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Changing the clock: practical approaches to extend payment system operating hours

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Changing the clock: practical approaches to extend payment system operating hours[1]

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Highlights

- Several real-time gross settlement (RTGS) systems have extended operating hours in recent years and have experienced notable adoption of the additional hours by participants. With the extended hours, payment system participants can offer better services to end users, such as 24/7 fast payments. Many more RTGS systems are evaluating or planning to extend operating hours in the near to medium term.
- Involving payment system participants, a broader set of stakeholders or sometimes the general public from the onset and throughout such a project is critical to its success.
- RTGS systems that have successfully extended operating hours to 24/7 often did so gradually. Their experience in overcoming operational, technical and risk management challenges provides important insights to other payment system operators.

Introduction

Real-time gross settlement (RTGS) systems typically settle wholesale financial obligations in central bank money. Most of them are owned and operated by a central bank.[2] They provide the safe and efficient foundation on which retail payment systems and cross-border payment arrangements rely. Limited RTGS system operating hours and gaps between jurisdictions' operating hours due to time zone differences can lead to delays in settlement of cross-border payments. This is one of the key frictions identified by the G20 cross-border payments programme.[3]

Improvements in the safety and efficiency of domestic payments are likely to be a key motivation for the extension of RTGS operating hours by individual jurisdictions. However, operating hour extensions can also contribute to enhanced cross-border payments. An extension and alignment of RTGS system operating hours across jurisdictions may facilitate the interlinking of payment systems across borders, improve liquidity management, reduce settlement risk and help to speed up cross-border payments (CPMI (2022b)).

In 2022, the Bank for International Settlements' Committee on Payments and Market Infrastructures (CPMI) outlined three potential states for extending RTGS system operating hours, along

[1] The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements, its Committee on Payments and Market Infrastructures or its member central banks. We thank Federico Semorile, Takeshi Shirakami and Tara Rice for their valuable comments.

[2] Central banks can be the overseers, catalysts and/or operators of payment systems. While most central banks are involved in payments oversight, central banks may differ in their level of involvement in each of these three roles (CPMI (2023b)).

[3] In October 2020, the G20 endorsed a roadmap to enhance cross-border payments, developed by the Financial Stability Board in coordination with the Bank for International Settlements' Committee on Payments and Market Infrastructures and other relevant international organisations and standard-setting bodies. The G20 cross-border payments programme aims to address long-standing challenges in the cross-border payments market, including high costs, low speed, limited access and insufficient transparency.

with the concept of the global settlement window (see Annex 1 for a summary of these concepts, CPMI (2022a)). Building on that, the CPMI published a technical report providing an analytical framework to assist central banks and operators planning to extend RTGS system operating hours (see Annex 2 for a summary of the framework, CPMI (2023a)). The report set out technical and operational issues that central banks should consider when planning to extend RTGS system operating hours.

The benefits and drivers for extending operating hours have been covered extensively in previous reports (CPMI (2022a) (2023a)). This CPMI Brief follows on from such analyses and outlines practical approaches that have been used to address some of the key challenges of extending or aligning RTGS system operating hours.[4] It is based on the experience of 14 jurisdictions represented on the CPMI Community of Practice on Payment Systems.[5]

Recent extensions of operating hours

Most retail fast payment systems (FPS), which process low-value account-based transactions so that funds are immediately available to the payee, are operating 24/7. A growing number of RTGS systems now operate with extended hours or are in the process of analysing whether to extend operating hours (see examples of recent extensions in Box 1). They typically process large-value payments between financial intermediaries and often facilitate final settlement for retail systems (including FPS) on an RTGS basis. This often motivates them towards an extension of operating hours. Out of 69 RTGS systems that responded to the 2023 CPMI monitoring survey, seven already operate 24/7. A further 18 plan to extend operating hours – although not necessarily to 24/7 – within the next five years (Fitzgerald et al (2024)). Several central banks have recently issued public consultations to assess the demand, impact and options for future extensions of operating hours.[6]

Box 1

Recent extensions of operations hours: examples from India, Mexico and Brazil

One of the early movers to 24/7 operations was the Reserve Bank of India's (RBI's) RTGS system. It is a large-value funds transfer system that offers transaction-by-transaction settlement in the books of the central bank. The RTGS system processes push payments that include both customer credit transfer and interbank payments. Multilateral net settlement batch files originating from other ancillary payment systems are also settled in the system. RTGS was first introduced in India in 2004, and since then the system business hours have been extended multiple times, first to include weekends in 2013 and then evenings in 2019. Finally, it became operational on a 24/7 basis in December 2020. There has been a positive response to the system's round-the-clock availability, with around 10%

[4] We are grateful for the insights shared by colleagues at the Bank of Albania, Central Bank of Armenia, Central Bank of Brazil, National Bank of Cambodia, Reserve Bank of India, Bank of Jamaica, Bank of Japan, Central Bank of Kenya, Bank of Mexico, Bank Al-Maghrib, South African Reserve Bank, Swiss National Bank, Bank of Thailand and Bank of England. Some of these central banks are only analysing the case for extended operating hours, and therefore their contribution to this CPMI Brief should not be taken as a commitment to extending operating hours.

