Real Time Gross Settlement Systems: An Overview

RTGS Project Management Office

State Bank of Pakistan

The development of RTGS systems started as a response to the growing awareness of the need for sound risk management in large-value funds transfer systems. RTGS systems offered a powerful mechanism for limiting settlement and systemic risks in the interbank settlement process, because these risks effect final settlement of individual funds transfers on a continuous basis during the processing day. In addition, RTGS can also contribute to the reduction of settlement risk in securities and foreign exchange transactions by providing a basis for delivery-versus-payment (DVP) or payment-versus-payment (PVP) mechanisms. An understanding of RTGS is thus essential when considering risk management in payment and settlement systems.

It may also be noted that the design and operations RTGS systems vary from country to country. These differences partly reflect the fact that each country's system is designed to meet the needs and structure of the local banking system and that new system often represent modifications or enhancements to previous systems or procedures. However the main purpose of introducing the RTGS systems is to handle the large value interbank funds transfers on Gross Basis and in Real Time.

Large value interbank funds transfers:

Interbank funds transfer systems are arrangements through which funds transfers are made between banks for their own account or on behalf of their customers. Of such systems, large-value funds transfer systems are usually distinguished from retail funds transfer systems that handle a large volume of payments of relatively low value in such forms as cheque, credit transfers, automated clearing house transactions and electronic funds transfers at the point of sale. The average size of transfers through large-value funds transfer

systems is substantial and the transfers are typically more time-critical, not least because many of the payments are made for *Settlement* of financial market transactions.

Risks in Settlement of Transactions:

The payments of these interbank financial transactions are prone to *Settlement risk* which refers to the risk that the completion or settlement of the interbank funds transfer system as a whole, will not take place as expected. Settlement risk comprises both credit and liquidity risks. Two major sources of these risks are (a) a time-lag between the execution of the transaction and its final completion and (b) a time-lag between the completion of the two legs of the transaction (i.e. any lag between payment leg and delivery leg). Within large-value funds transfer systems the first type of lag, which takes the form of a *settlement lag* between the initiation of payment messages and their final settlement, can be a major source of settlement risk. Settlement lags create the possibility that sending banks could fail in the meantime or at least not be able to settle their obligations when due.

The second type of lag, sometimes referred to as *asynchronous settlement*, is the largest source of principal risk in the settlement of foreign exchange and securities transactions, or, more generally, in exchange-for-value systems. This is the risk that the seller of an asset could deliver but not receive payment or that the buyer of an asset could make payment but not receive delivery, which could entail a loss equal to the full principal value of the assets involved. The DVP Report of BIS concluded that a delivery-versus-payment system, which ensures that the delivery occurs if and only if payment occurs, would provide a mechanism for eliminating such principal risk. Since the payment leg in an exchange-for-value system is supported by interbank funds transfer systems, the settlement characteristics of interbank funds transfer systems as described above have an important influence on

how a DVP mechanism could be constructed for an exchange-for-value system.

As overseers of payment systems, central banks are particularly concerned with *systemic risk*. This is the risk that the failure of one participant to meet its required obligations when due may cause other participants to fail to meet their obligations when due. Such a failure could trigger broader financial difficulties that might, in extreme cases, threaten the stability of payment systems and even the real economy. By their very nature networks, interbank payment and settlement systems are potentially a key institutional channel for the propagation of systemic crises. Central banks have a particular interest in limiting systemic risk in large-value funds transfer systems because aggregate exposures tend to increase with the aggregate value of transactions and potential risks in large-value transfer systems are therefore often significantly higher than those in retail funds transfer systems.

The vulnerability of a system to systemic risk depends on a number of factors. The size and duration of participants' credit and liquidity exposures in the interbank settlement process are basic factors affecting the potential for systemic risk. As these exposures last for longer and become larger, the likelihood that some participants may be unable to meet their obligations increases, and any participant's failure to settle its obligations is more likely to affect the financial condition of others in a more serious manner. Interbank funds transfer systems in which large intraday exposures tend to accumulate between participants therefore have a higher potential for systemic risk.

The Settlement of financial market transactions from RTGS perspective means the transfer of balances in the books of a central bank (i.e. central bank money) or commercial banks (i.e. commercial bank money). In practice, settlement in the vast majority of large-value funds transfer systems takes place in central bank funds. Although the rules and operating

procedures of a system and the legal environment generally may allow for differing concepts of finality, it is typically understood that, where settlement is made by the transfer of central bank money, final settlement occurs when the final (i.e. irrevocable and unconditional) transfer of value has been recorded on the books of the central bank.

