

FUNDAMENTALS OF PAYMENT SYSTEMS



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Introduction

Payments are the financial instruments that people and businesses around the world use to transfer funds and this makes them one of the most important parts of a company's financial operations. The subject can become complex because there are often many different payment systems in a given country—and most countries have their own unique currency. Further challenges come with the continual introduction of newer payment systems such as PayPal, Bitcoin and various mobile payment options. The result is well over 750 payment systems throughout the world; systems that are constantly changing due to new technology or government regulation of the currency.

The **purpose** of this paper is to provide corporate treasury professionals with the working knowledge necessary to make informed decisions about payment practices for their organization. It is divided into six sections:

- I. *Payment Systems* describes the essential elements of a payment system and the participants.
- II. *Payment Channels* covers the three basic payments types; paper-based, high-value systems and batch systems.
- III. *Payment Processing and Controls* looks at payments from the corporate perspective dealing with topics such as making payments and processing collections.
- IV. *Settlement* describes how financial institutions involved in payments exchange value between each other.
- V. *Alternative Payments* deals with less conventional payments systems, such as Hawala, PayPal and Bitcoin.
- VI. *Conclusion* summarizes the paper and provides direction to additional resources.

I Payment Systems

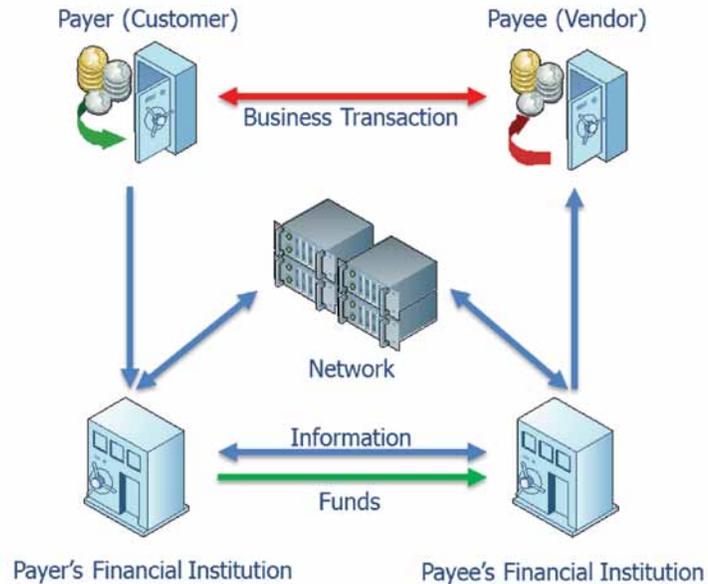
A payment system is a set of processes and technologies that transfer monetary value from one entity or person to another. Payments are typically made in exchange for the provision of goods, services, or to satisfy a legal obligation. They can be made in a variety of currencies using several methods such as cash, checks, electronic payments and cards. The essence of a payment system is that it uses cash-substitutes, such as checks or electronic messages, to create the debits and credits that transfer value.

The value that is being transferred is typically stored in depository accounts at banks or other types of financial institutions. The banks, in turn, are connected to a set of payment systems that they use to process payments on behalf of their customers or depositors. Most US banks are members of a number of different payment systems such as NYCE (New York Cash Exchange, a subsidiary of FIS), CHIPS (Clearing House Interbank Payment Systems) and Fedwire (US Federal Reserve Bank network). Non-US banks are connected into similar national systems such as CNAPS (China), BOJNET (Japan) and SPEI (Mexico). Banks operating in multiple countries connect to payment systems in each of the countries where they operate either directly or through a correspondent bank. Significantly for the settlement process and for the discussion of less conventional payment systems, banks in many countries typically maintain accounts with their central bank and participate in the central bank's payment systems. In the Eurozone, the authorities have taken it a step further by creating SEPA, the Single European Payments Area, under the authority of the European Central Bank (ECB). SEPA was created to provide standardized payments processing and costs among all the various countries within the Eurozone.

In the simplest case involving the traditional banking system, payments involve four participants:

- The payer: Makes the payment and has its bank account debited for the value of the transaction.
- The payer's financial institution: Processes the transaction on the payor's behalf.
- The payee's financial institution: Processes the transaction on behalf of the payee and generally holds the value in an account.
- The payee: Receives value of the payment by credit to its account.

This is illustrated in the “four corners payment model” diagram shown below.



In the simple case illustrated here the two banks may choose to transfer payment instructions and funds directly with each other. It is also possible for the banks to use various intermediaries to help facilitate the transaction. The diagram refers to these intermediaries as “network”.

