Automating the United States Payment System

by

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in Partial Fulfillment of the Requirements for the Degrees of
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# Table of Contents

Abstract  

Acknowledgements  

Chapter 1. Payment System in the US  

Chapter 2. Traditional Payment Method: Check  

2.1. Check Usage  

2.2. Popularity of Checks  

2.3. Drawbacks of Checks  

2.3.1. Check Fraud  

2.3.2. Destroyed Checks  

2.3.3. High Cost  

2.4. Check Clearing Process  

2.5. Major Providers  

2.6 Future of Checks Collection Market  

Chapter 3. Improvement Methods  

3.1. Types of Improvement  

3.2. Technology available  

3.2.1. MICR  

3.2.2. High Speed Sorter  

3.2.3. Imaging Technology  

3.3. Electronic Check Presentment  

3.3.1 The use of ECP  

3.3.2 To truncate or not to truncate?  

3.3.3 Benefits of ECP  

3.3.4 Drawbacks ECP  

3.3.5 Providers of ECP  

3.4. Point Of Sales Truncation (POS)  

3.4.1 Use of POS truncation  

3.4.2 Benefits of POS Truncation  

3.4.3 Drawbacks of POS Truncation  

3.4.4 Providers  

Chapter 4. Alternative Payment System  

4.1. Automated Clearing House  

4.1.1. The use of ACH  

4.1.2. Benefits of ACH  

4.1.3. Drawbacks of ACH  

4.1.4. Costs of ACH  

4.1.3. Provider of ACH  

4.1.4. Future of ACH
4.2. Credit and Debit Card 85
  4.2.1. The use of Credit and Debit Cards 85
  4.2.2. Benefits of Credit and Debit Cards 88
  4.2.3. Drawbacks of Credit and Debit Cards 88
  4.2.4. Providers of Credit and Debit Cards 89
4.3. Smart Cards 91
  4.3.1. The Use of Smart Cards 91
  4.3.2 Benefits of Smart Cards 92
  4.3.3 Drawbacks of Smart Cards 93
  4.3.4 Provider of Smart Cards 93
  4.3.5. Future of Smart Cards 95
4.4 Home Banking 97
  4.4.1. The use of Home Banking 97
  4.4.2. Benefits of Home Banking 101
  4.4.3. Drawbacks of Home Banking 102
  4.4.4. Provider of Home Banking 103
  4.4.5. Future of Home Banking 109
4.5 Future of Electronic Payments 111

Chapter 5. Comparison Study: International Comparative 113
  5.1. Developed Countries Case Study: G10 113
  5.2. Developing Country Case Study: Thailand 118

Chapter 6. The Future 129
Proposed Solution 131
  6.1. Example 131
  6.2 Technology 134
  6.3 Benefits 140
  6.4 Technology Providers 144
    6.4.1. Optical Character Recognition Providers 144
    6.4.2. Evaluation 151
    6.4.3. System Integrators 155
    6.4.4. Evaluation 160
    6.4.5. On-Line Payment Alternative NetCheque 161
  6.5 Service Provider: Cheqvision 162
  6.6. Conclusion 167

Appendix 169
List of Tables and Figures 169

Reference 171
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Abstract

Despite the advent of technology, the United States continues to write 66 billion checks each year while other G10 nations have successfully migrated to electronic payment. Although electronic alternatives promise future savings, the payment system is an evolutionary process, not a revolutionary process. Thus, a considerable cost savings can still be realized by improving the current check clearing process.

This work discusses the evolution of the payment system, examines the costs, benefits, and the reasons behind check's enduring popularity. Electronic payment alternatives such as automated clearinghouses, credit/debit/smart cards, and home banking are scrutinized for their benefits and feasibility. Check collection improvement methods such as electronic check presentment and check truncation are also studied. One particular system offers end-to-end process efficiency improvement by combining technologies developed at MIT. This system proposes to capture check images using a high performance digital camera, recognize the courtesy amount using patented technology, and transfer the check images with the relevant account information for settlement with a proprietary secure transfer protocol. The cost savings are realized through reduction of encoding operators, elimination of paper check transportation, reduction of fraud, shortened settlement cycle, and improved customer service. This system shows significant promise as the banking solution of tomorrow, and has received a favorable response from both the Federal Reserve Bank and the private sector service providers.

Thesis Supervisor: Amar Gupta
Title: Co-Director, Productivity from Information Technology (PROFIT) Initiative, MIT
School of Management.
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Thank you for the five wonderful years, I could not have made it without you.

*My Thesis Crew,*

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*Dr. Amar Gupta,*

Thank you for agreeing to supervise me and putting up with my constant harassment.

*Bob,*

Thank you for burritos, diskettes, proof reading, and your patience.

*Finally…. Grandma, this one is for you.*
Chapter 1. The Payment System

Every large and vibrant economy requires a reliable payment system to handle the staggering number of monetary transactions. The payment system is the lifeblood of the economy. But for many years the operation of payment systems was not considered to be a subject for active central bank interest or concern: it was relegated to be back-office activity. However, this attitude has been changing for the last two decades largely due to the following reasons:

a. The increase in volume/value of transactions: There has been a tremendous increase in the turnover of the payment systems, both in terms of the numbers of transactions made, and more importantly in terms of the value of those transactions. This phenomenon is attributed to the rapid growth in financial market activity around the world, and the payments generated by such activity. As a result, the existing payment system, unprepared for such a boom, scrambles to cope with the incredible volume of transactions. However, as the financial market activities continue to soar, an improvement or a revamp of the payment system becomes imperative.

b. Technological advances: The last two decades witnessed an incredible technological advance in all disciplines, including the payment system. As a result, financial institutions and consumers both have the ability and the resource to move funds much faster through the system, at a lower cost. Payment system improvement is no longer a vision, but a reality that can take place given sufficient interest.
c. Globalization of businesses: As more businesses reach across national and geographical borders, more financial transactions are flowing across countries. Companies need to pay bills to a supplier in France, pay the salary of the director expatriating in China, and manage the company cash flow globally. The company that has the capability to streamline its payment mechanism is able to trim costs and thus achieve competitive advantage. However, this can only be realized if countries actively search for a solution for cross-nation payments and invest in the infrastructure to make that possible. In order to promote global competition and stimulate national economy, both the government and the private sector need to work together and find the solution to improve cross-border payment system.

The following table illustrates the magnitude of payment system flows in the G10 economies. Looking at the US data, annual payment system turnover is seventy-three times greater than annual GDP; this means it takes roughly three working days for the US payment systems to process a value equal to the country’s annual GDP. The figure is impressive.
<table>
<thead>
<tr>
<th>Country</th>
<th>Annual Turnover in Payment Systems ($000 billion)</th>
<th>Ratio of Payment System Turnover to GDP</th>
<th>Number of days to Turnover annual GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>10.9</td>
<td>47.5</td>
<td>5 ¼</td>
</tr>
<tr>
<td>Canada</td>
<td>11.6</td>
<td>20.7</td>
<td>12</td>
</tr>
<tr>
<td>France</td>
<td>58.3</td>
<td>43.9</td>
<td>5 ½</td>
</tr>
<tr>
<td>Germany</td>
<td>129.1</td>
<td>63</td>
<td>4</td>
</tr>
<tr>
<td>Italy</td>
<td>20.4</td>
<td>29.9</td>
<td>12 ½</td>
</tr>
<tr>
<td>Japan</td>
<td>463.4</td>
<td>100.9</td>
<td>2 ½</td>
</tr>
<tr>
<td>Netherlands</td>
<td>12.4</td>
<td>37.5</td>
<td>6 ¾</td>
</tr>
<tr>
<td>Sweden</td>
<td>6.4</td>
<td>32.6</td>
<td>7 ¾</td>
</tr>
<tr>
<td>Switzerland</td>
<td>24.5</td>
<td>93.9</td>
<td>2 ¾</td>
</tr>
<tr>
<td>UK</td>
<td>42.9</td>
<td>41.9</td>
<td>6</td>
</tr>
<tr>
<td>US</td>
<td>506.5</td>
<td>73.7</td>
<td>3 ¼</td>
</tr>
</tbody>
</table>

Table 1. PAYMENT FLOWS AND GDP IN G10 COUNTRIES

In the United States, hundreds of millions of payments with an aggregate value of about $1.7 trillion are made every day. There are two major types of payments: cash and non-cash paper instruments. Cash accounts for less than one percent of the value of payments, a tiny fraction of the enormous market.

Non-cash payment instruments are instructions that are authorized by the party making the payment to pay a specific sum to a receiver. Non-cash payments are divided into two categories: wholesale or large dollar transaction made primarily by banks, businesses, and governments; and retail or smaller dollar payments made by individuals, businesses and other participants in the economy.
Growing use of electronic payment alternatives such as credit and debit cards have slowed the increase in check volume, but so far has not reversed it. On-line home banking is still in its infancy stage and accounts for a tiny fraction of payments. Moreover, the customer's bill paying instruction from a home computer often simply results in the bank cutting a check to pay the customer's bill, because many payees are not equipped to receive funds electronically. Hence, while the volume of checks is likely to plateau and eventually decline as electronic payments become increasingly convenient and familiar, checks are likely to remain a significant part of the payment system for some years to come.
1.1. History of United States Payment System

Currency

Prior to the Civil War, the most important manner of payment was currency. The dollar value of currency in the hands of the public exceeded the value of deposits, and the dollar value of currency payments exceeded the value of payments by check.

Currency consisted of coins minted by the federal government, U.S. notes, and national banknotes. Notes issued by state-chartered banks were eliminated by the Federal legislation in the 1860s.

A. Coins

The coins were the first official government currency. The U.S. coins have changed many times, since adopting the dollar as the standard monetary unit by the “Mint Act” of 1792\(^1\). The first dollar coin was the silver dollars, which was issued from 1794 to 1935. However, as the price of silver and gold increases, the dollar coin was reincarnated as the silverless Eisenhower dollar in 1971. It was later replaced by the silverless Susan B. Anthony coin, honoring the famed women's suffrage advocate in 1979. A new dollar coin depicting Sacajawea, the Native American woman whose presence was essential to the success of the Lewis and Clark expedition, will replace the Susan B. Anthony coins when the supply is depleted in the spring of 2000.

\(^1\) US Treasury Department. Know Your Money.
Other coin denominations in use today are the 25-cent, 10-cent, five-cent, and one-cent pieces, familiarly known as the quarter, dime, nickel, and penny. However, as the price of copper rises, it was costing more than a penny to produce a penny. In 1981 Congress authorized a change in the penny's composition, abandoning the ninety-five percent copper and five percent zinc alloy used for decades. The one-cent piece is now copper-plated zinc—ninety-seven-point-five percent zinc and two-point-five percent copper. The old and new pennies look virtually identical, but the new coin is about nineteen percent lighter.

- **Composition**

The U.S. Mint, which makes all U.S. coins, was established by Congress in 1792 and became an operating bureau of the Treasury Department in 1873. The US Mint buys the metal strips for various coins from commercial providers, except for pennies. The strips for nickels are an alloy of seventy-five percent copper and twenty-five percent nickel. Dimes, quarters, dollars are produced from three layers of metal fused together, the outer layers are the same alloy used for nickels, and the core is copper.

**B. U.S. Notes.**

During Civil War, the Government was desperate for money to finance the war, so it passed the Act of July 17, 1861, permitting the Treasury Department to print and circulate paper money. The first paper money issued by the Government were Demand Notes.

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Notes commonly referred to as "greenbacks." In 1862, Congress replaced the Demand Notes with United States Notes, also called Legal Tender Notes.

Prior to the founding of the Federal Reserve System, banks issued private bank notes for circulation. During times of financial panic, some banks and clearinghouses refused to clear checks drawn on certain banks. The refusal lead to a suspension of the payment system and further aggravated the financial crisis. To avoid similar disaster and to ensure the robustness of the financial system, Congress established the Federal Reserve System in 1913 to provide elastic currency and monitor the retail payment system. Today, Federal Reserve notes account for more than 99% of the total dollar amount of paper money circulating in the United States. The other small part of currency in circulation consists of U.S. notes or legal tender notes still circulating but no longer issued.

The Federal Reserve System issues Federal Reserve notes through its 12 Federal Reserve Districts. Each district issues currency according to the need in its district, and the note issued has the corresponding number and letter that are unique to each district.

Federal Reserve notes are printed and issued in denominations of $1, $2, $5, $10, $20, $50, and $100.
• Production

The Bureau of Engraving and Printing, a division of the U.S. Treasury Department, is responsible for the production of all currency for the Federal Reserve System, to replace damaged or worn notes, or to support economic growth.

U.S. currency is printed by the engraved intaglio steel plate method, a complicated procedure that gives notes an embossed feel and other distinctive features difficult to counterfeit. Each of the features on the note is made from a steel die. Rolls made from these dies are put together into a master die of the complete note. The master die is then used in the first of a series of operations leading to the making of press plates from which the notes are printed.

• Security Features:

Because United States currency is widely accepted and trusted, it is often counterfeited. In fact, the US Secret Service was created in 1865 to curtail counterfeiting4.

The first security measure is taken during the production phase. Each feature of the note – the portrait, vignette, ornaments, lettering, script, and scrollwork- is the work of a separate, specially trained engraver. A geometric lathe is used to produce the intricate lacy design and borders.

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The currency paper is a mixed cotton and linen rag paper. It has a distinctive, pliable feel and has embedded tiny red and blue fibers. The Bureau of Engraving and Printing specially manufactures the printing ink according to a secret formula to help prevent counterfeiting.

With the advance of technology such as scanners, cameras, copier, printers, and computers, security measures of the notes had to upgrade accordingly. This prompted the redesign of notes that first appeared in 1996 with the $100 note.

The new design for the $100 note, as shown below, has an impressive list of counterfeit prevention features.

![Image of new US $100 note]

**Figure 1. The New US $20 Note**

• Portrait: The new portrait is larger and incorporates more detail. It is also slightly off-center to reduce wear (when people fold the note in half) on the portrait and provides more room for the watermark on its right.

• Watermark: The watermark is created during the papermaking process and it is visible on both sides of the note when held up to the light. It depicts the same historical figure as the portrait.

• Security thread: One of the new security features is the security thread. It is a polymer strip, embedded in the note at a unique location for each denomination. The thread contains Microprinting with letters “USA”, the denomination of the bill, and a flag in the case of the $50 and $20 notes. It is visible when held up to a bright light and the thread glows a distinctive color for each denomination under ultraviolet light.

• Microprinting: Microprinting appears at different locations depending on the denomination of the note. It can only be read under a microscope and is blurry when photocopied.

• Fine-Line Printing Patterns: This refers to the pattern that appears on both sides of the note, in the background of the portrait and the buildings. This type of fine-line printing is difficult to reproduce on scanning equipment or replicated by other printing methods.
C. Checks and Drafts.

As the economy boomed and the value of transactions increased, consumers started to use bank drafts and checks to settle large value obligations. Bank customers created checks payable to those with whom they wished to settle obligations. The bank that accepted a check for collection would then seek payment from the bank on which the check was drawn. However, a majority of inter-regional financial obligations are settled using bank drafts that the consumer can purchase from his or her local bank. The bank draft is usually drawn upon a major national depositary institution and is cleared through clearinghouses in the financial centers. When the draft is cleared, the bank on which it was drawn would debit the account of the bank that sold the draft.

Around the end of the 19th Century, personal checks began to slowly replace drafts to settle inter-regional payments. As the volume of checks increased, the clearing system scrambled to keep up with the workload. Local checks were cleared through local clearinghouses or by presenting the checks to the paying banks. However, out of state checks were far more complex, especially when taken into consideration the exchange charge. The banking law required the banks to pay on par for checks presented directly, but they could pay less than the face amount if the checks arrived by mail or other indirect means. The exchange charge was introduced to cover the expense that the paying bank incurred when transporting coin or banknote to the collecting banks. To avoid the exchange charges, many collecting banks came together and formed a system of correspondent clearing where checks were routed through the member banks until the

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check arrived at the same region as the paying bank and the checks were presented in person.

The advance in technology and continuing increase of check volume introduced new machinery and equipment designed to facilitate the check clearing process. For the past two decades, economists have been predicting a check-less, paper-less society. In fact, it was thought by the end of 1990s checks will be obsolete. However, it was not so. Check continued to enjoy a good health and great popularity with the United States citizens.
Chapter 2. Traditional Payment Method: Checks

2. 1. Check Usage

Compared with other developed countries, the US relies very heavily on paper-based transactions. In Europe and Japan, the paper instrument used is mostly cash, whereas in the US, it is more likely to be a paper check. At seventy-five percent of all non-cash transactions, checks are used much more widely in the US than in any other industrial economy. This reliance on paper-based retail payment method is astounding in this electronic age when information can travel in seconds at minimal costs.

<table>
<thead>
<tr>
<th></th>
<th>% of Retail Payments</th>
<th>% of Noncash Payments</th>
<th>% of Retail Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cash</td>
<td>Noncash</td>
<td>Paper</td>
</tr>
<tr>
<td>US</td>
<td>75</td>
<td>25</td>
<td>78</td>
</tr>
<tr>
<td>Japan</td>
<td>76-86</td>
<td>14-24</td>
<td>34</td>
</tr>
<tr>
<td>Europe</td>
<td>90</td>
<td>10</td>
<td>22</td>
</tr>
</tbody>
</table>

Table 2. Payment Methods of G10 countries

Source: US Treasury, Bank of International Settlements, correspondence with central banks and others.

*Include transactions paid by cash, checks, and paper-based giro.

In 1996, Americans wrote sixty-four billion checks worth about seventy-five trillion dollars. Over the last ten years, the number of checks written in the US grew at an average annual rate of approximately three percent. Average American households write

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eight to ten checks per week while small businesses write about sixty per week. Large corporations write over six thousand checks per week. Despite the effort to replace checks by electronic payments in the last several decades, the growth in check volume merely slowed to two percent annually over the last five years. That is a growth of 1.3 billion checks every year.

2.2. Popularity of Checks

So why has the American retail payment system been so resistant to change? This issue should be examined from both perspectives in the payment system: end users and the financial service institutions:

A. Consumers continue to write checks due to the following reasons
- **Familiarity**
When it comes to the matter of money, people are especially conservative and fear the unknown. The tangibility of paper is somewhat of a security blanket for users because you can touch it, see it, and put it away in a shoebox. Furthermore, many people are not comfortable with smart cards and electronics because they do not understand them.

- **Convenience:**
Checks are easy to write, widely accepted, and the legal status as proof of payment is established. Checks can be used to pay both remote transactions, such as invoices, and point of sale transactions.

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• **Price Sensitivity:**

Checking accounts are lucrative business for banks. Depository institutions tried to make checking accounts more attractive to customers by eliminating a per check fee. As a result, checks appear cheap to the users.

• **Network Effect**

The success of a payment system depends on a large number of willing users. Similar to the telephone system, the benefit of the system increases with the number of users. Checks have been in circulation for over fifty years, and it is accepted by virtually every institution. Consumers are unwilling to switch to a new electronic system that have not been widely adopted by businesses, and merchants are reluctant to invest in the new system unless they are sure that the consumers will accept and use it.

• **Float**

Float is money in the banking system that is counted twice during the delay in the check settlement process.

Businesses and individuals deposit millions of checks at banks every day. When a bank receives a check for deposit, it credits the depositor’s account immediately and later collects the funds from the paying bank. Rather than sort all the checks and send each one back to the bank it was drawn upon for settlement, depository institutions transfer many of their checks to Federal Reserve Banks or other intermediaries for collection. In turn, The Federal Reserve Banks pay the depositing banks for the total amount of the checks, then collect the funds from the banks on which the checks are drawn. A Federal Reserve Bank gives credit for most checks on the same or the next business day, and within two
days for almost all others. However, the bank on which the check is drawn does not pay the Reserve Bank until the check is presented to it. During the delay in processing, both the collecting and the paying bank list the funds on their books thus double counting the money and creating a float.

Any delay element in the check-clearing process can cause float. For example, due to reduced processing hours over the weekend, the backlog of checks causes the float on Tuesdays to be the highest. Holdover float also increases in December and January, when check volume increases for the holiday season. Transportation floats, occurring during the transportation of checks, is caused by weather, mechanical failures or air traffic. Winter weather generally causes transportation float to be highest in December and January\textsuperscript{10}.

A consumer benefits from float because as the check writer, he or she continues to collect interest on his or her money until the check is cleared. This means the longer the delay, the higher the benefit.

B. Banks continue to support check writing for the following reason

- Network Affect:

Banks do not want to invest in a new electronic system unless they are sure their customers will accept and use it. Moreover, an effective new payment system is only useful if other deposit institutions also deploy it. The cost of being the pioneer in a highly network dependent venture is too high for most banks to handle and the full

\textsuperscript{10} Federal Reserve Bank of New York. Fedpoint 8: Float.
benefits of the new system can only be realized when the majority of the industry also implements the changes.

- **Familiarity**

  Similar to its consumers, the financial industry is highly risk averse and suspicious of new technology. They feel they have already dealt with check processing for the past 50 years, so all the problems are either solved or at least known. With the electronic system, it represents the unknown, and thus is perceived to be risky.

- **Cost**

  More than anything else, banks are concerned with profit. They have already invested millions of dollars in the check clearing infrastructure and equipment. Scraping all of that and investing more money in an unproven system is an unappetizing thought for banks. Furthermore, an incremental approach to install a new system requires investing in a new system and maintaining the existing check process in parallel, which is far too expensive for most banks’ tastes.

