White paper

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Blockchain's role in real time payments systems

Blockchain is introducing a shift in the way that global payments are settled. Over the past 5 years, the consumer experience has improved markedly in many countries. But below the hood, often the underlying settlement process continues to use traditional methods. The ability to decentralize how payments are cleared, posted and settled is attracting the interest of real time payments systems around the world. In addition to describing how the process is adjusting, we also consider blockchain's next step: connecting domestic real time payments systems around the world.

Executive summary

Blockchain has the potential to make fundamental changes to the infrastructure of global payments. Payments is a sector that has experienced continuous innovation since the 2008 global financial crisis. As a result, retail payments are faster and easier than ever for users. But the improved consumer experience belies the fact that some core processes in business-to-business (B2B) payments remain largely unchanged. The banks that settle accounts on the back end have largely continued to use traditional methods of clearing, posting, and settlement. Until now.

Real Time Payments Systems (RTPS) are the primary outcome of payments innovations globally. RTPS has improved the consumer experience and increased the variety of ways that funds can be transferred. Countries are implementing RTPS at different speeds. For example, the United Kingdom, Singapore, and the United States have the Faster Payments Service (FPS), Fast And Secure Transfers (FAST), and FedNow systems, respectively; while others are still exploring.

The current technology used to build existing systems shares some characteristics. It is a micro-service, cloud-native architecture. This uses open application programming interfaces (APIs) to integrate with legacy architecture and share information. Together these differ from traditional payments systems that rely on a monolithic architecture, which is brittle and makes small changes expensive to implement.

Blockchain has entered the discussion as a way to address a challenge that existing technologies have not yet been able to solve: inefficiency of processing costs. Currently, RTPS requires that banks settle transactions several times per day instead of once. This multiplies processing costs. Decentralization enables different financial institutions to connect to the same ledger. This one change can increase transactional efficiency.

In this paper we will explore how this is coming together. The first section covers what an RTPS infrastructure looks like and where frictions remain. The second describes how blockchain implementation frees up efficiency by removing the “under the hood” frictions that exist between settling banks. The final section is a future look at how blockchain might be used to solve the next great frontier: connecting real time payments systems to each other.

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1 Today's real time payments infrastructures

RTPS infrastructure is being built globally, though with distinct characteristics that differ among jurisdictions. In this section, we look at both what sets an RTPS apart from traditional clearing methods and also what challenges RTPS infrastructure faces in efforts to expand.

One of the pivotal reasons for the adoption of an RTPS is payment immediacy. While "paying now" is not a new concept (cash is also an immediate payment transaction instrument), RTPS offers consumers the immediacy of payment without the hassle of carrying cash.

RTPS also offers benefits to the financial services industry. For banks, cash is an expensive instrument.[1] According to the European Central Bank, the total cost of cash in the European Union is at least 1% of GDP (over 150 billion euros). This includes the costs associated with storage, circulation, transport etc. The reduction in implicit and explicit costs for customers, financial institutions (FIs), Payment Service Providers (PSPs), and central/reserve banks is enormous when considering the move from using cash to using RTPS for real-time payments. Built-in security and audit features also make payments through RTPS safer and more traceable.

1.1 The current state of RTPS and blockchain

There is no single RTPS template. Each system is custom built for the features of the domestic financial market. However there are some common features that set a RTPS apart from a traditional clearing system. These include:

- **24 x 7 x 365:** Payments are sent and received throughout the day, every day of the year
- **Instant Payments:** Payments are sent within seconds
- **Irrevocability:** Once payments are sent, they cannot be recalled
- **Certainty:** Payments sent to a beneficiary bank – or others in the financial supply chain – are actively acknowledged or rejected, giving certainty to the sender that the payment was/was not successfully received
- **Delayed settlement:** Periodic net settlement between participants after the payment has been made.

Table 1 describes some of the major RTPS frameworks. This illustrates the current state of play of each domestic system.