In the real world the network includes central banks such as the Fed (US Federal Reserve), ECB (European Central Bank) and The Bank of England and clearinghouses such as CHIPS. There are also information transmission mechanisms such as SWIFT (Society for Worldwide Interbank Financial Telecommunications) and payment systems such as Fedwire and BOJNet which also include information transmission systems. Entities such as payroll processors, check printers, systems providers and card systems such as Visa and MasterCard that are outside of the four corners model also participate in the payment process. Non-traditional payment systems such as Bitcoin bypass the banking system almost entirely by fulfilling the role of financial institution, currency and network themselves.

The operation of the model is often referred to as the payment process and it involves four basic steps:

- Payment instructions are the information contained in a wire transfer or check. These instructions are from the payer and tell the paying bank to transfer value to the beneficiary through the network and receiving bank.
- Payment generation is when the instructions are entered into the system—printed on a check or transmitted via ACH or wire.
- Clearing is the process where the banks use the payment information to transfer money between themselves on behalf of the payor and the beneficiary.
- Settlement is the final step in the basic process and occurs when the beneficiary's bank account is credited and the payor's bank account is debited. Final settlement occurs when the banks pass value among themselves, a distinction that has important treasury implications.

The actual payment process will depend on the type of payment instrument that the payor and payee choose to use—or have chosen for them by their financial institutions.



II Payment Channels

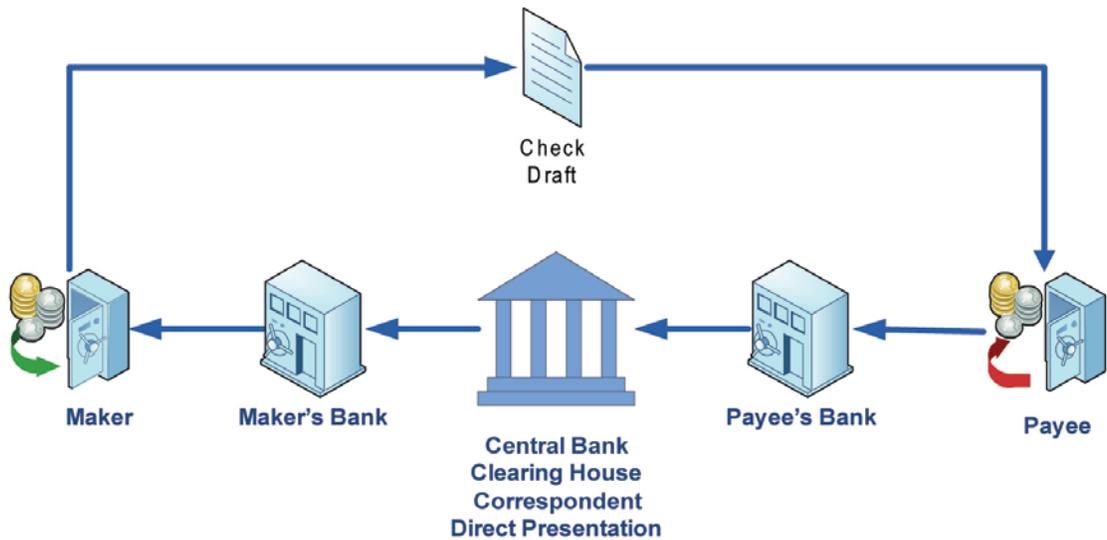
Processors for the payment systems can use different channels to make a payment and each has different operating characteristics, rules and settlement mechanisms. Broadly speaking, all payment systems can be placed into one of the following four payment channels:

- Paper-based systems such as checks or drafts. Payments are initiated when one party writes an instruction on paper to pay another. These systems are one of the oldest forms of non-cash payment systems. Checks are a common paper-based channel and are still widely used in the United States and a few other countries.
- RTGS (Real Time Gross Settlement) or High-Value Payments; called wire transfers by most people. Wires came into being in the late 1800s with the invention of the telegraph but did not become widely used until the early 1900s.
- RTNS, or Real Time Net Settlement systems or Automated Clearing House (ACH) batch payments were introduced in the early 1970s and were designed to replace checks with electronic payments. Unlike wires, which are processed individually, ACH payments are processed in batches and were originally intended for small payments under \$100,000 such as payroll and consumer transactions.
- Cards are a payment channel that includes credit, debit and stored value cards. They are a fast growing segment of the methods for making and receiving payments.

