

The Evolution of Payment Systems

By Masashi Nakajima



The evolution of payment systems will never stop. Payment systems are social infrastructures that support all economic activities, and the financial market will require more sophisticated payment systems with greater safety and efficiency.

Importance of Payment Systems

Payment systems are the mechanisms that enable the smooth transfer of funds between buyers and sellers, and/or between banks. In the modern society, no economic activities are possible without the transfer of money. In this sense, it can readily be said that payment systems are one of the most significant social infrastructures.

As a limited scope of people in central banks and commercial banks play a central role in payment systems, the people on the street seldom or never notices the role and importance of payment systems. For this reason, payment systems have sometimes been regarded as the “behind-the-scenes activities,” which are not seen by a large audience. Similarly, payment systems are even compared to the “plumbing business”. This analogy indicates that payment systems are extremely important, but their operation is carried out mostly underground and out of sight. The steady efforts have been made for the smooth functioning of payment systems, even though it is not conspicuous.

But the times have changed, and a lot of attention is now currently focused on payment systems. The background of the attention is twofold. First, the volume of fund transfers handled through payment systems has increased dramatically. That means “settlement risk” which arises when a payment is not made as expected, has also increased. Large risk is always a

cause of concern for authorities and central banks. Second, the remarkable evolutions have been made on payment systems due to the development of Information Technology (IT). The progress of IT has enabled the advancement of payment processing and created some enhanced payment systems.

Payment Systems as Infrastructures

A payment system plays a pivotal role in circulating funds all over the economy. If some malfunctions were to happen to a payment system and hinder the flow of funds, the impact would be extraordinary and disruptive. The economic activities and functions of financial markets would become completely paralyzed. You can easily imagine such a disastrous situation where no one can receive money from others and all the flow of funds between banks stopped dead.

Therefore, we can conclude that payment systems are social infrastructures that support all economic activities, including commercial activities and financial transactions. A safe and efficient payment system is an important mechanism that props up the functions of financial markets and the financial system.

Central Bankers’ Concern

An episode involving Alan Greenspan highlights the importance of payment systems. When the chairman of the Federal Reserve Board (at that point) heard of the September 11 attack in 2001, he was on the flight back from the international banker’s meeting in Switzerland. At that time, his immediate concern was not the inflation rate or the unemployment rate of US economy, but the “Fedwire”. The Fedwire is the electronic payment system in the US, which transfers more than \$4 trillion a day in money and securities between banks all over the country. He was greatly concerned about a shutdown of the Fedwire. Because, he was certain that the breakdown of the Fedwire would lead to the collapse of financial markets and financial systems in the US. That was the worst scenario he could come up with. Fortunately enough, his nightmare did not come true.

In the case of the Great East Japan Earthquake in March 2011, the senior officers for the Bank of Japan were mightily relieved to know that the major payment systems continued to work as usual. The robust payment systems helped to

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minimize the confusion of the Japanese economy after the unprecedented natural disaster.

Fast-growing Settlement Values

It is needless to say that larger settlement values are accompanied with larger settlement risk. Thus, the fast-growing settlement values came to realize the importance of robust payment systems. Settlement values of payment systems in industrialized countries have increased at a very rapid pace, which has been higher than that of economic growth. The settlement amount became more than double during the past fifteen years in developed countries. The progress in globalization and financial innovation has had a direct impact on the drastic increase on settlement amounts.

Figure 1 shows the settlement values of payment systems relative to the nominal GDP in thirteen industrialized countries. In most countries, this ratio is between 40 to 100 times annual nominal GDP. The difference of ratio mainly comes from the activeness of financial transactions in each economy. The average ratio is 75.3 times in 2007.

This fact means that only a one-week settlement amount of a payment system is larger than the annual GDP of the nation. In other words, a payment system settles the nominal amount of annual GDP only in three or four days. With this knowledge in mind, you can imagine the tremendous social impact if there were to be a problem with a payment system.