- **Float**

  As described above, not only individual consumer benefits from float, so do banks. The daily million-dollar check transactions translate into huge value of floats, generating lucrative profits for the banks.
2. 3. Drawbacks of Checks

2.3.1 Check Fraud

Losses due to check fraud are huge—and growing. According to the Federal Reserve’s study of check fraud, the estimated value of check fraud losses at commercial banks, credit unions and savings associations in 1995 was four hundred and eighty-seven million dollars. This number increased to one billion dollars of attempted fraud\(^\text{11}\) and five hundred and twelve million dollars actual loss in 1997. The same study also showed that check fraud losses are increasing at the rate of nineteen percent per year.

There were 529,000 cases of check fraud and about fifty-seven percent of all banks incurred some form of check fraud losses every year\(^\text{12}\).

Types of fraud include account closed and kiting, counterfeit, forgery, bankruptcy, and refer-to-member. The most common type of check fraud in 1997 was forgery, which include forged maker’s signature and forged endorsement. More than half of the fraud cases and four dollars out of every ten dollars in fraud losses are attributed to forgery\(^\text{13}\).

Checks written against consumer accounts were the most common source of check fraud, with community banks and mid-size banks more adversely affected than larger banks. At small banks, three out of four fraud cases and two dollars out of every three dollars in

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\(^{12}\) Board of Governors of the Federal Reserve System. 1995.

fraud losses were from consumer accounts. At large banks, consumer accounts accounted for about six in ten fraud cases and half of the fraud losses\textsuperscript{14}.

Regulation CC, created to enhance the check clearing system, has an unintentional benefit for the criminals. This regulation stipulates that banks are no longer allowed to hold checks for 10 days. As a result, criminals can forge a check, open a new account, and deposit the fraudulent check at a local bank. The account will be credited immediately and the money will be available for withdrawal the very next day. The bandits will be long gone before the physical check even arrives at the alleged paying bank.

2.3.2 Destroyed Checks

In the normal course of check collection, occasionally checks are lost or destroyed. In November of 1991 a plane crashed containing a significant volume of checks. Without some backup system such as photographing or photocopying the physical checks prior to relocation, destroyed checks present a big problem to the banking community.

2.3.3 High Cost

According to Jake Guynn, the President and CEO of Federal Reserve Bank of Atlanta, the existing payments system consumes one to two percent of Gross Domestic Product, a number four times that of other industrial nations\textsuperscript{15}. In 1997, one hundred and eighty-one billion dollars was spent processing checks\textsuperscript{16}

\textsuperscript{15} Guynn, Jake. October 28, 1996.
The current paper based check-collection system is resource-intensive with little promise of future cost savings. This system relies on operators, mechanical processing equipment, buildings and a huge transportation network of cars, trucks, and planes. The processing of checks involves receiving and preparing deposits for processing, sorting checks and inputting accounting data, reconciling the accounting data, and packaging and dispatching the checks for presentment to paying banks. If some processing problems occur during the process, additional human intervention is required. Personnel costs account for about half of all direct and support costs involved in processing commercial checks at the Federal Reserve, while transportation expenditures account for about ten percent.\(^{17}\)

The actual cost breakdown of check clearing is very difficult to obtain. But it is reasonable to assume the cost has two major components, a fixed cost such as building, equipment, and salaries of operators, and a variable cost such as handling of checks. The fixed costs are amortized over the volume of checks handled, and the variable costs are the marginal costs associated with each check processed. Federal Reserve Banks, as the largest third-party check-processing providers, are a good indicator for the industry standards.

Under the Monetary Control Act of 1980 (MCA), the Federal Reserve is required to set its payment service fees to recover all direct and indirect costs in the long-run\(^{18}\). In addition, the Federal Reserve Banks are required to recover imputed costs, which are the

\(^{17}\) Rivlin, Alice M. September 16, 1997.

\(^{18}\) Rivlin, Alice M. September 16, 1997.
cost of capital and taxes, to correctly reflect the true costs and profits of a private-sector service provider.

- **Transportation Cost:**

  Each Federal Reserve has its own local transportation network to present checks to local paying banks. This transportation consists of private-sector ground couriers, supplemented in many cases by private-sector air couriers. The nonlocal checks are shipped between the forty-five Federal Reserve regional offices by a transportation network. Inter-district Transportation system, ITS, is a privately owned network managed by the Federal Reserve. ITS is a ground and air courier network made up of private-sector firms who are awarded the contract based upon a competitive bidding process. The network is divided into five geographic regions with the following five hub cities: Atlanta, Chicago, Cleveland, Dallas, and Philadelphia. Checks are flown into the regional hub cities then sorted at the hub cities according to their final destinations. Those shipments destined for Federal Reserve offices in the same region are flown and delivered to those offices. The shipments for other regional offices are flown to the corresponding hub city serving those regions for eventual delivery to their final destinations. Approximately fifty aircraft make about two hundred flights nightly in addition to innumerable ground courier pickups and deliveries. This system costs thirty-six million dollars in 1996.

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19 Rivlin, Alice M. September 16, 1997. Appendix II.
20 Rivlin, Alice. September 16, 1997. Appendix II.
• **Labor Cost**

Check clearing is a very labor intensive process. Each check is handled on average by eight to twelve operators during the collection cycle. Those operators handle deposit slips, sort and bundle checks, read and input the relevant check information, verify and re-conciliate the account information, and finally send the physical check (or image of the checks) back to the check writer. At the small and mid-size banks, there are on average two salaried employees and five hourly workers responsible for check clearing. At larger institutions, the encoding staff can be made up of forty salaried employees and seventy hourly operators. The average wage rate ranges from $6.75 to $10.67\textsuperscript{21}, so the labor expense for the hourly operators alone costs about eight million dollars. At the larger banks, about forty-five percent of check processing costs is for salaries. Furthermore, the high turnover rates necessitate training for new operators, which is also a costly expense.

• **Other Costs**

**Equipment Costs:**

As check clearing becomes more automated, the number and the type of machines required increases. At the same time, as the technology becomes more sophisticated, the price raises accordingly. Banks anticipating spending approximately three times as much on imaging equipment than on other types of equipment (e.g., sorter/reader, proof/encoding). Larger financial institutions planned on spending an average of four-point-one million dollars for imaging equipment in 1997\textsuperscript{22}.

\textsuperscript{22} American Bankers Association. 1996. Survey on Check Processing
Service fees:

Most financial institutions, except regional banks, pay the Federal Reserve Bank for the clearing and net settlement service. The average monthly charges per bank range from $14,000 for mid-sized banks to $700,000 for super-regional banks.

Regional banks use the correspondent network to clear the checks. The average monthly charge per bank for such service range from $12,000 in the mid-sized banks to $700,000 at money centers\textsuperscript{23}, very comparable to the fees paid to the Federal Reserve.

2.3.4. Cost Associated with Checks

Although checks seem so cheap and easy to use to consumers, in the macroeconomic perspective, checks are extremely inefficient method of payment due to the high processing costs.

In a study by Wells, the estimated social cost of a check transaction is $2.78 to $3.09\textsuperscript{24}. Social cost refers to the extent of influence one single action has on the rest of the society. In the case of check, the paper check must be produced, the bill must be mailed to the consumer, the consumer must write the check, put the check inside a stamped envelop with the invoice, and sent it through the US Post Office system. The postal service must handle this envelope multiple times before it arrives at the destination. At which point, operators will handle the check, reconcile against the consumer’s account, and deposit the check. Once the check is deposited with a bank, it must be processed
several times before the final settlement. As one can see, this process incurs a significant cost at the expanse of rest of the society, while the check writer feels none of this cost.

From the banking industry’s perspective, the cost associated with checks can best be estimated using the Federal Reserve Fee schedules which combine fixed and variable fees and is set locally by Federal Reserve offices. The “cash letter” fee, associated with the fixed cost, is intended to recover costs that do not vary with the number of item deposited, while per item fees are intended to recover at least the margin all cost of processing an additional check (variable cost). Prices for various products are related to deposit deadlines, the amount of processing the Reserve Banks must perform before the checks are packaged for delivery, and the distance the checks must be transported to paying banks. In 1996, the Reserve Banks charged an average of $0.023 to collect a local check and $0.045 to collect a non-local check. Over the last ten years, the Federal Reserve has recovered 100.7 percent of the costs of its priced services, including imputed costs and profits. Moreover, the Federal Reserve’s revenue has exceed its actual costs of providing priced services by approximately $1 billion, which is turn to the Treasury for the benefit of the US citizens.

2.4 Check Clearing Process

Payment processing encompasses the systems and procedures that are used to authenticate a payment instruction and to facilitate the transfer of funds from the bank

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24 Wells, K.E. 1996.
account of the person making a payment (payer) to the bank account of the receiver (payee).

Currently, the process of clearing and settling checks is based almost entirely on physical presentment of the paper check to the paying bank, which then usually mails the canceled checks to its depositors with their monthly bank statements.

Each day at closing, bank sorts the inter-Bank checks it has received into separate piles corresponding to the subsequent collection process. The direct presentment checks are packaged for delivery via a prearranged air or ground transportation network. Clearinghouse checks are bundled and delivered by messengers to the other members of the clearinghouse at a designated time each day. The remaining checks destined for intermediaries such as correspondent banks and Federal Reserve Banks for collection are deposited at the local branch of the appropriate institutions.

- Federal Reserve Banks: Checks deposited at the local branch of Federal Reserve Banks are sorted into the local paying banks and the nonlocal Federal Reserve Bank offices. Nonlocal checks are shipped to other Federal Reserve Bank offices around the country via the Federal Reserve’s Interdistrict Transportation System (ITS), which is a network composed of private air and ground couriers that operate under contracts with the Federal Reserve to ship checks. After all the checks have been arrived at the proper Federal Reserve Branch and sorted, the Federal Reserve Bank office makes checks available for pickup or arranges to have them sent to the paying bank via a private courier.
• Correspondent Banks: Checks processed by correspondent banks are cleared in either one of the two ways: the checks can be sorted according to the individual paying banks, then presented directly to paying banks or at a clearinghouse. Checks can also be collected using additional intermediary. In this case, checks are sorted based on the requirements of the other intermediary. Correspondent banks arrange with private couriers to deliver checks to paying banks for presentment or to other intermediaries for collection.

![Paper Check Processing](image)

**Figure 2. The Check Clearing Process**


2.4.1. Demographics of Check

• **On-Us Checks**

On – Us checks are checks written by the customer of a bank to another customer of the same bank. Upon presentation of the check, the bank can clear it within the bank’s internal system. Approximately thirty to thirty-five percent of all checks are on-us checks and cleared in-house.
• **Inter-Bank Checks**

The remaining checks are inter-bank, which are checks presented at a bank different than the paying bank. About forty-two to forty-five billion checks have to be transported and presented to the paying bank to obtain payment every year\(^{26}\). There are many methods of collection for inter-bank checks:

• **Direct Presentment**

Also known as bilateral correspondent arrangement, if the bank receives sufficiently large volumes of checks drawn on an individual paying bank, the two banks can establish a bilateral relationship, whereby each bank holds an account with the other. The collecting bank will ship the checks directly the paying bank. In 1996, about one-seventh of the inter-Bank checks were presented directly\(^{27}\). Each bank uses its own private air and ground transportation couriers to present the checks.

• **Clearing Houses**

Payment system with multilateral net settlement usually operate through a clearing house, a central location through which the payment instructions pass and which is responsible for calculating the multilateral net positions of the member banks and passing them on to the central bank for posting to the members’ settlement account.

Clearing houses may be owned and operated by the Federal Reserve or by the commercial bank, or by a combination of the two. They may be designed to handle either paper or electronic/automated payment instructions. With electronic payments, the clearinghouse may process them in batches, or in real-time as each instruction arrives.
Clearing houses may be organized to serve the whole country, or on a regional basis within the country. The regional organizations are particularly useful in the countries with poor communications and transport infrastructure, or countries with large geographical distribution.

There are over one hundred and fifty local and regional check clearinghouses and one national clearinghouse in the US. Participating banks typically establish operating rules for the clearinghouse and agree to exchange checks with each other at a specified time at a designated location. In 1996, about one-fourth of inter-bank checks were exchanged at clearinghouses.28

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**Figure 3. Role of the Clearing House**
Source: Bank of England

- **Third-Party Service Provider**

Over sixty percent of all inter-bank checks are collected using intermediaries such as correspondent banks and Federal Reserve Banks. The earliest correspondent clearing network was the Suffolk System. The Suffolk Banking System, which operated during 1825 and 58 was a net-clearing system for commercial banknote organized and operated by Suffolk Bank of Boston. Suffolk required the banks for which it cleared notes to hold deposit balances with the Suffolk Bank. Prior to the founding of Federal Reserve System in 1914, interregional collection of checks and bank drafts was carried out mainly through correspondent bank networks. An out-of-town check deposited at a bank in one city might be sent to one or more correspondents of the receiving bank before being presented to the bank upon which the check was drawn. This system was widely deemed unsatisfactory because the time and expense of interregional clearing often seemed excessively high.

One of the important motives for establishing the Federal Reserve System was to improve the efficiency of interregional payments. Toward this end, the Federal Reserve System also serves as an intermediary in check collection, serving primarily small banks in remote regions. In 1996, the Federal Reserve Banks collected about one-third of all inter-Bank checks, and correspondent collected about a one-fourth of them.

Banks determines how to collect the checks based on its processing capabilities, the price charged by various intermediaries, and the amount of time it takes the intermediary to provide access to funds collected from check deposits.

<table>
<thead>
<tr>
<th>Check collection channel</th>
<th>Volume (billions of checks)</th>
<th>Market Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing house</td>
<td>10-11</td>
<td>23-24</td>
</tr>
<tr>
<td>Direct Presentment</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Correspondent Banks</td>
<td>10-11</td>
<td>24-25</td>
</tr>
<tr>
<td>Bankers’ Banks</td>
<td>&lt;1</td>
<td>1</td>
</tr>
<tr>
<td>Third-party Service</td>
<td>&lt;1</td>
<td>1</td>
</tr>
<tr>
<td>Provider</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal Reserve Banks</td>
<td>16</td>
<td>35-37</td>
</tr>
<tr>
<td>Total</td>
<td>42-45</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 3. Check Collection Market**  
Source: Federal Reserve Bank.

### 2.4.2. Encoding/Proofing

Most banks maintained only a single center for check processing-related data/computer processing. Community and mid-sized banks typically have one capture site and one proof/encoding site, while larger institutions average two sites for each of these functions.

At small and mid-sized banks, about ninety percent of all encoding/proofing were performed at a central location with an average monthly volume of 99,000 checks\(^{31}\). Regional and super-regional banks have encoding sites at several locations, and process on average thirteen million checks a month.

Power encoding, which are technologically enhanced encoding techniques such as image capture and image processing, is more likely to be employed by larger banks.

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\(^{31}\) American Banking Association 1996.
Encoding/Proofing is a labor-intensive process. Banks employ a mix of full and part time personnel to staff the encoding operations. The number of staff ranges from two at small community banks to one hundred and twenty at the super-regionals. At the smaller banks, approximately half of the staff is full-time salaried, and the other half is paid on a permanent hourly basis with benefits. Proofing and encoding are extremely tedious and fatiguing tasks, as a result, there is significant and costly operator turnover rate. At larger banks, there are more part-time hourly workers, and the turnover rates range from thirty-two percent to forty-one percent, compared to twenty-one percent at the community banks.32

2.5. Major Players

- Federal Reserve Bank

As mentioned before, one of the founding reasons for the Federal Reserve System was to improve the efficiency of payment system. To this end, the Federal Reserve System acts both as the regulatory authority, as well as an active provider of check clearing services.

Each Federal Reserve Bank offers a wide range of payment services to banks and other depository institutions in the inter-Bank market. These services include cash services, net settlement services, wholesale payment services, such as Fedwire funds and book-entry securities transfers, and retail services, such as check collection and the Automated Clearing House. In addition, the Federal Reserve serves as the fiscal agent and provides a range of payment services to the Treasury Department.

The check collection services offered by the Federal Reserve consists of the processing and transportation of checks from those depository institutions wishing to collect funds associated with checks deposited by their customers. The Reserve Banks process and sort checks deposited by these “collecting banks” and transport them to “paying banks” (the depository institutions on which the checks are drawn) to initiate presentment. The Reserve Banks are capable of receiving from and presenting to all depository institutions throughout the United States. The Reserve Banks also handle checks that are dishonored by the paying bank for various reason, also known as return items, and provide a range of service to paying banks, such as early notification of checks that will be presented for payment later in the day. In 1996, the Federal Reserve accounted for about one-third of the estimated forty-five billion inter-Bank checks collected in the United States.  

- **New York Clearing House (NYCH)**

The New York Clearing House Association is the nation’s first and largest bank clearing house. Established in 1853, its role was to establish order from confusion, to simplify the chaotic exchange and settlement process among the banks of New York City. Prior to the founding of the Federal Reserve, the New York Clearing House was also responsible for stabilizing currency fluctuation and the monetary system through recurring times of financial panic. With fifty-two member banks and twelve hundred users, daily average transaction of one-point-five billion dollars, New York Clearing House is by far the largest clearinghouse in the United States. New York Clearing House leverages its prominence in the industry to push for technological innovations.

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improvements such as the Clearing House Inter-Bank Payments System (CHIPS), introduced in 1970, an on-line, real-time payment system that transfers funds and settles transactions. Other technological innovative services include:

- New York Automated Clearing House (NYACH), an electronic funds transfer for small-dollar payments.
- Clearing House Electronic Check Clearing System (CHECCS), a system for electronic check presentment. It was established to reduce risk and improve the efficiency of check clearing, by speeding up the transfer of check information.
- Private ACH Exchange (PAX) for nationwide ACH exchanges, to reduce risk and costs for banks.
- Funds Availability Notification System (FANS), a shared regional database for fraud reduction.

2. 6. Looking forward: The changing landscape

The ongoing consolidation in the banking industry has several significant impacts on the payment processing market. First, the consolidations can lead to the creation of nation-wide banking organizations. This means more organizations will need to develop the capabilities to process inter-regional “On-Us” checks. The absorption of medium size banks by large corporations will reduce the number of regional players, leaving community banks with fewer choices of check service providers in the future. Furthermore, the decreasing need for inter-regional inter-bank check clearing will lead to the withdrawal of active correspondent banks, a scenario that has been reported in some local markets. Smaller depository institutions have also expressed concerns about the

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\[34\] New York Clearing House WebSite.
continuity of check collection services provided by commercial providers, since these providers can choose to withdraw services at any time when facing decline in demand and revenue. These recent changes have lead many financial institutions, large and small, to re-examine their payment processing capabilities.
Chapter 3. Improvement Methods

3.1. Types of Improvements

A. Reduce Process Time

The check settlement process is very time consuming. The process starts with the operators manually sorting, reading, and encoding each check at the site of deposit, transporting the checks from one point to another, to subsequent handling, inspection, and verification of each check. This lengthy process is inefficient and costly. There are several areas of possible improvement.

Sorting Time

At the back office, a high-speed high-volume reader/sorter can be employed to sort and handle checks. These machines will read the MICR encoded information on the check regarding paying bank, bank branch, and account number, then sort them into corresponding piles for the next stage of settlement. The machines are faster than human operators, and free the operators from the tedious tasks of sorting and packaging.

Encoding Time

- Automatic Reading/Encoding: Bank employs a software algorithm that will read the courtesy amount and encode it in MICR at the bottom of the check along with the rest of the information. This will eliminate human operator encoding;

- MICR encoding at the teller station: When the customer presents the check to the teller for deposit, the teller keys in the amount on the check to credit the customer’s account and prints the receipt for the customer. A peripheral device can
simultaneously take in the information and print the amount in MICR at the bottom of the check.

**Transportation Time**

Clearly, the most time consuming lag of the settlement process is the physical movement of the checks. Certainly, a well-organized and dedicated air and ground transportation team can reduce the time, but no matter how fast the plane flies or the truck drives, it is still limited by the constraints of physical capabilities. If the physical movement of the check can be eliminated, the process can speed up considerably. Settlement of the checks is really dependent on the relevant information captured on the paper, so the necessary information is the name of the paying bank, the branch of the paying bank, the payee’s account number, and the amount on the check. The physical item of the check is important only in the authentication process, where the signature of the check writer can be used to check for fraud. With the advent of technology, we are now capable of transmitting and receiving data electronically within a matter of nanoseconds, irrespective of physical location and geographical boundaries. This change shows the greatest promise to drastically reduce the time of check settlement.

**B. Decrease Cost**

The check clearing process is extremely costly. It is estimated that banks with high customer check usage spend over fifty percent of the operation budget on the check clearing and support system. This cost consists of operators' salaries and compensations, machine purchase and maintenance, retaining private transportation crew or contracting out to private couriers, and fees to clearing houses or the Federal Reserve.
• Machine Sort: Using machines to sort and handle checks can greatly reduce the number of operators, thus reduce the costs of salaries and benefits.

• Transportation: if the physical presentment of the checks can be eliminated, then there will be no need for the transportation network, crew, and private couriers, which will provide even more significant cost saving.

• Furthermore, the electronic settlement also reduces the need for operators in the downstream of the settlement process. More specifically, there will be no need for the operators at the clearinghouse or the paying bank to handle the checks, which will provide further cost reduction.

• Finally, if all banks have the capability to transfer check-clearing information multilaterally with each other, then there will be no need for clearinghouses or the Federal Reserve's payment services. The elimination of intermediaries will save the banks monthly and per-check service fees, and allow the Federal Reserve to concentrate on the task of monitoring the monetary policies of the country.

C. Increase Accuracy

Check reading and encoding is an extremely tedious and tiring job. Continuously reading the sometimes illegible script and keying in the amount for an extended amount of time can result in mistakes, especially under the time pressure as most banks have a tight window of settlement time. Misread checks are costly if not caught earlier on during the settling process, because they must be returned from the paying bank to the bank of deposit. To safeguard against costly mistakes, banks
sometimes have a second operator who proofreads all the inputs. Redundancy in system increases reliability, but at the same time also increases the cost. A possibility would be to build in this redundancy in the form of a feedback system in the automatic reading algorithm mentioned above. This will not only eliminate the need for the proofreader but also protect the banks from costly mistakes.