1. Paper-Based Payments

Checks are still a popular way of making payments in the US and some other parts of the world, but they are not the only paper-based payment system. A number of countries still operate Giro systems where participants use paper to initiate a money transfer. Because Giro systems are slowly going away, this section will focus exclusively on checks.

The process of exchanging value through checks is generally called check clearing and is illustrated in the following diagram:



The entity or person making the payment, payor, is referred to as the maker of the item. They mail or otherwise convey the check or draft to the payee. The payee deposits the item in its bank and it is then up to the bank to determine how it will receive value from the maker's bank. The maker's bank, having been debited for the value of the item, then charges the maker's account for the value of the check.

A check contains the names of the payor and the payee, the payor's account number, amount of the check, the date the check was issued and the name and routing number of the maker's bank. There is generally a coding strip at the bottom of the checks that enables high-speed reader/sorter equipment to process them quickly. In the US and Canada the coding strip uses magnetic ink character recognition (MICR); other countries use an optical character (OCR) system. Before the banks can process the check they must add the amount of the payment to the coding strip at the bottom of the item, a manual step that adds cost and the possibility of error to the check clearing process.

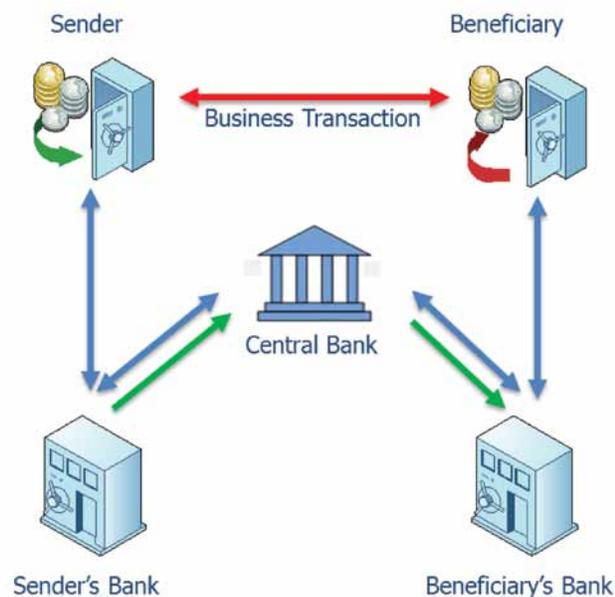
The value of the check is usually made available on a provisional basis to the payee within one or two days. The value transfer is provisional because the payee's bank has not received final confirmation from the maker's bank that the item is valid. Settlement and finality are important issues in payments and

are discussed in more detail in the Settlement section. In recent years, check clearing has been improved through the use of images of the checks, which speeds the clearing process while creating a few issues as well. Check images can be created in a number of ways. Sometimes the image is created at a retailer's point of sale where the check is scanned into the register. Yet another way to create check images is through the use of a smartphone or tablet.

2. High-Value Transfers

High-value transfers are generally used between businesses when there is the requirement for fast, secure and final transfer of value. Frequently referred to as wires they are considerably more costly than paper-based or batch systems.

The following diagram shows the elements of a high-value transfer system.



The sender (payor) instructs its bank in a mutually acceptable way to wire money to the beneficiary (payee). Included in the sender's instruction are the name of the beneficiary, the beneficiary's bank and other address details specific to the particular high-value system. In the case of Fedwire this would include the ABA number (American Bankers Association) of the banks being used along with the beneficiary's account number. The sender's bank would then use its direct access to the high-value system to instruct the beneficiary's bank to debit its account with the central bank and credit the beneficiary.

Because the instruction is final and irrevocable and because the beneficiary's bank is receiving immediate value from the central bank it provides the funds to the beneficiary virtually on an immediate basis. A significant point with respect to these types of system is that the central bank stands as a guarantor of the system to both banks. The receiving bank can rely on the central bank for the funds in the event that the sending bank fails to adequately cover their account with the central bank. This element of RTGS systems adds considerably to their cost and is a major difference between conventional payments and new concepts such as Bitcoin.

In reality, making high-value payments is a bit more complex. There are a number of ways in which sender's can instruct its bank to effect the payment. These include bank-proprietary systems, ERP (Enterprise Resource Planning) file transfers through SFTP (secure file transfer protocol), Third-party systems, SWIFT and occasionally the telephone or by fax. How the sender structures its message to the bank will determine the speed, cost and risk with which the bank can complete the transfer.

