Committee on
Payments and Market
Infrastructures

Final report

Facilitating increased adoption of payment versus payment (PvP)

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Executive summary

This report explores how private and public sector stakeholders can foster broader adoption of payment versus payment (PvP) to reduce foreign exchange (FX) settlement risk and improve cross-border payments. The report, written by the Bank for International Settlements' Committee on Payments and Market Infrastructures (CPMI), analyses the causes of persistent FX settlement risk and provides an overview of existing PvP arrangements. Based on extensive engagement with a wide range of industry stakeholders, the report discusses proposals by industry participants for new PvP solutions and suggests potential roles for private and public sector stakeholders to facilitate increased adoption of PvP.

PvP is a settlement mechanism that serves to reduce settlement risk in FX post-trade processing. Settlement risk materialises if one party to a trade of two currencies fails to deliver the currency owed, while the counterparty has delivered the other currency owed. This can lead to significant losses for individual market participants, notably demonstrated by the failure of Bankhaus Herstatt in 1974, and potentially have systemic consequences. A PvP arrangement reduces settlement risk by ensuring that the final settlement of a payment in one currency occurs if and only if the final settlement of a payment in the other currency takes place. Many PvP arrangements also offer tools for liquidity optimisation, such as multilateral netting, which serve to reduce funding costs and liquidity risk for cross-border and cross-currency payments.

Existing PvP arrangements have been successful at reducing settlement risk for much of the FX market, but certain growing market segments remain exposed to settlement risk. While PvP arrangements are available for the most traded currency pairs and instruments, they are not available for all emerging market and developing economy (EMDE) currencies, may not be practicable for settling certain trades, or are deemed too costly by some users. As existing PvP arrangements continue to explore ways to expand their coverage, industry participants have proposed new solutions to complement the existing arrangements, for example, by specifically targeting EMDE currencies.

Existing PvP arrangements and new proposed solutions face similar barriers to broader adoption. Among those barriers are (i) weak incentives for market participants to settle FX trades using PvP; (ii) technical challenges for PvP providers to access and interoperate with real-time gross settlement (RTGS) systems during operating hours that meet user demands; and (iii) legal challenges for PvP providers to reconcile differences in national legal and regulatory frameworks (eg regarding settlement finality, the enforceability of netting and related insolvency protections).

Private and public sector stakeholders, including central banks, can take on various roles to reduce these barriers and facilitate the increased adoption of PvP. Private sector entities can align nostro operating hours and processes, explore potential changes to conventions for an international value date, and promote integration and interoperability between legacy and emerging systems. Central banks and other public authorities could play a role in assessing any operational and regulatory barriers, and sharpening regulatory incentives for market participants to settle FX trades using PvP. Specifically, they can (i) evaluate the benefits, risks and barriers in expanding access to central bank accounts for PvP providers, (ii) consider extending and aligning operating hours of RTGS systems in support of PvP arrangements, (iii) explore new functionalities in RTGS systems and promote interoperability where practical, and (iv) ease liquidity constraints on PvP settlement where practical. The G20 cross-border payments programme separately addresses issues regarding access, liquidity constraints and operating hours in more detail under building blocks 10, 11 and 12, respectively. Finally, central banks can use their convening power to help catalyse private sector engagement and solutions for addressing structural problems in FX markets.

Most of the new solutions outlined in this report seek to provide PvP settlement for wholesale FX transactions and, if implemented, could increase in systemic importance over time. While this report does not seek to determine the systemic importance of the solutions, the CPMI expects any financial market infrastructure (FMI) determined as systemically important by relevant authorities to observe the *Principles for financial market infrastructures* (PFMI) (CPSS-IOSCO (2012)).

In addressing FX settlement risk, central banks will continue to play important roles as operators of RTGS systems, providers of settlement assets and liquidity, overseers of payment systems, supervisors of financial institutions and convenors of industry stakeholders. The CPMI, in cooperation with other public stakeholders and relevant international committees, will continue to monitor the evolution of FX settlement risk. The CPMI will also further engage with industry stakeholders and relevant authorities to explore possible practical actions to foster broader use of PvP settlement with the aim of reducing settlement risk and enhancing global cross-border payments.

1. Introduction

In October 2020, the G20 endorsed a roadmap to enhance cross-border payments, developed by the Financial Stability Board (FSB) in coordination with the CPMI and other relevant international organisations and standard-setting bodies. The roadmap resulted in the G20 cross-border payments programme, which aims to address long-standing challenges in the cross-border payments market, including high costs, low speed, limited access and insufficient transparency. The programme comprises the necessary elements of a globally coordinated response in the form of a set of 19 building blocks (CPMI (2020a,b)).[1]

PvP is a settlement mechanism that ensures that the final settlement of a payment in one currency occurs if and only if the final settlement of a payment in another currency or currencies takes place. PvP arrangements are designed first and foremost to reduce settlement risk, which is the risk of loss when a party in an FX transaction pays the currency it sold but does not receive the currency it bought. FX settlement failures can arise due to default events, operational issues, market liquidity constraints or other factors. In addition to reducing settlement risk, PvP arrangements typically provide other features such as netting which serves to substantially reduce the liquidity requirements of funding FX settlement. New FX settlement solutions additionally seek to address other aspects of funding costs by providing real-time visibility of bilateral exposures, greater flexibility on when to settle and additional netting options. These extended functionalities can help reduce the amount of trapped liquidity and better meet specific needs of local money markets. More ambitious new solutions aim to mitigate other cross-border payment frictions, including long transaction chains, limited operating hours and weak competition.

Although existing PvP arrangements such as CLS have made significant progress in reducing settlement risk, they are not available to all segments of the FX market such as EMDE currencies in which trading has increased in recent years. In parallel, as the cross-border payments market strives to move towards real-time settlement, there has been a focus in the market for same-day or even instant PvP services that allow for fast and reliable access to liquidity in foreign currency.

Increasing the adoption of PvP has been on policymakers' agenda for decades. In 1996, the G10 central banks endorsed a concerted strategy to reduce settlement risk (CPSS (1996)), which ultimately led to the establishment of CLS in 2002. In 2013 the Basel Committee on Banking Supervision (BCBS) set out expectations for FX market participants in the *BCBS Guidance* (BCBS (2013)) that expanded and strengthened its earlier guidance issued in 2000. These expectations are echoed in the *FX Global Code* (GFXC (2021)): market participants should eliminate settlement risk by using settlement services that provide PvP, and where PvP settlement is not used, market participants should reduce the size and duration of their settlement risk as much as practicable. In December 2020, the BCBS and CPMI Chairs issued a joint letter urging market participants to follow these expectations (BCBS-CPMI (2020)).

This report follows up on these central bank policy and regulatory actions and provides an overview of existing PvP arrangements and proposals by industry for new solutions. It identifies the potential barriers to using and expanding PvP services and suggests potential roles for the private and public sectors in catalysing greater availability and use of PvP. The report does not ascertain which of the solutions are best suited to foster broader use of PvP, but rather seeks to identify practical actions that would facilitate and encourage increased adoption of PvP over the medium term.

The report compiles information from three sources. The CPMI (i) conducted a survey of existing PvP arrangements in April 2021, (ii) issued a call for ideas on solutions to expand PvP settlement in October 2021, which resulted in 16 written submissions, and (iii) engaged with industry stakeholders, including via two industry workshops and a public consultation, over the course of 2022.

[1] This report, prepared by the CPMI Cross-border Payments Foreign Exchange Workstream, is the output of action 3a of building block 9. It builds on action 2 which (a) took stock of existing and in-development PvP arrangements designed to support FX settlement and (b) developed proposals for increased adoption of PvP by encouraging enhancements to existing PvP arrangements and exploring new public sector or private sector led PvP solutions. Sub-actions 2a and 2b were completed in May 2021 and July 2022, respectively.

The remainder of the report is structured as follows. Section 2 investigates the causes of non-PvP settlement and provides an overview of existing PvP arrangements. Section 3 analyses several solutions proposed by industry participants that aim to complement existing arrangements by providing additional coverage, flexibility and functionalities. Section 4 suggests potential roles of the private and public sectors in facilitating increased adoption of PvP. Section 5 concludes and sets out next steps.

2. FX settlement risk and existing PvP arrangements

Existing PvP arrangements have been successful at reducing settlement risk for much of the FX market, but certain growing market segments remain exposed to settlement risk. This section lays out the developments in FX settlement risk over time, analyses the causes of non-PvP settlement and describes how five existing PvP arrangements cover the market in terms of currencies, instruments and participation.

2.1 Growth in FX settlement risk and causes of non-PvP settlement

The FX market is the largest financial market in the world and has grown substantially in recent decades, from a daily turnover of \$1.2 trillion in 2001 to \$7.5 trillion in 2022.[2] The US dollar (USD) remains the dominant currency, being on one side of 88% of all trades, while the euro is the world's second most traded currency, on one side of 31% of all trades. The Japanese yen (JPY) and British pound (GBP) were on one side of 17% and 13% of all trades, respectively. EMDE currencies are gaining market share, reaching 26% of global turnover in 2022, with the Chinese renminbi (CNH) being the most traded of these at 7% of global turnover.