Settlement characteristics and the types of interbank funds transfer system:

Interbank funds transfer systems can be classified in several ways. Differences in the way settlement takes place provide a useful framework to distinguish the Settlement Systems. A common distinction in this respect is to divide systems into *net settlement systems* and *gross settlement systems.* In a net settlement system, the settlement of funds transfers occurs on a net basis according to the rules and procedures of the system. A participating bank's net position is calculated, on either a bilateral or a multilateral basis, as the sum of the value of all the transfers it has received up to a particular point in time minus the sum of the value of all the transfers it has sent. The net position at the settlement time, which can be a net credit or debit position, is called the net settlement position. Net settlement systems for large-value funds transfers are primarily multilateral (rather than bilateral) net settlement systems in which each (settling) participant settles its multilateral net settlement position. In a gross settlement system, on the other hand, the settlement of funds occurs on a transaction-by-transaction basis, that is, without netting debits against credits.

Interbank funds transfer systems can also be classified according to the timing (and frequency) of settlement. Systems can in principle be grouped into two types, designated-time (or deferred) settlement systems and real-time (or continuous) settlement systems, depending on whether they settle at pre-specified points in time or on a continuous basis. These two types are more narrowly defined in terms of the timing of *final* settlement. One type of system is thus a *designated-time (or deferred) settlement system*, in which

final settlement occurs at one or more discrete, pre-specified settlement times during the processing day. Designated-time settlement systems, in which final settlement takes place only once, at the end of the processing day, are called end-of-day settlement systems. Currently, net settlement systems for large-value transfers are typically end-of-day net settlement systems that settle the net settlement positions by means of transfers of central bank money from net debtors to net creditors. In some countries, there are systems in which the final settlement of transfers occurs at the end of the processing day without netting the credit and debit positions - on a transaction-by-transaction basis or on the basis of the aggregate credit and aggregate debit position of each bank. Such systems are often called end-of-day gross settlement systems. On the other hand, a *real-time (or continuous) settlement system* is defined as a system that can effect final settlement on a continuous basis during the processing day.

It is worth stressing here that the distinction between different systems such as RTGS and designated-time net settlement (DNS) systems concerns the form of settlement, not the form of transmission and processing. Like RTGS systems, many net settlement systems transmit and process payment messages in real time on a transaction-by-transaction basis, but they settle, by definition, on a net basis at discrete intervals.

An important concept that is often used in connection with the timing of finality is *intraday finality* or an *intraday final transfer capability.* This finality mostly depends on the legal framework in which the system is operating. If the intraday finality is recognized in the legal framework, where the system is operating than the system can be defined as a true Real Time Gross Settlement System. In some countries though the IT systems offer the Real Time Gross Settlement technically but the legal framework does not recognize the intraday finality, without which all the risk that can be eliminated because of RTGS System remains there.

Central bank systems and private sector systems:

Interbank funds transfer systems are sometimes classified according to whether they are central bank systems or private sector systems. The distinction typically depends on who owns and operates the systems (rather than on the identity of the settlement agent). At present, it is possible to identify two "typical" types of large-value funds transfer system: (a) central bank systems owned and operated by the central bank (or its affiliated entities) in which the central bank also provides settlement, and (b) private sector systems owned and operated by a private sector group (e.g. a banking association or clearing house), where the main operational role of the central bank is to act as the settlement agent. In the G-10 countries, for example, RTGS systems often belong to the former category and many DNS systems belong to the latter. Nonetheless, a number of DNS systems are owned and operated by the central bank, while in some cases RTGS systems are owned and operated by a private sector group.

Moreover, there are several DNS and RTGS systems in which ownership and operation are shared between the private sector and the central bank.

Main features of RTGS systems

An RTGS system is defined as a gross settlement system in which both processing and final settlement of funds transfer instructions can take place continuously (i.e. in real time). As it is a gross settlement system, transfers are settled individually, that is, without netting debits against credits. As it is a real-time settlement system, the system effects final settlement continuously rather than periodically at pre-specified times provided that a sending bank has sufficient covering balances or credit. Moreover, this settlement process is based on the real-time transfer of central bank money.[18] An RTGS system can thus be characterized as a funds transfer system that is able to provide continuous intraday finality for individual transfers.