3.2. Technology Available

3.2.1. MICR

Invented through a joint program of Stanford University and Bank of America, Magnetic Ink Character Recognition, commonly known as MICR, is the banking industry standard for machine processing checks.

This technology relies upon the interpretation of a unique magnetic waveform given off by characters printed with ink containing iron oxide. The character set adopted consists of four special symbols and ten digits. The characters are specially shaped to allow a single, wide, magnetic head (similar to those found in tape recorders) to pass over the character and generate a unique electrical pattern for each character.

After MICR imprinted checks are received at the bank, they are first put onto a track and pass through a magnetic field. The magnetic ink of each character retains this magnetic charge, allowing the read head to determine the character type. This is similar to data stored on a floppy disk, although less permanently. The reading is done based largely on character widths. The magnetic reading head generates a signal any time the amount of magnetic material under the head varies by a significant amount. Each character is contained in a one-eighth inch square box and is broken into imaginary cells as shown
below. Each character must be contained within these cells and must be printed with considerable precision to ensure that the reading equipment will read the information correctly\textsuperscript{36}.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{micr_symbol_nine.png}
\caption{MICR Symbol of Character “Nine”}
\end{figure}

\textit{Source: MICR News and Information}

\subsection*{3.2.2. High Speed Sorter}

The two earliest mechanical sorters are Sort-A-Matic and Top Tap Key Sort. The Sort-A-Matic provided 100 metal or leather dividers numbered 00 through 99, each check to be sorted would then be placed into a corresponding divider based upon the first two numbers of the account. This process was then repeated for the next two digits of the account number, etc. and when completed the checks would be sorted.

Checks using Top Tabs Sort had small holes punched in the tabs to indicate the one’s, ten’s, and hundred’s, etc. digits. By placing a long metal "key" through the holes in the

\textsuperscript{36}Mark, William, January 6, 1999.
tabs, all the checks with a corresponding 100's, 200's, 300's, etc. could be pulled. Then this would be repeated for the 10's, 20's, etc., until all the checks were sorted. At the time, there was even a marketing controversy concerning whether the holes should be round or square. The square hole was the ultimate victor.

Both methods were effective but slow. The "punch card" style checks were developed to provide faster mechanic sorting. Although these were much improved, they were too costly to produce and unsuitable for the mass market because of the cost of punching the holes and the problem of damaged or obscured holes leading to a mis-sorting of the checks.

Fortunately, with the invention of MICR encoding came the MICR reader/sorters. They were faster and more equipped to handle the sixty-six billion checks written by Americans each year. Currently there are two types of Reader/Sorters, Slot reader and Matrix Reader. The slot reader uses a wide magnetic read head as mentioned above. When the Slot reader encounters stray magnetic ink, dropouts in printing, or a badly formed character, it rejects the document. Furthermore, if the ink does not have enough magnetic material, the document will be rejected. This is an important fraud prevention feature to ensure fraudulent checks with an insufficient level of MICR content are ferreted out.

A rejected document must have a "repair strip" attached to it. It takes time to attach the strip and hand type the complete MICR line. The improperly MICR encoded checks are rejected by the reader/sorter and are sent back to the bank that presented the item. The
cost of reprocess can go as high as $2.75 per check\textsuperscript{37}. The Federal Reserve Bank passes the cost of processing reject items back to the bank that presented the reject item.

Matrix readers are much more expensive, cost in the million-dollar range, but are much better than a Slot reader. It reads the MICR character by breaking each character into a matrix of cells, as the figure shown on the previous page. This technology has sufficiently advanced so that it can reliably read a 0 character with half of the 0 missing.

MICR readers/sorters are costly investments, and with the large volume of the checks that passed through banks each year, often a single reader/sorter per processing site is insufficient. For small banks and financial institutions, it simply is not feasible to make such a large investment. As a peripheral to its payment services, the Federal Reserve also provides check sorting for smaller institutions. Responding to the need for clearing an increasing volume of inter-regional checks, the Federal Reserve recently unveiled a new program named Nationwide City Sort to promote the consistency and improve the check collection nationally. This new program will allow institutions to deposit with their local Federal Reserve office items drawn on institutions in any of the other 47 Federal Reserve cities, using a single cash letter. Financial institutions that perform in-house sorting will be able to reduce to a single reader-sorter pocket for all non-local Federal Reserve city items. Furthermore, they save on cash letter fees, since checks going to as many as 47 other Fed cities can be deposited in one cash letter.

\textsuperscript{37}Stavins, Joanna. July/August 1998.
All Federal Reserve offices offer Nationwide City Sort for a cash letter fee of $4.00, and a tiered per-item fee of $0.022 for low-cost destinations, and $0.032 for high-cost destination\textsuperscript{38}.

3.2.3. Check Imaging

There has been a heightened interest in the use of check imaging in the clearing process. Check imaging is the process of capturing the picture of a check electronically and storing that image on a computer. The images can be captured using either a scanner or a camera. The digitized image of the check contains all the relevant information needed for item storage, research and retrieval, printing in response to customer requests, and check image statements. Images can be sent to financial institutions on a tape or CD-ROM, or transmitted to a PC or fax machine. Once the image of the check has been captured, no further handling of the paper check is necessary.

The most common application of imaging technology is the creation of image statements. Instead of returning physical checks, financial institutions can send monthly account statements along with copies of check images to their customers. Furthermore, there is commercial software for image statements available that allows for flexibility in the production and delivery of account statements. For example, the software typically allows account holders to choose the format of their own check image pages, the number of checks per page, fronts only or front and bank of checks, and to order checks by clearing date or by check number. This flexibility has the potential to increase customer satisfaction.

\textsuperscript{38} Federal Reserve System Financial Services. Check Products.
Image statements eliminate the multiple reader/sorter passes required to link physical items with account statements each month. Moreover, since image statements replace checks in the account statements, the bank can place ten shrink-sized check images on a page. As a result, envelopes are lighter, and the statement only takes thirty-two cents postage to send.

Everyone in the banking industry agrees that imaging is an important new technology in check processing. Imaging reduces the handling of paper checks, lowers check processing costs, and improves the quality of service provided to depositors. Although many financial institutions would like to realize the benefits of check imaging, they are reluctant to make the investment necessary to acquire imaging equipment and software, re-train staff, and reconfigure internal operations.

Federal Reserve Bank of Cleveland, Minneapolis and Dallas Reserve Banks all offer full-service check imaging capability for those financial institutions who wish to take advantage of the image technology but are unwilling to commit fully to it. The Cleveland Federal Reserve does not create image statements for individual customers. Instead, the Federal Reserve Bank captures images of the checks it processes for a financial institution, then supplies the institution with a daily file of those images. The files can be stored on the institution's own computer system, and used to generate image statements for its customers.

The Cleveland Federal Reserve Bank has plans to use its imaging equipment to provide image enhancement to its existing check safekeeping service. Image-enhanced safekeeping offers greater speed and flexibility in delivering information to customers.
When a customer calls with questions about a specific transaction, the operator can retrieve the image very quickly and display it on a computer screen. The file containing the information can then be sent by modem, or images of the front and back of the check can be faxed.

The recent reduction in scanner price, between $4,000 and $8,500, also enables banks to install a scanner at each branch, thus allowing branch capture of the checks and eliminating the need of center site check processing. A standard scanning resolution is 300 dpi, at a speed of about 40 checks per minute. Outputs are usually image files, but some recent products also offer additional MICR reading capability, so ASCII files containing the MICR code line information will accompany the image files in this case.
3.3. Electronic Check Presentment

3.3.1. The Use of Electronic Check Presentment

An alternative approach to processing paper checks is electronic check presentment (ECP). The collecting bank sends check payment information electronically to the paying bank and the paper presentment is either sent at a later time ("paper to follow") or is truncated.

Many organizations still send the physical presentment of the checks to follow the electronically transmitted banking information because this follows the current process most closely and minimizes impact on the current banking operation. Furthermore, check users prefer to have possession of the checks they have written as a back up for future disputes.

Figure 5. Settlement Flow of Paper Check and ECP
Source: ECP 101. Electronic Check Clearing Organization.
However, the paper trail still exists in this version of ECP. Although the transportation cost is reduced because the paper checks can be sent using cheaper and slower methods, banks still have to spend money sorting and transporting checks. ECP with truncation eliminates the check at the point of deposit. After all relevant information has been extracted from the check, the paper form is either destroyed or archived at a safe location. This enables great cost savings from the elimination of physical movement of the checks, but it is also highly controversial.

Currently, just over one billion checks annually, only about one point five percent of the total US checks volume is processed using ECP\textsuperscript{39}.

3.3.2. To Truncate or Not to Truncate

A. The issue of Truncation: Truncating checks allows certain paper check functions to be discontinued or modified, providing reduction in operational expenses. This can be achieved by combining electronic check collection processes with image technology. Truncation stops the flow of physical checks thus lowers the cost of check transportation and handling, and increases the speed of settlement process. However, the following important issues need to be taken into consideration:

- Under the current legal system, banks are not obligated to release funds unless the paper check is present. This condition can be modified only by mutual agreement between the paying and the depository banks. If the checks are presented

\textsuperscript{39} Rivlin, Alice M. September 16, 1997.
electronically, the paying bank is unable to inspect the check for fraud before it can decide about paying it, thus increasing the risk of the paying bank.

- Many paying banks send canceled checks along with the monthly statement to the customers without charge. With truncation, the customer and the paying bank would have to give up canceled checks, and some studies indicate that customers value the returned checks highly.

B. **Where to Truncate:** Checks can either be truncated at the bank of first deposit or at an intermediary, such as a clearinghouse or a Federal Reserve Bank.

- Truncation at the first bank of deposit: In this scenario, the cost saving is the greatest due to the limited handling of the checks and the elimination of transportation.
  
  According to a study done by the Federal Reserve Bank of Boston, the net benefit of a check truncated at the bank of deposit yields $0.0497 above the paper presentment. With a volume of 66 billion checks per year\(^{40}\), this is savings of three billion dollars annually. Based on a Federal Reserve System survey, about thirteen percent of depository institutions are willing to store checks and retrieve check information on behalf of multiple paying institutions\(^{41}\). Most of the interested parties are larger institutions because of the significant economies of scale in the safekeeping and retrieval process.

- However, it is unreasonable to assume that all checks will be truncated at the bank of first deposit. Many smaller institutions may not have the capability to capture and transmit check data electronically, or unwilling to undertake the risk storing the

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\(^{40}\) Stavins, Joanna. July/August 1998.
checks either for verification or for the statutory retention period. In this case, truncation at an intermediary makes more sense. Bank of deposits will sort all incoming checks and send them to the intermediary, usually the Federal Reserve or a clearinghouse, yielding a net social benefits of $0.025 per check\textsuperscript{42}, or a possible savings of one point seven billion dollars if all checks are truncated at the intermediary.

\textbf{C. Cost of Truncation}

Most banks do not have in house truncation capabilities; however, the Federal Reserve recently added a new line of truncation service to their payment system services. The Federal Reserve Bank of Minneapolis uses volume-based fees for its check truncation product. Truncation customers may select from two sets of fees: a per-item fee of $0.015

\footnote{Stavins, Joanna. July/August 1998.}
with an $11.00 daily minimum or a per-item fee of $0.007 with a $25.00 daily minimum. The Federal Reserve Bank of Richmond uses volume-based fees of its account total and account total plus products. Account total customers may select from two sets of fees: a per-account fee of $0.25 with a $45 daily minimum or a per-account fee of $2.00 with a $15.00 daily minimum. Account total plus customers may also select from two sets of fees: a per-account fee of $0.25 with a $50 daily minimum or a per-account fee of $2.00 with a $20 daily minimum.

3.3.3. Benefits of ECP

By separating the check information from the physical check, operational efficiencies can be achieved. The physical check will be processed only once in most cases, and then the information can be moved and processed much more expeditiously. When the check information is released from its physical constraints, processing procedures can be re-engineered to avoid the physical constraints imposed by the paper medium that necessitates serial processing and multiple physical processing steps. ECP is estimated to save banks two to three billion dollars a year. The savings are realized in the following areas:

- Significantly reduce check processing costs, especially in the labor segment.
- Dramatically decrease the check settlement time.
- Reduce time to identify return items.
- Reduce check fraud: Studies by Electronic Check Clearing House Organization shows check fraud losses can be reduced by more than 95% through the use of

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44 Federal Reserve System, Docket No. R-0967
ECP and RNOTEs (electronic notices of nonpayment). ECP reduces the forward presentment time, thus reducing the check fraud effects of Regulation CC as mentioned previously. Typically, checks deposited on a Monday can be transmitted to the paying bank late that evening for posting on Monday. Through the posting process, return candidates can be identified early Tuesday a.m. even as the paper checks are arriving. The return process can then be initiated on Tuesday rather than on Wednesday. With RNOTEs, it is possible to directly improve the return process and further reduce the elapsed time by one or two additional days.

- Virtually eliminate transportation costs and avoid weather-related delays that plague truck and air carriers.
- Improve customer service by reducing the time to locate an archived check from several hours to a matter of minutes.
- Consumer payment behavior patterns are unaffected: the only change occurs in how the items are processed. This allows financial institutions to cut costs without the threat of losing customers due to radical changes.
- The rapid evolution of electronic processing and presentment technologies promises additional future savings.

45 Electronic Check Clearing Organization. ECP Vision.
3.3.4. Drawbacks of ECP

A. Cost: There are costs of the creation, transmittal, and processing of electronic files by collecting banks and check collection intermediaries, and the costs associated with the receipt and processing of these files by paying banks. The large startup cost is quite reasonable when amortized over the large volume handled by the system over its lifetime, but it is still difficult to justify because banks already have invested significantly in paper check infrastructure. Although in the long term ECP promises large cost savings in the long run, the banks are now processing paper checks at a relatively low marginal cost, and the interim period involves significant and uncertain fixed setup costs.

B. Network extremities: The number of financial institutions truncating checks and receiving electronic files affects the cost and benefits of ECP. The more banks have truncation capabilities, the more likely banks are to “communicate” directly with each other to avoid sorting and shipping paper, and the higher the benefits to each paying bank. Simply, the larger the network of participating banks, the lower the costs and higher the benefits to other participants. Until universal truncation takes place, banks will have to maintain two parallel check-processing infrastructures, which is an undesirable scenario for most banks.
Most banks are currently consumed with the Year 2000 issue, and all technical and financial resources are currently spent on fixing the Y2K bug. Furthermore, all sorts of activities in the banking industry, such as mergers, delivery strategies, and public outrage over ATM surcharging, are diverting attention away from the payment system issue.

3.3.5. Providers

Service Providers

- The Federal Reserve

The goal of the Federal Reserve System is to ensure the robustness and to promote the efficiency of the nation’s payment system. Federal Reserve Board has been an active proponent of electronic check settlement because it shows significant cost savings and promises great reduction in settlement time. All Federal Reserve Banks have the capability of electronic check settlement. Currently the Federal Reserve Banks present
about thirteen percent of their total checks electronically, this translates into two billion checks sent to two thousand depository institutions\textsuperscript{46}.

- **Small Value Payments Company (SVPCo)**

SVPCo is a partnership formed by New York Clearing House (NYCH) and several of the nation's largest banks to establish a nationwide framework for electronic check exchanges. The twelve partner banks include $260 billion BankAmerica, $140 billion Bankers Trust Company, $60 billion Bank of New York, $116 billion BancOne, $365 billion Chase Manhattan Bank, $311 billion Citicorp, $114 billion First Chicago NBD, $157 billion First Union National Bank, $85 billion Fleet Bank, $35 billion Marine Midland Bank, and $260 billion NationsBank\textsuperscript{47}. This is a very impressive list of membership.

NYCH, as the net settlement clearing house for SVPCo, is well positioned to lead the electronic check movement because it has inter-district net settlement capability, and also has experience supporting multilateral settlements involving Automated Clearing House and wire transfer services. NYCH is one of the few private sector organizations to obtain Federal Reserve authorization to provide net settlement services for check clearings involving financial institutions outside its Fed district. It is the only private sector organization to offer both ECP and net settlement services.

In January, Small Value Payments Co. (SVPCo) was appointed by Banking Industry Technology Secretariat (BITS) as the national coordination point for industry-wide

\textsuperscript{47} New York Automated Clearing House. Web Site.
ECP exchanges. SVPCo clears an average of six point five million ECP items monthly for member banks as well as for a group of Texas banks.\footnote{Banking Industry Technology Secretariats. March 2, 1999.}

**Governing Bodies**

- **Electronic Check Clearing House Organization (ECCHO)**

  The Electronic Check Clearing House Organization (ECCHO) was set up by Banking Industry Technology Secretariat (BITS) to be the private-sector group that will write industry rules to support electronic check presentment, much like the role served by the National Automated Clearing House Association (NACHA), the national rule-making body for the ACH. ECCHO also performs ECP services to its member institutions.

  Currently there are two ways to exchange ECP files: Either through an intermediary such as Clearing House or Federal Reserve, or directly with each other.

  Banks who want to exchange ECP files directly to one another must act under the governance of ECCHO and pay a membership fee to the organization, or they can elect to exchange ECP files through the Federal Reserve without any need for ECCHO membership dues. The initial dues, $100,000 up front and as much as $80,000 annually, was so steep that ECCHO earned the reputation as a “big-bank” ECP effort. Despite several adjustments of the fee, it has not garnered much interest. In a bold stroke in early 1999, ECCHO dropped its basic membership fee to one hundred
dollars\textsuperscript{49}, in effect making ECCHO membership a feasible option for any financial institution, regardless of asset size. This change should boost interest in ECP among small banks.

ECCHO’s short-term vision includes four parallel initiatives, which together offer the potential for improved, industry-wide earnings of two to three billion dollars per year\textsuperscript{50}. Those initiatives are:

- Electronifying the check collection process to create additional earnings of eight hundred-fifty million dollars annually.
- Electronifying notices of check returns to realize annual saving of four hundred-fifty million dollars.
- Truncating paper checks at the bank of first deposit using image technology and ECP to generate annual savings valued at six hundred million dollars.
- Creating new cash management product opportunities for tracking information on bad checks to earn annual revenue of seven hundred million dollars.

Electronifying the check collection process refers to capturing the MICR line information from the bottom of checks and transmitting that data directly to the banks on which each check is drawn.

Currently, ECCHO has seventy members exchanging an estimated forty-five million ECP files a month\textsuperscript{51}, on a bilateral basis, and mainly between large financial institutions.

\textsuperscript{50} Mission. Electronic Check Clearing House Organization.
\textsuperscript{51} Facts. Electronic Check Clearing House Organization.
ECCHO's parent entity, Banking Industry Technology Secretariats (BITS), claims it has extracted commitments from its members to implement ECP, which has the potential to result in fifty percent of all checks written in the country be settled by ECP by 2001\textsuperscript{52}. However, compared with the abysmal five percent of checks being processed by ECP currently, it seems like an ambitious goal\textsuperscript{53}.

\textsuperscript{52} Vision. Electronic Check Clearing Organization.
3.4. Point of Sale Check Truncation

3.4.1. Use

In the US today, approximately eighteen billion checks are written for goods and services purchased at the point of sale each year\textsuperscript{54}. However, bad checks are estimated to cost retailers six billion dollars annually, with seventy percent due to insufficient funds and thirty percent due to fraud. Check truncation at the point of sale will help address the current issues, such as time and fraud, associated with traditional check payment processes.

The method for converting checks at the retail point-of-sale into electronic transactions is also known as Electronic Check. In an electronic check transaction, the consumer presents the merchant with a paper check, and the merchant runs a check through the MICR check reader, which captures and transmits the bank account and routing number information as well as the check serial number from the check to the credit card terminal. The credit card terminal sends the data to a national verification database which verifies check writer against a national database. Verification service can either authorize or reject the check writer. If approved, a duplicate Electronic Fund Transfer (EFT) authorization is printed for the customer to sign, much like the credit card receipt. A customer's paper check is stamped \textit{Automated Clearing House (ACH) processed} and is either returned to the customer or is kept by the merchant. The check files are processed through the ACH central account information system electronically for settlement, which occurs off-line within twenty four to forty eight hours. A complete description of the transaction appears on the consumer's monthly statement.
Electronic Check Council

Figure 9: Flow Chart of Point of Sale Transaction.

National Automated Clearing House Association (NACHA) has set up two pilot programs to promote electronic check clearing and truncation. Customer As Keeper (CAK) and Merchant As Keeper (MAK) are two truncation programs at the point of purchase (POP), which will eliminate the paper trail of checks at the point of sale\(^{55}\). The only difference between the two programs is the custodian of the physical check. In CAK, the customer keeps the physical check after the merchant has verified and recorded the transaction, where as in MAK, the merchant retains the check, but the customer has a

\(^{54}\)Nelson Report on Check Usage.
signed receipt to keep as a record. An interim rule becomes effective on September 17, 1999 allowing the electronic check transaction to use an existing ACH processing format. On September 15, 2000, rules creating a new ACH Standard Class Entry Code - POP (Point-of-Purchase) - become effective on a permanent basis.56

3.4.2 Benefit of Electronic Check

A. The benefits to retailers of using check truncation at the point of sale include

- Reduced costs from the elimination of paper handling. Point of Sale truncation completely eliminates the flow of physical checks, so financial institutions do not have to spend any resources on the handling and transportation of the paper checks. This translates into huge cost savings.

- Faster and more effective redeposit and return item processing. Since the settlement of the check is based on the information that is transferred electronically, clearing is done promptly and any problematic checks are quickly identified.