[5] The Community of Practice on Payment Systems (CoPS), sponsored by the CPMI, is a forum of exchange for central banks on developing or upgrading their payment systems, factoring an international dimension into them and discussing innovative developments. It has representatives from over 40 jurisdictions (more than half from outside the G20) as well as from regional and international organisations. It meets at least quarterly. The community was launched in 2023 with a view to strengthen the involvement of both G20 and non-G20 central banks in the cross-border payments programme and to support their implementation of payment system enhancements. Such enhancements include, for example, expanding payment system access, extending RTGS system operating hours, implementing the ISO 20022 messaging standard and linking fast payment systems across borders.

[6] For example, see the Board of Governors of the Federal Reserve System and Bank of England consultations.

of the daily volume and 15% of the volume on holidays processed between 8:00 pm and 8:00 am (as of August 2024). The continuous availability of the RTGS system facilitated the availability of other payment systems also on a 24/7 basis, including nearly all retail payment products in India. The extension has reduced settlement risk and enhanced the overall efficiency of the payment ecosystem.

Another example is the Bank of Mexico's Sistema de Pagos Electrónicos Interbancarios (SPEI). SPEI settles wholesale and retail payments on an RTGS basis including a liquidity saving mechanism. It was operating 11.5 hours per day until March 2015, when its service was extended to 20 hours per day. Later that year, the service was further extended to 24 hours per day for fast payments initiated via mobile phone. In December 2017, the Bank of Mexico introduced the obligation for banks with more than 3,000 accounts to offer the service on a 24/7 basis for retail payments. There has been significant adoption of the extended hours by participating banks and other payment service providers, with 86% offering the service on a 24/7 basis even though only 65% are obliged to (from a total of 84 participants) as at July 2024. Adoption by end users has been considerable, with 30% of a week's payment volume occurring overnight (between 6:00 pm and 6:00 am on business days) and 22% on weekends in the first half of 2024. Consumers and small and medium-sized enterprises (SMEs) have benefited most from the new hours. The extended hours allow SMEs that are open outside standard business hours to receive payments in real time with immediate availability and likewise to pay their providers in a timely manner, reducing their operating capital. As of this year, SPEI requires an identifier to be included for remittances, and expects to have information about the impact of this change on cross-border payments in the medium term.

Other central banks have developed new 24/7 payment systems, rather than extending the hours of legacy infrastructure. For example, the Central Bank of Brazil launched Sistema de Pagamentos Instantâneos (SPI) to settle the fast payments processed via its Pix scheme around the clock. As at October 2024, more than 161 million individuals use Pix, representing 75% of Brazil's population. In addition, around 18 million companies use Pix. Between 2019 and 2023, cash use decreased from 77% to 40% of all transactions, while Pix now represents 25% of transactions. Pix transactions have surpassed many instruments previously available, and they partly substituted for other digital payment instruments such as bank transfers. Yet, notably, the total level of digital transactions has risen substantially. Using accounts from banks and non-bank service providers, more individuals entered the digital payment system, thus illustrating the marked impact Pix has had on financial inclusion in Brazil.

Sources: Reserve Bank of India, Bank of Mexico and Central Bank of Brazil.

Practical approaches to address the challenges of extending payment system operating hours

When extending RTGS system operating hours, operators are likely to face a number of challenges. Identifying these challenges upfront and learning from the experience of others could help operators to plan accordingly. This section lays out common challenges and discusses how they can be addressed.

Infrastructure changes

Extensions to operating hours are likely to require changes to the hardware and software that comprise the core payment system. Related applications and support systems that interface with the system such as the messaging platform used by participants and downstream applications (eg reporting systems) may need to be upgraded too.

The cost and level of difficulty of these changes is largely dependent on whether legacy infrastructure needs to be upgraded to support the extension. The point at which an upgrade of legacy infrastructure is required varies between systems. For some, even a small extension to operating hours may require an upgrade. For others, substantial hardware and software changes are only required once operating hours approach 24/7.

In cases where incremental operating hour extensions do not lead to significant infrastructure or technical changes, only adjustments to business rules and procedures are generally needed. Where more

substantial system upgrades are required to facilitate the desired extension, it is common for this to be done in conjunction with other strategic modernisation projects to upgrade legacy systems. For example, these upgrades can be done at the same time as changes involved in the migration to ISO 20022 messaging or in conjunction with an upgrade to support straight-through processing and automation.

A common challenge operators encounter is the need to expand database capacity if the extended operating hours are expected to result in an increase in payment volumes. Migrating to ISO 20022 messaging standards at the same time as extending operating hours further adds to the need for expanded storage space, due to the data richness of ISO 20022 messages. More storage is also likely to be required in the (ancillary) payment systems that interact with the RTGS system (and form part of the ecosystem), and hardware and software of associated systems often must be augmented to handle extended operations. Such systems may be upgraded to leverage the additional data being exchanged, such as the core banking system to operationalise a real-time accounting system for each participant.