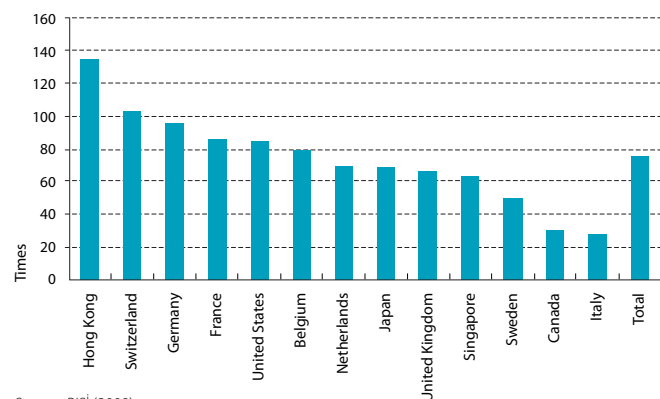
Recognition of Settlement Risk

Increased settlement values of payment systems means that the potential risk greatly increases, if settlements are not made properly; for example, due to the default of a participant.

It should be noted that potential risk does not always remain dormant. Actually, settlement risk sometimes becomes a reality causing huge losses. Certain examples are shown in some disturbances, which include the Herstatt Bank incident (1974), the Bank of New York incident (1985), the BCCI incident (1991) and the Bearings incident (1995).

The rise of awareness on the growth of potential risk

Figure 1 Settlement Values of Payment Systems relative to Nominal GDP
(As of 2007)



Source: BIS¹ (2009)

Settlement risk is not an imaginary risk but a “real risk” and it is a strong driving force for the reform of the payment system in each country.

encouraged the extensive reform on payment systems. Moreover, the awareness that settlement risk is not an imaginary risk but a “real risk” is a strong driving force for the reform of the payment system in each country. Especially, the central bank in each country becomes concerned about the inherent risk.

Emergence of Electronic Payment Systems

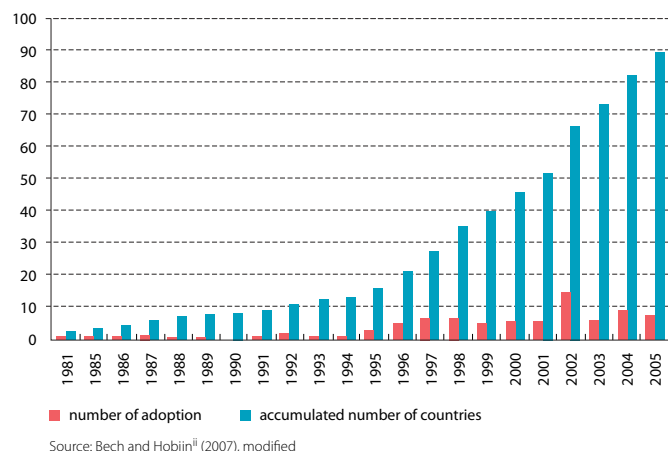
Payment systems show the remarkable changes in the past two decades. In the early days, the payments among the banks used to be made by exchanging paper payment instructions, which is called the “paper-based payment system”. But, as the number of payments increased dramatically, it became very difficult to process paper work with paper instructions and manual handling. Therefore, people tried to utilize information technology (IT) with regard to the payment system. This endeavor resulted in developing the payment systems using the computers and networks. In the beginning, these payment systems were called the “electronic payment systems”. However, the name became obsolete soon and these systems came to be simply known as the “payment systems”. That was because most payment systems became electronic within a short period of time.

From DTNS Systems to RTGS Systems

In many countries, when the electronic payment systems were first introduced, they were the “Designated-Time Net Settlement” (DTNS) systems. A DTNS system is a net settlement system, thus the settlement of funds occurs on a net basis. In concrete terms, a net position of each participating bank is calculated, which is defined as the sum of the value of all the transfers a participant has received up to a particular point in time minus the value of all transfers it has sent. A DTNS system is also a designated-time settlement system, in which final settlement takes place at a certain time, typically once, at the end of the day.

On the other hand, the “Real-Time Gross Settlement” (RTGS) systems have two features. The first feature is that the settlement of funds occurs on a gross basis, which means payment instructions are processed on a one-by-one basis without netting. The second feature is that final settlement is made on a real-time basis during the day. Thus the payments become final immediately.

The RTGS system is far superior to the DTNS system in terms of settlement risk. The RTGS system achieves finality earlier, which reduces credit and liquidity risk. On top of this, there is no “systemic risk” in the RTGS system. With the recognition of increased settlement risk, the central banks made the

Figure 2 Number of countries that adopted the RTGS system

transition from the DTNS system to the RTGS system. It was the first evolution of payment systems.