- Detailed settlement and transaction reporting. All relevant information is captured from the check and from the merchant regarding the transaction and the account. This allows the banks to properly manage the consumer accounts.

- Improved customer information flow. The detailed transaction report also allows the bank to provide its customers with comprehensive statements and speed up customer service time.

- Lower incidence of fraud. The shorter settlement time means the attempted frauds are caught straight away, before the banks lose any money.

B. The benefits to consumers of using check truncation at point of sale include

- More detailed information, such as the item purchased and the time of purchase, are included in their monthly statements.

- A receipt (in the case of MAK) or the physical check (in the case of CAK) as an immediate record of the purchase for account re-conciliation and safe-keeping.

- Minimal behavior change. There are no new electronic devices for the consumers to learn about, no intangible debit transfers for the consumers to get used to. They can continue to write out paper checks the way they have been for the past three decades.

3.4.3 Drawbacks of Electronic Check

Electronic check is still a relatively new method of payment so many consumers are unfamiliar with its use and benefits. Even if the merchants are interested in exploring the use of electronic check, they must also continue to support the paper check processing mechanism if the customers do not authorize electronic conversion. In this case, the merchant will have to maintain duel-processing systems, which is expensive.

Furthermore, in the case of Customer As Keeper (CAK), merchants must have some way of retaining customer and transaction information. This may require the service of a third-party provider. Although point of sale truncation eliminates the physical flow of the checks, consumers still carry their checkbooks with them and physically write out a check. Although this is a benefit to the consumers, this is a double-edged sword that continues to foster consumers' dependency on check writing. In addition, point of sale truncation is only applicable to transactions in real-time, but not for remote transactions such as utility bill payments.
3.4.4. Providers

- **TeleCheck**

Houston-based TeleCheck® International, Inc., a subsidiary of First Data Corporation, provides Electronic Check Acceptance (ECA SM), check guarantee and verification, and collection services to more than 200,000 retail, financial institution and other industry clients. In 1997, TeleCheck processed more than ninety-eight billion dollars in check authorizations, representing more than two billion checks\(^5\)\(^7\).

Designed to mirror the process currently used for credit cards, Electronic Check Acceptance converts paper checks into electronic items at the point of sale. The funds are automatically deposited into the payee’s account utilizing TeleCheck’s Accelera® SE payment terminal, a specialized set of terminal and host software and the National Automated Clearing House (ACH) system.

After the check writer presents his check, the merchant authorizes it through TeleCheck and gives the check writer a printed receipt for signature. This signature allows TeleCheck to electronically present the transaction to the customer’s bank for settlement and that money is automatically deposited into the merchant’s account usually within two business days. And, because the electronic transaction is TeleCheck’s responsibility, if it fails to clear the check writer’s account, the merchant does not bear the responsibility of returned check or returned check fees.

\(^{57}\) TeleCheck Company Website.
Chapter 4. Electronic Payment Methods

4.1. Automated Clearing House

The Automated Clearing House processes payments electronically, and was designed to reduce the use of paper checks for routine recurring payments.

4.1.1. Use

The ACH is a fully electronic payment service. The system consists of an infrastructure of data processing and communications hardware and software designed to deliver and settle large volumes of electronic payment transactions and related information.

Transactions are transmitted via data communications networks to one of four ACH operators – the American Clearing House, the Federal Reserve, the New York Automated Clearing House Association, or Visa, U.S.A. Individual payment instructions are grouped into batches and the batches are grouped into files for transmission to an ACH operator.

ACH payment instructions are transmitted to ACH operators one or two days prior to the date of payment settlement. Instructions are delivered to receiving institutions several times a day as they are processed. ACH processing is very similar to check processing except that the payment instructions are in electronic form, which are sorted and transmitted electronically to receiving banks.

On the settlement date for ACH transactions processed by the Federal Reserve, the Federal Reserve Bank posts the appropriate debit and credit entries to the accounts of sending and receiving banks. Private-sector ACH operators use the Federal Reserve
Banks' net settlement service to settle the transactions that they transmit among their participants.

The ACH is typically used to process recurring, small value payments for consumers, businesses and the government. Both credit transactions, such as payroll, social security, pension, and vendor payments and debit transactions, such as mortgage, insurance, and bill payments are processed over the ACH\textsuperscript{58}. Unlike the check collection market, which is primarily local, the market for ACH transaction is primarily national. In 1996, two-thirds of the ACH transactions processed by the Federal Reserve were interdistrict transactions\textsuperscript{59}.

Although participation in the ACH is voluntary, almost every bank in the US receives ACH payments for its customers. According to the Federal Reserve Bank, seventy-five percent of the originators of ACH processed by the Federal Reserve are the affiliates of the largest one hundred bank holding companies. In contrast, the recipients of ACH are much more diverse group, from large conglomerate to small businesses\textsuperscript{60}.

<table>
<thead>
<tr>
<th>Subsidiary of:</th>
<th>Origination</th>
<th>Percentage</th>
<th>Receipt</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Largest Bank Holding Companies</td>
<td>723</td>
<td>30%</td>
<td>274</td>
<td>12%</td>
</tr>
<tr>
<td>Next 90 Largest Bank Holding Companies</td>
<td>1,070</td>
<td>45%</td>
<td>477</td>
<td>20%</td>
</tr>
<tr>
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<td>25%</td>
<td>1,622</td>
<td>68%</td>
</tr>
<tr>
<td>Total</td>
<td>2,377</td>
<td>100%</td>
<td>2,374</td>
<td>100%</td>
</tr>
</tbody>
</table>

\textbf{Table 4. Demographics of Senders and Recipients of ACH}


\textsuperscript{58} Jaffe, Charles A. January 15, 1996.
\textsuperscript{59} Rivlin, Alice M. September 16, 1997.
\textsuperscript{60} The Federal Reserve System. January 1998.
Figure 10. Direct Payment (ACH Debit) Transaction Flowchart
Source: NACHA

Figure 11. Direct Payment (ACH Credit) Transaction Flowchart
Source: NACHA
The total number of ACH transactions processed in 1996 amounted to approximately four billion payments, with a value of about twelve trillion dollars. In 1998, ACH transactions surpassed five-point-three billion dollars, a seventeen-point-five percent increase, and are expected to add an additional billion transactions in 19996162.

![Graph showing ACH Transaction Statistics]

Figure 12. Volume of ACH Transactions.
Source: ACH Transaction Statistics. NACHA

During the last ten years, the volume of ACH transactions grew at an average annual rate of fifteen percent. Despite this rapid growth, ACH payments continue to represent only a small fraction – less than five percent – of noncash transactions in the United States.

4.1.2. Benefits of ACH

- Lower Processing Cost: The average cost of processing an ACH transaction is considerably less than those of processing a paper check. ACH unit costs have been falling, and are likely continue to do so, while paper check unit costs have stabilized.

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An estimated seventy cents is saved for each check deposited through the ACH Network instead of through the teller window.

- **Lower Social Cost:** Several studies show that the social cost of making a check payment is significantly higher than that of making an ACH payment\(^{63}\). Social cost is the cost on society as a whole incurred by the action, which includes the payer’s cost to initiate and send, the payee’s cost to receive and process, and the cost incurred by third-party intermediaries. A lower social cost translates into a more efficient system.

- **Convenience:** ACH service such as Direct Deposit is highly convenient for consumers because it eliminates the need for people to make special arrangements to deposit their payroll checks. Similarly, Direct Deposit alleviates the burden of remembering and paying monthly bills.

- **Increase Productivity:** Employees spend from eight to twenty-four hours each year going to the bank to cash or deposit their paychecks, according to a study done by NACHA. With up to twenty-five percent of all employees taking time to deposit payroll checks on payday, American companies could increase productivity by three to five billion dollars if all employees used Direct Deposit\(^{64}\).

- **Reduce Fraud:** The Federal Government estimates that more than four million paychecks are lost or stolen each year. FBI studies show that two thousand fraudulent checks are cashed each day in the United States. However, with Direct Deposit, checks are never lost or stolen because payments are made electronically.

- **Increase earnings:** By expediting the transfer of funds, the ACH Network also allows employees to begin collecting interest at the start of payday.

\(^{63}\) Wells, K.E. 1997. Are Checks over used?

\(^{64}\) National Automated Clearing House Association.
4.1.3. Drawbacks of ACH

The ACH began operation nationally in 1973, when US check volume was about a third of what it is today, only process about four billion transactions annually today. Although annual ACH volume growing at a faster rate than checks, but it only handles for less than one hundred million, or less than five percent, of the two-point-two billion bills paid each month. Only forty-five percent of the roughly two-point-eight billion annual payroll payments are made via direct deposit and an even smaller fraction of dividends and annuity payments are made via the ACH in 1996.

The reason for this small market share could be attributed to a multiple of reasons:

- Competitive market: There are a multitude of new electronic payment methods coming on the market competing to be the replace of paper check.
- High fixed costs: ACH requires a high fixed costs, including the need for powerful computers to process high transaction volumes and the need for data communications facilities to exchange transactions among participants and operators.
- Difficulties in Usage: ACH is difficult to use for ad hoc or one-time transactions. Even for recurring transactions, consumers and business have to deal with a cumbersome sign-up process. If a consumer changes his or her bank, he or she is responsible for contacting the originating corporation and change the information related to their direct deposit and direct payment arrangement.
- Poor Organization: Compared with other electronic payment methods such as ATM and credit cards, ACH transactions lack of a nationally coordinated and properly

funded education and marketing effort to educate the consumers and businesses. This concern is now been addressed by the Federal Reserve, local ACH associations, the U.S. Treasury and private ACH operators. However, the result of these efforts remains to be seen.

- Account Reconciliation: ACH has limited ability to send transaction information along with payment instructions all the way through to the end user. Although ACH transactions can carry remittance information in addenda records, most receiving depository institutions do not have the capability to provide this information to their corporate customers in a readily usable form. Some corporations send the payment through the ACH and the remittance information through a peripheral network, which can result in reconciliation problem for the receiving entity and increase transaction costs.

4.1.4. The cost of ACH processing

The total processing costs of ACH debits received by financial institutions generally range from about three cents to eight cents, and averages five-point-seven cents per item. In comparison, average processing costs for checks drawn on financial institutions generally ranges from about six-point-five cents to thirteen cents, and averages ten-point-five cents per item. Because ACH has been found to have lower social costs per item than paper checks, the Federal Reserve has been promoting more widespread use of ACH through marketing and by lower ACH processing fees. There has been a fifty percent reduction in the ACH premium surcharge, from one cent to half cent; a twenty-five
percent reduction in the fee for addenda records to ACH transactions, from point-four cent to point-three cent\textsuperscript{67}.

Both larger and smaller financial institutions reap significant benefit from processing ACH debits over checks. Larger financial institutions realize savings of forty-one percent and smaller financial institutions realize savings of fifty percent when comparing per transaction costs of processing ACH debits versus checks received by the financial institution\textsuperscript{68}.

For mortgage and other loan collections, financial institutions save even more. For each customer converted from a check to an electronic payment for a loan, financial institutions report savings of up to $4.11 per payment by eliminating loan coupons and related processing costs.

The marginal cost of sending an additional ACH transaction is low (less than one cent)\textsuperscript{69}, and there are evident economies of scale at current industry volume levels.

\textsuperscript{67} Federal Reserve of Atlanta. Oct-Dec 1996.
\textsuperscript{68} American Bankers Association. 1996.
4.1.5. Major Providers
Service Provider

- The Federal Reserve

The Federal Reserve, as the nation's central bank, is charged with responsibility of promoting the efficiency of the nation's payment system. It has been a longtime advocate of electronic payment method due to potentially significant benefits such as convenience and timeliness for all users.

The Federal Reserve is the dominant provider of ACH services, accounting for almost eighty percent of all interbank ACH activities, which include all government ACH activities, which accounts for twenty percent of all interbank ACH activities. Banks originate approximately the remaining eighty percent of all inter-bank ACH transactions through Federal Reserve. In addition, the three private ACH service providers send

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another ten percent of ACH transactions to the Federal Reserve for transmission to banks that use only the Federal Reserve's ACH service.

In 1997 over three-point-four billion payments with a total value of more than ten-point-seven trillion dollars were processed by ACH through the Federal Reserve System.\footnote{Federal Reserve Bank of New York. FedPoint 31: ACH.}

- **New York Automated Clearing House**

In 1975, the New York Clearing House arranged with the Federal Reserve Bank of New York to become the first private processor of commercial ACH transactions for the Second District serving New York, northern New Jersey, Puerto Rico and the U.S. Virgin Islands. Owned and operated by The New York Clearing House Association, New York Automated Clearing House (NYACH) became part of a national network of automated clearing houses linked by the Federal Reserve System. This network continues to be the largest ACH operator today, processing most of the government items and about seventy-five percent of all commercial transactions. In 1989, NYACH became the first ACH operator in the country to convert an entire Fed district to an all-electronic exchange.

In 1993, NYACH opened its membership to institutions nationwide to include California, Connecticut, Delaware, Florida, Pennsylvania, and Washington, D.C. Its membership swelled to nearly eight hundred commercial banks, savings banks, savings and loans, and credit unions. Annually, NYACH processes an average in excess of two-hundred-fifty million transactions with a total value of over two-point-eight trillion dollars. As an
active member of the National Automated Clearing House Association, NYACH represents its members at various NACHA standing committees and council meetings.

In 1994, NYACH partnered with VISA and Arizona Clearing Hours Association to create the Private ACH Exchange (PAX). PAX allows members to process automated clearing house items with one another directly without using the Federal Reserve System. This program improves the security of interregional items, while reducing interchange and night cycle surcharges and settlement delays for the members in each of the three systems.

**Figure 14. New York Clearing House ACH Volume.**

**Governing Body:**

- National Automated Clearing House Association (NACHA):

NACHA was formed in 1974 to establish uniform operating rules for the exchange of Automated Clearing House (ACH) payments among local ACH associations.
It represents more than 13,000 financial institutions through its 34 regional ACH associations, six councils and corporate Affiliate Membership program. NACHA develops operating rules for the Automated Clearing House Network and for emerging electronic payment solutions in the areas of Internet commerce, bill payment and presentment, financial electronic data interchange, cross-border transactions, electronic checks, and electronic benefits transfer.

4.1.6. Future of ACH

There have been many new projects planned for ACH network. One of the most promising project is the Worldwide Automated Transaction Clearing House (WATCH), the new cross-border global payment system. Given the increasingly global nature of business, the payment system must be developed accordingly to cope with the new economic landscape. Multi-national corporations are increasingly centralizing administrative functions and making repetitive transactions such as salaries and pensions cross-border, making a batch processing solution imperative.

Currently cross border payments are being made using checks and wire transfers. The checks have to be mailed overseas for settlement, a process that often takes weeks. For example, poor channels of communication between financial institutions hinder check clearing and return across NAFTA borders. As a result, an U.S. government check cashed in Mexico can take as long as six weeks to settle because it has to be returned to the appropriate institution in the United States. The wire-transfer, on the other hand, requires extensive account verification and several currency conversions. This process is also inefficient and costly.
The application of ACH for cross-border payments has been studied and worked on for a long time but a number of factors hindered its progress. The primary reason is the non-uniformity of infrastructure: ACH in different countries were developed as proprietary solutions using different IT standards (security and communication) formats and rules. In order for a multi-lateral cross border payment system to take place, each ACH would have to be modified to conform to all other standards. This requires a number of major IT projects and large investment. Furthermore, there were too many political issues involved for the system to be feasible to exist.

To circumvent these issues, a proposal to create a new global infrastructure was introduced in fall of 1998. The idea is to use Internet protocol to enable a location independent RTGS payment system which will support remote membership in the main currencies.

This global system is designed to operated under the not for profit cooperative atmosphere, where banks are the shareholders who can influence the individual product specification. It will be an open access community where every bank can become a member, and the service level is guaranteed with no fee deduction from the nominal amount. Sales and pricing is to be determined by the participating banks, and appropriate conversions will be the responsibility of the originating banks.
The proposal is to start simple, with credit transfers in six to eight currencies, and add more features such as direct debit, additional currencies later on. Pre settlement will be done in central bank money to guarantee finality of the transactions. It is believed this new system will reduce the “end-to-end” payment processing costs by fifty percent.\footnote{Cross-Border Payment Council. 1999. Global ACH Presentation.}
4.2. Credit and Debit Cards

4.2.1. Use of Credit and Debit Cards

Credit and debit cards provide consumers with a convenient method for purchasing a variety of goods and services. In 1995, approximately seventeen billion payments, with a value of about nine hundred and fifty-five billion dollars, were made using credit and debit cards.

Credit Card

When a bank issues a credit card, it grants the cardholder a line of credit, enabling the cardholder to make purchases or to draw cash up to a prearranged amount. Purchases made on credit cards are billed at the end of a payment cycle and accrue interest charge if not paid in full by a specified date, while cash withdrawals generally accrue interest immediately upon withdrawal. Over the past five years credit card use has been growing at an annual rate of about seven percent. Since 1993, the number of credit card transactions in the U.S. has about doubled to nearly 11 million a year.

Debit Card

Debit card payments have been available since 1970, but it is still considered an emerging product due to its slow acceptance. A debit card is a machine-readable (magnetic stripe) plastic card--also referred to as a POS card, check card or shopping card--that is read when swiped through the retail merchant’s card reader. Purchases made with a debit card are deducted directly from the cardholder’s account at the issuing bank.
and are limited to the amount of funds in the cardholder's account. There are two types of debit card transaction, on-line and off-line.

- On-line transaction: An on-line transaction uses a card that bears the logo of a national ATM/POS network or a national on-line ATM/POS network such as Plus/Interlink or Cirrus/Maestro. The POS terminal has a PIN pad where the consumer enters the unique PIN number. When customer presents the debit card for a purchase, the merchant swipes the card, waits for the customer to enter the PIN number, and the debit card transaction information is sent electronically to the issuing bank via the network. The purchase is settled by an immediate debit to the consumer's bank account, and the consumer loses the float associated with any delay in settlement. Most of the on-line networks are regional,

- Off-line transaction: Off-line cards bear the logo of off-line national POS network such as Visa or MasterCard and the merchant must partake in the off-line network indicated on the card. The consumer does not use a PIN number, but instead signs a receipt like the credit card. The purchase is settled by an Automated Clearing House (ACH) debit to the consumer's account a few days later, giving the consumer a float benefit similar to that when using a paper check.

Initially, regional ATM/POS networks transmitted all debit card transactions. A regional network had an established territory and connected card-issuing banks with acquiring banks that were all located within the boundaries of the territory. Over time, smaller regional networks began to merge, becoming super-regional networks that covered much larger geographical areas. However, the consumer was still limited to using a debit card within the same, regional network area as the merchants. The debit card transactions on
regional network are primarily on-line, meaning that the network connects the acquiring bank and its merchants to the POS database at the card issuer.

Debit cards use has been growing at a rapid annual rate of about 48 percent, albeit from a relatively small volume base\(^3\). The recent growth of debit card usage can attribute to the entry of the two major national credit card associations, Visa and MasterCard, in the early 1990s. Each of these associations established a national off-line POS network by piggybacking debit card transactions along its existing credit card network, and agreed to accept any debit card bearing its logo. The availability of the vast credit card network infrastructures of Visa (VisaCheck) and MasterCard (MasterMoney) dramatically increased the number of merchants who could accept debit card transactions. It increased the attractiveness of debit card to consumer because they can now use debit card at merchants that are not directly affiliated with the card issuer. In addition, the national off-line debit products are popular with financial institutions because, as card issuers, they earn higher *interchange fees* (similar to credit card interchange fees) than for on-line POS transactions. The attractive higher off-line fee has prompted many more financial institutions to issue debit cards, and to market their usage to consumers.

On-line POS networks have also felt the presence of the national associations--Visa (Interlink) and MasterCard (Maestro)--who piggyback transactions along their ATM networks (Plus and Cirrus). Since 1993, debit transactions have increased six-fold to about 2.5 million a year. Visa has the lion’s share of this debit-card business: in 1997 Visa’s U.S. volume was ninety-four billion dollars, compared with thirty billion dollars

\(^3\)Rivlin, Alice M. Sept 16, 1997. Appendix 1
for MasterCard\textsuperscript{74}. Although online debit payments are cheaper and more secure, offline transactions surpassed online ones in 1995—despite predictions that online is the wave of the near future.

### 4.2.2. Benefit of Credit/Debit Cards:

- **Convenience:** Debit and Credit cards are easy to carry and easy to use. Consumers save time from writing and mailing checks for every bill and transaction. Furthermore, pre-authorized payment of recurring bills can ensure timely payment for merchants, and reduce the penalty fees that consumers pay for missing or late payments.

- **Low Cost:** All the debit and credit card transactions are settled electronically either through ACH or private network. This translates to faster settlement cycle and lower per transaction cost.

### 4.2.3. Drawbacks of Credit/Debit Cards

Although credit card use replaces checks as the payment method of small value transactions, the majority of consumers are still writing a check at the end of each month to pay for the credit card balance. To fully realize the advantage of plastic cards, consumers need to be educated on the use of cards for recurring payments and the benefits of electronic debiting.

\textsuperscript{74} American Banking Association. 1998.
4.2.4 Major Providers

- Visa International

Visa is the world’s largest consumer payment system. It wields its considerable power in the payment system to encourage the advance in new payment products and technologies to benefit its 20,000 member financial institutions, their cardholders, and the global economy. Visa is the largest card issuer; its five hundred million cards are accepted at more than twelve million merchants worldwide. The Visa Global ATM Network consists of more than 284,000 ATMs in one hundred and six countries. Visa International is a multi-regional corporation that provides an operating structure to support consumer payment services globally; Each member is responsible for designing products and services to meet local needs anywhere in the world. For example, Visa U.S.A. has recently announced a new market development campaign to promote card usage as a replacement for the four hundred billion dollars in checks that consumers write each year for regularly-recurring payments, such as utility, insurance and phone bills. This addresses the need to extend the utility of plastic cards beyond point-of-sales transactions.