Payment processing: Within this broad definition, the operational design of RTGS systems can differ widely. In particular, important differences may arise in the approaches to payment processing when the sending bank does *not* have sufficient covering funds in its central bank account.

One possible way of treating transfer orders in such circumstances is for the system to *reject* the orders and return them to the sending bank. The rejected transfer orders will be input into the system again at a later time when the sending bank has covering funds. Until that time, sending banks may keep and control the pending transfers within their internal systems (*internal queues*). Alternatively, the RTGS system may temporarily keep the transfer orders in its central processor (*system or centrally located queues*) instead of rejecting them. In this case, the pending transfers will be released for settlement when covering funds become available on the basis of predefined rules, agreed between the system and the participating banks.

In many cases the transfer orders are processed and settled with the extension of *central bank credit*, normally provided for a period of less than one business day (*intraday credit*); in other words, the central bank provides banks with the necessary covering funds at the time of processing by extending such credit. The central bank could take a range of approaches to the provision of intraday credit in terms of (a) the amount of credit (including a zero amount), (b) the method by which credit is extended (e.g. overdraft or repo), (c) the terms on the credit (e.g. free or priced) and (d) the collateral requirements (if any).

These possibilities of payment processing (i.e. *rejected, centrally queued, settled with central bank credit*) are not necessarily mutually exclusive. For example, when the provision of central bank credit is constrained in some way, the transfer orders for which the sending bank could/would not obtain central bank credit will be rejected or centrally queued. In recent years, new or planned RTGS systems have tended to apply a combination of these

possibilities rather than being based on only one form of payment processing.

Ability to limit payment system risk: RTGS systems can contribute substantially to limiting payment system risks. With their continuous intraday final transfer capability, RTGS systems are able to minimize or even eliminate the basic interbank risks in the settlement process. More specifically, RTGS can substantially reduce the duration of credit and liquidity exposures. To the extent that sufficient covering funds are available at the time of processing, settlement lags will approach zero and so the primary source of risks in interbank funds transfers can be eliminated. Once settlement is effected, the receiving bank can credit the funds to its customers, use them for its own settlement purposes in other settlement systems or use them in exchange for assets immediately without facing the risk of the funds being revoked. This capability also implies that, if an RTGS system were linked to other settlement systems, the real-time transfer of irrevocable and unconditional funds from the RTGS system to the other systems would be possible. The use of RTGS could therefore contribute to linking the settlement processes in different funds transfer systems without the risk of payments being revoked.

Intraday liquidity requirements: Provided that there are no legal problems with regard to settlement finality, the only structural impediment to continuous intraday finality is any liquidity constraint a sending bank may face during the day. A liquidity constraint in an RTGS environment has two basic characteristics, namely that it is a *continuous* constraint for settling funds transfers and that intraday liquidity requirements must be funded by *central bank money*; banks must therefore have sufficient balances in their central bank accounts throughout the processing day.

Intraday liquidity requirements raise important issues for both the central bank and the private sector. Central banks, for their part, face a choice as to

whether or not to provide banks with intraday liquidity and, if so, what form that provision will take (e.g. by what mechanisms and on what terms the credit will be provided, and how any resulting exposures will be managed).

The intraday liquidity requirements under a particular RTGS system depend critically on (a) the structure of financial markets and systems (e.g. the adequacy of private sector sources of liquidity, the amount of collateral/securities available, reserve requirement regimes) and (b) the central bank's policy regarding the provision of intraday credit. The means by which intraday liquidity is provided can significantly affect the extent to which immediate, or at least very timely, final settlement occurs, and, ultimately, it can influence the balance between the potential benefits and costs of RTGS systems.

Message flow structures: A lag between the time at which information is made available to receiving banks and the time at which settlement takes place may have important risk implications in large-value funds transfer systems. Even in the RTGS environment, where both processing and final settlement are made in real-time, several circumstances can be identified in which the treatment of payment messages or the associated information could be a source of risk. There are two different types of message flow structure that are widely used in RTGS systems.

