2%</i>

Introduction to Electronic Payment and Systems

What is a payment system?

E-commerce application systems must provide payment processing and transaction service to buyers and sellers.

A payment system, as a part of E-commerce application system, is a such system which support secured payment processes by providing reliable, secured, and efficient transaction services between sellers and buyers.

The basic requirements of a payment system:

- *Provide secured and confidential transaction processes.*
- *Conduct authentication and authorization for all involved parties.*
- *Ensure the integrity of payment instructions for goods and services.*
- *Availability, cost-effective, efficiency and reliability.*
- *Global access and international useful*

Introduction to Electronic Payment Systems

Electronic payment is implemented by a flow of money from the payer via the issuer and acquirer to the payee.

Advantages:

- *Fast transaction processing*
- *Flexible of use (24 hours available)*
- *Low cost transactions*
- *Global accessible to customers and businesses*

Disadvantages:

High risks and security challenges due to:

- *Unlike paper, digital “documents” can be copied perfectly and arbitrarily often.*
 - *Digital signatures can be produced by anybody who knows the secret cryptographic key.*
 - *A buyer’s name can be associated with every payment.*
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Introduction to Electronic Payment Systems

Electronic Payment Models:(N. Asokan. Et al, [1])

Direct-payment systems:--> require an interaction between payer and payee.

- Cash-like payment systems

- A certain amount of money is taken away from the payer before purchases are made.

Example: Smart card-based electronic purses, electronic cash, and bank checks

- Check-like payment systems

- pay-now systems (like credit card-based payment systems)

- pay-later systems (like ATM card-based payment systems)

Indirect payment systems:--> the payer or the payee initiates payment without the other party involved online. (Example, electronic funds transfer)

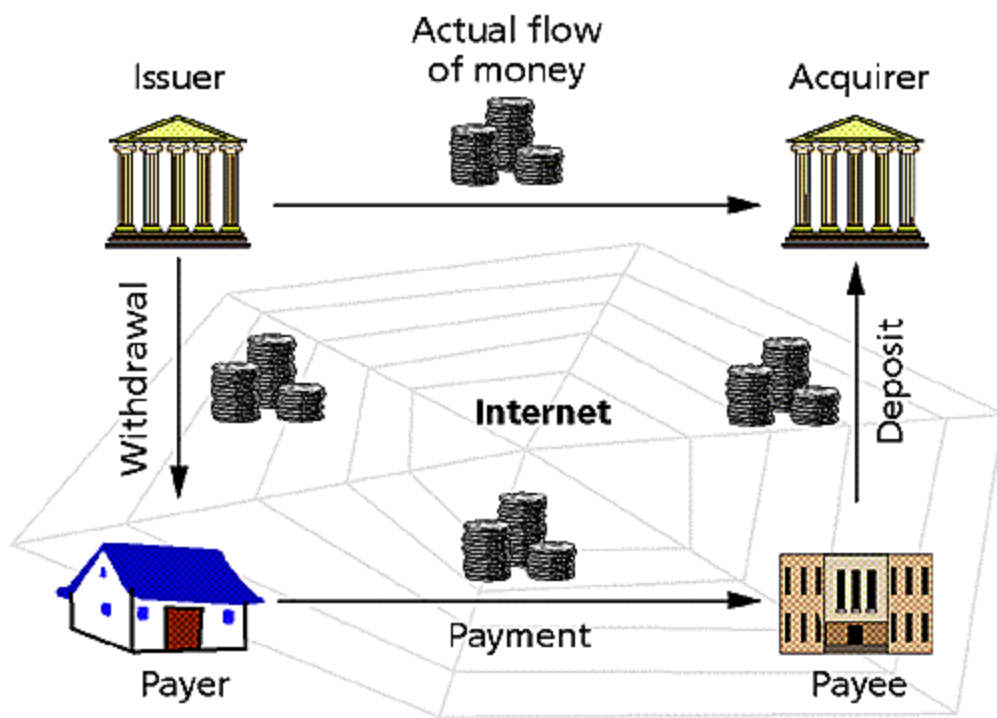


Figure 1. Money flow in a cash-like payment system [1]