As of 1985, there were only two RTGS systems observed; namely, the “Fedwire” in the US and the “DN Inquiry and Transfer System” in Denmark. From the late 1980’s, the number of RTGS systems increased gradually, especially in Europe, which includes the “RIX” in Sweden (1986), the “SIC” in Switzerland (1987), and the “EIL-ZV” in Germany (1988).

In the late 1990s, the RTGS system spread rapidly in the EU. These reforms were closely related with the TARGET system, which was planned to prepare for the introduction of the single currency Euro. The “TARGET” was the payment system for the whole Euro area and was developed by connecting the payment systems of each member country. A decision was made that only the RTGS systems were allowed to be linked to the TARGET system. It was impossible to link the RTGS system with the DTNS system, since the settlement methods and risk management were completely different between the two systems. Thus, having an RTGS system became a prerequisite for membership of the Economic and Monetary Union (EMU). In this way, the central banks that planned to introduce the Euro reconstructed their payment systems into the RTGS system one after another in 1996 and 1997.

Influenced by these movements, some Asia-Pacific countries also introduced RTGS systems in the late 1990s, which included the “BOK-Wire” in South Korea (1994), the “BAHTNET” in Thailand (1995), the “CHATS” in Hong Kong (1996), the “RITS” in Australia (1998) and the “MEPS” in Singapore (1998).

The use of RTGS systems also grew outside industrialized countries. Some countries in Eastern Europe, Latin America, the Middle East, and Africa were similarly adopting the RTGS systems. In South America, Uruguay was the first country to adopt RTGS in 1995. Saudi Arabia (1997) was the first country in the Middle East, and South Africa (1998) was the first comer in Africa. Some of these countries constructed their electronic payment systems from scratch as RTGS systems.

According to the “Global Payment System Survey 2008”

conducted by the World Bank, 112 countries out of 142 (or 79%) were using the RTGS system as of December 2006.

One can argue that the RTGS system has become the de facto standard in central bank payment systems.

Advent of Hybrid System

The second evolutionary step in the payment systems was the emergence of “Hybrid systems”. The Hybrid system is the combination of the best features of the DTNS system and the RTGS system.

In the Hybrid system, net settlements are made at frequent intervals or continuously and the transfer of funds becomes final at the time of these settlements. The traditional DTNS system has a disadvantage in that the transfer of funds becomes final only at the end of the day. With the frequent net settlement, the Hybrid system keeps the merit of the DTNS system, i.e. settlement capability with small liquidity, and in addition realizes the merit of the RTGS, which is early finality. That is why this system is called the “Hybrid system”.

The first Hybrid system in the world was the “EAF2” in Germany. Before becoming a Hybrid system in March 1996, the old EAF was a typical DTNS system, which executed the final settlement at the end of the day. In the EAF2, the bilateral net settlements were made every twenty minutes in the morning session and two multilateral netting settlements were made in the afternoon session.

Following the EAF2, the “PNS” in France, and the “CHIPS” in the US became the Hybrid system during 1999-2001. In these systems, the net settlements were made continuously based on the settlement events, like the receipt of a new payment instruction and the addition of liquidity to the payer’s account, instead of at regular time intervals.

The CHIPS is the latest and the most advanced Hybrid system, where the system judges the capability of net settlement for each payment instruction, and the net settlement is made continuously, if possible. The system selects the processing mode from the three types: Individual Release, Bilateral Release and Multilateral Release, according to the available balance of the payer and payee and the incoming and outgoing payment situation. We can realize that the processing method of the CHIPS is much more sophisticated than that of the EAF2 and the PNS.

Table 1 Introduction of the Hybrid System in Selected Countries

Country	Hybrid System	Timing of introduction
Germany	EAF2	March 1996
France	PNS	April 1999
US	CHIPS	February 2001

Emergence of Integrated Systems

The next step in the evolution of payment systems was the transition to the Integrated System. The Integrated System is defined as the payment system that has both the RTGS mode

and the Hybrid mode. Participants of the Integrated System can use both functions as the situation demands. For example, participants can use the RTGS mode for urgent and time-critical payments, whereas they can use the Hybrid function for non-urgent payments. The Hybrid mode performs continuous or frequent settlement and is often referred to as the “Liquidity-Saving mode”, because a participant can execute their payment with small liquidity.

The earliest adopter of an Integrated system was the “Large Value Transfer System” (LVTS) in Canada, which started operation in February 1999. The LVTS has two modes of payment: Tranche 1 and Tranche 2. Tranche 1 is the RTGS mode, which is suitable for urgent payments. Tranche 2 is the Liquidity-Saving mode, which is suitable for non-urgent payments and has the merit of small liquidity settlement capability.