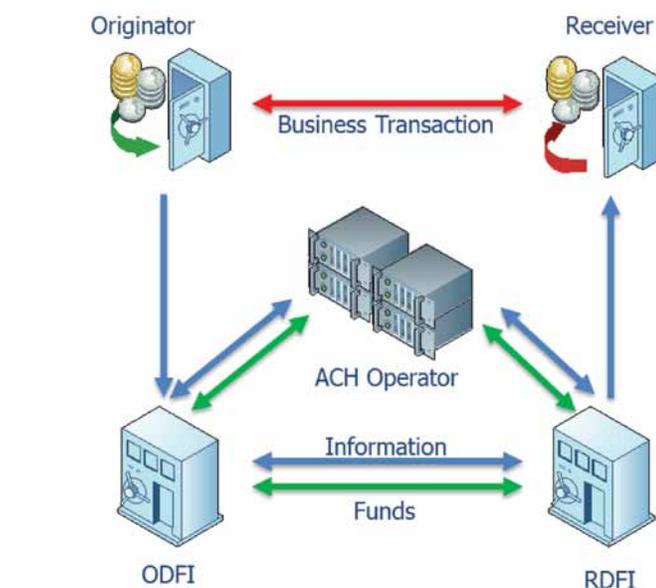
The preceding applies to high-value transfer systems that are Real Time Gross Settlement Systems (RTGS). There are still a few non-RTGS systems in operation. In these systems value is transferred between the sender's bank and the beneficiary's bank on a periodic basis. This reduces the immediacy of the transaction but not the finality. Because RTGS systems are important for global financial stability, non RTGS systems are in a state of permanent—and rapid decline.

Fedwire, the U.S. based high-value transfer system, is an RTGS system and there are similar public and private large-value transfer systems in most countries around the world. Examples include CHAPS in the UK, LVTS in Canada and CNAPS in China.

3. Batch Systems

Batch systems, such as the ACH (Automated Clearing House) in the US and BACS in the UK, were created to handle large volumes of relatively low value transfers. Because these transfers did not have the requirements of immediacy and finality that are common to high-value systems, participants would exchange batches of transfers on a daily basis settling the transfers the following day.

The following diagram shows the participants in the US ACH system; other global systems operate in virtually the same way.



Like high-value systems, senders (payors), called originators in the ACH world, provide their banks—ODFIs (originating depository financial institutions) with payment instructions. Unlike high-value systems, there are usually multiple payments in each instruction sent to the ODFI. The ODFI processes the instructions and sends a file of all customer instructions to its ACH Operator. The ACH Operator then distributes all of the payments in all of the batches to the appropriate RDFIs (receiving depository financial institutions) which then credit the individual receivers (payees). It is also possible within the ACH—and many other batch systems—to send instructions to debit the receiver’s account. It is for this reason that the terms originator and receiver are used rather than sender and beneficiary; in this situation the terms payor and payee would be reversed.

While the value of ACH type payments is usually less than large value wires, there is still a considerable range of checks and balances that apply to these

payments. These include debit filters and blocks, which restrict the ability of somebody that knows a firm's ABA routing code and account number from withdrawing money from the account using the ACH.

ACH systems have typically been used for domestic transactions but are now becoming a way of transferring money between countries and currencies using cross-border ACH transactions.

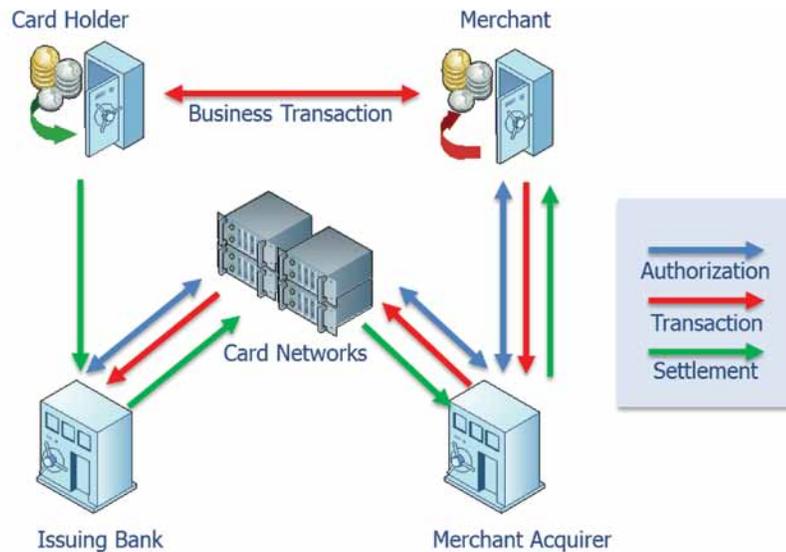
ACH has typically been a next-day payment system where it takes a day from initiation of the payment to value transfer by the bank. This is changing in countries such as the UK which offer a same-day BACS process known as Faster Payments Service (FPS) and some of the Nordic countries. In the US, there is the possibility of same-day ACH, but some financial institutions are wary of this as it could detract from the revenue stream they receive from RTGS payments.