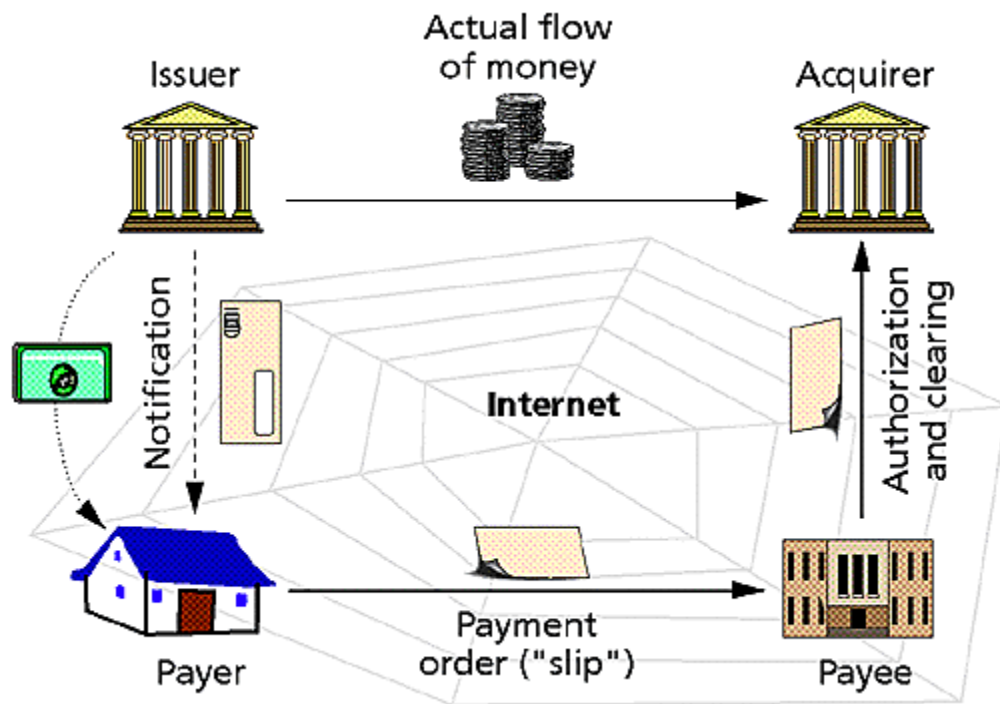


Figure 2. Money flow in a check-like payment system [1]

Introduction to Electronic Payment Systems

Classification of electronic payment systems:

- Card-based payment systems:

Examples: CyberCash, First Virtual (FV), VISA and MasterCard, CARI

- Electronic checking systems:

Examples: FSTC, NetBill

- Electronic cash payment systems:

Examples: Ecash (DgiCash), NetCash, CyberCoin, Mondex

- Micro-payment systems:

Examples: Millicent, SubScrip, PayWord, MicroMint, IKP micropayment.

Overview of Electronic Payment Protocols

To build secure and low overhead electronic transaction systems, different electronic payment protocols are generated and proposed.

A payment protocol is a communication protocol which defines message formats, transaction rules, and sequences between involved parties in payment processing for e-commerce application systems.

The major properties of the payment protocols are:

- Atomicity: This states whether the transaction must occur completely or not.

Two sub cases of atomicity:

a) money transfer atomicity, where funds are transferred atomically.

b) good-transfer atomicity, where the money and the goods are atomically transferred.

- Consistency: All the involved parties must agree on the facts of exchange.

- Durability: It must always be possible to recover the last consistent state.

- Transaction independent: All the transactions must be independent to each other

Overview of Electronic Payment Protocols

Some additional properties of payment protocols:

- *Cost Factor: Conducting a transaction must be economical.*
- *Divisibility: All the involved parties must agree on the facts of exchange.*
- *Scalability: It must support concurrent transactions.*
- *Interoperability: It must be able to move value back and forth between systems.*
- *Conservation: This is composed of temporal consistency, where holds its value over time, and supports different currency.*
- *Online: It gives whether the transaction can be performed online.*
- *Identified: It gives whether the identity of the person performed transaction is maintained.*

Overview of Electronic Payment Protocols

Classification of electronic payment protocols:

- *Account-based payment systems based on macro-payment protocols, where value is stored and exchanged via accounts in the existing systems.*