1 This includes but is not limited to financial institutions (FIs), central/reserve banks, and payment service providers (PSP)

Table 1: Characteristics of RTPS features (selected sample)

Country + date RTPS launched	Name of system	Payment types covered	Current state of RTPS	Central Bank blockchain expereince
Australia (2018)	New Payments Platform	Personal (P2P, P2B) Business (B2P, B2G) Government (G2P)	• Data-rich message standards implemented • Third-party payment initiation enabled • International payments coming in future	Reserve Bank of Australia keen to work with private sector to experiment with wholesale CBDC
Germany (2017)	SEPA Credit Transfer Instant payments (SCT Inst)	Personal (P2P, P2B) Business (B2P, B2B, and B2G)	• Request to Pay functionality enabled	Digital euro project under debate. Decision expected 2021 Bundesbank has completed work on DLT interoperability with TARGET2
India (2010, 2016)	Immediate Payment Service Unified Payments Interface	Personal (P2P, P2B) Business (B2B) Government (G2P)	• Focus on managing private companies contributing to and competing in real-time payments through the New Umbrella Entity • Inclusion of more sophisticated overlay services growing	Blockchain projects built in collaboration with the private sector. Focus on retail CBDCs
US (2017)	Real-Time Payments	Personal (P2P, P2B, A2A) Business (B2B, B2P) Government (G2P)	• Promoting adoption of RTP by FIs • Considering Request to Pay and instant cross-border settlement	Boston Fed is working with MIT to build a tech platform for a hypothetical digital dollar
Brazil (2020)	PIX	Personal (P2P, P2G, P2B) Business (B2B, B2G)	• Promoting increasing volumes and security • Considering QR codes	Released CBDC guidelines in 2020 Discussions dominated by retail CBDC
Chile (2008)	Transferencias en Línea	Personal (P2P, P2B) Business (B2B)	• Uses the older ISO8583 format. No plans to migrate to ISO20022	Desk research released 2020
Hong Kong (2018)	Faster Payment System	Personal (P2P, P2B, P2G) Business (B2P, B2B, B2G)	• Uses email address and proxies as account identifiers • Considering QR codes	Various POCs and research produced since 2016

Sources: FIS, European Payments Council, Individual Central Bank websites[2]

2 FIS Flavors of Fast 2020 Report, https://rba.gov.au, https://europeanpaymentscouncil.eu, https://www.cca.cl/oferta-de-servicios/, https://business.ebanx.com/en/resources/payments-explained/pix-instant-payment-system

1.2 If payments are already fast, what is left to be solved?

While RTPS has proliferated rapidly, challenges remain. Many of these are rooted in the clearing and settlement process, which has innovated far more slowly than the user experience. The reason is that most implementations of RTPS don't overhaul the existing settlement system. Rather, they simply introduce additional clearing events to speed up the process. There are three challenges in particular which have stubbornly remained part of the clearing and settlement process.

The first challenge is cost. The costs of settlement have not changed even as the process has become faster. There are two reasons for this. The first is that RTPS require banks to operate outside of standard hours. To allow 24x7 RTPS, banks must provide coverage past the normal 9-5pm day.

Another cost is that RTPS limits the ability to batch settlement.[3] Without batch settlement, banks must process payment-by-payment, which multiplies the costs involved. This multiplier extends across the infrastructure, from the payment processor to customer accounts payable/receivable and reconciliation.

A second category of challenges for RTPS implementation is technological. The execution of an RTPS requires two processing sites in live configuration. Operating in a 24x7 environment impacts how PSPs perform end-of-day batch jobs. Given the need to reduce downtime, PSPs need to run multiple processing sites (known as a hot/hot configuration) to allow continuous runtime if there is an outage or update to one of the sites.

Because of the way that RTPS is automated today small errors are not easily corrected without human intervention. In 2018, Deutsche Bank accidentally transferred US $35 billion to an outside account as a result of a **miskeyed entry**. Identifying and rectifying the mistake only took minutes but required human intervention. Outages can have serious ramifications as services being unavailable for even a few minutes means that, potentially, hundreds or even thousands of payments could fail.