4. Card Based Payments

Card based systems, which include both debit and credit cards, are the fastest growing form of payment. Although a third-party vendor may issue credit or debit cards, bank-issued cards are the most widely used. A credit card is issued against a line of credit that the institution or merchant has extended, whereas a debit card is issued against a deposit account held by a business or consumer. Stored value cards, such as gift and payroll cards, are a special type of debit card that do not access a specific bank account but are prefunded at the time of issuance. Some stored value cards can be "reloaded", that is have funds added to the available balance, to extend their usability.

The following diagram shows the participants in a typical card transaction. The cardholder presents a card for payment to a merchant. The merchant captures the transaction information and sends it to its merchant acquirer, typically a bank, for authorization. The merchant acquirer queries the issuing bank for authorization for the transaction via the appropriate card network which it then returns to the merchant. If the transaction is denied, the payment is cancelled. If the transaction is approved, the payment is completed. The merchant then sends the final transaction information to the merchant acquirer, either at the time of transaction or more typically in bulk at the end of the day. The merchant acquirer presents the transaction to the issuing bank, again using the appropriate network. Each card network net settles the day's card transactions between all of its member banks, typically through a separate batch payment system such as the ACH in the U.S. The issuing bank charges the card

holder's account and the acquirer credits the merchant's account net of any transaction fees.



Cardholders can typically dispute charges assessed to their accounts for anywhere from 60 to 120 days after the originally transaction. These disputes may result in a charge-back to the merchant unless the merchant can provide proof of the original transaction, e.g. a signed transaction receipt in the case of credit cards.

Debit card transactions can be either signature based in which case they are processed through the merchant's normal credit card networks and the cardholder signs a receipt at the time of the transaction. Alternatively, debit cards can be PIN-based in which case they are processed through an EFT or ATM network and the customer enters a personal identification number, or PIN, at the time of the initial transaction.

There are a number of variations on standard card payments, including procurement cards, single use card and virtual or ghost cards. Each of these is an attempt to improve the security of the basic transaction, but all use the same clearing channels as regular debit and credit cards.

The preceding described the payment process—getting the funds from the originator to the receiver. It did not explain how the banks settle the net difference in money sent versus money received which is not a trivial matter. This process is covered in the section on settlement.

III Payment Processing and Controls

The previous section, Payment Channels, focused on how the various parties in a payment transaction interact with each other. Payment Processing and Controls is a more individual/business-centric process consisting of six essential steps:

- I. Entry into the obligation to purchase goods or services or the incurrance of a legal obligation. This could result from a purchase order or an oral commitment to make a purchase.
- II. The obligation is approved and entered into an accounting system by the payor.
- III. The payment method, such as check, ACH, or wire, is selected keeping in mind that this might have been specified when the obligation was incurred. Since the speed and cost of receiving a payment are partial determinants of a seller's profitability, many sellers specify payment types and terms.
- IV. Initiation and execution of the payment by the purchaser.
- V. Funding and settlement of the payment.
- VI. Transaction reconciliation between company systems and external bank accounts.

In a large organization it is unusual, if not impossible, for any one individual or department to have detailed knowledge of the entire process. Instead people become expert on their step in the chain, such as, vouchering and the numerous discrete tasks it involves. But all of the processes, which could involve departments such as payroll, accounts payable, human resources and purchasing are connected through the six steps described above.

If a fictitious obligation is approved and entered into the accounting system, it is very difficult for systems to prevent the payment from being made. A classic example would be where a false invoice from a vendor for services never provided is entered into the system. With good controls this can be difficult to do. It might be easier for someone to try and change the name of a beneficiary on an already approved and legitimate invoice. If another someone had direct access to an external banking system—along with a full set of user ids and passwords, they could simply make themselves a payment.

Documentation is a general description of the collection of physical or electronic evidence to establish that a payment request is legitimate. This could be a completed request for payment form with the underlying invoice attached or it could be an electronic message directing the recipient to a source where underlying evidence of the payment's validity may be found. Regardless of its form, documentation is the first line of defense—and compliance—in good payments practice.