The data reported in the 2022 Triennial Survey indicate that, in April 2022, nearly a third of deliverable FX turnover was settled with potential exposure to settlement risk, and that this proportion of trades at risk has likely increased since the early 2010s (Graph 1.A).[3] EMDEs and countries *without* CLS currencies report higher risk rates than AEs and countries *with* CLS currencies (Graph 1.B). Individual market participants could suffer substantial losses if settlement risk materialised, and large losses could have systemic consequences.

Market participants use methods other than PvP to mitigate, if not fully address, settlement risk, particularly where PvP may not be available. Participants can bilaterally offset payment obligations to reduce the amounts that need to be settled (ie "pre-settlement netting"). If netting agreements are legally enforceable, they reduce settlement risk but do not eliminate it: the net payable amount still needs to be settled. Market participants can also settle on-us, that is, across the books of a single institution. On-us settlement can reduce settlement risk when the two currency legs are settled simultaneously or there is certainty that they will be settled within preauthorised credit lines (ie "on-us without exposure to settlement risk"). However, if that is not the case, the counterparties remain exposed to settlement risk and would be better off using a PvP mechanism. Market participants can also use controlled settlement, in which one counterparty prefunds one currency leg before the other counterparty releases the funds to settle the other currency leg.[4] However, this method only eliminates one counterparty's exposure to

[2] See the BIS Triennial Central Bank Survey of Foreign Exchange and Over-the-counter (OTC) Derivatives Markets in 2022 (2022 Triennial Survey), www.bis.org/statistics/rpfx22.htm.

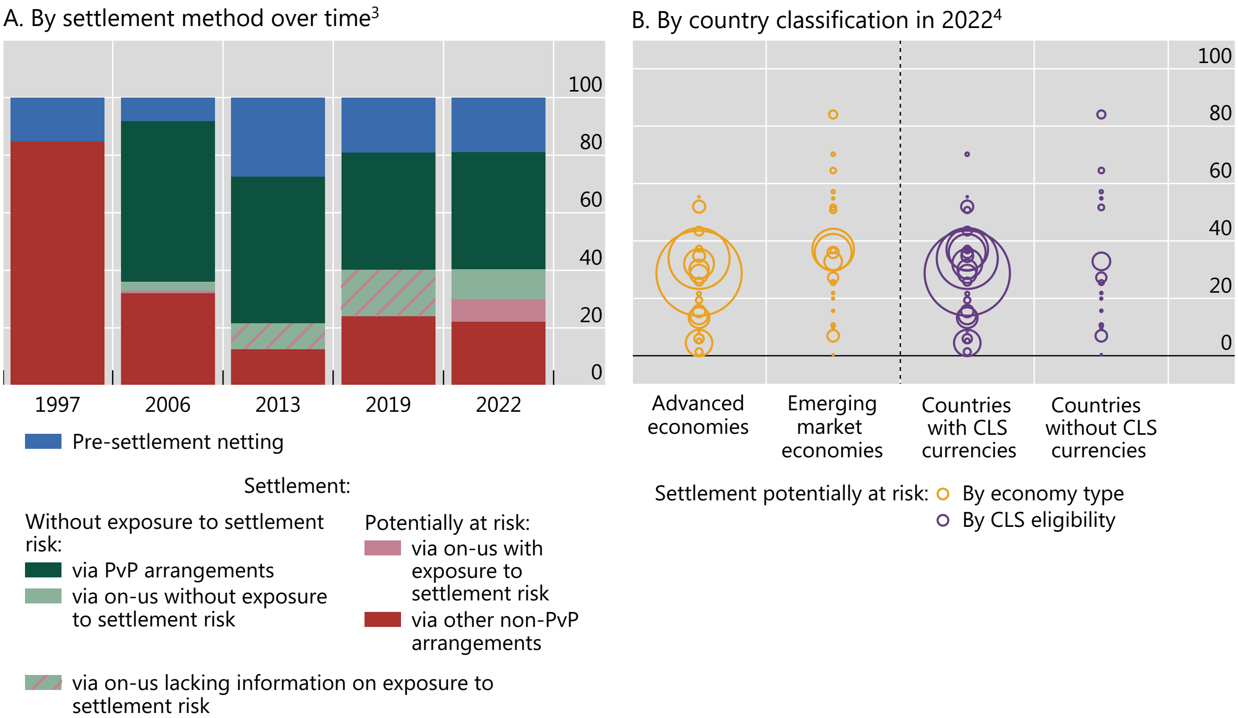
[3] Data on settlement risk are not fully comparable over time, primarily due to differing compilation methodologies, so the changes in risk levels cannot be measured precisely.

[4] The 2022 Triennial Survey did not collect data on the proportion of this type of controlled settlement in the non-PvP segment, nor did it collect data on the proportion of related-party trades (ie trades between branches and subsidiaries of the same financial group or other affiliated entities). Trades between related parties may have different settlement risk characteristics than those between non-related parties.

principal risk and may delay settlement or even lead to a market-wide gridlock in times of stress. It may also require manual intervention and introduce additional operational risk.[5]

Settlement of foreign exchange turnover[1]

As a percentage of deliverable turnover[2] Graph 1



[1] Adjusted for local but not cross-border inter-dealer double-counting, ie "net-gross" basis; daily averages in April. [2] Turnover settled with multiple payments between counterparties (eg spot trades, outright forwards, FX swaps and currency swaps). [3] On-us settlement is where both legs of a trade are settled across the books of a single institution; respondents in 2013 and 2019 did not report whether on-us settlement was with or without exposure to settlement risk. [4] Each circle represents a country, and circle area is proportional to the deliverable turnover reported by that country. A few countries reported greater settled turnover than deliverable turnover in which case the denominator is settled turnover.

Source: CPSS (2008); Kos and Levich (2016); BIS Triennial Central Bank Survey; CPMI calculations.

For counterparties to use a PvP arrangement to settle a deliverable FX trade, three conditions must be met. First, the arrangement needs to be *available*: the arrangement must support both currencies of the trade and the FX instrument (such as a spot, outright forward or FX swap), and both counterparties must have access to the arrangement either directly or indirectly through third parties. The relative decline in PvP settlement can be attributed partly to a lack of availability, driven by growth in the trading of currencies that are not supported by existing PvP arrangements. Although some EMDE participants have access to other regional or national PvP arrangements, these arrangements settle only a few currency pairs. Thus, the settlement risk rate in EMDEs is higher than in advanced economies (AEs).

Second, the PvP arrangement should be *fit for purpose*: (i) its operating window should allow for participants to transfer funds at times that serve their commercial and operational needs, and (ii) it should enable participants to adequately monitor their bilateral exposures and optimise liquidity usage in addition to mitigating settlement risk. Market participants often move funds outside the operating window of existing PvP arrangements for commercial or regulatory reasons, often related to liquidity constraints in local funding markets or operational circumstances, requiring settlement to be advanced or postponed.

[5] *Principal risk* is the risk that a counterparty loses the full value involved in a transaction. *Operational risk* is the risk that deficiencies in information systems or internal processes, human errors, management failures or disruptions from external events will result in the reduction, deterioration or breakdown of services (CPMI glossary, www.bis.org/cpmi/publ/d00b.htm).

Market participants report that they often must choose between mitigating risk by settling via a PvP arrangement and observing other commercial, operational or regulatory needs by settling on a non-PvP basis. For some FX transactions, they are constrained to using non-PvP methods despite the increased risk.

Market participants also report that mitigating settlement risk in and of itself may not be a strong enough selling point to adopt a certain PvP arrangement. However, this is notably from the point of view of individual financial institutions that may not consider the systemic risk associated with settling on a non-PvP basis. The incentives to settle using PvP are weak in part due to a miscalculation of settlement risk exposures, for example, when a settlement session lasts for several days across time zones but the risk is only recorded for one day (ie for the value date).[6] This may in part be due to challenges in interpreting and implementing the guidance on how settlement risk exposures are calculated.[7] Additionally, PvP settlement in and of itself can entail higher liquidity demands than non-PvP settlement. Therefore, in addition to reducing settlement risk, PvP arrangements typically incorporate other functionalities that serve to ease liquidity management and reduce funding costs for participants.

Most PvP arrangements offer netting, which is a mechanism that offsets the obligations among participants to reduce the number and value of payments needed to settle a set of transactions. Netting on a multilateral basis requires less liquidity but is also less flexible than on a bilateral basis (Box 1). Some PvP arrangements also offer other functionalities such as trade capture, which is a connection to third party systems for compiling and matching trade data, and real-time visibility of credit exposures, which allows participants to monitor changes in their net position against each other as trades are captured.

Box 1

Liquidity and settlement flexibility in netting mechanisms

When deciding which netting mechanism to offer in a PvP arrangement, a trade-off arises between ensuring that participants can (i) adequately reduce the liquidity needed to settle on a PvP basis and (ii) flexibly choose when and how to trigger a settlement session.① Multilateral netting, by which a potentially large set of payment obligations among three or more participants is reduced to one net position per participant, typically requires less liquidity but is also less flexible than bilateral netting, by which obligations between only two participants are offset.