Start-of-day and end-of-day processes

The opening and closing of an RTGS system typically comprise a series of tasks that could be affected by the extension of the operating hours. End-of-day (EoD) processes in an RTGS system usually include the rejection of queued transactions for the value date, verification of account balances, provision of overnight liquidity, calculation of reserves and production of account statements and statistical reports. Those tasks could have significant impact or dependencies on other systems and parties. For example, participants may need to adjust their liquidity positions close to the end of the day, either to fulfil their reserve obligations or to invest excess liquidity. They may need the account statements to proceed with their reconciliations or internal accounting processes. In addition, central securities depositories (CSDs) and securities settlement systems (SSS) may need to remain open for real-time collateral adjustments. Extending RTGS system operating hours by closing later may require more changes and coordination with participants than extending them by opening earlier. On the other hand, start-of-day (SoD) processes typically include reference data updates, revalidations of payments that had been sent in advance or during off-hours, and liquidity provisioning to interconnected accounts or an FPS.

To cope with an extension of the operating hours, SoD and EoD processes are often redesigned and automated, minimising or eliminating manual intervention. For example, the provision of liquidity to interconnected accounts or an FPS is automated based on parameters predefined by the participants, allowing them to establish and modify the amount of liquidity to be injected at the beginning of the day. Interest and charges are applied automatically at the end of the day. Pledged financial instruments as collateral are automatically revalued, collateral totals are subsequently updated, and the provision of liquidity is automated, where loans are provided based on the resulting collateral available.

An important decision is when to conclude the EoD processes, launch the SoD process and change the value date (see Box 2 on rethinking the concepts of "business date" and "value date"). Some payment systems perform a fully automated EoD at midnight to align calendar day and value date. Others maintain the same EoD or system cut-off time as was used before the operating hours extension, for example in the evening at around 18:00. This is done to reduce the impact on participants and monetary policy implementation, but it results in a misalignment of value and calendar dates for several hours. A specific approach may be applied over the weekend, for example using a Monday value date from Friday evening onwards.

Regardless of the approach taken, it is important that the value date of payments processed during the date change is unambiguous. This is important for the operator and payment system participants and if interdependencies exist between various systems which need a common cut-off. For example, to calculate a participant's aggregated position, snapshots taken to obtain the balance of multiple accounts would need to be synchronised. For systems processing cross-border payments, the determination of the cut-off for transactions and exchange rates to be used in the computation is crucial.

Box 2

Rethinking the concepts of "business date" and "value date"

A common theme for those operating outside of regular business hours, and in particular on weekends, was re-thinking the concepts of "business date" and "value date". These date conventions are the basis on which transactions are agreed and settled between parties, interest payments are calculated and cut-off times are managed (eg to determine if a repurchase agreement fails). These conventions are therefore central for legal/regulatory accounting, risk management, reference, monetary policy and other purposes.

"Business date" has traditionally aligned with working days, bound between the hours that the payment system is open. However, if operating hours are extended to include weekends or the payment system operates continuously, this convention may no longer be suitable. It may become necessary to define a SoD and EoD for the payment system.

In addition, the definition and application of the "value date" (also known as "settlement date") of the payment will need to be reviewed, for example for settlement of correspondent banking transactions. Currently, the value date is applied to the local business day of each currency within the transaction and is therefore especially relevant when the operating hours of the RTGS systems of the two currencies involved in a transaction do not overlap. For example, in a transaction in AUD-USD settling on 1 December, the AUD-leg will settle on 1 December in Australia. Meanwhile, the USD-leg will settle on 1 December in the United States which, due to the time zone difference, will actually be the next business day (ie 2 December) in Australia.

In the case of SPEI, the Bank of Mexico consulted with participants to define at what time to change the value date. The stakeholders' most important consideration was to not impact existing monetary policy processes and the accounting of participants. Therefore, the SPEI value date changes every banking day at 18:00, meaning that value date T ends at 17:59:59 and value date T + 1 starts at 18:00. Payments over the weekend are settled with a value date of Monday, which starts at 18:00 on the preceding Friday and finishes at 17:59:59 Monday. Likewise on a holiday, the value date starts at 18:00 of the last banking day and finishes at 17:59:59 of the next banking day. This change is seamless for clients, who can obtain an electronic payment receipt that states the actual date and time at which the funds were credited into the receiving client account. The conduct of monetary policy requires knowing the total liquidity position of the participants in order to commence open market operations. To concentrate the liquidity in one place, when SPEI changes its value date at 18:00, SPEI settles the financial institutions' balance into their current accounts at the central bank, which are managed in a different infrastructure called Sistema de Atención a Cuentahabientes (SIAC-BANXICO). This system immediately sends back to SPEI a percentage of the participant's deposits in T + 1 value, ensuring enough liquidity is maintained in SPEI to continue settlement of payments. Open market operations are settled in SIAC-BANXICO, and after that SIAC-BANXICO changes its value date at 19:00. Then the participants are able to transfer funds between their current accounts (SIAC-BANXICO) and SPEI as needed.