Due diligence is the process of ensuring that the documentation and other elements of the payment request comply with an organization's standards. Such standards can include a prohibition on the use of physical currency (cash) or the requirement to confirm new or modified payment instructions via a documented call-back.



Confirmation is the final step in verifying that the payment is valid and being directed through proper payment channels to the appropriate beneficiary. For example, there could be a change in the remittance address to which a check is mailed, or the account number or IBAN (International Bank Account Number, required in the Eurozone) for an electronic payment.

Documenting a payment is critical both in terms of making sure that money is not being paid for a non-existent obligation and in making sure the money is being paid to the right recipient. Losses can also result from paying an invoice or payment request that was never legitimate in the first place. Unscrupulous vendors sometimes submit invoices for services never provided and employees have been known to submit falsified payment requests or invoices when they thought they could do so without detection.

Due diligence in documenting payments and confirming payment instructions is important. Recently a group of Nigerian criminals targeted firms that they suspected were making large vendor payments using the ACH. The criminals used the internet to harvest financial information about a group of vendors that were supplying a large number of businesses. They then used email and faxes to submit changes in payment instructions that were sent to selected customers of those vendors.

Since they were using names of vendors that the companies were already used to paying for goods and services, they did not need to falsify invoices or payments. They just needed to change the payment instructions to redirect the payments to their own bank accounts. Because the financial teams at most companies are very busy, sometimes with limited staff dedicated to confirming payment instructions, in a number of cases fraudulent changes were made without confirming their validity using call-back procedures. The companies then made legitimate payments to their vendors except that these payments went to the wrong banks' accounts.

IV Settlement

Settlement, sometimes called availability, refers to the actual movement of funds from the payor's account to the payee's account. In other words the time at which the payee can actually use the money involved. It is different from finality which is the point in time when the payee knows that the money involved cannot be taken back by the payor or the payor's bank. Settlement becomes final when a payment is unconditional and irrevocable.

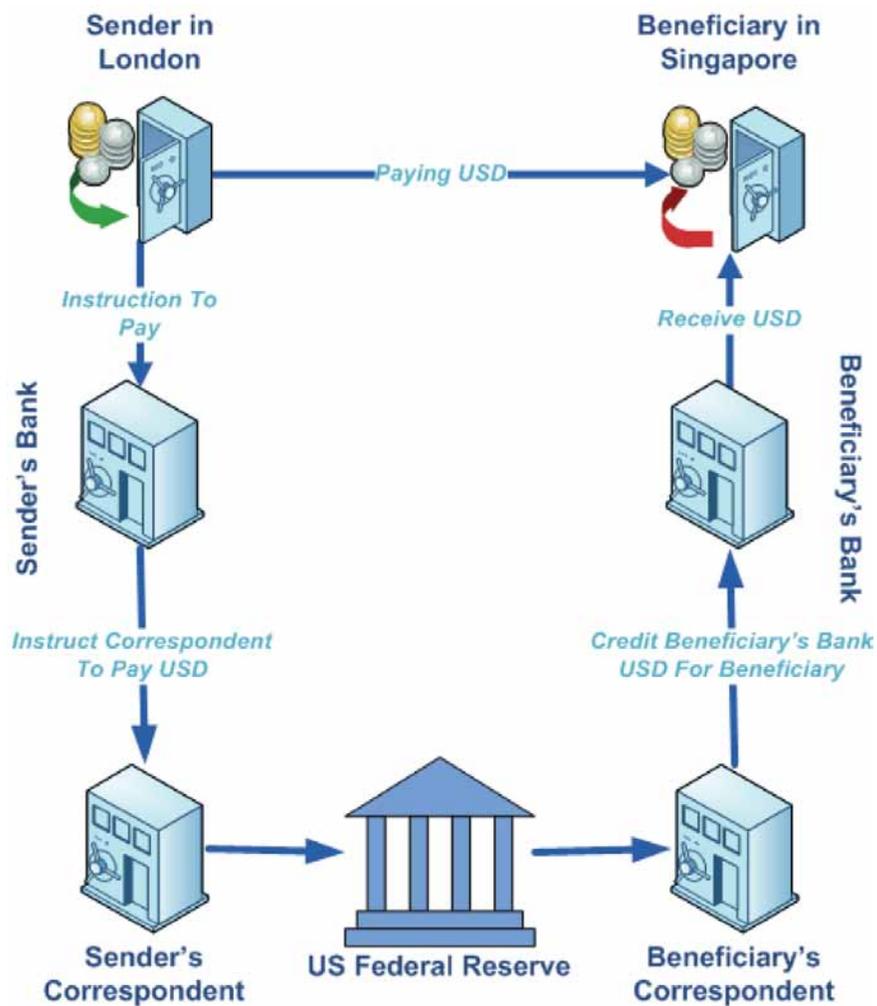
Finality varies depending on the payment system and the parties involved in the transaction. Payment systems that offer immediate and irrevocable value are called Real Time Gross Settlement (RTGS) systems. Others, such as check-based systems, provide immediate information with value following shortly. But the value sometimes is contingent on the payor or the payor's bank not attempting to retract the payment, a right which can exist for sixty days or more, depending upon the payment system. This can be a major issue for global companies using many different low value payment systems that feed into some sort of cash pooling or concentration system. While the amount of a rescinded payment may not be large, accounting for the rescission can prove challenging, particularly when it involves two currencies.