Multilateral netting significantly reduces funding costs because the volume and value of offsetting payments typically increase considerably as the number of participants increases. Some market participants argue that multilateral netting is a necessary requirement for any PvP arrangement that settles EMDE currencies, because money market liquidity in EMDEs is often scarcer than in AEs. However, multilateral netting leads to a rather rigid settlement session as accounts need to be funded and transactions settled during prespecified time intervals. These intervals are set to allow ample time for intricate rules and procedures to be followed if one or more participants fail to meet their net payment obligations.

Bilateral netting involves only two counterparties, so its offsetting potential is lower, but it can allow for more flexibility in when and how to settle. For example, it can allow counterparties to bilaterally agree on triggers for the settlement session to begin not only at specific points in time but based on exposure limits or even on an ad-hoc basis if, for example, both counterparties agree to settle earlier than initially planned. Some market participants argue that the demand for such flexibility will increase if the FX post-trade market moves towards real-time settlement.

Either form of netting may serve different user requirements, and market participants may even find it beneficial to use multiple complementary PvP arrangements. Conversely, market participants may still prefer to settle without using PvP if the only available PvP arrangements offer less than ideal netting options.

① The settlement session is the time spent and processes associated with funding, settling and defunding a set of FX payment obligations.

6 In this report, the *settlement session* refers to the time spent and the processes associated with funding, settling and defunding a set of FX payment obligations.

7 See BCBS (2013), paragraphs 3.2.8–3.2.15, for the guidance on measuring expected principal risk.

Third, the PvP arrangement needs to be *efficient*: the benefits of reducing settlement risk and funding costs should outweigh transaction fees and monthly charges in addition to the one-off costs associated with onboarding. Onboarding can be costly as it requires a participant not only to configure technical access to the PvP arrangement but often also to change internal processes for complying with service rules. For any market segment, it is difficult to ascertain how these costs and benefits influence a market participant's decision to use a PvP arrangement. In any case, market participants should, individually and collectively, consider the full range of risk mitigation benefits, including the reduction of systemic risk.

2.2 Existing PvP arrangements

In April 2021, the CPMI surveyed five existing PvP arrangements that settle wholesale FX transactions (Table 2).[8] These include the B3 Foreign Exchange Clearinghouse in Brazil (B3), the Clearing Corporation of India Limited's Forex Settlement (CCIL), CHATS in Hong Kong SAR, and CLSNow and CLSSettlement, which are global solutions provided by CLS Bank International in the United States. The survey contained 63 questions covering the currencies and instruments settled, participation criteria and costs, the timing of settlement as well as drivers and barriers for increased adoption of PvP.

Overview of existing PvP arrangements

Table 2

	B3	CCIL	CHATS	CLSNow	CLSSettlement
Operator	B3 SA	The Clearing Corporation of India Ltd	Hong Kong Interbank Clearing Ltd	CLS Bank International	CLS Bank International
System name	Foreign Exchange Clearinghouse	Forex Settlement	Clearing House Automated Transfer System	CLSNow	CLSSettlement
Jurisdiction	Brazil	India	Hong Kong SAR	United States	United States
Launch year	2002	2002	2000	2019	2002
Primary regulator/ overseer	Central bank of Brazil	Reserve Bank of India	Hong Kong Monetary Authority	Board of Governors of the Federal Reserve System	Board of Governors of the Federal Reserve System
Type of FMI	Central counterparty	Central counterparty	Payment system	Payment system	Payment system
PvP mechanism	Central clearing, net settlement	Central clearing, net settlement	Simultaneous gross settlement	Simultaneous gross settlement	Simultaneous gross settlement[1]
Settlement timing	Once per business day	Once per business day	Throughout the business day	Throughout the business day	Once per business day
Money settlements[2]	Central bank money (BRL) Commercial bank money (USD)	Central bank money (INR) Commercial bank money (USD)	Central bank money (HKD, IDR, MYR, THB) Commercial bank money (CNH, EUR, USD)	CLS Bank is the settlement institution with funding in central bank money[3]	CLS Bank is the settlement institution with funding in central bank money[3]

[1] Funding is on a multilateral net basis. [2] BRL = Brazilian real, CNH = Chinese renminbi, EUR = euro, HKD = Hong Kong dollar, IDR = Indonesian rupiah, INR = Indian rupee, MYR = Malaysian ringgit, THB = Thai baht, USD = United States dollar. [3] Payments to and from CLS Bank are made via central bank accounts.

Source: CPMI survey.

[8] This report does not intend to give a complete overview of all existing FX settlement arrangements. For example, some other CCPs also clear and settle deliverable FX trades and CLS offers CLSClearedFX, a settlement service for CCPs.

B3 and CCIL guarantee settlement and use the measures typical to central counterparties (CCPs) for managing counterparty risk, including exposure limits, margins, default funds and loss sharing arrangements. CHATS, CLSNow and CLSSettlement do not guarantee settlement, so while participants in these systems are protected from principal risk (ie the risk of losing the full principal amount), they are still exposed to liquidity risk (ie the risk of not receiving a currency when expected) and replacement-cost risk (ie the risk of incurring extra costs when replacing the original transaction at current market prices).

The five arrangements support markedly different sets of currencies. CLSSettlement supports any combination of 18 currencies (Graph 2), including the currencies of most AEs in addition to three EMDEs. CLSSettlement is the only PvP arrangement with global reach. CLSNow supports six pairs of four AE currencies, while CHATS supports nine pairs of seven currencies, of which five are Asian currencies and two are global reserve currencies (ie USD and EUR). B3 and CCIL settle just one currency pair each as they cater specifically to the needs of the FX markets in Brazil and India, respectively.

The five arrangements also support different FX instruments (Table A1). All except CLSNow process spot transactions although the two CCPs, B3 and CCIL, have a limited instrument scope: B3 only clears spots whereas CCIL also clears outright forwards and FX swaps. CHATS and CLSSettlement additionally settle currency swaps, options and other transactions (such as bilaterally netted payment instructions related to over-the-counter (OTC) credit derivatives). CLSNow is designed specifically to settle the out-legs of in/out swaps and other same-day trades.[9]

The five arrangements manage, and in some cases reduce, participants' liquidity obligations in various ways. CLSSettlement reduces funding requirements through multilateral netting by up to 96% of gross notional value with further reductions being possible via in/out swaps. Similarly, CCIL's multilateral netting process reduces participants' funding requirements by 90%, which in turn reduces funding costs for clients at the nostro level.[10] CHATS offers participants of the respective RTGS systems operating within the PvP service the availability of interest-free intraday liquidity in the form of intraday repo transactions.

All five arrangements provide direct access to banks subject to eligibility criteria including financial, legal and operational requirements (Table A2). For example, direct participants must adhere to a rulebook, use specified messaging standards, participate in operational tests, maintain minimum credit ratings and contribute to a default fund (for CCPs).[11] B3, CCIL and CLSSettlement also extend access to certain other financial institutions, however, none of the five arrangements extend access to non-bank payment service providers (PSPs). B3 and CCIL only extend access to domestically domiciled participants while CHATS is also open to participants domiciled in jurisdictions which are connected to the system (ie Indonesia, Malaysia and Thailand).

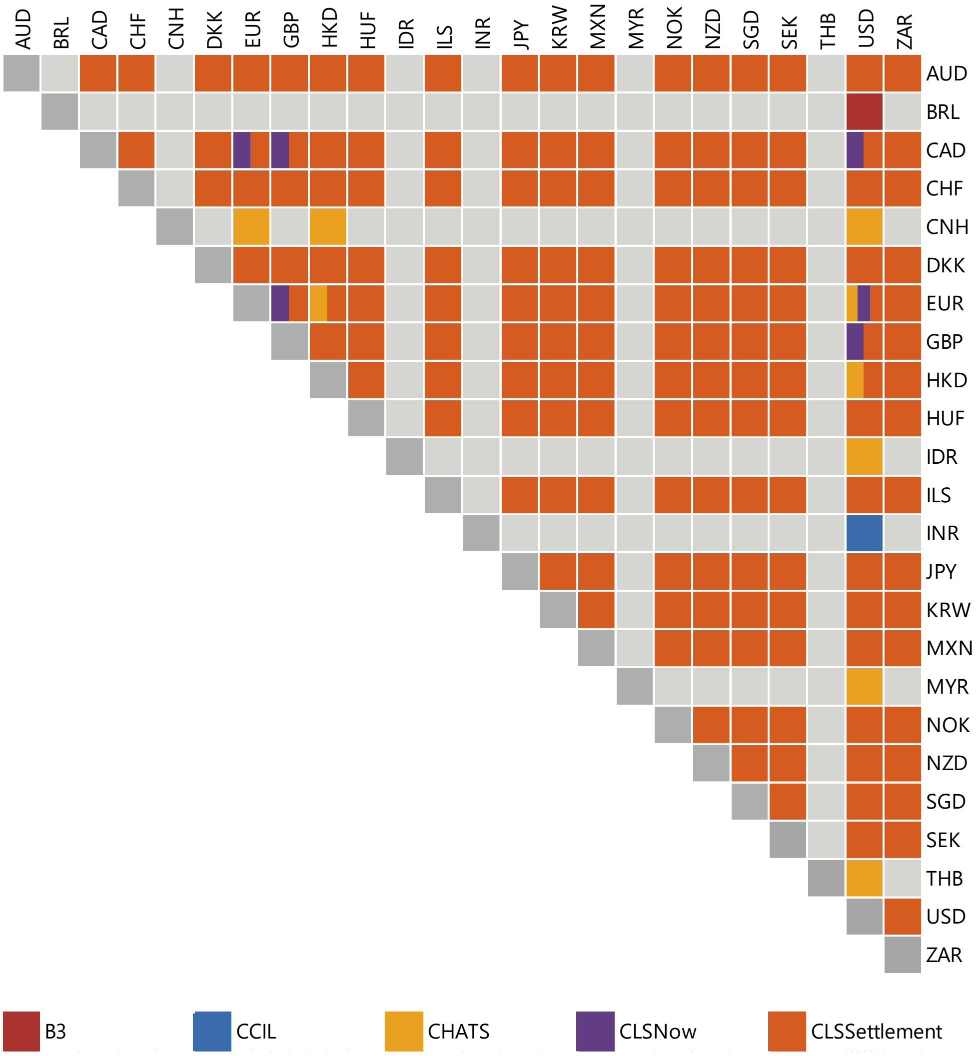
Finally, the five arrangements have different operating hours. They all settle transactions only on weekdays and in a window between five hours (for CLSSettlement) and ten hours (for CHATS), and their settlement sessions also vary in length from less than a minute to several hours. None of the five arrangements report plans to extend operating hours as they (i) consider the demand for extensions to be limited, which in turn could be driven by the types of FX instruments settled, and (ii) need offline hours to maintain and update the systems to preserve operational resilience.