Sources: Authors and Bank of Mexico.

System maintenance

System maintenance and upgrades are commonly recognised as some of the biggest challenges in extending operating hours. These activities often include the deployment and testing of preventive measures to address potential vulnerabilities, upgrades to system components or capabilities to improve performance, migration to new technical standards as well as the introduction of new functionalities. Traditionally, these activities were performed outside of system operating hours, in the evening or on weekends. As operating hours increase, the window of time available for upgrades and system maintenance is shortened and rolling back changes, if needed, is more difficult. As systems approach 24/7 operations, the ability to perform these activities on a rolling basis while the system is open is needed.

Despite the challenges, several RTGS system operators have successfully transitioned to 24/7 operations and perform system maintenance with no downtime (see the example of Brazil's SPI and Pix in

Box 3). To achieve this, an architecture may be developed that is able to operate despite failures or faults in one or more of its components and allows for replication to a secondary site in real time. The system changes can therefore be performed to one site at a time while the other remains online.

For these systems operating with no downtime, a re-engineering of change management processes is required. Technical and operational staff follow rigorous change management procedures and testing in development and pre-production environments. Post-implementation testing and monitoring is conducted to ensure settlement instructions and related responses can still be sent and received. Participants are included in the testing when required to assist with confirmations. Back-out planning, ie to undo changes in the case of undesired outcomes, and troubleshooting are an integral part of the change management process. Even with these controls in place, changes tend to be scheduled during lower-volume periods such as late in the evening and in the early morning to reduce the potential impact of operational issues caused by change failures.

When transitioning to 24/7 operations, some operators retain the flexibility to close the system for maintenance if needed. This decision may be taken in consultation with relevant industry stakeholders and usually requires notifying participants well in advance. For example, changes may be implemented when the system rolls over from one day to the next, so only a short delay to the next day's processing is required. In these cases, the operator may redefine maintenance cycles and combine patches to reduce the number of closures required per year. Other operators opt for *near* 24/7 operations so that a short maintenance window in the evenings or overnight, such as between end-of-day and start-of-day processes, would always be available.

Box 3

System maintenance with no downtime in Brazil's SPI and Pix

SPI and Pix were built to operate 24/7. From their project initiation phase, maintenance with zero downtime for critical functionalities was prioritised as a core business requirement. To achieve this, the infrastructure operates in two active-active (also referred to as hot-hot) data centres, each with a substantial internal level of redundancy. Additionally, all software layers were engineered to support maintenance without downtime. For transaction storage, a cluster of servers were employed that operate on a consensus mechanism, so the service will still be operating even if a certain number of servers stop working. High-availability relational databases are also used, but dependency on these tools is minimised where possible.

Furthermore, applications were designed to allow new version deployments without interruption. For example, to run the applications, a cloud infrastructure allows multiple instances of each process to run simultaneously. Internal processes were designed to manage 24/7 operation without maintenance windows. This includes fundamental processes such as for incident response and change management.

Despite the non-stop deployment of system updates, a change management process is still performed to assess the risk associated with each change and determine whether it should be deployed during the day, at night or on weekends. A substantial volume of transactions continues to be processed overnight, but the impacts of any technical issues arising from changes during this period tend to be less significant in comparison with those during business hours.

Source: Central Bank of Brazil.

Operational risk management and recovery measures

Payment system operators are responsible for managing a variety of operational risks that may arise from different disruptive events, including natural disasters, cyber attacks and fraud. The extension of operating hours generally does not change the types of risks faced. However, it does extend the time window during

which operational issues can arise and might require changes to existing plans to address operational disruptions.

Operators must ensure the availability of incident response and recovery capabilities outside regular business hours. This includes extending, updating and regularly testing business continuity plans, and ensuring crisis communication and escalation mechanisms are effective outside regular business hours. The extended presence of technical, operational and crisis management staff is needed too and is discussed further in the section on staffing arrangements. Risk assurance or audit teams should review the processes and controls in place before changes are implemented and then on an ongoing basis afterwards, to ensure any gaps are identified and remediated promptly.

Operators of payment systems that have extended operating hours note that they face increased pressure to respond quickly to disruptive events. RTGS systems are normally designed to meet a two-hour recovery time objective and a recovery point objective with zero data loss. For 24/7 systems the recovery time objective is often even more demanding and less than two hours, since users rely on an "always available" system. Examples of ways that operators manage this pressure and aim to prevent unavailability include:

- Implementing automated recovery processes by using high redundancy hardware arrangements and a so-called "hot-warm" configuration within a site and between sites. This allows for operations to switch from the hot (ie live) infrastructure to the warm (ie stand-by) infrastructure in a matter of seconds if there is an incident, so it is seamless for participants and there is no downtime of the service.
- Redesigning core infrastructure to reduce interdependencies as well as complexity. This can enhance the efficiency of the business continuity plan and assist with quickly identifying the root cause of any disruptions that occur. For example, a modular-based design can minimise the possibility of contagion of cyber attacks to other parts of the system by allowing modules to be disconnected, tested and validated separately. .
- Building functionality to roll back to a specific "golden point" in time if the database is compromised due to an attack or any other incident.[7] This involves duplicating and storing payment message data in a secondary site that can be used to replay messages and/or reconcile data in the case of an incident.[8]
- Utilising additional resilience services. These services, which can be provided by third parties, allow the operator to switch to the separate service within two hours in the event of a cyber attack or a major problem with the core application.