The Visa Recurring Card Payment Market Development Campaign is the first comprehensive campaign by a major payment card company. It includes marketing support to member financial institutions, resource materials for billers, advertising and promotions, as well as procedures and systems that will make it easier for biller merchants to offer the card payment option and for consumers to use their Visa cards to pay recurring bills.
In 1995, Visa recurring payment sales volume was four-point-six billion dollars across thirteen recurring payment merchant category codes. Visa transactions in this market segment are expected to account for more than twenty billion dollars by the end of the decade. According to Payment Systems Incorporated, a syndicated research company, the recurring bill payment market is projected to grow by two-point-seven percent a year to nearly four-hundred and sixty billion dollars by 1999.
4.3. Smart Cards

4.3.1. Use of Smart Cards

Smart card, sometimes referred to as stored-value card, is an ATM-like card with embedded microchip which can store data, such as electronic money. It was hawked as the replacement for cash for small transactions, while offering more security than cash. A single card can act as a credit card, debit card, ATM card, and “cash.”

Consumers will go to special kiosks or ATM terminals, insert the card, and instead of receiving cash, an equivalent amount of “electronic cash” is transferred into the smart card. This monetary value is in the form of a promise that bank makes to pay the debts the consumer incurs by using the stored-value card up to its available balance. The bank moves the withdrawn funds from the customer’s account into its own account, from which it will settle transactions its customers make with stored-value cards. These funds, which could have been earning interest for the customer, can now earn interest for the bank while awaiting a payment order.

The multi-purpose prepaid cards are already common at universities and corporate offices. The university or employer collect cash from students or employees and issues them cards with stored value. The cards can then be used to make purchases at a variety of sites on campus. For example, the MIT multiplan card is good for purchases at the cafeteria, laundry facilities, and Domino Pizza. Campus merchants accept the value from the card as payment because they know the university or corporation will convert these balances back into cash. Thus, the university or corporation acts like a bank because it collects funds and then disburses them to the various merchants to settle transactions. However, the use of these cards is limited to specific regions and or merchants.
The new smart cards will act like multi-purpose prepaid cards, but with broader in scope because they will not be limited to specific region or merchants.

Figure 16. Smart Card Transaction Flow Chart.
Source: Regional Economist. "Will that be Cash, Charge, Check, or Smart Cards?"

4.3.2. Benefit of Smart Cards

Convenience: Smart cards eliminate the need to dig up the rattling change at the bottom of your purse or carrying a thick wad of cash.

Privacy: Unlike credit cards, which needs to be swiped at each transaction in order to connect with the credit card company’s central computer for account number and purchase amount authorization, Smart cards has off-line capability. The embedded microchip verifies the availability of funds, and authorization merely means there is enough available credit for the transaction to occur. There is no account to verify, because the funds are in the bank’s general pool, rather than an individual’s account. The smart card is an off-line, electronic authorization for the bank to pay the bearer. In this case, the bank need not even know who paid the merchant because it doesn’t have to
identify an individual’s account to debit. This feature is important to those consumers who value their privacy and the security of their financial accounts.

4.3.3 Drawbacks of Smart Cards

Acceptance: U.S. dollars (or some foreign legal tender) are on deposit at the issuing institution to “back” the stored-value card balances, which presumably will be accepted for transactions because consumers and merchants believe they can be exchanged on demand for legal tender. If consumers and merchants do not have faith that these liabilities will be honored by the issuing institutions then stored-valued balances might not circulate as a medium of exchange.

Lost Cards: It is still unclear on what happens when the card is lost. When the card is lost, damaged, or stolen, it can either behave like cash (irrevocably lost), or be reimbursed like some credit cards. However, unlike cash, the funds on a stored-value card cannot actually be “lost” because they are still at the card-issuing institution’s account. This issue requires further examination before smart cards proponents begin the marketing campaign.

4.3.4 Major Providers

• VISA

Visa International is piloting a new program titled “Visa Cash” for small cash purchases. There are two types of cards available, one is disposable and the other reloadable. Disposable cards are purchased with a pre-determined value, typically in denominations of local currency. When the value of the card is used, the card is discarded and a new

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75 Zaretsky, Adam. Regional Economist April 1996.
card may be purchased. These cards are dispensed from “Card Dispensing Machines (CDMs) which accept a variety of payment methods. Disposable cards are usually sold at face value.

Reloadable cards come without a pre-defined value. Cash value is reloaded onto the card at specialized terminals and ATM terminals.

The Visa Cash cards require special terminal to process, and can be used at merchants displaying Visa Cash logo.

Normal cash withdrawal or cash advance fees may apply when moving money from the banking account to the chip on a reloadable card. There are no transaction fees to make purchases with Visa Cash.

Visa has several programs around the world testing various smart card applications. For example, in United Kingdom, consumers are using Visa Smart Debit and Visa Smart Credit card as replacement for the traditional magnetic strip credit/debit cards. In San Francisco, Employees at Bank of America use a multi-application smart card for door access, personal computer access, file encryption, and Visa Cash.

In May 1997, Visa and Bank of America started a pilot program to test the use of Visa Cash chip card for Internet shopping. The Bank of America/Visa Internet trial for chip-based payments is the first of three Internet-related chip-card programs scheduled by Visa this year. Smart Commerce Japan, a government-sponsored initiative involving Toshiba and financial institutions, is expected to commence in Kobe this fall. In France, Project e-COMM, a consortium co-founded by Visa, will test Internet payments with chip cards.
and the SET (Secure Electronic Transaction) protocol later this year. Visa has more than seventy smart card programs in thirty countries and on the Internet, with twenty million Visa chip cards, including eight million Visa Cash cards.

4.3.5. Future of Smart Cards

Whether stored-value cards take off depends on their acceptability. Merchants must be willing to accept them as a form of payment, and consumers must have the assurances they now have with other types of payment instruments. There is certainly some regulatory role for the government, but most regulators and industry proponents agree that Congress should wait and allow the market to develop before attempting to regulate it.

Stored-value card balances will also not likely replace cash as means of payment. Although there may be some who see cash becoming a useless relic, others understand that it will continue to serve an important role. Electronic mail is a good analogy. Although e-mail has become a popular communication tool, the U.S. Postal Service is still operating and widely used.

However, there has been talk of multi-applications smart cards, which adds the attractive convenience of portability. The most popular possibilities are loyalty programs (e.g., offering frequent-flier points for purchases); preferences (e.g., hotel accommodations, seats and meals on airlines); physical access (to buildings and parking lots); authorizations (e.g., to spend company money or to utilize a restricted computer program); and personal information (e.g., medical records, insurance information).

76 VISA. Product and Services.
However, some of these applications require security measures such as encryption, firewalls, coprocessors, digital signatures, and certification authority, but these can all be programmed into computer chips embedded in plastic cards.

The most compelling reason for going to smart cards may turn out to be security. Over the next few years, as the global economy deepens its commitment to electronic commerce, reliable security will become an imperative. Any transaction will require encryption applications that have complex infrastructure that is capable of handle pairs of public and private software keys. Today, keys up to 128 characters long are embedded in Web browsers. Software designers are assuming that a person’s private key will most likely be stored on his or her hard disk, and PC manufacturers are already building in slots to receive smart cards.

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4.4. Home Banking

Home banking services primarily include the ability to inquire remotely about account balances, transfer funds between accounts and pay bills. But the definition extends to include almost any banking service that can be accessed or initiated remotely can be considered a home banking service, for example, obtaining loan payment or rate information, buying and selling securities, receiving stock quotes and viewing images of canceled checks.

4.4.1 Use

There are three fundamental ways these services are being offered today: telephone systems, PC-based systems and screen phone-based systems. Although the banking industry has discussed the eventual use of interactive television and personal digital assistants (PDAs) as possible delivery channels, viable consumer products have yet to reach the marketplace. In 1995 approximately four-point-two trillion telephone call center and automated voice response system transaction and fifty-five million PC-based banking transaction occurred78.

- Telephone-based Banking

Telephones and Automated Voice Response System (AVRS) are the most widely installed and trusted systems to conduct remote banking services in the banking industry. This platform includes “personal service” from call center agents that answer account inquiries, as well as more efficient computerized AVRSs. Under both of these services, consumers can generally check account balances, transfer funds and pay bills. Some banks offer broader services that include opening new accounts, obtaining stock

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quotations and making loan payments. Most banks are moving away from the human-intensive call center services to AVRSs. The majority of the banks that offer AVRSs own and internally operate their systems. To use an AVRS, a consumer phones in and is immediately prompted for a personal identification number (PIN) and account number to access information about his account. After this is completed, a consumer is prompted through the main menu of services and options available.

- **PC-based Banking**

Implementing PC-based banking services is not as simple as implementing AVRSs. Banks must choose the transportation mechanism to reach their customers, which include creating a private network, using an *on-line service* (OLS) such as America On-line and/or using the Internet. Banks must also choose the PC software their customers will use, whether it is bank-developed proprietary software or popular off-the-shelf money management software.

For security and technical reasons, the majority of PC-based banking services to date are delivered through bank-owned private networks. These networks are similar to bulletin board services in that they serve a single purpose: to access a single bank’s home banking services. Historically, these systems needed proprietary software which could be difficult to operate. However, increasingly banks are revamping these services to accommodate popular off-the-shelf money management software such as Quicken and Microsoft Money, which is easier to use and has greater functionality. As with telephone-based banking, a password is required for a customer to access the account under all of these PC-based methods.
Screen Phone-based Banking

The screen phone offers a hybrid solution between telephone-based and PC-based home banking services. Screen phones have the ability to project images onto a small screen. This allows a consumer to combine the familiarity of the telephone with some of the display capabilities of a PC. The platform is being used on a limited scale with only four of the thirty largest banks offering the service. However, customers are required to purchase a screen phone or rent a unit for approximately six dollars to ten dollars per month, when the same services can typically be accessed over a traditional phone at no additional cost.\(^7\)

Home banking bill payment services include bank-prepared, as well as service provider-prepared, payments where the consumer initiates the transaction via computer, ATM, screen phone or telephone. Telephone bill payment services have been available to consumers for many years. As screen phones, computers and modems have become more prevalent in homes, consumers are becoming increasingly interested in saving time and money by paying their bills with devices other than the telephone. The increased use of on-line services and the Internet have also generated new interest in these services for computer users.

Payers can access electronic bill payment services directly through a bank or bank-sponsored bill payment service provider, such as Intuit Services Corp. or through a non-bank-sponsored service provider directly like CheckFree. Depending on the method used to access computer-based bill payment services, payers can use bank-developed

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\(^7\) Federal Reserve Bank of St. Louis. July 1996.
proprietary computer software or service provider-developed PC software (e.g., Quicken by Intuit, Money by Microsoft, Managing Your Money by Meca).

A payer initiates an electronic bill payment by indicating the dollar amount of the payment, the date of payment, the payer’s account number and the payee’s name and address. The payer can schedule a bill to be paid on a recurring or as a single nonrecurring payment. For computer-originated payments, after all the information has been entered into the bill payment software, the file is transmitted to the payer’s bank or to a service provider either through a proprietary network or via the Internet. At this point, the service provider or bank must determine how to compensate the payee. Payee’s compensation method is based on: whether the payee accepts payments electronically, the length of time between when the bill is due and when the payment information is received from the payer, special agreement and history between the payer, payee, and the service provider.

Figure 17. Home Banking Transaction Flow Chart
Source: Emerging Product Primer. Federal Reserve Bank of St. Louis

If the payee can receive payment electronically, ACH will be used to settle the payment. However, if the consumers do not hold transaction accounts directly with the service
provider, two separate transactions are required to complete the bill payment. The first transaction involves the service provider initiating an ACH debit through its clearing bank to the payer’s bank account, and receiving the offsetting credit to its account. The second transaction involves the service provider initiating ACH credit to the payee and receiving the offsetting debit to its account.

If the payee cannot receive payment electronically, the service provider or bank will send a paper check to the payee for settlement. The bank or service provider cuts a check to the payee drawn on the payer’s bank account for the amount of the bill and mails the payment. The service provider can legally draft a check on the payer’s account only if they have written documentation from the account holder who authorizes the provider as a signatory. The service provider drafts a check using the consumer’s MICR information and substitute the consumer’s signature with a stamp indicating the provider as an authorized signatory. The bill is finally “paid” when the reserve account of the payee’s bank is credited for the deposited check and the item is posted as a debit to the payer’s account. As of March 1996, approximately 80 percent of Intuit’s and 62 percent of CheckFree’s bill payments were paper-based.

4.4.2. Benefits of Home Banking

- Banking Industry: banks could benefit by being able to offer their services on a more global basis twenty-four hours a day, regardless of where they are chartered. Providing a comprehensive set of innovative financial products and services via the Internet, telephone and other remote access channels will enable institutions to lower

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delivery costs, improve customer service and expand their share of the consumer market.

- Consumers: Home banking services over the Internet gives consumers the ability to perform a variety of functions available on the Internet, as well as conduct banking business, all on one network. Consumers can also take care of their financial needs in the comfort of their homes

4.4.3 Drawbacks of Home Banking

Although home banking services offers potential benefits to both banks and consumers, banks have been hesitant to offer services over the Internet because it is perceived as lacking necessary security. The few banks offering services on the Internet require consumers to have passwords to access the services and the ability to encrypt every transaction through a consumer-owned Web browser. The questions on the effectiveness of encryption standards, PINs, dual-challenge, biometrics techniques against risk of fraud, invasion of privacy or mischief must be answered. Furthermore, banking service providers must evaluate if such secure system is cost-effective to implement, and the consumers must decide what types of disclosure rules are necessary to protect their privacy.

There are also further policy issues that are not being addressed currently, such as the liability for the financial loss in case of software error or a system malfunction. Is it the responsibility of the software vendor, service provider, consumer, or financial institution. Lastly, it is expensive to invest in a brand new infrastructure to support the home banking capabilities, which may not be the dominant payment methods of tomorrow.
4.4.4 Major Providers

Payments systems have historically been closed networks. In contrast, the Internet remains open, with low barriers to entry. As a result, there are a multitude of players all wanting to claim stake in this potentially lucrative market. The group includes heavyweights like Microsoft; large-scale card transaction processing and technology outsourcing companies; bank industry/technology consortia such as Integrion Financial Network, which IBM is behind technically; plus a ferocious flow of venture capital going to Internet commerce startups.

<table>
<thead>
<tr>
<th>Role/Company</th>
<th>Payment Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CheckFree provides bill payment software and prepares the check for ACH payment to the payee. CheckFree can also receive bill payment information directly from consumers through its private network.</td>
<td>√</td>
</tr>
<tr>
<td>Intuit provides its bill payment software Quicken to consumers. Intuit service Corp. is an Intuit Corp. subsidiary that prepares payments.</td>
<td>√</td>
</tr>
<tr>
<td>Microsoft provides its bill payment software Money to consumers and can transport payment information if its Microsoft Network is used. For Money users, Visa Interactive prepares the check or ACH payment to the payee.</td>
<td>√</td>
</tr>
<tr>
<td>Banks develop proprietary software, prepare checks or ACH payments, provide in-house bill payment processing and settling of on-us transactions, post ACH and check payments to consumers' accounts and own proprietary home banking networks.</td>
<td>√</td>
</tr>
<tr>
<td>MECA provides its bill payment software called Managing Your Money to consumers.</td>
<td>√</td>
</tr>
<tr>
<td>America On-line, Prodigy, and the Internet provide network transportation services</td>
<td></td>
</tr>
<tr>
<td>The Federal Reserve provides check clearing services, ACH services, and FEDNET transportation services.</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Home Banking Market Segment and Service Providers
Source: Emerging Payments Primer. Federal Reserve Bank of St. Louis
Headquarters in Mountain View, California, Intuit has approximately four thousand employees in the U.S., Asia and Europe. The company has attained leading market share not only in personal finance and small business accounting, but in personal and professional tax preparation as well.

Quicken, the company's first product introduced in 1984, met with enthusiasm from consumers and has since become synonymous with personal finance. Its success fueled the creation of Intuit's other category-leading businesses beginning with the QuickBooks small business accounting program in 1992; and continuing, through acquisition of ChipSoft in 1993, with the TurboTax personal tax program. To support these products, Intuit created a financial supplies business selling paper checks, forms and envelopes to millions of software customers.

In 1995 the company added online banking and bill payment to Quicken.com web site. At Quicken.com, consumers and businesses find one-stop shopping for insurance and mortgages as well as information on investing, planning and taxes. To broaden the availability of the firm's financial tools, Intuit has developed relationships with many of the sites on the Web - Excite, AOL and CNNfn. Intuit is also teamed with more than one hundred financial institutions including: banks, credit unions, brokerages, insurance companies, mortgage lenders and small business lenders. By mid-1998, Intuit announced a joint effort with TCI, Bank of America and @Home to develop personal financial management tools for cable subscribers and expanded its professional tax business with
the acquisition of Lacerte Software Corp., which produces software for professional tax preparers.

Earlier this year, Intuit made major strategic changes in its banking activities, departing the payment processing business through divestiture of Intuit Services Corporation. At the same time, it teamed with Microsoft and CheckFree, a leading payment processor to develop Open Financial Exchange (OFX), a standard computer language that streamlines interoperability between front-end user interfaces like Quicken and back-end "legacy" systems at financial institutions.\(^1\)

- **CheckFree**

CheckFree was founded in 1981, headquartered in Atlanta, Ga. with sixteen hundred employees. It designs, develops, and provides services in the electronic payment and collection arena. It has three major business units: Electronic Commerce, Investment Services, and Software. CheckFree has more than eleven hundred connection with merchants for the delivery of electronic payments, and has “pay-anyone” capability. That is to say the billers who aren’t set up for electronic payments still get paid with paper checks. CheckFree processes nearly ten million payments each month, serving more than two-point-five million consumers, one thousand businesses, and eight hundred fifty financial institutions.\(^2\). It is also the exclusive provider for bill presentment and payment services through Quicken TM software and Quicken.com. In March 1997, CheckFree launched the first electronic bill presentment product in the market. It services more than one fourth of the top one hundred billers, including AT&T, BellSouth, Chase Credit Card

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\(^1\) Intuit. Company Website.

\(^2\) CheckFree Company Website.
Full Service Providers

- **MECA**

Started out as a client/server solution provider, MECA made a decisive change to the development and support of internet-oriented solutions in 1997. The company is best known for its “Managing Your Money” personal financial management software, which the company customized to provide the on-line banking capabilities for large financial institutions such as NationsBank, Royal Bank of Canada, and Fleet Financial Group. MECA has met with great success with its online products; the custom-tailored online banking solution for NationsBank featured a NationsBank branded user interface and full back-end integration with NationsBank's middleware provider. As a result, the NationsBank PC Banking program has been lauded as one of the most successful online banking programs in history. In 1997, NationsBank was awarded the Online Banking Association's grand prize for Most Innovative and Successful Marketing Program.

- **Integrion Financial Network**

Integrion financial network is an interactive banking and electronic commerce service provider to financial institutions. Operating on the Interactive Financial Services (IFS) platform, Integrion provide a network through which electronic transactions flow from multiple consumer access points to a bank’s host system and/or processor. IFS platform is part of the IBM network computing platform which interfaces with the IBM Global
Network, which already securely handles a large volume of electronic payment transactions.

Integrion's direct customers are financial institutions in the United States. Indirect customers include the consumers and small businesses that are customers of Integrion financial institutions. Integrion enables financial institutions to offer real-time or strip-file transaction with their Internet Banking product. This program allows consumers to access their bank accounts and make transactions online. Partnering with CheckFree, Integrion provides electronic presentment, payment, and settlement of any bills. Integrion also helps banks to improve customer service by consolidating all customer concerns such as inquiry, payment status, and technical support into one comprehensive program, Consolidated Customer Care.

Integrion Financial Network is jointly owned by thirteen financial institutions, IBM and Visa USA, and banks determine the manner and format in which home banking and electronic commerce services are offered, ensuring consistency with the bank's full range of services, effective branding by the bank and maximum customer benefit.¹³

Banks/Financial Institutions:
- CIBC

CIBC, previously known as Canadian Imperial Bank of Commerce, with C$264 billion-in-assets (U.S.$176 billion), was among the early entrants to Internet banking, anywhere.

The company's first foray into electronic banking occurred in October 1996, when CIBC offered its wholly-owned banking, securities brokerage, and health insurance services

¹³ Company Website.
electronically to the PCs of consumer and small-business users over a private intranet called IBM’s Global Network. The package relied simply on a Netscape browser and a standard Internet dialer.

Then, anticipating the popularity of the public Internet, CIBC offered the same product—same software, branding, and operability—to customers directly over the Internet in September of 1998.

CIBC has since signed 270,000 customers for PC Banking (out of 6 million customers over all—1.38 million of whom have a PC and Internet access), with 25% now accessing the electronic services via the public Internet. The cost to process each transaction over the Internet is C$0.25, versus C$0.40 over the private intranet, compared to as much as C$2.00 to $3.00 per non-electronic transaction.

- **Citibank**

Citibank, striving to achieve John S. Reed’s vaunted one billion customers by 2010 goal, began disassembling its traditional in-house technology organization in 1998 in favor of a decentralized strategy of licensing commercially available systems from external providers. In consumer PC banking and personal finance, Citibank has signed with several ventures concurrently. It has joined MSFDC, Integron, and invested in Meca Software L.L.C., a bank-owned home banking/personal finance technology company.

In commercial Internet services, Citibank licensed electronic commerce development software last June from Netscape Communications, the firm credited with the innovating

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84 CIBC. Company Website.
85 Citibank. Company Website.
the Web browser. Citibank will employ Netscape’s Commerce Expert Internet programming tools to develop corporate Internet banking products and services.