From the bank perspective the actual transfer of funds, or settlement, can be handled in several different ways. In a domestic transfer, one in which all parties are in the same country, settlement is often handled between the banks using common accounts held at their central bank. In the United States these accounts are held at the Federal Reserve Bank and referred to as reserve accounts. In a cross-border payment involving more than one country, banks typically use depository accounts with each other, called correspondent accounts, to settle their customers' funds transfers with the correspondent banks using their reserve accounts on behalf of their clients. Settlement through correspondent banks is illustrated in the following diagram.

In the example shown, the sender based in the United Kingdom has an obligation in US dollars to a beneficiary in Singapore. Because currencies are always settled in the country of currency the sender's bank and the beneficiary's bank are required to use correspondent banks located in the US that have accounts with the Federal Reserve. This makes the transaction similar to the high-value example shown earlier with the addition of two intermediary banks. This addition adds a level of complexity—and cost—to a very basic transaction. It also

impacts the quality of the information that travels with the payment which can often be truncated, removed or replaced with an intermediary bank's reference number. Global banks that operate in a number of countries often use their own branches as correspondents for certain types of transaction. This eliminates the total number of counterparties but not the number of steps that are involved in the payment.

The number of accounts maintained with other banks by a large institution for this purpose can run well into the thousands. These accounts are necessary to participate in global payments systems of which there are well over 750 in the world today.

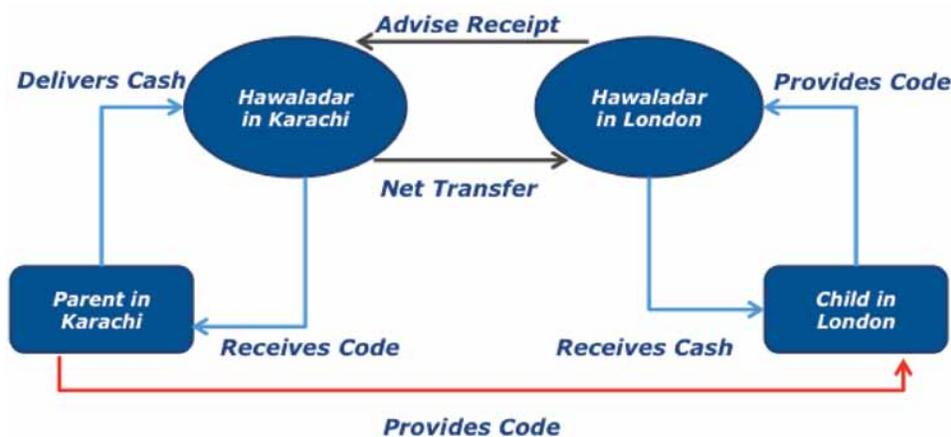


V Alternative Payment Systems

From the casual participant's perspective the infrastructure and rules surrounding payments are seldom given a second thought. Payments for small retail purchases are made with a debit card, which can be swiped—or waved—past a terminal with charges taken directly from the user's bank account. The marginal cost of these payments is very small and it is only when something goes wrong that these issues are given consideration. But debit cards, which use a variety of networks and are issued under a variety of brands, are ultimately settled through a wire or ACH type system.

The need to transfer value is not something exclusive to highly developed economies with sophisticated networks and consumer protection schemes. Hawala, an informal money transfer network predates all of the systems discussed thus far. In its modern form, Hawala is a way for payors and payees without access to technology and modern banking systems to transfer money between themselves.