V-shaped Structure: To initiate a funds transfer the sending bank dispatches a payment message which is subsequently routed to the central bank and to the receiving bank as the system processes and settles the transfer. Arrangements for routing payment messages in the majority of RTGS systems are or will be based on a so-called *V-shaped* message flow structure. In this structure the *full message* with all the information about the payment (including, for example, the details of the beneficiary) is initially passed to the central bank and is sent to the receiving bank only after the transfer has been settled by the central bank

Y-shaped Structure: In this case, the payment message is transmitted by the sending bank to a central processor. The central processor takes a *subset* of information that is necessary for settlement from the original message and routes this core subset to the central bank (the original message being kept in the central processor). Upon receipt of the core subset, the central bank checks that the sending bank has sufficient covering funds on its account and informs the central processor of the status of the transfer, for instance queued or settled. Once settled, the full message containing the confirmation of settlement is rebuilt by the central processor and sent to the receiving bank. The business information exchanged between the sending and receiving bank (such as the identity of the beneficiary) is therefore not known by the settlement agent.

Queuing arrangements: Broadly defined, queuing refers to an arrangement whereby funds transfer orders are held pending by the sending bank or by the system in a certain order so as to prevent any limits set against the sending bank from being breached or to manage liquidity more generally. In RTGS systems, queues are most commonly generated when sending banks do not have sufficient covering funds in their central bank account. Individual banks' queues may be held at the system's central processor (*system or centrally located queues*) or they may be held within the banks' internal systems (*internal queues*). These two broad possibilities according to the *location* of the queues are not mutually exclusive; banks may maintain internal queues in addition to the queues at the centre, as is done in some RTGS systems with centrally located queues. Queuing can also differ according to the *management* of the queues, that is, how an individual bank's queue is controlled. The management may be carried out by the centre (*centralised management*) or by banks individually (*decentralised management*). Irrespective of whether the queues are physically located at the centre or within banks' internal systems, the management of queues could in principle be either centralised or decentralised. Combinations of

these possibilities in terms of the location and management can thus lead to various forms of queuing.

Conclusion:

The concept of RTGS is straightforward but the systems themselves can take many different forms. These differences partly reflect the fact that circumstances vary from country to country, so that arrangements that are appropriate for one country may not be relevant for another. In many cases a pragmatic approach has been adopted to certain design features.

Finally, as mentioned earlier, RTGS systems are on the whole a relatively recent concept and thus there has often been little operational experience on which to base comparisons between different options.

Given these factors, while it may be difficult to draw any universally applicable conclusions about the merits of particular features of RTGS systems, it might be useful to set out the key criteria that are likely to be used when choosing between different options. RTGS systems can be categorized according to three main considerations, namely (a) whether the central bank provides intraday credit to participants in the system and, if so, on what terms, (b) the message flow structure and (c) the facilities, if any, available for queuing. Although there are many other ways in which systems differ, these three areas seem to capture the most important aspects.

Whether *intraday credit* is provided or not may depend partly on whether interbank funds transfer systems are seen simply as mechanisms that enable settlement to take place, in which case it may be decided that no specific liquidity facilities will be provided, or whether the provision of intraday liquidity is seen as being a straightforward extension of a central bank's existing role as a provider of liquidity to the banking system. The decision to extend intraday credit may also reflect a view that intraday credit is necessary to enable the system to function smoothly. Where credit is provided, there are variations in the terms set (e.g. whether the credit has to

be collateralized and what fee or interest rate, if any, is charged), reflecting a number of important considerations.

As far as the *message flow structure* is concerned, the key choice is often between the V-shaped and Y-shaped structures, and an important consideration here is the role of the central bank relative to the private sector in the day-to-day operation of the system: for some, the attraction of the Y architecture is that it enables a distinction to be drawn between the central bank's core role as settlement agent and the rest of the system processing, which can be a separate, private sector function.

Approaches to queuing may depend importantly on views about the relative roles of the private sector and the central bank, the central bank's policies regarding the granting of intraday credit and the extent to which banks can obtain liquidity easily from their own sources. If, as noted above, an interbank funds transfer system is seen as being simply a settlement mechanism, then it may also be that no centralised *queue management facilities* are provided beyond basic FIFO processing. Or the balance between centralised and decentralised queue management may depend on the extent to which banks see such management as a competitive issue rather than one on which they want a standard approach to be adopted. Consideration of the balance to be struck between risk, cost and liquidity may also determine whether queued incoming transfers are transparent or not.

Finally, it is important to stress that, in designing an RTGS system; attention must be paid to the broader financial environment in which the system is to operate. Mention has already been made of the fact that circumstances vary from country to country, and this is true not just of the payment system environment but also of the financial system in a wider context. Hence system architects while designing an RTGS systems should keep the ground realities and the environment in which the system is to operate in mind so that the end consumer or a common man receives the ultimate benefits.