There has also been a shift in the technology used in the payments space. Historically, legacy payments systems were built using what is called a monolithic architecture. In this format, any update requires the entire service to be re-written. [4] In order for payment providers on a monolithic architecture to engage in RTPS, they must build expensive, bespoke integrations to the components of the RTPS. This is in part why in RTPS, it is more common to use a microservices architecture. This allows any component (or microservice) to be changed without affecting any other parts of the software.

A third challenge is that even the RTPS-based clearing process keeps capital locked up. Since banks are executing the traditional clearing processes, just more of them, they still need to allocate capital into a central clearing scheme. This has an opportunity cost for banks. The inability to maximise their liquidity means potentially better uses for the locked-up funds are missed.

3 Settling in batches refers to the practice of grouping transactions to settle at the end of a period or session, rather than settling each transaction individually.
4 Software built in this manner is designed to be self-contained, with components of the software interconnected and interdependent. If any program component must be updated, the whole application must be rewritten.

2 Blockchain's four fundamental changes to RTPS

Architecturally, the nature of an RTPS changes with the use of blockchain. In particular there are four activities that become available under a blockchain architecture. These activities also offer solutions to the historical challenges discussed in the previous section. New activities include:

- Implementation of decentralized databases
- Lower cost settlement
- Instant clearing and settlement
- Enhanced use of liquidity

The first change that blockchain can offer is a decentralized database. This means that there are multiple independent devices that are connected and provide different nodes within the network. These nodes are independent, meaning that they can set their own rules with regards to data workload availability. Additionally, vertical scaling is possible: each node can add resources (hardware, software) to increase in performance of the entire system. As mentioned earlier in the paper, this allows for high availability. Also, there is increased data privacy as well as a reduction in processing requirements in cloud data centres. This means it is cheaper to run.

A second change is that blockchain reduces operational costs and brings us closer to real-time payments between financial institutions. An advantage of using blockchain, more specifically a permissioned Peer-to-Peer DLT platform for settlement is that everyone with permissions to access would have an unencumbered view of shared facts on that platform. Additionally, there exists the possibility to enable transaction-level privacy: this means that access to data is enabled on a "need to know" basis. All information would be immutable and transparent. This also means that there would be no reliance on network or custodial services and correspondent banks; transactions could be settled directly on the blockchain.

The third blockchain benefit is "atomic" transactions. These are transactions that have no ambiguity on either leg of the transaction, with both legs either being committed to a database, or not. The participants to the transaction will know whether it's committed or not, right away. This is in line with the concept of delivery versus payment (DvP), whereby the transfer of an asset or financial instrument would happen simultaneously with the receipt of payment for that asset or financial instrument. DvP allows for immediate settlement. This stands in contrast to current banking systems, which do not settle transactions in real-time.

The fourth change that blockchain provides is enhanced use of liquidity. As compared to existing systems, decentralised solutions may enable banks to have more flexibility and visibility with regards to how their payments are netting network-wide, thus reducing their reliability on the central operator for that calculation. A more efficient use of capital benefits all participants in a financial system since funds can be deployed more efficiently to where they can be best used.

3 The next frontier: cross-border real-time payments and settlement

While domestic payments have innovated quickly, cross-border payments have remained largely static for the past 50 years. Payment rails today use the inter-bank, correspondent banking model, with distinct borders and jurisdictions. But this is increasingly at odds with a world where trade is global and happening around the clock.

As an example, payments adhere to strict business times both in the initiating country and in the destination country. This can lead to the payment taking several days. It may also have to go through more than one intermediary bank before reaching its destination, which causes further delays and fees. And unless it is a repeating payment, current methods do not even guarantee certainty that the payment is valid for the destination account.