During summer 1998, Citibank pilot-tested highly secure financial communications and transaction data encryption software. The protocol for this encryption software is called SET-Secure Encryption Transaction. SET is now emerging as a standard.

Using Netscape tools, Citibank hopes to facilitate procurement information for Citibank’s business customers, such as consumer’s purchase pattern, tracking, and payment methods.

4.4.5. Future of Home Banking

There are still many issues that need the attention of both private and government sectors before home banking can be touted as the future of banking.

Establishment of Governing Bodies

- For various current payment methods, standards and guidelines have been developed (for example, NACHA rules for ACH, Federal Reserve governs CHIPS). Who and how should standards and guidelines be advocated for home banking?

Accessibility

- Will home banking affect the overall accessibility to the payments system? In the long run, if home banking replaces current methods for accessing bank services (from tellers and telephones to PC banking), it can potentially results in service limited to only certain segments of users, more specifically, those have the means and access to internet, affecting the overall
Public Policy

- Banking Regulation: Non-bank provider are not governed by the regulation on bank service providers, thus result in a competitive advantage for unregulated non-bank providers. If a bank uses a third-party service provider, should the provider be subject to examination by federal regulatory agencies, as is the case with providers of some other services? Should financial institutions be required to ensure that third-party service providers are subject to independent third-party audits?

- Firewall: Should Internet firewalls be reviewed during regulatory examinations or should regulators only require that service providers have policies and procedures that address the risk of firewalls? Should firewalls be a separate category of risk control?

- Authority: Who or why types of entities should take on the role as certificate authority? Digital certificates require assignment of public key certificates. The certificate is used for authentication and digital signature verification. Therefore, having a trusted certificate authority is imperative.
4.5. The Future of Electronic Payment Methods

The variety of emerging retail payments methods reflects the competitive environment in which retail payment service providers operate, where these providers strive to meet the diverse needs of consumers and businesses throughout the country. Private sector innovation has been the key driving force behind the evolution of the United States retail payment system and will continue to be so in the future. These commercial providers have the creativity and financial resources to envision and design a wide variety of retail payment methods, and the methods that eventually gain widespread acceptance will surface through market competition. In many cases, new retail payment methods are being developed by coalition of retail payments system participants, often including both financial institutions and non financial companies. Thus, innovation in the retail payments market is coming not only from traditional service prodders, but also from new entrants to the market.

The challenges facing commercial provider of retail payment services include uncertainty about the future direction of technology, multiple ventures to introduce new payment methods, and inter-operability problems. Those issues are the reasons behind financial institutions' reluctance to invest in and consumers' reluctance to adopt these new methods.

The good news is that consumer and business readiness for electronic commerce is notably accelerating. A joint study by Bank Administration Institute and PSI Consulting reveals that the increasing use of electronic payment methods entails a shift of revenues
and customer loyalties, enlarging opportunities for electronic providers while chipping away at the still-dominant paper check and the traditional banking system that supports it.

Even cold, hard cash is feeling the heat from electronic alternatives, particularly from credit cards. This is evident at supermarkets, where card acceptance in the checkout lane is a fairly recent phenomenon.

Consumer responses to electronic tax filing and refund payment options also are indicative of a growing receptivity to electronic payments. Electronic filing, either by phone or computer, was up nineteen percent over last year. The larger computer-filing segment had a strong gain of almost twenty-seven percent, with a nearly twenty percent increase from tax professionals and a one hundred sixty-one percent growth among home computer users.

Nearly twenty million taxpayers have refund directly deposit into their accounts this year, surpassing the nineteen million for all of 1998. The IRS offered another new way to pay electronically this year -- credit cards. More than fifty-three thousand taxpayers charged their balance due this year on their credit cards. Furthermore, more than seventy-four thousand taxpayers elected to authorize direct debit, in which the tax payment goes directly from the taxpayer’s account to the Treasury.

This is encouraging news for the future of electronic payment alternatives, because consumers are slowly changing their behaviors, away from the dependency on check writing.

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Chapter 5. An International Comparative

5.1. Developed Nation Case Study: G10 Countries

In most developed countries, payment system has been undergoing major restructuring. Especially in Europe, where alternative electronic payment methods have gained relative importance over paper medium as shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Checks</th>
<th>Credit Transfers</th>
<th>Direct Debits</th>
<th>Payment Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
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<td>61</td>
<td>9</td>
<td>18</td>
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<tr>
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<td>France</td>
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<td>16</td>
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<tr>
<td>Germany</td>
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<tr>
<td>Italy</td>
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<tr>
<td>Netherlands</td>
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</tr>
<tr>
<td>US</td>
<td>78</td>
<td>2</td>
<td>1</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 5. Relative Importance of Non Cash Payment Instruments
(Percents of Total Number of Transactions)

* Total may not sum to 100% due to other items.

5.1.1. Check:
Check is a debit-based instrument in the form of a written order to pay a specified sum on demand when the instrument is presented to the issuing institution (the payer’s bank). It is very popular in Canada, France, the UK and the USA. Its popularity is partly a reflection of its adaptability - it can be used in a variety of circumstances, from ‘point of sale’ transactions to a range of ‘remote’ transactions. However, as with all debit-based instruments, there is the potential problem of the credit-worthiness of the drawer of the check. A number of countries have devised the following ways to counter this problem:
Check guarantee cards: In a number of countries, banks have developed check guarantee schemes to improve the acceptability of checks. Banks issue check guarantee cards to their check account customers. When customers present the cards along with the checks, the cards give assurance to the merchant that the check will be honored up to a specified amount by the payer’s bank.

The check as a pre-paid instrument: Bank customers can purchase by having a specified sum debited to their account in advance. For example, traveler’s’ check and the banker’s draft are pre-paid checks. The check recipient can accept such instruments as payment in the certain knowledge that they will be honored.

Consumers may also be discouraged from issuing checks that will subsequently be dishonored, by making such practices illegal - with fines (and even the possibility of a prison sentence) for offenders. Alternatively, customers could have their checkbooks confiscated and their right to use checks suspended for a specified period.

5.1.2. Payment Cards
There are a wide variety of cards; general purpose debit, credit or charge cards, ATM cards; check guarantee cards; retailer-specific charge or credit cards; and even pre-paid electronic money cards. Both debit and credit card systems incorporate some form of authorization procedures, whereby merchants at the point-of-sale obtain the approval of the card issuer to proceed with the transaction. Most card payments are electronic, typically made by ‘swiping’ the card through a terminal which either belongs to the retailer or is provided for them by their acquiring bank.
Credit card has been enjoying a constant rise across Europe. In 1997, eighty-four percent of all adult population of the United Kingdom has at least one card, and many held more than one\(^9\). A total of one hundred and twenty million cards are issued that year. Often banks offer general purpose cards which has co-operative arrangement with other branded products, such as MasterCard, Visa or Switch. Many individual plastic cards provide more than one function and the machines used to facilitate transaction (ie. ATM machines and retailer terminals) can generally accept a wide range of different cards.

Payment transaction made using a MasterCard or Visa card, whether debit or credit, is accepted by the retailer, passed to a bank (called the acquiring bank), then passed across the relevant card scheme and paid by the card issuing bank.

5.1.3. Pre-Paid Card
Pre-Paid Card is a card incorporating a computer chip or integrated circuit on which value is "stored", either from the card-holder's bank account or in return for cash. Value is then removed from the card as purchases are made, using special point-of-sale terminals. Single-purpose, non-reusable prepaid cards have been in existence for a number of years, for use in telephone kiosks and car parking lots for example. The new generation of cards will be multi-purpose, and rechargeable.

5.1.4. Giro Payments:
Credit transfers, or giro payments, are the traditional means of non-cash payment in a number of European countries - including Belgium, Germany, the Netherlands, Sweden

\(^9\) Sheppard, David. Payments System.
and Switzerland. They can be in paper or electronic form and can be used for both non-recurring and recurring payments. However, they are not suitable for ‘point-of-sale’ transactions. A particular advantage of credit transfers is that the receiving customer does not have to worry about the credit-worthiness of the payer since, by definition, a credit transfer cannot be sent without the approval of the paying customer’s bank, and without the paying customer’s account having first been debited.

Customers who need to make recurring payments, such as utility bills, can enter into a standing order arrangement with their bank, which is responsible for carrying out the necessary credit transfers on a regular specified data, to a specified customer and for a specified amount. Corporate customers can similarly arrange for regular payments such as wages and salaries to be made under a direct credit arrangement. Customers needing to make (or receive) time-critical and/or high-value payments may use an electronic credit transfer. It not only provides greater certainty of payment for the receiving customer but the funds can be received on the same day the payer initiated the transfer. As indicated by Table 5, giro payment accounts for more than fifty percent of all payment volume in countries such as Sweden, Switzerland, Belgium, and Netherlands. In fact, in terms of total value of payments, in all the countries mentioned above, with the addition of the United Kingdom, Italy, Germany, and France, giro payment accounts for more than ninety percent of all payments. The dominance of the electronic credit transfer is readily apparent.

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5.1.5. Direct Debit
A direct debit is an instrument specifically developed to facilitate recurring customer payments, and it is well-suited to automation. It is becoming of increasing importance in a number of countries such as Germany and the Netherlands. Direct debit payments are pre-authorized by the paying customer, who gives permission for the bank to debit the account upon receipt of instructions initiated by the receiving customer.

For example, a customer can authorize his or her bank to pay for monthly electricity bill. Each month when the power company collects payment, it sends an invoice to the bank, and the bank will automatically deduct the appropriate amount from the customer’s account, and credit it to the power company.
5.2. Developing Nation Case Study: Thailand

Since 1987, Thailand has experienced an economic boom that is unparalleled in its postwar history. Real GDP had risen by an average of eleven and a half percent per year between 1987 and 1990 before leveling off to the rate of eight and a half percent in the recent years\(^91\). The rapid economic expansion necessitates the establishment of a more sophisticated, speedy, and reliable payment system to cope of this economical boom.

Since 1989, the Bank of Thailand has formulated medium- and long-term plans to prepare the groundwork for the development of the Thailand's financial structure in response to internal needs and external competition. Payment system development has become one of the most important issues of the financial sector reform in Thailand.

5.2.1. An overview

Thailand is very much a cash-oriented society. Public cash holding amounts to sixty to seventy percent of total money supply - a considerably high ratio compared to other countries, both less developed and developed. The Band Of Thailand (BOT) has the sole right to issue bank notes in Thailand.

\(^{91}\) Bank of Thailand's Experience in Payment Systems Development. Bank of Thailand.
Check is the most dominating non-cash instrument, accounting for ninety-eight percent in terms of value and sixty-three percent in terms of volume. Credit cards, debit cards, direct debit and credit transfers make up the rest of non-cash payments.

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5.2.2. Recent Developments
The Thai payment system has undergone some very significant developments recently.

The first phase of payment system modernization is set for 1993-1996. The objectives of the modernization plan are to increase the payment system's efficiency by reducing paper-based and increasing electronic means, and to manage and contain payment system risks.

The plan consists of three major initiatives:

BAHTNET—Bank of Thailand Automated High-value Transfer network, a large-value interbank electronic funds transfer system.

Electronic Check Clearing System (ECS)—a system for electronic presentment and clearing of checks.

MediaClear—an electronic interbank clearing system of retail payments for bills, direct deposit of payroll, dividends, interests, and other similar types of consumer payments.

- **BAHTNET**: BAHTNET is an electronic network linking members and the Bank of Thailand's current account system. Members can initiate fund transfers from their books to another member's book on a real time gross settlement (RTGS) basis. If a member does not have sufficient fund in its account for a transfer, the payment order will be rejected. The Bank of Thailand provides fully collateralized intraday liquidity to BAHTNET members but charges a fee at the market rate.

BAHTNET is built in order to reduce the settlement and systemic risks associated with large-value payments. Banks and other financial institutions traditionally use a bank cashier's check or a Bank of Thailand check for large-value payments. Large corporations...
also use a bank cashier’s check or a draft for the same purpose. Receiving large payments with checks has high risks for a number of reasons. For example, checks can be lost in the course of transportation for clearing. The recipient is exposed to credit risks during the day since checks are not cleared and settled until the end of the day.

It was hoped that with the development of BAHTNET, payers and payees of large payments would realize that they could protect themselves against payment risks by moving out of checks and into BAHTNET. Although the volume of payments via BAHTNET has increased by almost twenty times and the value by seven times, with a more than doubling of members, the average daily payments via BAHTNET still accounts for only one-tenth of payments with checks.\(^{93}\)

\(^{93}\) Payment System In Thailand. Bank of Thailand.
There are two reasons why checks are still the most popular means for large-value payments. First, there is a lack of legal support for electronic payments. At present, electronic data and evidence are not admissible in Thai courts. Secondly, BAHTNET with RTGS requires a significant amount of intraday liquidity compared to the netting and settlement of checks. Even though the Bank of Thailand provides intraday liquidity, it comes with a high cost and most banks do not have enough collateral for the intraday credit. Obviously, further measures and/or development of the payment systems are needed to reduce risks associated with large-value payments.

BAHTNET has been in operation since May 1995 and was the first RTGS large-value payment system in this region. Currently it has eighty-eight members including commercial banks, specialized banks, finance and securities companies, Thailand Securities Depository, and a few windows of the Bank of Thailand. The number of members is expected to increase further.

• **ECS:**

As mentioned above, check is the main paper-based mode of payment, accounting for almost ninety percent of non-cash payments transactions. The use of checks continues to grow rapidly both in volume and in value. In 1996, the average daily volume of checks cleared by the Electronic Check Clearing System (ECS) for Bangkok and the vicinity areas amounted to three hundred thousand checks or B300 billion. In the rest of the country, checks are cleared by up-country clearing houses, with the average volume of
checks cleared in 1995 amounting to roughly ninety thousand checks or B10.0 billion each day\textsuperscript{94}.

Check is traditionally cleared manually. With two hundred thousands to three hundred thousand checks on an average day and double those numbers on a peak day, manual check clearing is becoming an increasingly formidable task. Banks are also forced to shorten the deposit hours to the first two banking hours for same-day clearing checks, to secure more time for back-office processing before checks can be sent out for clearing.

The ECS system enables clearing banks to electronically send the data on the code line to the clearing house for processing throughout the day. In the evening, settlement among clearing banks will be done based on the electronic data. Physical checks will be transported for sorting and clearing at the clearing house in the evening. With the new ECS system in place, customers now can deposit their checks until early afternoon for same-day clearing.

The ECS system is developed to increase the efficiency of clearing and settlement and to reduce the credit and systemic risk in the payment system.

\textsuperscript{94} Payment Systems in Thailand. Bank of Thailand.
• Media Clearing

Media Clearing is an off-line retail funds transfer system for transactions occurring on a recurring basis. The system provides interbank clearing for small-valued transfers, including payroll, dividend transfer on the credit side, and payment of household utilities bills on the debit side. Participants of Media Clearing comprise fifteen domestic banks, nine foreign banks, and two specialized banks. A sending bank can send all payment

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95 Bank of Thailand’s Experience in Payment System Development. Bank of Thailand.
data recorded in electronic media, such as magnetic tapes or diskettes, to the Electronic Clearing House (ECH) located at the Bank Of Thailand (BOT) two to seven days prior to the effective date. The ECH will then sort the payment data by banks and send information on to the relevant banks. The preliminary net clearing positions will be calculated two days prior to the effective date, and the final net credit or debit balance will be settled through the multilateral funds transfer function of BAHTNET on each effective date. If the debtor has insufficient balance in the deposit account for its net clearing position at any time, then the transaction is canceled and the ECH will notify all participants and arrange for immediate recalculation of the net clearing positions by excluding the data related to the defaulting participant.

The BOT charges sending banks B0.60 per transaction for Media Clearing services. The fee for canceled transactions or invalid transactions is B100 per data media.
Figure 22. Media Clearing Transaction Flow Chart
Source: Bank of Thailand
5.2.3. Electronic Payment methods

- **Credit card**

Although credit cards have not played a major role as means of payment in Thailand, their use has increased significantly in recent years. The number of cards issued rose from around one hundred forty-three thousand at end 1986 to approximately one-point-nine million in 1996, with the value of credit card transactions averaging about B11,770 million per month\(^6\). There has also been a parallel increase in the number of outlets accepting credit cards, most of which are retail stores, restaurants, and hotels.

- **ATM card/Debit card**

ATM card or debit card services allow cardholders to use ATMs to withdraw money from and deposit money to their bank accounts. They also allow funds transfer between accounts at the same bank and inquiries on account balances. Some ATM cards allow cardholders to debit their bank accounts through EFTPOS terminals at shops and stores. Acquirer banks then collect payment by transferring funds from the customers’ accounts to the stores’ accounts at the same banks. At end August 1996, there were approximately fourteen-point-four million debit cards in circulation\(^7\).

There were originally two ATM networks: Banknet and Siamnet. These networks merged in 1993 to form a single nation-wide ATM network system called the ATM Pool. The new network allows customers to access their accounts from any bank’s machine. At end-June 1996, there were approximately thirty-six hundred ATMs installed throughout the country.
- Prepaid card

Prepaid cards used in Thailand are mostly single-purpose cards, such as magnetic-stripe phonecards. Recently, cards embedded with integrated microchips, known as smart cards, have been introduced for cinema ticketing and expressway toll payment. The use of smart cards for multi-purposes, such as the ability to purchase goods and services from a wide range of merchants, is still limited to a small number of pilot schemes. However, in November 1996, a non-bank institution launched a full-scale card scheme called "Microcash" in Bangkok, whereby holders can use these cards to pay for city bus tickets, mobile phones installed on board buses, and goods and services at designated coffee shops and convenient stores.

![Electronic Payment Methods](image)

Figure 23. Electronic Payment Instruments in Thailand.
Source: Bank of Thailand

Chapter 6. The Future

Even as society moves from bartering to cash, then from cash to checks, the underlying trend is to migrate to a more reliable, efficient, and user-friendly payment system. With the advent of electronic payment, alternatives such as ACH and on-line banking are being hailed as the next generation payment solution. However, as discussed in the previous chapters, the electronic alternatives are still in the infantile stage. The technology, although exists, still needs considerable refinement, and the electronic payment system as a whole still requires debugging. The currently proposed system is so complex, that a simple bill payment originated from a PC-based financial management software could pass through as many as twelve different payments service providers before it reached the paying bank.

For example, the payment’s journey starts with a software package developed by an entrepreneurial software firm (like Microsoft’s "Money"). The consumer initiates the payment order that travels over a network such as America OnLine to a payment service company like CheckFree. CheckFree then creates an ACH debit against the consumer's account, and sends it to the Federal Reserve for delivery to the customer’s financial institution or its designated third-party processor. The credit to the payee company can be presented through another ACH provider, like Visa or NYACH, then travel over a private network to another third-party bank processor (like First Data Resources) for posting to the corporation's account. That service provider may have to translate the payment information through a piece of EDI translation software produced by yet another software firm before it is finally delivered to the corporate receiver.
Public policies and laws are not yet in place to govern the new system and protect the consumers and the service providers. As a result, the electronic alternatives are perceived as highly risky and unreliable. For example, eighteen million credit card transactions travel, unencrypted, over the insecure network, the Internet. The growth of electronic payment means has been very slow, accounting for only 5 percent of the total payment transactions.

The payment system progression is an evolution, not a revolution. Despite industry pundits' prediction of a checkless society, every study continues to project the growth of checks while the electronic alternatives evolve. This implies the economy must support dual systems for an indefinite period of time. The costs can be even higher if alternate payment systems evolve without clearly defined standards or if the transition from old system to new system becomes a costly hurdle.

Furthermore, the overall goal is to make the payments system more efficient over the long run. The goal is not to make it more electronic, per se, unless electronic is really more efficient. But if the check remains a big part of the future, then it is economically sound to look for more opportunities to lower the cost of the paper-based system and improve the efficiency of the end-to-end process. Of course, all the improvement on the check clearing system should not be done at the expense of promising electronic alternatives, and preferably have synergy with the future electronic alternatives to further leverage the investments.

There are several technologies that are currently under development which promise to alleviate the current check clearing headache.

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Proposed Solution
Two things are for certain:

a. Paper checks are not going away any time soon.

b. Electronic data communication is the low cost, fast speed solution to all future information exchanges.

Check settlement is primarily dependent on the information contained on the check, such as the payee’s account number, payer’s bank number and account number, and the amount of the of the transaction. The paper presentment is used mainly for validation purpose, such as signature verification. Since the handling and transportation of the paper checks are the highest cost factor in the process, the way to reduce check processing cost is to eliminate the paper movement and make the settlement process electronic. The earlier the check information is made electronic, greater the end-to-end system cost saving. Once the check information is made electronic, account settlements can take place straight away. The advantages are clear: faster settlement time means more interest generated for the depositors, lower systematic risks, drop in the incidents of fraud, and reduce clearing costs for the financial institutions.

However, many service providers interpret check electronification to mean check imaging. Check imaging, in terms of capturing the physical appearance of the check by the way of scanning or photographing, is an improvement method to check archiving and customer service. In order for electronic check settlement to take place, information must be extracted from the paper check or from the digital images. Currently, the conversion of information from paper to electronic is performed by human operators who read and encode the courtesy amount of each check. Because encoding is a tedious and fatiguing task, mistakes often
happen and a second operator is often required to verify inputs. This procedure is not only
time consuming but also costly. Intelligent Character Recognition is a technology capable of
recognizing either hand-written characters or MICR encoded bank information. Another
alternative is the Point-of-Sale truncation as discussed in Chapter Four, where the merchant
extracts the information from the consumer’s check at the point of sale and send the
electronic information for verification. If the merchant’s financial account information can
also be appended to the consumer’s check information, electronic settlement can then take
place.