9 CLSSettlement offers an optional liquidity tool, the in/out swap, by which CLS suggests an intraday swap of two equal and opposite FX positions that allow participants to further reduce their pay-in obligations. The in-leg is settled in CLSSettlement but the out-leg is settled outside CLSSettlement and may be subject to settlement risk; however, participants can mitigate this risk by settling the out-leg via CLSNow if the currency pair is supported.

10 Nostro credit gives rise to additional funding costs when a participant needs to bridge the time gap between sending payments to the PvP arrangement early and receiving nostro credit repayments later in the day.

11 Indirect participation is typically extended by direct participants with limited involvement of the PvP service operator. Direct participants may choose to extend the PvP service to clients (also referred to as third parties) that meet certain criteria, and direct participants typically charge for these services.

Eligible currency pairs in existing PvP arrangements Graph 2



AUD = Australian dollar; BRL = Brazilian real; CAD = Canadian dollar; CHF = Swiss franc; CNH = Chinese renminbi; DKK = Danish krone; EUR = euro; GBP = British pound sterling; HKD = Hong Kong dollar; HUF = Hungarian forint; IDR = Indonesian rupiah; ILS = Israeli new shekel; INR = Indian rupee; JPY = Japanese yen; KRW = Korean won; MXN = Mexican peso; MYR = Malaysian ringgit; NOK = Norwegian krone; NZD = New Zealand dollar; SGD = Singapore dollar; SEK = Swedish krona; THB = Thai baht; USD = United States dollar; ZAR = South African rand.

Source: CPMI survey.

3. Proposals for new solutions

This section examines the proposed new solutions identified by the CPMI, including (i) a summary of the call for ideas; (ii) the characteristics of the proposed solutions; (iii) how the proposed solutions may address cross-border payment frictions; and (iv) a summary of PvP for retail cross-border payments. Respondents to the call for ideas are categorised into two groups: potential providers of FX settlement solutions ("providers"), and FX market participants that use existing PvP arrangements and/or would use the new solutions ("users"). Appendix 1 contains information on each respondent (Table A3 and Table A4), and further details can be found in the consultative version of this report (CPMI (2022b)).

3.1 Summary of the call for ideas

In October 2021, the CPMI publicly invited FX market stakeholders, including commercial banks and fintech companies, to share their solutions or views on potential approaches to increase adoption of PvP.[12] Interested parties were asked to share their thoughts on existing PvP arrangements and submit proposals on potential new public and/or private sector solutions to foster broader adoption of PvP settlement. The call for ideas mainly addressed providers, who were asked to explain how their proposed solutions would achieve PvP, what FX instruments and currency pairs the solutions would be well suited or designed to settle, as well as how the solutions would incentivise and broaden user participation. They were also asked how they would address the challenges faced by the market related to settling cross-border wholesale deliverable FX payments and to identify what roles public authorities and other private sector entities could play. Inclusion in this report does not imply the BIS, the CPMI or its members endorse the solutions, nor that the solutions achieve PvP settlement or have been determined to observe the PFMI. Notably, the CPMI did not evaluate any of the proposed solutions against the PFMI.

Most of the proposed solutions were submitted by providers in the European Union, the United Kingdom and the United States, while one provider is based in the Asia-Pacific region and another in the Middle East region. The CPMI engaged in follow-up conversations with 11 providers of concrete solutions to learn more about their system design and views on potential barriers to broad adoption of their services. Of the five remaining responses, two provided industry views on ways to expand PvP to a wider range of transactions, two offered conceptual proposals, and one suggested how its service could assist in enabling PvP. The industry views also discussed PvP arrangements that support retail payments and remittances.

3.2 Characteristics of the proposed solutions

The providers suggest different PvP settlement models and ways of broadening adoption of PvP, including by extending the range of currencies that can be settled using PvP and by providing additional features to meet participant needs. These features include: (i) extended settlement windows to accommodate transactions across different time zones, particularly through services that operate 24 hours a day, seven days a week (24/7); (ii) increased access for smaller participants who may find the costs and operational requirements of existing PvP arrangements too high; (iii) functionalities to manage intraday liquidity such as instant settlement and/or multiple netting options; and (iv) integrating the cross-currency payment with the associated FX trade.

3.2.1 Maturity and time to market

Of the 11 concrete solutions, one is live, eight are in development or under consideration with different target times to market, and two are prototypes. For the solutions in development, the time to market depends on several factors, including time for solution design; technological development, testing and roll-out for production; further engagement with potential participants; and discussions with central banks and other public authorities regarding account structure, planned services and supervisory expectations.

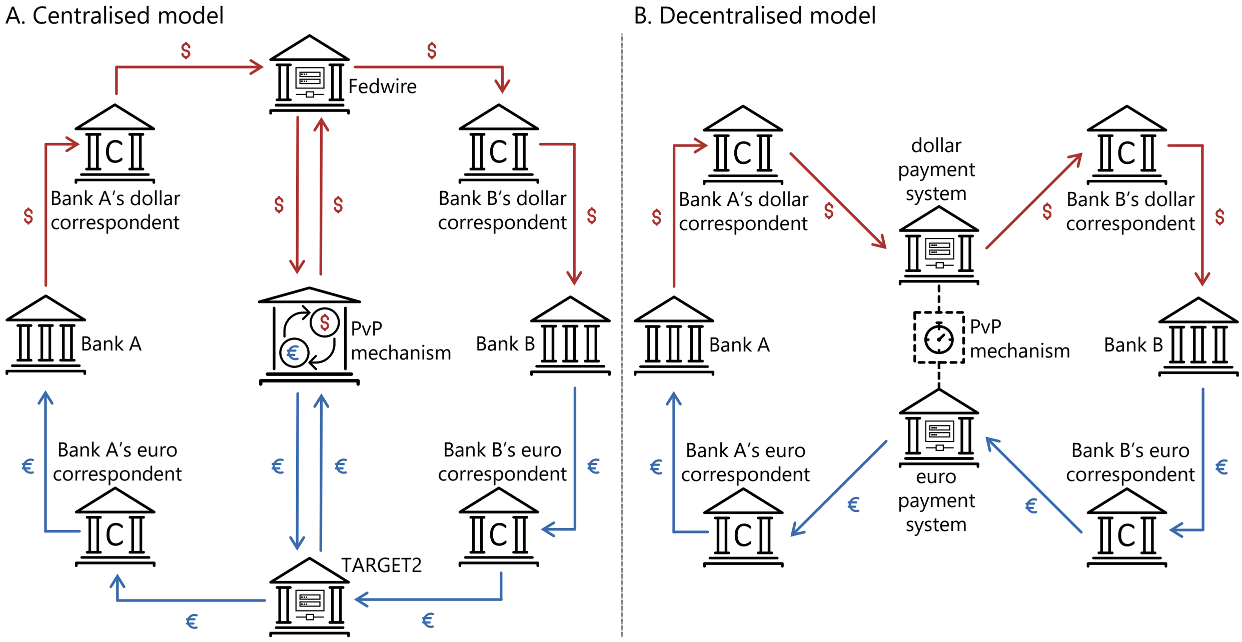
3.2.2 Proposed settlement models

The providers aim to achieve PvP settlement in different ways. Some providers use a centralised model in which settlement of both currency legs occurs on the ledger of a single settlement institution (Graph 3.A). Others employ a decentralised model in which settlement of each currency leg occurs on the ledgers of two separate settlement institutions and is synchronised either by a settlement agent or by the counterparties themselves (Graph 3.B).