Payment system participants similarly need to extend their monitoring and incident response capabilities in line with the extended operating hours. They may face heightened fraud risks during late hours. Operators may introduce requirements for participants to put in place measures to detect fraud and install cyber risk monitoring tools during extended hours to identify, escalate and address cyber events on time.

[7] "Golden point", also referred to as a "golden copy", is the point from which affected IT environment components, data or applications can be restored to the state they were in prior to the attacker's presence (CPMI (2014)).

[8] The secondary site should in principle not be affected by an event that affects the primary site, with the exception of some very specific threats, such as a coordinated attack. Each site should have robust resilience based on the duplication of software and hardware, and the technology in place to replicate data between the various sites should be consistent with the chosen recovery point objectives (CPSS-IOSCO (2012)).

Liquidity management

Participants need to identify, control and manage liquidity needs during extended operating hours and weekends. There are various tools that can help payment system participants manage their liquidity, they include: (i) intraday and longer-term liquidity facilities; (ii) monitoring of liquidity levels (eg alerts if they fall below a preset limit); (iii) enabling of consolidated views of a participant's position with the ability to set parameters (min/max balances); and (iv) transfer of liquidity/sweeping of balances between different payment systems.

The central bank may choose to facilitate liquidity management by RTGS system participants during extended operating hours in various ways (see the example of the Reserve Bank of India's RTGS system in Box 4). Some offer automated solutions (overdraft or fund transfer mechanisms) or follow a prefunding approach. Others provide, or plan to extend, central bank liquidity facilities while interbank money markets are not available. In some cases, a combination of several solutions are offered. Different types of participants may be offered access to different liquidity management mechanisms. A range of approaches could be considered, including:

- An automated intraday liquidity facility which must be reversed by the end of the day could be used. The facility is triggered automatically if there is a shortage of funds to settle transactions and reversed once there is sufficient liquidity in the accounts. The availability of the facility should be aligned with the payment system operating hours.
- Opening the collateral management system during extended hours for collateralised overdraft or loans would ensure participants can pledge securities and obtain secured funding. A prerequisite is that the CSD and the SSS are operational during the extended hours too. In some cases, overdrafts may be granted using the monetary policy deposits kept at the central bank as collateral.
- An automated collateralised overdraft facility could be complemented with the offering of an intraday repurchase order (repo) which operates during normal business hours every working day when the SSS is open. An overnight repo option would cover additional liquidity needs during extended operating hours when the SSS is closed (eg during weekends). An emergency liquidity facility may be available between the repo market closure and the end of clearing and settlement processes, if such a gap exists.
- For systems operating on a prefunding settlement model, different instruments may allow the injection of liquidity automatically in the settlement accounts during normal operating hours to be used during the extended operating hours. Liquidity can be transferred from the RTGS account to the FPS prefunding account based on configurable parameters. Provisions and withdrawals can be made at any time during RTGS operating hours. Operators may also require participants to prefund special reserve accounts to support payments after normal business hours.
- A liquidity shortage financing facility operating 24/7 could facilitate moving central bank liquidity directly to the payment system settlement accounts.
- Where a jurisdiction has two or more payment systems (or two or more modules of the same payment system) with different operating hours, it may be possible for participants to move excess liquidity from their account in one system to their account in another. For example, liquidity could be moved from the RTGS system to FPS accounts, if participants of the RTGS system expect that the RTGS system balance and overdraft facility will not be needed during the RTGS non-operational hours. The unused excess liquidity can be transferred back to the RTGS system once it is open again.

Box 4

Liquidity management in the Reserve Bank of India's RTGS system

The RBI provides the intraday liquidity (IDL) facility to eligible participants to overcome liquidity shortfalls. With the RBI's RTGS system operating on a 24/7 basis, the IDL facility was made available round the clock too. IDL is provided against eligible collateral such as government securities. It is invoked automatically when a shortage of funds is identified in the participant's RTGS settlement account and is provided in multiples of an amount decided by RBI, subject to a maximum amount that is determined upfront. To make use of IDL, participants are expected to have sufficient securities earmarked in their securities account.

The credit provided to a participant is automatically reversed as and when sufficient funds are available in the settlement account of the participant. Outstanding credit at the end of the day must be repaid in full by the participant before the RTGS system's cut-off is executed, ie at 23:50. If a participant fails to repay the credit before the cut-off is executed, it is repaid using funds available in the current account of the participant maintained with the RBI. If sufficient funds are not available in the current account, the securities against which the credit was provided is transferred to the investment account of the RBI and the participant is liable to pay the RBI interest at twice the RBI repo rate prevailing on that day.