The electronic settlement of checks requires both receiving and sending financial institutions
to have compatible electronic system. This calls for a common protocol for batch file
exchange so the information can be useful.

Furthermore, the electronic file exchange must be fast, reliable, secure, and low cost.
Currently, the Internet is the communication channel of choice due to its availability and low
cost. However, because the Internet is a public channel, it is very susceptible to hacks and
attacks. Thus, the electronic file exchange protocol must also have build-in security features
to protect the highly sensitive and valuable financial information.

The proposed solution to the check clearing headache must have the following three
elements: information extraction capability, common file sharing protocol, and electronic file
transfer security feature.
6.1. Example

An on going research project at the Productivity From Information Technology Initiative (PROFIT) at the Massachusetts Institute of Technology’s Sloan School of Management seeks to leverage the technology to improve the efficiency of the overall system and lower the processing cost of check clearing. This initiative involves the following three technologies: image capture, optical character recognition (OCR), and secure transfer over insecure public communication infrastructure. The system proposes to improve the quality of check image quality, reduce the time and costs in the handling and inputting of the check courtesy amounts, and enable low cost secure transmission of the check information.

The proposed system is intended to add to the functionality and improve the overall quality of Electronic Check Presentment (ECP) with truncation program that is currently being aggressively promoted by the Federal Reserve Board.

Most of the check clearing improvement strategies focus on the physical movement of the checks. The proposed system intends to minimize human intervention at an even earlier stage, thus providing more cost savings and further reduce processing time. The hand-written courtesy amount is “read” by a patented intelligent character recognizer, and this output is appended to the digital check image output from the camera. The whole file is then sent over the Internet to the intended recipients protected by a security protocol. The technologies are described in more detail below.
6.2. The Technology:
A. Image Capture

The high performance digital camera has resolution of 1.3 Megapixels, which will enable it to re-create a digital image of the check that is recognizable both to the automated check amount verification module and to human visual system as a reasonable facsimile of the check for identification purposes. The camera acquires the image as an 8 bit grayscale matrix of digital values at high speed and uploads the image to a computer so that the recognition software can analyze it.

B. Optical Character Recognition (OCR)

The Optical Character Recognition (OCR) technology was developed at MIT and is protected by a broad US patent entitled “System and Method for Character Recognition with Normalization” (Patent Number 5633954 issued on May 27, 1997), with Dr. Amar Gupta, Dr. Maram Nagendraprasad, and Dr. Patrick Wang listed as the inventors.

The technology was originally designed to interpret hand-written material at high speed and accuracy. By a team headed by Dr. Amar Gupta, the technology was further refined for application on the banking industry, focusing on developing Intelligent Character Recognition technology for automating recognition of handwritten numerals on bank checks.

This system is divided into three stages: preprocessing, recognition, and post processing.

The first step in preprocessing is segmentation that divides each numeral into its individual digits. Punctuation such as commas and periods, and other special characters, are identified
based on their location, alignment, and size within the segment image. Once each individual symbol is established, each segmented digit is then passed to the recognition stage.

The next step in preprocessing normalizes each digit to a standard size of 16x16 pixels. Then the character is rotated to an upright, vertical position using the slant correction module. Next, the character is thinned to one pixel width skeleton. A good skeleton retains the connectivity and structural features of the original pattern. Once defined, the symbol is re-thickened to a width of two pixels.

After preprocessing, each 16x16 segment is passed to a neural network based recognizer to read the characters. The network has been trained over a large number of feature vectors and histograms. The first layer of the network consists of 256 input nodes, one for each element in the 16x16 matrix. Furthermore, these input nodes are connected to forty hidden nodes that actually perform the computational recognition. These hidden nodes are connected to ten output nodes, each corresponding to the digits zero to nine. Each segment is also sent through a second neural network trained with "negative templates" of the same set of histograms as the primary network. Following recognition, the outputs from the two networks are compared and if they conflict, the courtesy amount image is re-segmented and the recognition starts again from the top.

The neural network provides a high level of accuracy and to gauge its ability to correctly identify digits, confidence measures of the recognized digit are produced by post-processing. Below a certain confidence, the digit is rejected and either the entire courtesy amount is re-
segmented and processed again or the user intervenes to recognize the digit. Following is a pictorial representation of the recognition process.

![Image of digit segmentation process](image)

**Figure 24. Segmentation of Digits**
Source: Automated Reading Project, PROFIT, Sloan School of Management, MIT.

![User Interface](image)

**Figure 25. User Interface.**
Source: Automated Reading Project, PROFIT, Sloan School of Management, MIT.

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1. Automated Reading Project. April 1999.
Figure 26. Representation of Figure 8 Post Segmentation and Normalized

Figure 27. Representation of Figure 8 Thinned

Figure 28. Representation of Figure 8 Thickened

Figure 29. Representation of Figure 8 Slant Corrected

Source: Automated Reading Project, PROFIT, Sloan School of Management, MIT.
C. Secure Transfer

Secure Transfer refers to the transmission of critical banking information over public and private communications links with a very high degree of security and privacy, comparable to that used by MasterCard and Visa. This work, performed under the direction of Dr. Amar Gupta at Sloan School of Management, uses an innovative “briefcase” approach to enable information of different types to be transmitted without revealing the contents of the briefcase. The term "Briefcase" refers to the security measure taken to protect top-secret information in which the highly sensitive material is placed in a briefcase and handcuffed to the transport agent. Only the intended recipient has the corresponding key to unlock the briefcase and view the material. No one else, including the agent, is capable of viewing the content.

The Internet is an insecure channel of communication. Exchanging highly sensitive and confidential information over the Internet requires extraordinarily high degree of security to protect data compromise against numerous unseen attackers. The secure transfer protocol is capable of providing this level of security by using a combination of both symmetrical and asymmetrical encryption.

When users initiates the transaction using the web browser with security plug-in, the security application is launched to establish session key with the server and obtain authentication certificate and signature. Asymmetric encryption is used to create signatures and verify certificates and to establish the session key. Once the authentication and session key have been determined, symmetrical encryption is used to
encrypt the information contained in the "briefcase". Only the designated receiver can view the contents of the packaged 'briefcase' of checks, and a digital signature on the electronic package proves the sender's identity.

**Encryption**

Cryptography is the lock and the key that protects information on the Internet. Encryption transforms data into a form that is impossible to interpret without the appropriate knowledge (a key). The security system's purpose is to ensure privacy by keeping information hidden from anyone for whom it is not intended. Decryption is the reverse of encryption; it is the transformation of encrypted data back into an intelligible form, which is only possible with the appropriate key.

Encryption and decryption generally require the use of some secret "password", referred to as a key. There are two types of encryption: symmetric and asymmetric.

- **Symmetrical Encryption**: Also known as secret key cryptography, the sender and receiver of a message know and use the same secret key: the sender uses the secret key to encrypt the message, and the receiver uses the same secret key to decrypt the message. This method is known as secret key or symmetric cryptography. The main challenge is getting the sender and recipient or agree on the secret key without anyone else finding out\(^1\).

- **Asymmetrical Encryption**: Also referred to as a public-key cryptosystem, it has two primary uses, encryption and digital signatures. In this system, each person creates a

\(^{101}\) RSA Laboratories, 1998.
pair of keys, one called the public key and the other called the private key. The public key is published, while the private key is kept secret. Anyone can send a confidential message by just using the public key to encrypt the information, but the message can only be decrypted with a private key, which is in the sole possession of the intended recipient (usually, the owner/generator of the key pairs).

As an illustration, suppose B wishes to send a secret message to S, B looks up S's public key in a directory, uses it to encrypt the message and sends it off. S then uses his corresponding private key to decrypt the message and read it. No one intercepting the message can decrypt the message. Anyone can send an encrypted message to S, but only S has the correct private key to decode the message. Since the encryption and decryption uses different keys, henceforth the nomenclature of asymmetrical encryption.

For additional security, the message composer can sign the message digitally to authenticate that he or she did indeed compose the message. For example, a digital signature could consist of the message encrypted with the sender’s private key. This signature is then attached to the unencrypted message before encrypting the entire package with the recipient’s public key. The message recipient can verify the sender’s identity by decrypting the signature using the sender’s public key and comparing the messages.

6.3. Benefits of the Proposed System

There are several significant benefits to motivate both the service providers and the consumers to deploy the new check clearing system. Philosophically, the new system
follows the concept of check truncation that the Federal Reserve Board and the financial industry have been heavily promoting. Electronic check presentment, or ECP, involves the capture of a check at the bank or Fed of first deposit (we will call this the "keeper" bank), and the conversion of that item into an electronic image for further clearing and posting to the customer's account. The check is imaged at the keeper organization and the paper is eventually destroyed. Returns and disputes are handled through electronic retrieval of the images from a keeper's databases.

The proposed system is superior to the current ECP capabilities in that it eliminates the need for human intervention even earlier in the check clearing process. Furthermore, it is a fully integrated system, unlike the current ECP efforts, which consist of a variety of vendors for each capability.

A. This system provides the following benefits to financial services providers

- **Reduce Cost**

  The reduction of encoding operators drastically reduces the operational cost of check processing. It is estimated that forty-five percent of check processing costs go to salaries. Furthermore, the electronic clearing truncates the check at the branch of deposit, so there will be no transportation network to maintain, no ground crew to load and unload the checks, and no operators to handled and sort the checks. This provides further significant cost savings.

- **Reduce Processing Time**

  The high performance camera has speed advantage over conventional scanners. This fact is trivial when imaging ten checks a day, but can amount to significant difference
when banks process millions of checks a day. The automated check verification procedure has speed advantages over human operators. It can also work around the clock, is not subjugated to fatigue, so all the checks can be processed as quickly as possible. Once the information is extracted from the check, the file can be sent to the clearinghouse almost instantaneously, reducing the check transportation time from days down to seconds.

- **Improve Customer Service**

  The improved quality of the check images allows the bank to offer check images as the substitutes for actual paper checks to the customers for record. When disputes arise and the customer demands the check for verification, banks can retrieve the digitized check images from the data warehouse in a matter of seconds. Ultimately, a check depositary institution can hold the physical check if necessary.

- **Guaranteed Return**

  There are so many electronic alternatives being explored that the banks are confused and bewildered by their options of investment. There are also significant risks associated with the emerging electronic payment methods in terms of their feasibility and usability. But one thing is for certain, there are still 66 billion checks in circulation, and that number is increasing. The investment in this system is guaranteed to improve the check collection system, and increase the profitability of the banks.

- **High Security**

  The ease of use, growing popularity and incredible speed of transmission has made the Internet the most desirable medium of data communication. However, because

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the Internet is a public channel, it is also very insecure. The highly sensitive and confidential banking information will be protected from the prying eyes of Internet bandits with the use of secure transfer protocols.

- **Reduce Fraud**

  Today, the delay between presentation of a check at the local bank and its arrival at the issuing bank is between two to four days. By law, the bank at which the check was deposited must credit the account of the payee within a stipulated period of time, which may be shorter than the lag time in several cases. This disparity allows the encashment of checks that are issued on: accounts that carry insufficient funds; non-existent accounts at real banks; and non-existent banks. The total loss to banks due to the fraud is in the order of billions of dollars each year. Since the check is digitized at the branch of deposit and the movement of check information is electronic, any of the above three types of fraud will be detected immediately. Furthermore, the secure transfer mechanism and the use of digital signature will protect against other types of fraudulent activities.

**B. The system provides the following benefits to the consumers:**

- **Minimal change in Behavior**

  The largest benefit to the consumer is their ability to continue writing checks the way they are accustomed to. This system addresses the check collection process that occurs after the consumer has already deposited the check at the bank. Consumers are conservative when it comes to the matter of money, and changes represent the unknown thus have associated risk. The system has the advantage over ECP with
truncation because it provides consumers with an image of their checks for safekeeping, and some studies show that consumers value that.

The system is also beneficial to the society on a macroeconomic level. It does not hinder the progress of electronic alternatives because the check is already being chosen by the payer as the payment of choice. Since there is minimal difference from the consumers’ perspective, this system does not inherently encourage the use of paper checks. As a matter of fact, if the clearinghouses use ACH as the format and delivery system for net settlement, then this is actually helping the financial institutions to transition to ACH. The new transaction volumes can improve economies of scale, and reducing the marginal cost of ACH. Furthermore, as the consumers grow accustomed to the replacement of check images for actual paper checks, it will smooth the transition to other electronic alternatives such as ACH and debit card entries because that is how the transaction record will resemble.

6.4. Technology Providers

There are many technology providers in the market with products designed to address a specific issue in the check clearing process. In the area of handwriting recognition, there are several active players: Orbograph Limited, CGK Computer Gesellschaft Konstanz, and ParaScript Systems. In terms of imaging equipment, BancTec, Mitek, and IMR all offer a suite of products to facilitate the image capturing step in the check clearing process.
<table>
<thead>
<tr>
<th><strong>Optical Character Recognition</strong></th>
<th>CGK RecoStar</th>
<th>Orbograph OrboCAR</th>
<th>Parascript CheckScript</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Description</strong></td>
<td>Courtesy amount recognizer with dynamic linked libraries</td>
<td>Courtesy amount recognizer with dynamic linked libraries and API.</td>
<td>Cross validation of handwritten dollar amount and courtesy amount based on complex symbol matching</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>WSA</td>
<td></td>
<td>NHR</td>
</tr>
<tr>
<td><strong>Input Data Requirement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitalon</td>
<td>-</td>
<td>Yes</td>
<td>TIFF or RAM</td>
</tr>
<tr>
<td>Greyscale</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Resolution</td>
<td>200-400 dpi</td>
<td>100-300 dpi</td>
<td>200-300 dpi</td>
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<td><strong>Data Recognized</strong></td>
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<tr>
<td>Courtesy Amount</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Legal amount</td>
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<td>No</td>
<td>Yes</td>
</tr>
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<td>Date</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Recognized Digits</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Confidence Level</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Recognition Rate</strong></td>
<td></td>
<td></td>
<td></td>
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<td>Hand Written &amp; Bitalon</td>
<td>Variable</td>
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<td>70%</td>
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<tr>
<td><strong>Error Rate</strong></td>
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<td></td>
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<tr>
<td>Hand Written &amp; Grayscale</td>
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<td>0.1%</td>
<td>-</td>
</tr>
<tr>
<td>Hand Written &amp; Bitalon</td>
<td>-</td>
<td>0.1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Processing Capability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount Location</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Noise Removal</td>
<td>On Courtesy Field</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Character Segmentation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Throughput</td>
<td>8 character /second</td>
<td>30 to 2400 dpm</td>
<td>750ms/check</td>
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<tr>
<td><strong>System Requirement</strong></td>
<td>Windows 95/NT V3.51,</td>
<td>Windows NT, UNIX</td>
<td>Window 95/ NT</td>
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<td><strong>Customers</strong></td>
<td>Unisys</td>
<td>Banks</td>
<td>Mitek</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System integrators</td>
<td>NCR</td>
</tr>
</tbody>
</table>

Table 6. Optical Character Recognition Providers and Characteristics
6.4.1. Providers

A. CGK Computer Gesellschaft Konstanz

A subsidiary of Seimens, CGK was founded in 1974 and headquartered in Constance, Germany. Its core competencies are in the areas of ICR technology and data capture. CGK is a major supplier to the European public and private service sectors in processing checks, postal mail, and other remittances. It offers an entire suite of products including reader/sorters, scanners, and Intelligent Character Recognition (ICR) software.

CGK’s color scanners feature 24 bit CCD color sensor cameras with digital color filtering and archiving capabilities, all at a throughput of fifty documents per minute. The image outputs can be grayscale, binary, or color TIFF 6.0 formats.

CGK’s RecoStar is an ICR software capable of reliably reading both handwritten and machine printed numbers on a wide range of layouts. RecoStar locates the information field, reconstructs the courtesy amount field, recognizes the characters, and verifies the output with either a user-defined library or a pre-defined trigram analysis.

- Location: Search strings and other characters are used to identify the type of document being processed and to locate the courtesy amount field for processing. A black frame (box) can also be used as search criterion for the information to be read. Characters which touch this box or which cross the surrounding lines are reconstructed. Any skewed writing is corrected by comparing it to the position of the search string.

- Background Removal: Any background detected in the courtesy amount field is removed using line removal functions and the characters are “reconstructed” for
recognition. Since the noise filtering is only performed on the courtesy amount field instead of the whole document, the process is faster.

- Recognition: RecoStar is capable of reading both machine printed and hand written characters. The technology underneath the product is WSA (Winkelschnittanalyse), which slices the image of each digit into several sections using parallel lines from a number of different angles. From those sections several feature vectors are created, from which the recognition takes place\(^\text{103}\). Country specific symbols can also be identified to increase the accuracy of the output.

- Verification: The output from the recognition module is then compared with a Trigram program for verification. This compares the recognition results against common 3-character combinations that normally occur within a specific language and automatically corrects the results as necessary. It reduces the correction effort significantly. A user-defined library can also be created to act as a reference for the recognition output\(^\text{104}\).

B. ParaScript

Spun off in 1996 from ParaGraph, founded in 1985 by a joint group of Russian and American institute scientists to study the application of computer recognition ideas by noted Russian scientist Shelya Guberman, ParaScript focuses on practical and market-ready applications for recognition technology.

ParaScript’s product for the banking industry is CheckScript, which identifies the amount written on personal checks by cross-referencing the legal and courtesy amounts.

\(^{103, 105}\) CGK Company Web Site. April 1999.
- **Courtesy Amount Field Location:** An algorithm searches for the location of the courtesy amount based on a set of descriptions. This may be the size of the box or the distance from the right edge of the check.

- **Courtesy Amount Field Noise Removal:** Background noise and other features aside from the amount in the courtesy amount box are removed. The box itself is eliminated using Hough transformation.

- **Courtesy Amount Segmentation:** The first segmentation separates the dollar and the cents portions of the numeric amount. This is done by identifying special features, such as dashes or points between characters or the denominator portion of the cents. Next, the image is decomposed into components and all possible interpretations of the components are generated based on a set of simple rules. A special estimation function is then performed on each combination of components, yielding the best segmentation choices.

- **Numeric Recognition:** The best choice from the segmentation module can be inputted into the recognition module either as a whole image or as independent elements, depending on the size of the output. A set of transformations corresponding to typical handwriting variations is performed on the graphical representation of the input. This is followed by a separation of the symbols which are then matched with the prototypes.

- **Legal Amount Recognition:** Similar to the process used on the courtesy amount field, the legal amount field is first located using a set of rules. Then the noise and background are filtered to facilitate the recognition process. Next the dollar amount is separated from the cents by looking for a horizontal line, dash, or point to the right.
of the dollar amount. The same algorithm used for the numeric recognition identifies
the cents portion of the legal amount field. The written dollar amount is recognized
without parsing through two steps: feature extraction and the input phrase feature
matching to all lexicon entry representations.

- Cross Validation: The answer list from legal amount recognition is compared against
the answer list from the numeric recognition module. All possible answers are then
assigned a confidence score, then final answer is the one with the highest confidence
level.\textsuperscript{105}

ParaScript licenses CheckScript software to a number of system integrators including
Mitek and NCR. At seventy-five percent recognition rate and less than one percent error
rate, it has a relatively high performance by industry standards\textsuperscript{106}.

## C. Orbograph

Orbograph is a supplier of advanced image character recognition technologies and
solutions to system integrators such as Bisys, NCR, and BancTec. Headquartered in
Yavne, Israel, Orbograph is a subsidiary of Orbotech Limited, a world leader in the
design, development, manufacture, and marketing of automated optical inspection
("AOI") systems for the printed circuit board ("PCB") and flat panel display ("FPD")
industries.

Orbograph's main product is OrboCAR\textsuperscript{TM}, a Courtesy Amount Recognition (CAR)
software engine specifically designed to realize the benefits of image-based remittance
and check processing systems. Running on open platforms and industry standard LANS,

\textsuperscript{105} G. Dzuba, A. Filatov, D. Gershuny, I. Kil, V. Nikitin. 1997.
OrboCAR™ reads unconstrained, handwritten numeric Courtesy Amounts from checks, remittance stubs, and bank control documents. OrboCAR™ boasts of read rates over seventy-five percent and a false-positive rate, or error rate, of one-tenth of a percent\textsuperscript{107}. It can be configured to process from 30 to 2400 documents per minute (dpm) and up to 150,000 items per hour due to its parallel architecture based on LAN-linked PCs and innovative recognition processing algorithms. Recognition is a four step process: Finding the amount, removing the background, segmenting the individual characters, and recognizing the characters.

- **Amount Location**: The recognition fields on different documents are located using an image proof application. This is a table function which takes as an input either transaction code or other unique information (ABA Account number) from the MICR line to identify the coordinates of the amount field. There is also another built-in search engine which uses clues such as the dollar sign ($) to identify the presence of the amount field.

- **Background Removal**: OrboCAR removes all background on the check that is not part of the characters in the recognition field.

- **Segmentation and Recognition**: Each character segment is reconciled to belong to the most logical character. This mechanism enables the recognition of overlapping or connecting characters. Each segmented character is then recognized using in-house proprietary software. The confidence level associated with the output is also provided.

\textsuperscript{106} ParaScript Corporation. Company Web Site.
\textsuperscript{107} Orbograph Limited. Company Web Site.
Balancing: The confidence level of each output is compared against the established system confidence level to determine if the recognition is acceptable. If the confidence level is below the acceptable level, then the output will be discarded and a human operator is called to attention.

Orbograph also produce the new product, OrboCAR Gemini, an enhanced automated reading software program. It combines two recognition engines: OrboCAR by Orbograph and intelligent character recognition software LCAR by Lucent Technologies. Lucent Courtesy Amount Reader is the build on the patented technologies of Bell Laboratory in the areas of amount location, neural network, and amount analysis. The output is determined via intelligent voting schemes that compare the results of each recognition engines.