A simple—and fictitious—example of Hawala is illustrated in the following diagram:



In the situation illustrated above, a parent in one city/country wants to transfer some money to a child in another city/country. Neither the parent nor the child has a bank account so the parent uses a trusted agent, known as a Hawaladar to act on his behalf. The parent brings an amount of cash to the Hawaladar and explains his intentions. The Hawaladar provides the parent with

a code that the child will use to obtain the counter value of cash in London. The parent duly provides the child with the code and along with the name and address of a Hawaladar in London who will provide the child with cash when the appropriate code is presented. The Hawaladars then exchange details about the transaction in a way convenient to them and move the appropriate amount of money between themselves using the banking system.

This trust-based system is very effective and reasonably cost-effective for the participants. And these two attributes make it very popular for those with limited means and access to the formal banking system. The Hawaladars function as banks, aggregating a number of small transactions, which are ultimately settled through the formal banking system. Unfortunately, Hawala has characteristics that also appeal to those operating outside of the law such as criminals or terrorists. A terrorist whose transaction would be flagged and rejected by a bank with access to sanctions lists would not be flagged by a Hawaladar who would bundle the transfer of funds with other, entirely innocent, transfers. For this reason, Hawala is not looked at with favor by regulators and other officials.

The need and interest of individuals to find low cost ways of moving money between themselves is not exclusive to the developing world. PayPal, a system that has been around for some time is a good example of a system that is low in cost and quite efficient. Essentially PayPal operates as the interface between the payor and receiver handling the payment process and other banking functions and settling the transaction using wire or ACH between the payor's bank and the receiver's bank. PayPal can handle multiple currencies and card payments as well and is efficient and low in cost. The key difference between a PayPal transaction and that of a conventional bank transfer lies in PayPal's role and obligations as opposed to those of a bank. Banks are highly regulated and operate with sophisticated security tools and capital adequacy requirements. If something goes wrong with a payment and the payor has complied with the bank's requirements, any loss or other problem is generally absorbed by the bank. PayPal does not have this overhead and so is able to appear more consumer friendly—and definitely lower cost.

The preceding is not to say that banks are always better or PayPal is always a bad idea, the correct payment approach will depend on the context of the payment and the amount. But extend the PayPal thinking a bit further and this brings one to Bitcoin. Bitcoin is not only a value transfer system but a currency as well.

In very simplistic terms one can acquire Bitcoins by purchasing them with a conventional currency or providing goods or services with the payment denominated in Bitcoins. The holders of Bitcoins can then transfer them amongst other Bitcoin holders using an extremely clever and secure process. If everyone used Bitcoins it would be very difficult for conventional payment systems to compete. In the near-term there are two aspects of Bitcoin that make this highly unlikely.

First is the rate at which one can acquire or dispose of Bitcoins for a conventional currency. As with conventional currencies, the rates vary. Unlike conventional currencies the factors that drive this variance are unknown and there is no central bank of Bitcoin to intervene in the market to ensure stability and protect participants. For example, a country could decide that it did not want holders of its currency converting the currency to Bitcoins. They could prohibit Bitcoin operators from changing Bitcoins into their currency and depositing the funds in someone's account at a bank in that currency.

Second is the way Bitcoin accounts for the holdings of its participants. While the technical aspects of Bitcoin are extraordinarily elegant, secure users of Bitcoin have little recourse if something happens to their holdings. The recourse that users have with conventional currencies and payment systems—banks and central banks—is not available in the Bitcoin world.

The one thing that is clear from looking at alternative payment systems from Hawala to Bitcoin is that the desire for alternatives to conventional systems is strong and technology enables some truly elegant ways of meeting this demand. The future is likely to see additional developments and variations to address the issues and opportunities inherent in alternative systems.



VI Summary

Payments are a critical part of modern commerce that are simple conceptually but complex in application. The objective in this paper was to provide treasury practitioners with the basic principles of payment systems and their operation to help in understanding the issues involved in developing global account structures and using various treasury techniques. Operational details of major payment systems such as BOJNet and Fedwire were not included but can be found through a number of resources including the Bank for International Settlements and many commercial banks. Also excluded were details of access and transmission systems such as third-party treasury management systems and SWIFT. Similar resources for this area also exist on company websites and the SWIFT website. Finally, there has been no discussion of hybrid payment systems including mobile banking, payment cards and the like.

Regardless of the payment system or its ancillary details, there is a common set of elements that govern their operation. There will always be a sender and a receiver and both will need bank accounts. The banks holding the accounts will need to have a method of exchanging payment instruction among themselves and transferring money between themselves. Central banks will be needed to operate payment systems or operate as guarantors of the systems. More simply, while the names may change, the fundamental relationships and interaction will not.

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