[12] See www.bis.org/press/p211007.htm.

PvP settlement models[1]

Graph 3



[1] Both models illustrate a settlement session including funding for settling an FX trade where Bank A buys euros for dollars from Bank B. CLSSettlement is an example of the centralised model, and Baton Systems is an example of the decentralised model.

Source: CPMI.

PvP settlement is generally achieved through a clear legal basis governing settlement finality and through settlement rules and procedures that clearly define the point at which settlement is final. This ensures that final settlement of one currency leg occurs if and only if final settlement of the other currency leg (or legs) also takes place. In decentralised models, the settlement rules and procedures across multiple settlement institutions aim to ensure that final settlement of one currency leg is conditional on final settlement of the other currency leg. Further, to observe the PFMI, any PvP arrangement should take reasonable steps to confirm the effectiveness of cross-border recognition and protection of cross-system settlement finality, which generally necessitates a well-reasoned legal opinion (CPSS-IOSCO (2012)).

Most providers aim to offer settlement 24/7, with many relying on prefunding deposited in central bank or commercial bank accounts, depending on the currency and access eligibility requirements in the respective jurisdictions. Some solutions involve the use of an omnibus or technical account either at central banks or commercial banks, which would be commonly owned by participants or an approved third party, while the ownership shares of each currency would be recorded by the provider, possibly using a distributed ledger.

Some providers envisage conducting money settlements either by using central bank accounts or commercial bank accounts exclusively. Others suggest that either would be suited to the design of the solution and that a combination of both could be used to facilitate settlement in a range of currencies.

One proposed solution relies only on central bank money in that participating banks would segregate some amount of liquidity in their central bank accounts for use in the solution's third party payment system. FX transactions would be reflected on the third party's ledger as bilateral transfers between participating banks, but the third party itself would not be a financial intermediary. Two proposed solutions would use both central bank and commercial bank accounts. One would settle in commercial bank money in the form of transfers via demand deposit accounts at an authorised deposit taking bank or non-bank PSP that are fully matched by central bank balances. The other would use central bank money for regional currencies and commercial bank money for globally traded currencies (ie EUR and USD). One provider of a live solution has chosen to settle only in commercial bank money, arguing that leveraging existing correspondent banking relationships allows more participants to access the solution, and settle in a broader range of currencies, than would have been possible with settlement in central bank money.

Two BIS Innovation Hub projects have experimented with settlement directly in central bank money, one in tokenised wholesale central bank digital currency (wCBDC) and the other across multiple RTGS systems. The former would require central banks to issue and redeem wCBDC on a new platform, and the latter would require new functionality to be implemented in multiple RTGS systems to earmark liquidity and synchronise settlement.

3.2.3 Currencies and instruments

While most providers note that their solution designs are "currency-agnostic", meaning that they could be used to settle any currency pair, several providers nevertheless target specific EMDE currencies. Their solutions would initially focus on transactions with an AE currency on one leg and an EMDE currency on the other leg (AE/EMDE pairs), as FX turnover and settlement risk in AE/EMDE pairs are much higher than in EMDE/EMDE pairs. Several providers mention settlement in USD/CNH as their primary target, and other notable mentions include USD against Polish zloty (PLN) and Turkish lira (TRY).

Users remark that any new PvP arrangement should include AE as well as EMDE currencies. Even if providers see no theoretical limit to the currency pairs that their solutions can settle, there are practical considerations that may limit expansion to some currencies. These considerations could, for example, be tied to settlement finality protections in different jurisdictions' legal frameworks. Due to economies of scale, users suggest that it may be beneficial for new providers to target not only EMDE currencies but also settle in highly traded AE currencies, even if they can already be settled via existing PvP arrangements.

The providers suggest that most solutions are designed to support all deliverable FX instruments including spots, forwards and swaps, and some would additionally support real-time or same-day trades. While the responses mainly focus on FX settlement, a few providers note that their solutions could also be used for delivery versus payment (DvP) settlement of other asset types, which would entail interoperating with other types of FMIs, notably CCPs and securities settlement systems (SSSs).

3.2.4 Settlement timing and operating hours (availability)

Both providers and users suggest that some PvP-eligible transactions settle on a non-PvP basis due to a lack of available options that allow users to settle FX transactions on the same day and at any point during the day. All providers aim to offer settlement 24/7 or in a predetermined settlement window based on funding aspects. A few solutions would allow users to customise their settlement sessions based on their liquidity needs, and these sessions need not be aligned with the operating hours of RTGS systems. Another solution aims to ensure settlement sessions occur at optimal times in terms of when liquidity is best available for each currency.

Any proposed solution needs to consider the implications of offering settlement 24/7. As this will require the solution to operate during RTGS offline hours, participants will likely be unable to fund the solution via their RTGS accounts at all points in time during the settlement window.[13] This in turn may impair participants' ability to properly manage liquidity when the operating hours of the two RTGS systems for a currency pair do not overlap. Users also suggest that real-time reconciliation of the movement of central bank money needs to be supported by real-time reconciliation of nostro account statements, as market participants may not know with certainty that settlement finality has occurred until the statements from nostro providers showing daily activity are reconciled. Hence, in addition to requiring extended RTGS operating hours, solutions offering settlement 24/7 may require commercial banks that provide nostro services to extend their settlement windows and reconciliation accordingly.

[13] If central banks choose to extend and align their RTGS operating hours, they will mitigate the problem of funding and defunding during RTGS offline hours. Extending and aligning RTGS operating hours is the subject of building block 12 (CPMI (2022a)).

3.2.5 Access and participation

Access and participation requirements vary among the proposed solutions. Broadly, the solutions limit direct participation to commercial banks, though some providers suggest that participation could be extended to non-banks such as PSPs and corporates, and a few providers also aim to support cross-currency payments by retail users. Some solutions necessitate access to local RTGS systems or are otherwise tied to central bank approval by virtue of their design, consequently limiting the types of entities that could have direct access, although broader indirect access could be achieved by implementing a tiered participation structure.

Users emphasise the need to ensure broad access to as many FX market participants as possible, while recognising that participants' level of technical sophistication and cost sensitivity may vary. Such participant stratification may be a factor impacting PvP adoption, as more sophisticated participants drive liquidity needs and technology uptake, while creating complexity for smaller participants who have less access to costly infrastructure. Several providers aim to support smaller participants, for whom cost may be a barrier to entry, who may not be executing a high volume or value of trades, or who may need support in securing liquidity for instant payment transactions and may not otherwise have adequate arrangements in all markets to obtain liquidity. Another provider similarly suggests linking the settlement of a cross-currency payment directly to the associated FX trade to enable banks or non-bank PSPs to send and receive multi-currency payments without needing to manage the risks of handling multiple currencies.

Both providers and users mention that broad adoption and market support is essential to achieving network effects. Users specifically emphasise the need for any solution to have critical mass in terms of market participation to avoid partial adoption and unrealised benefits: a wide user network would result in greater liquidity management efficiencies and may realise operational economies of scale. Further, users note that, if multiple solutions are deployed at the same time, fragmentation risk should be addressed in a way that does not impede innovation and competition. Interoperability across systems may be one way of avoiding such fragmentation. Users also express concerns around multiple solutions serving currencies with limited liquidity and/or fragmenting liquidity in currencies with high volume.

3.2.6 Netting options

The providers aim to offer a range of netting features: two propose multilateral netting; four propose bilateral netting; and the remaining five rely on gross, instantaneous settlement to deliver operational flexibility in addition to reducing settlement risk. Some users suggest that, to meet the needs of clients and best manage liquidity, PvP arrangements should provide several netting options. However, one provider finds that, also based on market feedback, multilateral net funding with gross PvP settlement is optimal and even necessary from both an operational and liquidity management perspective.

3.3 Addressing frictions associated with cross-currency payments

This subsection describes how the design of new arrangements for FX settlement could address frictions in cross-border payments such as high funding costs, long transaction chains, limited operating hours and weak competition. The analysis is based on views expressed by respondents to the call for ideas, relating to design features that may still be in development or exploration.