6.4.2. Evaluation

Virtually every ICR engine is accurate enough to be used in a generic hand print recognition application. However, some engines are better-suited than others to certain vertical applications. For applications in the banking industry, there are several important criteria: throughput, recognition rate, error rate, and price. Throughput measures the rate at which the software is able to process the document, while recognition rate measures the ability of the recognition engine to identify the hand-written character. Error rate is an important criteria because a mistake made in a financial transaction is far more costly than an improperly filed census data report. Due to the large volume of checks written each year, 1.3 million checks at the community banks and 468 million checks at super-
regional banks\textsuperscript{108}, the recognition engine must be able to process at a reasonable rate over the capability of human operators. On average, human operators read 1000 checks per hour with an error rate between one to two percent\textsuperscript{109}. In terms of speed and throughput, OrboCAR, at an average rate of 70,000 documents per hour, outshines its competitors CheckScript (4,700 checks per hour) and RecoStar (5,700 checks per hour).

CheckScript’s lower throughput can be attributed to its more complex system. The system not only recognizes the hand written numeric amount, but the hand-written legal amount as well. Unlike other neural network based recognition software, CheckScript recognizes words, not individual characters. This is done with the aid of complex data validation routines, which compare ICR results with words through the use of special word and element dictionaries. This means CheckScript can handle natural, cursive handwriting as well as unconstrained hand print. The cross-validation of the recognized numeric and legal outputs also necessitate additional algorithms to compute the similarity percentage and confidence level. The result is a higher recognition rate, at seventy percent. OrboCAR’s sixty percent read rate is acceptable at many financial institutions, but facing competition from other recognition engines, OrboGraph unveiled a new product OrboCAR Gemini, an hybrid of OrboCAR and Lucent’s neural-network based Lucent Courtesy Amount Reader. OrboCAR Gemini boasts a read rate of over ninety-percent. Although no performance number was available for CGK’s RecoStar, its wide spread use and popularity with European countries are indicative of its performance. In 1993, the National Institute of Standards and Technology conducted its second worldwide test for handwriting recognition technologies. CGK achieved the best results

\textsuperscript{108} American Bankers Association. 1996.
\textsuperscript{109} Tania Hershman, April 01, 1998.
of all commercial recognition systems developers and manufacturers\textsuperscript{110}. Furthermore, CGK also has AEG Recognition Software which is known for its high speed and high performance in difficult character types. The company is considering merging the two ICR engines by the year 2000 to provide a multi-purpose ICR solution.

All three software report low error rates, at about one percent or lower. This is an important measurement because a wrongly cashed check is expensive to re-process. The error rate is also a variable that can be defined by the user. For applications that are not as accuracy critical, where some errors can be tolerated, the error rate can be set higher, allowing even higher recognition rate. For application in the banking industry, however, an ICR engine is acceptable when the error rate is less than one percent. As far as price goes, the CGK toolkit starts at $4,500, while ParaScript’s CheckScript costs $15,000 and OrboCAR Gemini runs about $20,000 each.

There is a clear trade-off between speed and recognition rate due to physical constrains. An engine with a more complex algorithm such as CheckScript takes more time to run but achieves a higher recognition rate, while OrboCAR is a high speed processor with lower recognition rates. On the same note, there is also a tradeoff between error rate and recognition rate as discussed above. Due to industry specified error rate upper-bounded by one percent, the really relevant benchmarks between different engines are the throughput and recognition rate.

In terms of the application of the recognition engine to the end-to-end check clearing process, issues of system throughput and compatibility arises. As important as

\textsuperscript{110} CGK Success Stories.
recognition throughput is, it only needs to be as fast as the prior stage – image capturing. A top-of-the-line scanner such as the one offered by BacTec, DocuScan 4500 is capable of imaging documents at ten to three hundred dpi resolutions. For resolution of 300 dpi, DocuScan achieves throughput of 2,580 documents per hour. At resolution of 200 dpi, the scanner is capable of processing 3,240 documents per hour. Thus, in terms of overall system speed, Orbograph’s OrboCAR is a major contender because it is able to accept a lower resolution of input (100 dpi) and achieve a maximum recognition output of 2,400 documents per minute. The low resolution requirement enables the use of OrboCAR with existing imaging equipment, thus reducing additional equipment purchase costs and deployment time. It is evident that the speed of OrboCAR far exceeds the capability of the scanner, thus perhaps OrboCAR is better suited for interpreting pre-captured data, such as data stored on CD-ROM or other storage devices.

CGK RecoStar requires much higher input resolution, between two hundred to four hundred dpi, so the corresponding imaging equipment in the system needs to be more sophisticated, and thus more expensive. The current imaging equipment at financial institutions are not likely to have the high resolution capability, so any deployment of RecoStar will require the purchase of new imaging equipment.

As for ParaScript’s CheckScript, it offers a high recognition rate with a reasonable throughput, thus making it a good candidate for the end-to-end check clearing solution. However, the high price tag may serve as a deterrent for small banks, so this is better suited for large banking institutions.
**System Integrator**

<table>
<thead>
<tr>
<th></th>
<th>Banctec</th>
<th>Mitek</th>
<th>IMR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reader/Sorters</strong></td>
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<td><strong>Scanner</strong></td>
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<td><strong>Supplier</strong></td>
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<tr>
<td><strong>Throughput</strong></td>
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<tr>
<td><strong>Resolution</strong></td>
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<td><strong>Supplier</strong></td>
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<td>ParaScript</td>
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<td><strong>Recognition Rate</strong></td>
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<tr>
<td><strong>Throughput</strong></td>
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</tr>
<tr>
<td><strong>Error Rate</strong></td>
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</tr>
<tr>
<td><strong>Electronic Data Transfer</strong></td>
<td>Yes</td>
<td>N/A</td>
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</table>

Table 7. System Integrators
6.4.3. Providers

- BancTec

BancTec is a system integration house which specializes in automating applications for the banking, financial services, insurance, healthcare, government, utility, telecommunications and retail industries. BancTec employs over four thousand people worldwide and is headquartered in Dallas, Texas. The core competence of the company is system integrated solutions, which account for forty-one percent of revenues.\(^1\)

BancTec has a variety of products designed to facilitate any paper-intense project. In check processing hardware equipment, BancTec has several models of scanners, sorter/readers, and workstations. Several models of the reader/sorter transport feature full field encoders for rejects and return item processing. BancTec Reader/Sorter transports are available in 400, 750 and 1150 documents per minute (dpm) speed, and are configured to accept additional features such as a digital camera to capture images for microfilming.

The scanners are capable of duplex or simplex scanning in a single pass with a full range of resolutions (from 10 to 300 dpi), multiple windowing and independent scaling. Once the image is captured, there is on-board image compression capability into CCITT Group III or IV format, image enhancement features such as edge sharpening, dynamic thresholding, and speckle removal capabilities and optional grayscale output.

\(^1\) BancTec Incorporated. Company Web Site.
BancTec’s recognition software, ReadFIRST, analyzes character and field-level data in a variety of image-enabled applications, including remittance, check, POD, and international GIRO document processing. Check and document images are preprocessed to locate fields of interest such as courtesy and handwritten legal amounts. Courtesy amounts are processed for recognition multiple times to obtain the best possible read rates. Confidence levels are established for each recognition pass both for the courtesy amount field and on a character basis. The resulting CAR/LAR recognition process is achieved through a technique called multiple-voting engines, which compares the courtesy amount, the written (scripted) legal amount, and the fractional amount in the legal amount field. This voting process results in extremely high recognition rates, between seventy and eighty percent, and correspondingly low error rates of less than 0.5 percent.

Marking Detection locates and automatically sorts out those checks with address changes and customer correspondence during image capture to reduce the need for manual detection.

BancTec also has electronic data transaction capability. BancTec develops and deploys payment processing solutions for other companies, but also acts as a third-party transaction provider.

BancTec offers a systematic solution to check processing through ImageFIRST® TPS™ check clearing system and ImageFIRST® GeMS (General Enquiry Management Suite), together with ImageFIRST® OpenARCHIVE™. When the checks pass through the reader/sorter transport, ImageFIRST TPS recognizes details on the checks at a rated
speed of 1000 documents per minute. Any 'rejects' are sent to PC workstations to be re-keyed by an operator, from an image on screen. These images can also be used for signature verification. All items are archived to BancTec’s ImageFIRST OpenARCHIVE, from where they can be retrieved by any terminal on the network, making the information instantly and easily accessible for later inquiry purposes. Exceptions such as unpaid items are then passed to BancTec’s ImageFIRST GeMS system where they are routed by a workflow system through the various inquiry processes.

- **MITEK**

Mitek Systems was founded in 1982 as a major supplier of computer products to government agencies and defense contractors dealing in sensitive and classified information areas. When the Cold War ended, Mitek transitioned into the emerging commercial market of document imaging, targeting the specialized areas of Intelligent Character Recognition (ICR) and Automatic Document Recognition technologies. Mitek is a major supplier of recognition technology to banking industry system integrators such as BancTec and IBM. The check reading software, CheckScript, licensed from ParaScript, combines courtesy amount recognition technology with natural handwriting recognition to process personal bank checks.

Mitek has several other recognition products for document processing. Quickstroke is a full-featured, flexible Application Programmer’s Interface (API) which allows software developers and systems integrators to incorporate a variety of forms processing and character recognition tools into a comprehensive forms processing and data entry system.
Based on sophisticated neural network techniques, recognition engines are used to recognize a variety of characters - machine print, hand print, alpha, numeric, alpha-numeric, special national or regional characters or symbol sets and gray scale images. Mitek regularly upgrades its large family of character classifiers so that more and more characters are accurately recognized.

- **IMR**

IMR is a full service information management provider focusing on the Mid-Atlantic region founded in 1981. It offers equipment and services to capture, archive and retrieve the image of documents. The images are scanned using scanners from a variety of suppliers such as Kodak, Cannon, and Xerox, then are stored either digitally or microfilmed. IMR contracts OnBase software from Hyland Software Company to provide information indexing, archival and retrieval capabilities. Inside OnBase, core storage and retrieval mechanisms treat all types of data as information objects. This uniformity provides flexibility in establishing document relationships and interactions, and facilitates. OnBase also has a cross-referencing feature which has the ability to double click on a document and automatically retrieve any or all related documents. IMR also has a banking industry-specific information management solution, Checksafe. CheckSafe is an imagining system that scans and stores checks. It offers immediate search for check images via computer and has printing capability. The Canon DR-3020 scanner processes checks at a rate of up to eighty checks per minute\(^{112}\). Critical over the counter documents can be scanned with speed, efficiency and no overlaps.

\(^{112}\) IMR Company Web Site.
6.4.4. Evaluation

IMR’s core competency is in the conversion of paper documents into digital information. It offers a wide variety of imaging equipment, and storage options. The OnBase software has been tested in many sites, but mainly for information management purposes. The CheckSafe product, although advertised as a financial-industry specific product, offers no additional benefit over generic scanning equipment. IMR has no recognition engine or electronic data transfer ability, and the information storage capability of CheckSafe limits its use to small batch processing, unsuitable for check clearing use. In terms of end-to-end check clearing system design, the role for IMR most likely will be limited to check image management.

Mitek’s forte, on the other hand, is in the recognition software arena. It has several document processing engines with proven records in many industrial applications. Its check processing specific recognition engine is licensed from Parascript, which has high industry approval due to excellent performance. There is a definite possibility for Mitek to combine its other recognition engine such as QuickStroke to enhance the CheckScript’s capability. Quickstroke can be developed to recognize the payee’s name, and other hand written information on the check (such as the “For” field). This additional capability will further enhance the check clearing system by reducing human intervention. Mitek has no hardware imaging equipment nor data transfer capabilities, so its role in check clearing system is mostly like be a supplier of recognition software.

BancTec is by far the most complete solution provider out of the three discussed. It offers sorter/readers and scanners to physically handle the checks. It also has the ability
to archive images using its ImageFIRST OpenARCHIVE™ system, and read the check using ReadFIRST software. Although it has not yet incorporated its electronic data transfer capabilities, BancTec does have the basic infrastructures set up. BancTec is poised to be a major provider for the end-to-end check clearing system of tomorrow.

6.4.6. On-line Transaction: NetCheque™

The NetCheque payment system is an electronic payment system for the Internet developed at the Information Sciences Institute of the University of Southern California. NetCheque is a distributed accounting service supporting the credit-debit model of payment. Clients using NetCheque maintain accounts with accounting servers in much the same way that people maintain conventional checking accounts with banks. Users registered with NetCheque accounting servers are able to write electronic checks to other users. The check itself contains the currency unit, the amount of the check, an expiration date, an account server identification number, the payee, together with the signatures and endorsements collected during the processing (verifiable by the accounting server against which the check was drawn). Users can write and deposit checks using the write-check and deposit-check functions, and determine their account balances using the statement function. These checks may be sent through e-mail or as payment for services provided through other network protocols. Similar to a paper check, NetCheque bears an electronic signature, and "must be endorsed by the payee, using another electronic signature, before the check will be paid". These signatures are authenticated using Kerberos™113, which provide reliability and scalability using multiple accounting servers.

113 Kerberos, invented at MIT, is designed to protect systems by using chaining encryption to authenticate sessions between server and client. 
6.5. Service Provider: Cheqvision Technologies

Cheqvision is a business entity conceived to handle check processing more efficiently in terms of cost, time delays and resilience to fraud. Cheqvision proposes to streamline the end-to-end check clearing process by applying the combination of patented recognition technology with a secure transport protocol that is implemented over a common carrier, publicly accessible infrastructure like the Internet. The technologies are based on several years of research at the MIT School of Management’s Productivity from Information Technology (PROFIT) Initiative, under the direction of Dr. Amar Gupta.

The first stage of the proposed system takes place at the back office of a bank branch. When the check enters the back office, a high speed, high resolution camera takes a snap shot of the check. The digital image of the check is both stored and sent to the next stage for processing. Currently there is scanning capability at some financial institutions, but the quality of the images are generally low because the images are only meant for archival purposes. The new image capture facility is specifically designed for check processing, so the quality of the images is more suitable for the transmission and information processing.

Stage two of the system is the automatic check amount verification. This is based on a patented off-line character recognition technology developed at Massachusetts Institute of Technology (MIT). The software is capable of locating the position of the courtesy amount block and interpreting the hand written amount on the check. This mechanism eliminates the need for the human operator to read and encode the courtesy amount, thus significantly increasing the process speed and reducing the labor cost.
Finally, information extracted from the check is appended to the check and sent to the Clearing House for presentment and settlement. Also known as electronic check clearing, this capability allows secure transmission of check images and other banking information over insecure networks, such as the Internet. The innovative "briefcase" technology achieves the same security level as that of Visa and MasterCard’s SET credit card protocol over secured lines without any appreciable time delay over regular transmissions. The electronic clearing addresses the most problematic component in check clearing, the transportation of physical checks. The costs associated with transportation, which include both operator salaries and vehicles maintenance, are dramatically reduced. The process time, which was upper-bounded by the maximum speed of the transportation vehicles, can be greatly shortened. Since the information can be transmitted in a matter of seconds, check settlement can occur within hours. By the same token, return items can also be identified expediently, thus reducing the opportunities for check fraud and bad checks and decreasing the banks’ write off expenses.

In short, the financial institutions can truncate the paper checks at the back office of the local branches, further eliminating the cost to transport checks to the central check processing facility.
Check Processing

Local Bank

Central Bank

Customer

Electronic

Figure 30. Proposed Check Processing Flow
Image by Shiu-Chung Au.
Cheqvision plans to partner with local system integrators already working with the financial service institutions to provide this solution to the banking industry.

There is currently a conceptive demonstration prototype of the automated check verification module, name WinBank, available. The WinBank optical Character Recognition system is designed to interpret the handwritten numbers within the courtesy amount block on standard checks using neural networks. WinBank is in Borland C++ runs on Microsoft Window 3.1 platform. Field testing of the prototype is planned in Brazil in conjunction with Integris, the largest system integrator in Brazil and an affiliate of Bulls France.

This system has received enthusiastic response from financial services firms and system integrators. The system has two main venues to enter the check clearing market: partnership with banking system integrators and partnership with clearing houses.

• Partnership with system integrators:

In the words of Jack Guynn, President and CEO of the Federal Reserve Bank of Atlanta, “the banking business was beginning to depend on technology. Today, the banking business is technology, just like every other service industry in this global economy that increasingly defies our traditional beliefs in how payments systems work.”

System integrators manage the technology capabilities for the financial institutions, and have strong influences on the operations of the banks. A partnership with leading system integrators will result in prominent initial customers and instant market share thus uniquely position Cheqvision as the preferred solution provider in the check processing arena. Once the success stories with the initial customers spread and establish the
reputation of Cheqvision, other banks will soon follow suit. Once the majority of all financial service providers have the system, the network externality takes affect and increases the net benefits for the whole economy.

- **Partnership with Clearing Houses:**

  Clearing Houses are the cross road of check processing system. Checks that are not presented directly, which is the majority of checks, are cleared by the Clearing Houses. Once Cheqvision partners with a Clearing House, the banks who utilize the Clearing House will need to conform to the new system under the recommendation of the Clearing House. This also yields a significant number of first customers, and gain appropriate amount of market share. The success with one Clearing House will be enough to convince other Clearing Houses to follow, and this will lead to more efficient inter-regional Clearing House network settlements.

  While other technology providers mentioned above target at a specific area of the check clearing process (ie. ICR, Scanners), the system offered by Cheqvision has the end-to-end capability that is unique and promising.

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6.6. Conclusion

After examining all possible improvement methods to the United States payment system, the following conclusions can be drawn:

- Emerging electronic payment methods promise the most future cost saving and systemic efficiency, so it is in the best interest of the economy to continue to develop and refine those alternatives.

- Checks will remain the most popular payment instrument in the United States for at least two more decades, so the financial service providers must continue the check collection improvement effort to keep up the volume of checks and reduce the cost. In the face of mounting competition from third party service providers, banks must be pro-active in their effort to enhance customer service, cut operational costs, and stay at the forefront of technology.

- The key to reducing cost and speeding up the check clearing process is to liberate relevant information from the physical constraints imposed by the paper medium. The information then can be transferred and exchanged electronically at a fraction of the time needed for physical transportation of the checks. The important financial data, whether sent over a private network or an insecure public network such as the Internet, need to be encrypted for security reasons. Even a private network is exposed to danger because bandits can either cut the physical cable or telephone line and intercept the information, or use electromagnetic devises to read the data. The most reliable and secure mean of transferring data over telecommunication channels is the use of encryption. With encryption, highly sensitive information can be transmitted...
over insecure and public channels such as the Internet, which is free and easily accessible.

- Additional cost savings can be realized if the conversion from physical to electronic medium can also be automated. This can be achieved by adding an automated character recognition feature that can decipher the amount of the checks, along with other relevant information, to the existing imaging capabilities.

- The images of checks become very important when the physical checks are destroyed or eliminated in the electronic check system. The existing imaging technology is adequate for image archival, but not for image processing and account settlement. The upgrade of imaging equipment is important.

- Although there are many technology solution providers in the area of imaging, secure transfer, and character recognition, the integrated solution offered by Cheqvision is most promising. The complete system combines all three technologies to create the most value-added solution to check processing. The enhanced check imaging improves customer service, the automated check verification reduces time and cost, while the secure transfer protocol allows transmission of confidential check settlement information over the Internet thus eliminating transportation cost and dramatically reducing the settlement cycle. The proposed system can benefit the whole economy by improving the overall efficiency of the check clearing process.
Appendix

List of Tables

Table 1 Payment Flows and GDP in G10 Countries 11
Table 2 Payment Methods of G10 Countries 21
Table 3 Check Collection Market 38
Table 4 Demographics of Senders and Recipients of ACH 102
Table 5 Relative Importance of Non-Cash Payment Instruments 113
Table 6 Optical Character Recognition Providers and Characteristics 145
Table 7 Banking System Integrators 155

List of Figures

Figure 1 The New US $20 Note 17
Figure 2 The Check Clearing Process 34
Figure 3 Role of the ClearingHouse 36
Figure 4 MICR symbol of Character “Nine” 47
Figure 5 Settlement Flow of Paper Check and ECP 53
Figure 6 Truncation at the Bank of First Deposit 56
Figure 7 Truncation at an Intermediary 56
Figure 8 Check Truncation Network Externality 60
Figure 9 Flow Chart of Point of Sale Transaction 66
Figure 10 Direct Payment (ACH Debit) Transaction Flow Chart 72
Figure 11 Direct Payment (ACH Credit) Transaction Flow Chart 72
Figure 12 Volume of ACH Transactions 73
Figure 13 Cost of Check versus ACH 78
Figure 14 New York Automated ClearingHouse ACH Volume 80
Figure 15 Cross Border Payment Flow Chart 83
Figure 16 Smart Card Transaction Flow Chart 91
Figure 17 Home Banking Transaction Flow Chart 99
Figure 18 Percentage of Cash Use in Thailand 119
Figure 19 Percentage of Non-Cash Payment Instruments Use in Thailand 119
Figure 20 BAHTNET Transaction Flow Chart 121
Figure 21 Electronic Clearing System Transaction Flow Chart 124
Figure 22 Media Clearing Transaction Flow Chart 126
Figure 23 Electronic Payment Instruments in Thailand 128
Figure 24 Segmentation of Digits 136
Figure 25 User Interface 136
Figure 26 Representation of Figure 8 – Normalized 137
Figure 27 Representation of Figure 8 – Thinned 137
Figure 28 Representation of Figure 8 – Slant Corrected 137
Figure 29 Representation of Figure 8 – Thickened 137
Figure 30 Proposed Check Clearing Process 164
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173