Examples: iKP, SET,

- *Electronic check payment systems based on electronic check payment scheme.*

Examples: NetBill

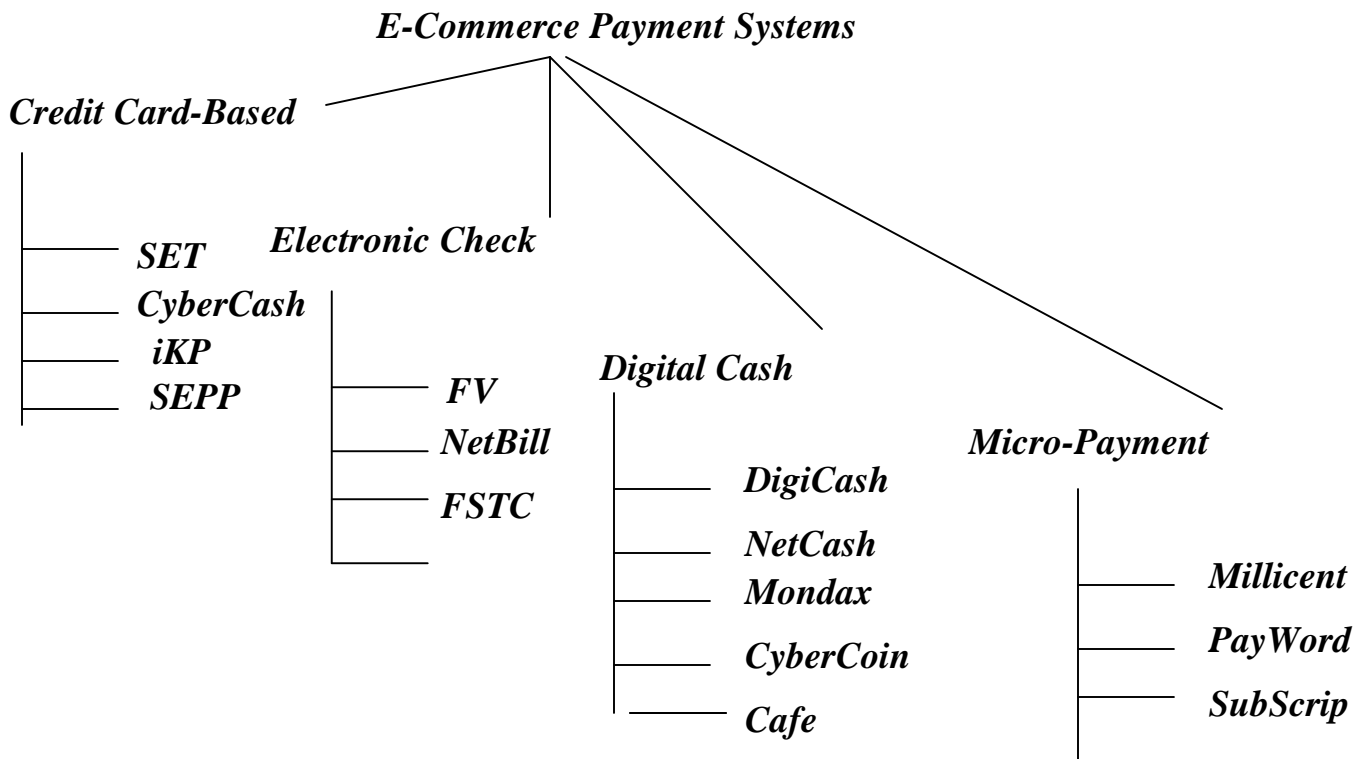
- *Digital cash payment systems based on digital cash payment protocols, where the medium of exchange is a maker representing value.*

Examples: Digicash, Netchash

- *Micro-payment protocols on the Internet:*

Examples: Millicent,

Classification of Electronic Payment Systems



Analysis of Electronic Payment Systems

Credit Card payments:

- *Use the underlying banking network and systems.*
 - *Flexibility: Highly flexible, support ,multiple cards, and adopt to new protocols*
 - *Payment method: pay later*
 - *Cost: transaction cost is high*
 - *Performance: affected by online authorization.*
 - *Scalability: proven to be scaleable.*
 - *User base: large user base*
 - *Application: used for both low-value and high-value payments*
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Analysis of Electronic Payment Systems

Check payments: (based on debits consumer accounts)

- Use the underlying banking network and systems.*
 - Flexibility: Highly flexible, support ,multiple cards, and adopt to new protocols*
 - Payment method: pay now*
 - Cost: least expensive because of one time installation.*
 - Performance: faster than credit-card payments due to no online authorization.*
 - User base: 11% of all Internet transactions are through checks*
 - Application: used for low-value payments*
 - Security: use of digital envelopes and digital signature, payer's account*
-

Analysis of Electronic Payment Systems

Cash payments:

- *Use of smart cards or electronic mint software*
 - *Not flexible due to vendor-specific digital cash or digital coins*
 - *Payment method: pay before*
 - *Cost: expensive at installation, very low or no transaction-cost*
 - *Performance: faster than credit-card payments due to no online authorization*
 - *User base: not widely used yet*
 - *Application: used for low-value payments*
 - *Security: use of digital signature, payer's account*
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References

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- *Donal O'Mahony, Michael Peirce, and Hitesh Tewari, "Electronic Payment Systems", Artech House, Inc., 1997.*