On the next business day, the participant is required to repurchase the securities by 10:00 am; failure to do so might result in a suspension from the RTGS system. Thus far, no participant has failed to reverse IDL by the daily cut-off time, since the RTGS system started operating 24/7.

Source: Reserve Bank of India.

Staffing arrangements

Staffing arrangements need to be updated to support extended operating hours. Most central banks ensure operational and information technology (IT) staff are available at all times the system is open to promptly respond to incidents and support participants. This could involve:

- Introducing a 24/7 help desk to facilitate ongoing communication with participants.
- Restructuring staff working hours for operations and IT teams into shifts to enable 24/7 coverage. There are various ways to structure these shifts. Regardless of the structure, new shifts will require increased staffing and staff-related costs. Typically, IT shifts cover longer periods than operational shifts.
- Introducing "on-duty" and "on-call" teams, particularly for crisis management, which often relies on the ability to connect to workstations remotely. Typically, on-duty staff cover core settlement windows, while on-call teams provide support outside normal business hours and on weekends and holidays. Key decision makers such as those in management positions may, in practice, always be on-call, as they would likely be needed during the response to major incidents.
- Reviewing and adapting human resources policies and contracts to ensure staff availability and accommodate shift requirements in line with local labour laws and regulations.

Some operators cover these new shifts and on-call roles with their own staff, while others subcontract the service to an external provider. In most cases, operational support is covered internally while IT support may be outsourced. The outsourcing of system monitoring and IT staff is usually a natural evolution of situations where IT support was already previously provided by external service providers. In cases where some system components are provided by external vendors, application specialists generally need to be on call 24/7. In this regard, service level agreements with the vendors need to be reviewed and updated if necessary to include after-hours support.

Depending on the liquidity management options provided by the central bank, the collateral management teams may need to be strengthened. Extending operating hours might also have staffing implications in functions such as payment system oversight and bank supervision. Staffing of participating institutions, the CSD and SSS may also be impacted by the extended operating hours. In some cases, the impact could be reduced if the extension of the operating hours is implemented on an opt-in basis.[9] This leaves participants the option to largely maintain their standard operating hours.

The changes to staffing arrangements generally result in increases in staff-related costs, for example, in training staff to conduct the necessary processes to operate systems safely during the extended time window. Often shift work and standby allowances are paid more, further increasing costs. Staff retention may become more challenging following the transition to shift work, which will have associated costs. However, there may be more possibilities for automating processes, minimising manual monitoring, testing and intervention tasks, as technology evolves and as part of any upgrade of systems required to facilitate the extension.

Implementation considerations

The implementation strategy for an extension of operating hours should consider the path of the implementation and the rules for participation in the extended hours. In most cases, a dedicated project team is established to deliver the implementation strategy and to manage the coordination between internal teams, payment system overseers and supervisors of payment systems, as well as external stakeholders such as participants and ancillary systems.

Implementation path

A key decision to take in planning an extension of payment system operating hours is the implementation path. The path takes into account the time needed to achieve an extension and whether the extension involves a single step to a new end state or a series of incremental extensions over time. The path may be impacted by the public policy objectives of the extension and the level of demand and support from industry to participate in such an extension.

Most payment systems that are now operating (near) 24/7 have reached those operating hours following gradual extensions over several years. For some, these incremental extensions were planned in advance and delivered in a phased manner. For example, the payment system may first extend operating hours to 24 hours on weekdays in phase one, followed some years later by a further extension to weekend operations. Taking a phased approach and having the industry aligned on clear milestones can support budgeting and resource planning for all impacted stakeholders. Built into this phased approach could be the option to proceed or pause after each phase, based on the success and level of uptake of the previous phase and any other changes in the payments landscape in the meantime.

A gradual approach to extending operating hours may be taken without necessarily having planned it from the outset. Operators may deliver incremental extensions over time in line with demand from the industry. For example, many operators extended hours in the early 2000s to accommodate settlement of CLS obligations, and more recently some have begun to extend hours as part of large-scale RTGS system modernisation projects and as part of global coordination efforts (such as the G20 cross-border payments programme).

Among operators that have recently extended payment system hours, it has been common to implement the technical capability to operate 24/7, even if the operating hours are not yet extended to

[9] The potential drawbacks of an opt-in solution are lower network effects. See also the discussion in the section on participation.

24/7. This forward-looking approach allows the flexibility to do further extensions without needing to do significant system and infrastructure changes, in consideration of the likelihood that new use cases will continue to arise from industry participants. Operators that adopted this approach indicated that future extensions would require only minimal infrastructure or system changes such as to system parameters, though substantial changes to business processes will be required and industry participants may still face substantial changes to their systems.

Participation

The implementation strategy should consider the rules and expectations for participation in the extended operating hours. The heterogeneity of participants within a payment system is likely to impact the participation rules, as participants may be differently impacted by such an extension. Depending on participants' size, cross-border presence and other business needs, they may benefit from or be burdened by the need to accommodate extended operating hours.