Also increasingly unacceptable to consumers are the transactions fees. Surprisingly, the exchange rate used for a cross-border payment may be unknown at initiation and transaction fees can vary. The transaction fees for a cross border payment make up a high percentage of the transaction amount. The World Bank estimated this at around **6.5% in 2018**. This is significant for countries which depend on remittances. The World Bank estimated that remittance inflows accounted for as high as 40% of the GDP for some countries, totalling $716 billion in 2019. Blockchain could reduce fees in these flows by between 40-80%. The adoption of blockchain for cross-border payments could decrease global total transaction fees of up to US $20 billion.

The processing of cross-border payments on RTPS would replace the traditional correspondent banking model with a more reliable model that has a collaborative ecosystem at its core. This collaborative ecosystem would be open to all types of payments stakeholders that could move money instantaneously, with improved traceability.

To realize cross-border RTPS payments, central and reserve banks need to be open to discussions with each other to achieve interoperability and the near real-time movement of funds. In certain parts of the world, this has already been accomplished. Thailand, Malaysia, and Singapore, for example, are collaborating to create a real-time payment service across Southeast Asia.

There is already movement away from the legacy SWIFT data formats. ISO20022 is a data-rich XML format message. It is replacing the outgoing ISO15022 (MT Standards) message format. ISO20022 will allow for greater flexibility, harmonisation, resilience, and straight-through processing (STP), among other things. This will enhance the speed, efficacy, and ease of adoption of RTPS systems around the world.

The use of the ISO20022 messaging format, underpinned by blockchain technology and networks, could expedite the move to real-time cross border payments on RTPS. The data-rich nature of ISO20222 messages means they could add information required to meet compliance requirements. This potential harmonisation with payments systems around the world allows for enhanced efficiency and increased STP, further adding credence to the use of RTPS for cross-border transactions.The standardised message format possible with ISO20022 will allow for STP for any faster payment anywhere in the world.

4 Conclusion

The reason that correspondent banking has worked for so long is the vast reach of SWIFT. It has over 11,000 banks and businesses in its network. Any solution that would hope to replicate this would need to be based on a global ecosystem with a similar element of data uniformity for all participants.

Yet even SWIFT has run into problems. In the 13 years from 2002 to 2015, the number of correspondent banking relationships has declined by over 50%. This is a problem for banks and countries that no longer have these relationships. This underscores both the threat and the potential of RTPS. As RPTS scales globally, actors will rely less and less on the traditional role of correspondent banking. And for those systems that include blockchain, they will further remove the need for the nostro accounts associated with correspondent banking and the need to pre-fund these accounts.

Looking to the near future, there are a few emerging trends in the payments infrastructure:

- The investigation into CBDC and its potential to be used for settlement for interbank payments, both domestically and internationally, as well as for retail payments.
- An increased focus on overlay services such as Request to Pay (R2P) and aliases. R2P overlays on RTPS will improve efficiency and speed of payments
- In certain markets, real-time payments done through RTPS are promoting entrepreneurship by encouraging third-party firms to develop innovative and improved products for RTPS users. It is also helping corporate treasuries improve working capital and liquidity management.

As has been illustrated in this paper, there exists a great deal of potential with RTPS, particularly with the continuing work being done on blockchain, and the use thereof.

Links for related reading:

- **Optimizing Commercial Payments at Time of External Crisis**
- **Seamless Payments on Ledger and From Ledger**
- **Integrating Token-Based Payments into Existing Payment Systems - A Plug and Play Approach**
- **Future of payments in a post-Covid society**

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R3 Contributors

Alisa DiCaprio
Head of Trade and Supply Chain

Muneeb I Shah
Head of Payments Product Strategy & Commercialization

Jared Shanley
Product Business Analyst

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New York
1155 Avenue of the Americas, 34th Floor
New York, NY 10036

London
2 London Wall Place, London
EC2Y 5AU

Singapore
8 Robinson Road,
Level 14-02
Singapore, 048547

São Paulo
Av. Angélica, 2529 - Bela Vista, 6th Floor
São Paulo - SP,
01153-000, Brazil

Hong Kong
40-44 Bonham Strand
7F Sheung Wan
Hong Kong

Dublin
50 Richmond St. South,
Saint Kevin's, Dublin,
D02 FK02