3.3.1 Reducing costs of cross-border FX settlement

Funding costs

To settle using a PvP arrangement, users need to have reliable access to liquidity in foreign currency at the time of settlement. They often rely on correspondent banks to pre-position liquidity in multiple currencies to meet the funding deadlines set by the PvP arrangement. Along with the cost of pre-positioning funding, users incur additional costs tied to currency conversion before onward payments are made and to managing exchange rate risk until the end-to-end process is complete. The use of PvP to mitigate settlement risk can directly reduce funding costs, because one element of pricing a cross-currency payment is the cost of managing the associated settlement risk. In addition, the proposed solutions offer ways to increase liquidity efficiency that may further reduce the costs of funding. These include:

- *Real-time visibility of liquidity and FX pricing transparency to simplify liquidity management and reduce cost pressures.* The providers suggest to integrate real-time currency conversion into the settlement service to reduce costs by eliminating both the need to pre-position funding in multiple currencies and the need to manage the risks of handling multiple currencies. This would allow users to redistribute their balances across multiple currencies within the system and could thereby reduce the costs of operations. Currency conversion on the platform would be particularly advantageous to small and medium-sized banks that do not have adequate bilateral arrangements in place to obtain liquidity in all currencies, or are able to secure these only on costly terms. Providing increased visibility into exposures and liquidity positions may also improve liquidity management and therefore reduce funding pressures, especially in the context of efficiently securing liquidity for processing cross-border payments 24/7.
- *Instant settlement to provide immediate liquidity availability.* The providers suggest that settlement of FX transactions instantly and on a transaction-by-transaction basis would eliminate lag and allow currency conversion to be available immediately, which in turn could reduce liquidity pressures. Shorter and more flexible intraday settlement sessions, as well as support for settlement on demand, would thereby reduce funding costs. However, the providers also note that instant settlement could increase users' need to hold precautionary liquidity, that users may find it difficult to ensure sufficient liquidity is available across multiple currencies to allow same-day or instant settlement, and that the absence of netting would exacerbate these problems.
- *Extending participant control as well as reducing intermediation to introduce flexibility in managing funding needs.* The providers suggest that if users are able to maintain control of settlement balances within the arrangement, those balances can be used to make non-FX payments, which may simplify liquidity management and reduce funding costs. Providers that develop services enabling point-to-point bilateral transfers or FX settlement directly between participants suggest this could reduce reliance on commercial bank accounts and services from nostros and thus reduce funding costs by avoiding trapped liquidity. Others note that removing the requirement to prefund transactions could reduce liquidity inefficiencies, and they suggest to do so by earmarking funds held in central bank accounts instead of prefunding transactions in commercial bank nostro accounts.

Participation costs

Users' decisions on whether to use a PvP arrangement are likely to be affected by implementation costs and ongoing participation costs, particularly where users have varying levels of technical sophistication. The providers have highlighted a range of design solutions that may impact these costs, including:

- *Increased standardisation and automation to reduce the risk and costs of payment failures.* The providers suggest that enabling greater automation may allow for efficiencies and cost savings, and payment volumes netting, the use of real-time status notifications and real-time reconciliation may also reduce operational overheads and costly compensation claims (where payments fail to settle as intended). The providers as well as users suggest that leveraging common standards such as ISO 20022 messaging may improve end-to-end processing efficiency and thus reduce participation costs.
- *Interoperability with existing processes and systems.* The providers note that leveraging existing technologies and protocols may minimise implementation costs for participants. This may address the lack of appetite for large-scale or disruptive technology changes expressed particuarly by smaller participants, especially in EMDE jurisdictions, and participants for which FX does not comprise a significant part of their business. The providers also suggest using application programming interfaces (APIs) for access and integration and note their intentions

to streamline additional elements of the payment process. These elements include integrating know-your-customer (KYC) processes to reduce the cost of managing partner bank relationships and simplifying compliance with anti-money laundering and combating the financing of (AML/CFT) requirements through a centralised screening process.

3.3.2 Reducing delays in clearing and settling cross-border payments

Delays in clearing and settling cross-border payments increase liquidity and credit risk and can have a negative effect on business and investments, particularly where payments are time critical. One source of delays is the lack of overlapping operating hours across jurisdictions to effect settlement. Another is a lack of automation and straight through processing of payments.

- *Providing settlement 24/7*. The limited operating hours of key stakeholders, including RTGS systems and intermediaries involved in clearing cross-border payments, create delays in settlement, particularly in corridors with large time zone differences. The providers aim to mitigate this friction by offering mechanisms for settlement or for confirmation and matching on a 24/7 basis, even while the timing of funding and defunding may be dependent on the operating hours of RTGS systems.
- *Improving the rate of automation and straight through processing of payments*. Relying on manual intervention without real-time monitoring and automated reconciliation processes may extend settlement delays and introduce inefficiencies in liquidity management. The providers aim to improve the rate of straight through processing by automating reconciliation or providing real-time payment and settlement notifications, in addition to automating other steps in the process from trade capture to final settlement.

3.3.3 Eliminating long transaction chains

Users typically rely on chains of linked correspondent banks to transmit cross-border payments in multiple currencies, as direct connections are often costly or unavailable. Longer transaction chains increase costs associated with pre-positioning liquidity and managing risk, and they introduce settlement lags by increasing processing and reconciliation times, especially where manual intervention is required.

Reducing the layers of intermediation may help avoid settlement lags by shortening the length of the transaction chain. This could be achieved by enabling settlement directly between participants on a peer-to-peer basis. However, users will still need to fund and defund their positions via either the correspondent banking network or the relevant RTGS system, although only a few global banks will be able to do the latter in every or most currencies.

A cross-currency payment requires a bank along the payment chain to execute an FX trade, either before or after the cross-currency payment is made. Some providers plan to integrate currency conversion into their systems to enhance transparency regarding fees and exchange rates and to shorten the number of steps required in ensuring the transfer of each leg of a cross-currency payment. Depending on the design, this may enable the use of a single payment instruction to replace sequential processing by each party involved in the chain connecting the payer to the payee.

3.3.4 Increasing competition

Weak competition in the provision of cross-border payment services has typically been due to the barriers to entry posed by the other frictions mentioned already, particularly cost. A few providers seek to increase competition among PvP solutions, particularly around currency conversion for retail and wholesale use-cases. However, considering the number of proposed solutions, some users also encouraged providers to consider how they can complement each other and existing PvP arrangements as any PvP arrangement needs to reach a critical mass of adoption to meaningfully reduce FX settlement risk on a global scale.

3.4 Summary of PvP for retail cross-border payments

The cross-border retail payments market is complex, involving many different parties and underlying arrangements. Cross-border retail payments, including remittances, often rely on correspondent banks or other back-end arrangements for the provision of FX services. For less common currency pairs (largely those involving EMDE currencies), this may consist of a series of correspondent banking relationships for a single payment transaction, which increases costs, operational complexity and processing times. For example, transaction chains often lengthen, and FX settlement risk increases, as payments involving EMDE currencies typically require an AE currency as a bridge. Individuals and small and medium-sized enterprises (SMEs) are especially affected by slow payment execution and high costs. For low value payments, costs are particularly high relative to the sum being transferred.

Existing PvP arrangements and most of the proposed solutions target the wholesale market, focusing on deliverable FX trades (ie trades that settle using multiple payments). However, a few providers suggest that functionality designed for the wholesale market may also improve retail transactions (eg by allowing for currency conversion), so they consider both use cases. Several providers focus on retail use cases, particularly on how lowering costs could enhance cross-border and cross-currency retail payments, including remittances, and expand PvP in EMDE currencies.[14]

One provider proposes to enhance the end customer experience by offering multiple currency choices, and services for currency conversion and FX rate management, potentially reducing transaction costs for end customers, whether retail or wholesale, while supporting regional economic integration. Another provider suggests that tokenised, regulated liabilities could be made available to retail as well as corporate customers of financial institutions: the solution would create a network of regulated banks and non-banks through shared infrastructure, which encourages financial inclusion by lowering the cost of serving expanded customer segments. Yet another provider aims to give banks and non-banks the ability to compete and offer single-currency and cross-currency payment services with PvP protection to depositors and end users (retail and wholesale). Finally, a respondent suggested that interlinking existing PvP arrangements with newer and cheaper solutions could broaden reach to additional currencies. This could help address cost factors that inhibit the adoption of PvP arrangements for lower value payments in both the remittance and retail payments segments.

4. Options to facilitate increased adoption of PvP

Whether existing and new FX settlement solutions can facilitate adoption of PvP depends on whether the providers can overcome various operational, technical, regulatory, oversight and supervisory barriers. Close collaboration between public and private sector stakeholders in reducing barriers could help increase adoption of PvP and unlock the full potential of innovation in new settlement solutions while mitigating systemic risk. This section identifies key barriers and potential ways to address them.

4.1 Roles for the private sector

The FX settlement ecosystem comprises many private sector entities, including PvP providers, correspondent banks providing nostro services, liquidity providers and messaging services. It is also shaped by a range of market standards and conventions (eg nostro cut-off times), many of which have developed organically over time. Some of these standards and conventions may act as barriers to expanding the functionality and range of transactions covered by existing and new PvP arrangements. A collaborative, cross-industry approach is likely to be needed to identify and lower these barriers. This

[14] Some of these proposals are also explored under building blocks 13 and 17 on interlinking of payment systems and multilateral platforms, respectively.

subsection sets out a range of possible roles for the private sector – acting collectively – in overcoming barriers to expanding PvP settlement. The roles are not mutually exclusive, and it is likely that their benefits in terms of PvP adoption will be multiplicative rather than additive.

4.1.1 Aligning nostro operating hours and processes

Limited operating hours of nostro providers is an operational barrier that restricts the available time window for PvP settlement. To address this barrier and to allow for greater use of same-day PvP services, market participants could extend nostro settlement hours and refine associated end-of-day activities. These activities include: (i) checks to ensure that all payments requiring processing have been made (including subsequent resolutions); (ii) end-of-day batch processing (eg to roll trading positions to the next business day and unwind intraday liquidity); (iii) interest payments; and (iv) regulatory reporting. Such activities may need to be performed throughout the day in addition to late in the day to expand the range of transactions eligible for same-day PvP settlement.