Participants may face substantial upfront costs and effort to update their systems and processes, as well as other ongoing costs such as for staffing of operational and treasury teams. If their products largely relate to payments during standard business hours, these costs may outweigh the benefits of extended hours. To minimise any unintentional burden on participants whose business does not require extended operating hours, a voluntary (ie an opt-in solution) or tiered participation model may be offered. However, this may reduce the overall benefits for end users of the network effects of having widespread adoption of the extended hours.

The option to send and possibly also receive payments might be introduced. If only the sending is optional, but all participants are required to receive payments, there is a risk that liquidity becomes concentrated with receive-only participants overnight, resulting in higher liquidity provisions by sending participants. Conversely, if both sending and receiving are optional, active participants need to know who else they can send payments to during the extended hours, which adds complexity.

In practice, many operators require participants to at least receive payments during the extended operating hours, either from day one or following a short transitional period. While the costs of such an approach faced by participants should not be underestimated, they should be manageable if there has been sufficient stakeholder engagement during the planning and design of the change and if the change is driven by industry demand to facilitate their use cases.

It is possible to take a hybrid approach, where optionality is offered only to particular segments of industry that are more likely to be negatively impacted by the operating hours extension. For example, the Bank of Mexico allows participants with less than 3,000 accounts to not participate in the extended hours of the SPEI service. However, as noted above, most of these non-obligated participants still chose to participate 24/7.

Stakeholder engagement

Close coordination with payment system participants and ancillary systems is critical for the success of an extension of operating hours. The involvement of the payment system overseer and the supervisors of the payment system participants at an early stage would be useful too. Operators may target these different stakeholders and use different modes of communication depending on the phase of work. This engagement requires significant planning, effort and resources from the operator. Given the number of stakeholders involved, central banks might not only be required to engage in their role as operators but as catalysts too.

Before the scope and details of any extension is agreed on, the operator should engage with payment system participants to understand their use cases – and therefore likely uptake – of additional

hours. This will help the operator to assess the viability and indeed benefit of any potential extension. At the same time, to consider the feasibility of industry to accommodate any such changes it is necessary to understand the likely costs to be borne by payment system participants and ancillary systems, where relevant, in updating systems, infrastructure and processes. In some cases, the realisation of potential benefits may depend on whether other ancillary systems, such as the SSS for liquidity and collateral management, are prepared or willing to accommodate the extended operating hours.

Both bilateral meetings and multilateral channels, such as participant forums, may be used to facilitate these conversations. Operators can engage with the general public, such as by conducting public consultations or opting to participate in public events. This engagement can help to ensure that the scope and rules of the extension would align the public objectives of the central bank better with the private interests of the different market agents. The need for collective financial industry support for an extension can be key to increase awareness among clients and effective use of the extended hours.

Once the decision to extend operating hours has been taken, stakeholder engagement remains important during the project planning phase. Participant input to the design of the implementation plan ensures that the expectations on industry are realistic and feasible. To do this, a co-creation process with a group of stakeholders representing various categories of payment system participants is common.

Finally, the operator will need to work closely with technical staff of participants to complete thorough testing and then monitor operations during and after going live. This may be done through existing channels used for other system upgrades where they are fit for purpose or through new bespoke channels as needed. Some operators chose to maintain the working groups that contributed to the design phase, transitioning them to an ongoing consultation role, to allow for continued engagement relating to operational and security matters for the system in the long term.

Conclusion

The operating hours of several RTGS systems have successfully been extended to (near) 24/7. Many of these systems report widespread adoption of the service by end users and payment system participants outside of standard business hours, with benefits spanning the payments landscape, including reduced settlement risk, enhanced efficiency and improved financial inclusion.

The experience of these early movers demonstrates that the challenges of extending operating hours are manageable with effective planning and stakeholder engagement. Given the changes usually required to system infrastructure to facilitate extended hours, upgrades may be combined with other projects to modernise the payment system. To minimise system downtime, many operators took the opportunity to automate system maintenance, SoD, EoD and in some cases recovery processes such as switching between sites. While this may reduce the manual effort needed for such processes, overall costs associated with staffing often still increased, for example due to the need for continuous monitoring of the system for incident management purposes.

It is widely recognised that engagement with payment system participants from the onset and throughout such a project is critical to its success. Collaboration between the payment system operator and participants to determine the scope and details of the extension will help to ensure adoption of the additional hours. Some payment system operators have decided to consult the financial sector and the general public more broadly before extending payment system operating hours. Engagement with relevant public authorities (eg payment system overseers, supervisors of payment system participants) is also important.

Operators should keep in mind that regardless of the extent of the system upgrades implemented as part of an extension of operating hours, the need for ongoing improvements will remain. The rapid pace of change in the payments landscape means that operators must monitor new developments in the

industry, technological advancements and best practices of operational resilience and in particular cyber security risk management.