The “Paris Integrated System” (PIS) in France was the second to come. The “Liquidity Bridge” was established in April 1999, between the Paris Net Settlement (PNS), a Hybrid system and the Transferts Banque de France (TBF) which was a RTGS system. The Liquidity Bridge allowed the participants to transfer liquidity between the PNS account and the TBF account. With this integrated management, these two systems were called the “Paris Integrated Systems” (PIS) as a whole, which is also regarded as one of the Integrated systems.

The third one was the “RTGS^{PLUS}” in Germany, which started operation in November 2001. The RTGS^{PLUS} also had two payment modes: the EX payment mode and the Limit payment mode. The EX payment mode is a RTGS mode, which is suitable for high priority payments. The Limit payment mode is a Liquidity-Saving mode with continuous offsetting settlement.

Just like the RTGS^{PLUS}, the Bank of Italy added the Liquidity-Saving mode to the BIREL in April 2004. The new system, which was called the “new BIREL”, was another Integrated system with two payment modes.

The Integrated system then spread to the Asia-Pacific region. One of them was the “BOJ-NET” in Japan. The project to enhance the BOJ-NET was called the Next-Generation RTGS (RTGS-XG) project. The important aspect of the project was to add a Liquidity-Saving Feature (LSF) to the pure RTGS mode of the BOJ-NET. At the completion of the project, the BOJ-NET became an Integrated system in October 2008.

In Europe, the TARGET2 began operation in November 2007. The TARGET2 was the second generation of the TARGET. The biggest feature of the project was the transition from the decentralized structure to the centralized structure with a Single Shared Platform (SSP). However, that was not all. The TARGET2 has advanced features that were derived from the RTGSplus, the new BIREL and the PIS. That is to say, the TRGET2 has a Liquidity-Saving mode as well as an RTGS mode, which means that it is one of the Integrated systems. Currently, the advanced feature of the TARGET2 is available all across the Euro area.

Table 2 Introduction of the Integrated System in Selected Countries

Country	Integrated System	Timing of introduction
Canada	LVTS	February 1999
France	PIS (PNS and TBF)	April 1999
Germany	RTGS ^{plus}	November 2001
Italy	new BIREL	April 2004
Singapore	MEPS+	December 2006
EU	TARGET2	November 2007
Japan	BOJ-NET (RTGS-XG)	October 2008

Future of Payment Systems

Most likely, the evolution of payment systems will never stop. Technological progress will continue to make further contributions to enhance the functionality of payment systems. Besides, the financial market will require more sophisticated payment systems with greater safety and efficiency.

The direction of next evolution is not clear enough at this point. However, one possibility would be the spread of multi-currency payment systems. Usually, a payment system deals only with the payment instructions in domestic currency. On the other hand, the multi-currency payment systems deal with the payment instructions in several currencies. A typical example of multi-currency system is the “CLS Bank”. CLS Bank was established in 2002 in order to reduce the foreign exchange (FX) settlement risk arising from time-zone differences. Currently, it settles seventeen currencies, including US Dollar (USD), Euro, UK Pound, Japanese Yen (JPY), Swiss Franc, Canadian Dollar, Australian Dollar, Singapore Dollar, and others.

Another possibility would be the widespread use of offshore payment systems. Offshore payment systems handle transactions both in local currency and in several foreign currencies. A prime example is seen in Hong Kong. In addition to the payment system of domestic currency (HK Dollar), Hong Kong has the payment systems for US Dollar, Euro and even the Chinese currency, Renminbi. This kind of globalization of payment system probably would probably become widespread in some parts of the world.

About the author

Masashi Nakajima is a professor at Reitaku University in Japan. He had a long career at the Bank of Japan (BOJ) and also worked for the Bank for International Settlements (BIS). His research focuses on payment systems and securities settlement systems. His most recent book, “*Payment System Technologies and Functions*” (IGI Global, 2011) can be found on the web (<http://www.igi-global.com/book/payment-system-technologies-functions/49580>).

Notes

- i. Bank for International Settlements (2009) Statistics on Payment and Settlement Systems in Selected Countries, March 2009
- ii. Bech, M., & Hobijn, B. (2007) Technology Diffusion within Central Banking: The Case of Real-Time Gross Settlement, International Journal of Central Banking, Vol.3