An extension of nostro operating hours necessitates further review both to assess what changes market participants would need to make and how those changes would impact other business areas. For example, many market participants currently reconcile their nostro account balances at the end of a settlement date using statements of activity from their nostro providers that list the final and irrevocable payments into their accounts. Market participants would need to change or adapt this form of reconciliation such that it can be performed throughout the day.

4.1.2 Exploring potential changes to conventions for an international value date

Conventions for an international value date may also need to change to accommodate changes to nostro operating hours. Expanding the time window during which PvP settlement can be achieved in support of greater same-day PvP transactions may have little practical benefit unless supported by a market standard on value dates for trades in which the two legs settle simultaneously but on different local dates at either side of the International Date Line. Industry feedback indicates that central bank engagement could be important to secure a broad consensus on possible changes to market conventions given the impact on the wider financial ecosystem, including central banks' own monetary policy operations.

4.1.3 Promoting integration and interoperability between legacy and emerging systems

A lack of integration and interoperability between different payment systems for FX settlement can present a technical barrier to broader adoption of PvP. FX settlement is subject to network effects and economies of scale, especially when it includes netting mechanisms that offset obligations between parties to reduce liquidity usage: liquidity efficiency increases quickly with the number of transactions and participants in the netting set. Fragmentation across multiple PvP arrangements operating in the same market segment may erode some of the benefits of netting and PvP settlement, especially if the arrangements are not interoperable.

To operate effectively, PvP arrangements need to connect and exchange data with other parts of the payments ecosystem, including participants across multiple jurisdictions. Different technical standards present a challenge for providers, particularly as they seek to achieve straight through processing for FX transactions settling PvP. Industry participants highlight technology interoperability and data standardisation, including the migration to ISO 20022 messaging standards, as important enablers for existing and new PvP arrangements.[15]

[15] Adopting a harmonised ISO 20022 version for message formats (including rules for conversion / mapping) and harmonising API protocols for data exchange are considered under building blocks 14 and 15, respectively.

4.2 Roles for central banks and other public authorities

Central banks play a unique role in the FX settlement ecosystem as RTGS system operators, liquidity providers, prudential regulators, supervisors and overseers, as well as catalysts for innovation and convenors of industry. In all these capacities, central banks (and other public authorities) have an interest in reducing FX settlement risk as far as practicable, while maintaining a resilient ecosystem and ensuring that systemically important PvP infrastructures are soundly designed and operated in line with the standards set out in the PFMI. This is especially relevant for EMDE jurisdictions, where greater access to global infrastructures could increase currency trading and cross-border economic activity.

Several industry participants opined that broad adoption of any new PvP solution is possible only with sufficient support from, and collaboration between, central banks and other relevant authorities as well as local market nostro providers in the jurisdictions of the currencies that the PvP solution targets. However, including a currency in a specific PvP solution is not always consistent with the policy objectives of the central bank and other relevant authorities for that currency. In this case, pre-settlement netting, underpinned by robust legal arrangements, may be necessary to reduce settlement risk until existing or new PvP arrangements become available.

This subsection sets out the range of potential roles for the public sector, noting that some are considered as part of other building blocks (noted alongside each option where appropriate). They divide into three broad categories mirroring central banks' functions as regulators, supervisors and overseers; RTGS system operators; and conveners of or catalysts for industry discussion.

4.2.1 Addressing regulatory barriers and sharpening regulatory incentives

Regulation affects the users as well as providers of PvP settlement services. Users of wholesale PvP settlement services are typically subject to banking regulations anchored in BCBS standards, while providers are usually (but not always) treated as FMIs and are subject to the PFMI, if they are considered systemically important by relevant authorities.

On the user side, the *BCBS Guidance* and *FX Global Code* both encourage use of PvP arrangements and rigorous management of FX settlement risk. Some industry feedback suggests that stronger regulatory measures could help to encourage greater use of PvP services. For example, central banks (and/or prudential regulators) could examine possible ways to strengthen regulatory incentives for FX market participants to use PvP arrangements, including through global adoption of the *BCBS Guidance* across jurisdictions and more rigorous application of the guidance to market participants. Among other things, central banks could encourage better reporting and measurement of settlement risk exposures. For example, they could require the full duration of the exposure to be captured, especially in cases where the settlement session lasts multiple days due to time-zone differences, correspondent banking arrangements or other factors.

On the provider side, regulation, supervision and oversight aim to ensure that PvP arrangements are safe, secure and reliable, such that they support market confidence and do not act as conduits for systemic disruption. Central banks and other authorities have an interest in the ongoing supervision and oversight of large-scale PvP arrangements operating in their jurisdiction and/or settling transactions in their currency. PvP arrangements should fulfil all applicable regulatory requirements in every jurisdiction in which they operate, and systemically important PvP arrangements should observe the PFMI.

Robust settlement finality protection is a prerequisite for expanding the range of currencies available for settlement in PvP arrangements. For some EMDE currencies, the domestic legal regime may not adequately provide for these protections and may also define the points of irrevocability and finality in different ways, such that conflicts of law could emerge. This is a particular concern for PvP providers that, by design, operate in multiple jurisdictions or currencies. The PFMI provide standards regarding settlement finality.[16] Relevant authorities should aim to implement the standards in their legal and regulatory frameworks, and, to support such efforts, international financial bodies could consider how best to provide technical assistance where requested. This could remove a significant barrier to the ability of PvP operators to onboard additional currencies and may help prevent further regulatory fragmentation.

Similarly, some industry participants identified the need to secure regulatory approvals in multiple jurisdictions as a potential obstacle to launching new PvP services. Central banks could explore whether and how regulatory, supervisory and oversight assessments of new or expanded PvP services could be coordinated to reduce administrative costs and encourage innovation. Any such coordination would need to respect central banks' individual regulatory, supervisory and oversight mandates towards PvP providers operating in their jurisdiction or offering settlement in their currency.

4.2.2 Addressing central bank operational barriers

The terms on which PvP providers and their users can access and use central bank accounts have important implications for the broader utility of PvP arrangements. Industry feedback has identified several ways in which adjustments to central bank operations could ease the work of their systems as well as its utilisation by users, thereby encouraging greater adoption of PvP settlement.

Holistically assess the benefits, risks and barriers for expanding access to central bank accounts for PvP providers[17]

The CPMI identified, through a global survey of central banks (CPMI (2022c)), that only a minority of payment systems currently provide direct access to entities other than resident banks. Other stakeholders in the cross-border payments ecosystem, such as non-bank PSPs, FMIs and foreign banks, can face challenges in obtaining direct payment system access. Direct access to central bank payment systems can foster greater competition and innovation, which can help lower costs for smaller participants as well as reduce the length of cross-border payment chains. However, it can also introduce risks to payment system users and central banks. Some national legal and regulatory frameworks limit the types of entity eligible for direct access to payment systems or central bank accounts.

Existing PvP arrangements and some proposed new solutions rely on settlement in central bank money, or settlement supported by funds at a central bank. If users are required to participate directly in RTGS systems to also participate directly in a PvP arrangement, this can present a barrier to non-banks such as investment firms and non-bank PSPs. It follows that incumbent banks may possess the advantage of choosing which new infrastructures to participate in.

Central banks may consider holistically evaluating the barriers, benefits and risks of expanding access to central bank accounts and services to PvP providers, recognising that – in some jurisdictions – access to central bank accounts is determined by legislative and regulatory requirements. Examples of potential account structures across jurisdictions include accounts for the limited purpose of making payments without access to credit; allowing an FMI to act as a settlement agent with operational control of a joint account (also known as an omnibus account); or recognising the use of accounts to maintain central bank money of third parties. Some central banks have already adopted these models.[18]

16 See Principle 1 on legal basis, Principle 8 on settlement finality, Principle 9 on money settlements and Principle 12 on exchange-of-value settlement systems of the PFMI (CPSS-IOSCO (2012)).

17 Expanding access for FMIs, non-banks and foreign banks to key payment systems is the subject of building block 10. Providers of PvP arrangements are often FMIs or non-banks that require access to central bank accounts to hold pooled funds or discharge payments made between counterparties.

18 For example, in April 2021 the Bank of England introduced a new omnibus account model whereby an operator of an ancillary payment system (eg a PvP arrangement) can hold funds in the omnibus account to fund its participants' balances with central bank money.

Consider extending and aligning RTGS system operating hours in support of PvP arrangements[19]

Central banks extending RTGS system operating hours can support certain PvP arrangements that rely on the use of central bank money in settlement. The CPMI has set out three possible "end states" for central banks to consider and introduced the concept of the "global settlement window", which is the period when the largest number of RTGS systems simultaneously operate (CPMI (2022a)).

Extending RTGS operating hours in a coordinated manner, especially across currency pairs where the overlap of operating hours is limited could extend the global settlement window. Expanding the overlap of operating hours provides a foundational component in support of PvP arrangements that rely on central bank accounts. This could widen the set of FX transactions that could be settled using PvP. Central banks could use their convening power to coordinate industry and analyse, as well as possibly implement, the most efficient extensions at the regional or global level.