Extended operating hours can improve the safety and efficiency of domestic payments and contribute to enhanced cross-border payments. If RTGS system operating hours overlap or are aligned across jurisdictions this might facilitate the interlinking of payment systems across borders, improve liquidity management, reduce settlement risk and help to speed up cross-border payments. The CPMI Community of Practice on Payment Systems will continue to provide a forum for central banks that are considering extending operating hours or are in the process of doing so.

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[10] The Committee on Payment and Settlement Systems (CPSS) changed its name to Committee on Payments and Market Infrastructures in September 2014. References to reports published before that date use the Committee's old name.

Annex 1: Summary of the potential "states" for extending RTGS system operating hours and the concept of a "global settlement window"

The CPMI report "Extending and aligning payment system operating hours for cross-border payments" (CPMI 2022a) presents three potential scenarios for extending RTGS system operating hours ("states") and proposes the "global settlement window".

States

State 1: Extend operating hours on days with current operations (usually "standard working days"). State 1 involves the most incremental extension in operating hours for an RTGS system. This state holds current operating days as fixed and envisions an extension achieved through increased operating hours on those days. Such an increase in operating hours could involve a later closing time for an RTGS system, an earlier opening time, or both. If undertaken by multiple jurisdictions, this state would help to close daily gaps in RTGS operating hours, primarily on standard working days given that the majority of jurisdictions' RTGS systems currently do not operate on weekends and public holidays. This state could therefore help to alleviate frictions for cross-border payments on those days but would not address frictions that arise on other days. Pursuing an earlier opening time on current operating days could be the least challenging option for many RTGS systems and participants, as such an extension would not impact critical end-of-day activities or practices. For instance, such extensions to RTGS opening times could be particularly beneficial for jurisdictions in the Americas by enabling overlap with the global settlement window and greater opportunities for payment versus payment (PvP).

State 2: Expand operating hours into days without current operations (eg weekends and public holidays, as applicable). State 2 involves an expansion of operations into additional days on which a jurisdiction's RTGS system is not currently operating. As documented in section 3 of CPMI (2022a), limited operations on weekends for RTGS systems give rise to substantial gaps in RTGS operating hours over the course of a week. A lack of operations on holidays in many jurisdictions also gives rise to substantial gaps in operating hours over the course of a year, as well as gaps during certain weeks that involve holidays. If undertaken by multiple jurisdictions, this state would help to close those gaps. For a jurisdiction that does not currently operate on weekends and holidays, an expansion could involve applying current operating hours on working days to weekends and holidays. An alternative expansion could involve limited weekend and holiday hours that are focused more directly on achieving a specific period of operations and overlap on those days.

State 3: Extend operating hours to 24/7 (or near 24/7). State 3 involves the boundary scenario of a jurisdiction extending its operating hours to 24/7 (or near 24/7). This state reflects the most extensive versions of state 1 and state 2 combined (ie extending operating hours to 24 hours per day on working days as well as on weekends and holidays). In practice, this state could involve a brief period of time at the end of the operating day to support EoD activities and system maintenance. At present, only a small number of jurisdictions already have RTGS systems that operate 24/7 or near 24/7.

Global settlement window

The global settlement window is a concept reflecting the time period during which the largest number of RTGS systems are simultaneously operating. At present, the global settlement window is best characterised as the time period from 06:00 to 11:00 Greenwich Mean Time (GMT) on working days. This is broadly the five-hour period when, on average, the highest number of CPMI and non-CPMI RTGS systems are operating concurrently across all jurisdictions covered in the report.

The global settlement window is not intended to be a target in and of itself, but rather a key consideration in each jurisdiction's decision-making process. When evaluating an extension of RTGS operating hours, in addition to domestic considerations, individual jurisdictions may consider the resulting

aggregate outcome in terms of the overall global overlap as reflected in the global settlement window. While each state represents a potential extension of an individual jurisdiction's RTGS operating hours, a key objective for an extension of RTGS operating hours to support enhanced cross-border payments could be a state that meaningfully improves on the status quo by adding to the current global settlement window in terms of the number of hours and days and the number of jurisdictions with operating hours in that window.

Annex 2: Summary of the analytical framework for considering extending or aligning payment system operating hours

The CPMI report "Operational and technical considerations for extending and aligning payment system operating hours for cross-border payments: an analytical framework" (CPMI 2023a) presents a systematic three-step approach to help central banks and RTGS system operators determine the most appropriate extension of operating hours.

- In a first step, a central bank and/or operator should determine the most appropriate nature of the RTGS system operating hours extension, such as earlier opening, later closing or operating on additional days. An evaluation of the most effective extension vis-à-vis relevant cross-border payment corridors and/or the global settlement window could inform this decision.
- Second, a central bank and/or operator should identify technical and operational issues that come with the envisaged operating hours extension. Technical issues include RTGS system infrastructure changes and adaptations to processes such as RTGS system maintenance windows. Operational issues include adaptations in staffing, changes to risk and liquidity management procedures and changes to the cost recovery and pricing policies.
- Based on these considerations a central bank and/or operator can develop a practical, forward-looking implementation strategy, with shorter- and longer-term milestones.

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