Operating hours could also be extended on a bilateral basis to prioritise certain high-value or high-volume currency corridors, or where there is an additional driver such as high trading volumes or labour mobility. However, it should be noted that extending operating hours in isolation is unlikely to yield appreciable benefits without cooperation from market participants, specifically nostro providers, and their readiness to upgrade their systems and processes to take advantage of the extended settlement window.

Explore functionalities in RTGS systems and interoperability where practical

Many central banks around the world are renewing their RTGS systems to replace legacy infrastructure with more modern technology, including developing plans to put in place functionality that allows liquidity to be ring-fenced and settlement to be synchronised across ledgers. This could enable two RTGS systems, possibly with the help of a third party, to link payments in their respective currencies such that a payment in one currency occurs if and only if a payment in the other currency occurs, that is, PvP settlement.

Today, the use of central bank money is complex because each RTGS system has its own rules relating to, among other things, account access and settlement. Some central banks are exploring ways to interoperate multiple RTGS systems to significantly expand opportunities for external providers to settle FX transactions on a PvP basis, for example by allowing easier connection to synchronised settlement in central bank money for a broader range of assets and systems. This in turn could lower funding costs and reduce settlement risk in more markets.

Close cooperation by central bank operators to facilitate standard operational ways of working could help to facilitate innovation and interoperability. This could include standardising APIs, messaging and other technical on-boarding requirements to prevent further fragmentation in the ecosystem, which could enable PvP entrants to avoid bespoke technical builds and connection processes in each jurisdiction. That in turn would make it easier and cheaper for PvP entrants to scale up and enter new markets.

Ease liquidity constraints on PvP settlement where practical

Overcoming liquidity constraints is challenging for users and settling FX transactions using PvP in real time can be liquidity intensive. Existing PvP arrangements and some proposed new solutions mitigate liquidity risks by multilateral netting such that participants do not need to fund the full gross value of their transactions. However, industry feedback suggests that some business-to-business payments (eg those connected to corporate activity) require settlement at specific times that may preclude the use of multilateral netting.

The emergence of new PvP arrangements, whether they offer settlement on a gross, bilateral net or multilateral net basis, could increase industry appetite for facilities that allow surplus central bank liquidity to be rotated between currencies more easily. Users could thus better manage intraday liquidity, particularly unexpected liquidity shortfalls, and reduce funding costs.

[19] Extending and aligning operating hours of payment systems to allow overlapping is further examined under building block 12.

Central banks could explore how to ease liquidity pressures in a number of ways, for example by building a network of central bank guarantees based on collateral at the home central bank to provide foreign central banks with guarantees.[20] This was the rationale for developing the Scandinavian Cash Pool, an example of a so-called liquidity bridge between central banks, when CLSSettlement onboarded the three Scandinavian currencies in 2003.[21] In a liquidity bridge, RTGS participants pledge collateral to a given central bank ("facilitating central bank") in exchange for short-term (typically intraday) liquidity from another central bank ("lending central bank") in the latter's currency. This liquidity, provided by the lending central bank, can be used to meet the participants' own routine payment obligations, or those of the participants' subsidiaries or affiliates, in the lending central bank's currency.

The implementation of a liquidity bridge or similar cross-border collateral arrangements may reduce FX and credit risks for participants that raise intraday liquidity through FX transactions with commercial counterparties. It may also provide broader financial stability benefits, including by reducing intraday settlement risk across borders and providing a source of central bank liquidity in times of market stress. Liquidity bridges must, however, be designed in a way that minimises financial risk to the central banks involved, and they must not disrupt other central banking functions such as monetary policy implementation and the regulation of liquidity risks among RTGS participants.

4.2.3 Catalysing private sector engagement and innovation

In addition to their operational and regulatory roles, central banks can use their convening power to facilitate coordinated industry solutions to structural problems in a particular market. For example, several central banks have established standing committees to serve as forums for central banks and market participants to discuss risks and vulnerabilities in FX markets. At the global level, the Global Foreign Exchange Committee (GFXC) serves to collate and identify responses to challenges common to multiple jurisdictions, for example through development of the *FX Global Code*.[22]

These and similar groups could help to develop and build support for the changes to market conventions described in Section 4.1.1. Industry participants have emphasised that clear direction from central banks, for example through the GFXC, would be necessary to catalyse industry discussion on revised value date conventions and similar practices, especially where these are currently well established and difficult to change.

Further, these groups, working together with central banks, could coordinate efforts to improve the data collected on FX settlement risk. Improved data could help policymakers and market participants to better understand and track settlement risk and mitigation in different segments of the FX market.[23]

Finally, central banks could engage with authorities and industry bodies in the jurisdictions that are not currently supported by existing PvP arrangements to identify the key barriers to mitigate. Current understanding of the causes of non-PvP settlement could improve by learning more about the specific issues arising in these markets to create a tailored approach to providing targeted technical assistance to expand PvP into these currencies where possible.

[20] Reciprocal liquidity arrangements across central banks (liquidity bridges) are explored in detail under building block 11, see CPMI (2022d).

[21] The Scandinavian Cash Pool enables the pledging of cash as cross-border collateral between Denmark, Norway and Sweden. The system was developed in order to facilitate CLSSettlement participants' access to intraday liquidity in the Scandinavian currencies, although the use of the SCP is not limited to liquidity provision for CLSSettlement (Danmarks Nationalbank (2003)).

[22] The GFXC continually works on strengthening adherence to the *FX Global Code*, see www.globalfxc.org/press/p220628.htm.

[23] Several of the local FX committees are collecting or are beginning to collect data on FX settlement risk.

5. Conclusion

Existing PvP arrangements play a significant role in reducing FX settlement risk and optimising liquidity usage, particularly for AE currencies. New solutions, if properly designed and regulated, may complement existing PvP arrangements to support a wider range of EMDE currencies, reach smaller market participants and provide enhanced functionality such as same-day (or even real-time) PvP settlement.

Enhancements to existing PvP arrangements and the development of new solutions can benefit from private and public stakeholders working together to address common barriers to facilitate increased adoption of PvP. The private sector could explore potential changes to conventions for value dating, align nostro operating hours, and promote integration and interoperability between legacy and emerging systems. Central banks could assess operational barriers to the use of central bank accounts and credit facilities by new PvP providers, including limited access to, liquidity constraints in and operating hours of RTGS systems. The CPMI is addressing these three issues under building blocks 10, 11 and 12, respectively, of the G20 cross-border payments programme. In addition, central banks could explore functionalities in, and interoperability between, RTGS systems to enable PvP settlement. Finally, central banks and other public authorities could consider sharpening regulatory incentives for market participants to use available PvP services and catalyse continued private sector engagement on reducing FX settlement risk.

As next steps, the CPMI will further engage with industry stakeholders to explore possible practical actions to expand PvP settlement. The CPMI, in cooperation with other public stakeholders and relevant international committees, will continue to monitor the evolution of FX settlement risk and PvP adoption with the aim of reducing settlement risk and enhancing global cross-border payments.

References

Basel Committee on Banking Supervision (BCBS) (2013): *Supervisory guidance for managing risks associated with the settlement of foreign exchange transactions,* February.

BCBS and Committee on Payments and Market Infrastructures (CPMI) (2020): *Supervisory Guidance on managing FX settlement risk and the Global FX Code*, December.

Committee on Payments and Market Infrastructures (CPMI) (2020a): *Enhancing cross-border payments: building blocks of a global roadmap*, July.

——— (2020b): *Enhancing cross-border payments: building blocks of a global roadmap - Technical background note,* July.

——— (2022a): *Extending and aligning payment system operating hours for cross-border payments,* May.

——— (2022b): *Facilitating increased adoption of payment versus payment (PvP) – consultative report,* July.

——— (2022c): *Improving access to payment systems for cross-border payments: best practices for self-assessments,* May.

——— (2022d): *Liquidity bridges across central banks for cross-border payments*, September.

Committee on Payments and Settlement Systems (CPSS) (1996): *Settlement risk in foreign exchange transactions*, March.

——— (2008): *Progress in reducing foreign exchange settlement risk,* May.

CPSS and International Organization of Securities Commissions (IOSCO) (2012): *Principles for financial market infrastructures*, April.

Danmarks Nationalbank (2003): "SCP – Scandinavian Cash Pool", *Monetary Review 4th Quarter,* December.

Financial Stability Board (FSB) (2020): *Enhancing cross-border payments: Stage 3 roadmap,* October.

Global Foreign Exchange Committee (GFXC) (2021): *FX Global Code,* July.

Kos, D and R Levich (2016): "Settlement risk in the global FX market: how much remains?", *CLS Insights*, 26 October.

Appendix 1: Supplementary graphs and tables

Eligible FX instruments in existing PvP arrangements

Table A1

	B3	HK CHATS	CCIL	CLSNow	CLSSettlement
Spot transactions	✓	✓	✓		✓
Outright forwards		✓	✓		✓
Foreign exchange swaps		✓	✓	✓	✓
Currency swaps		✓			✓
Options		✓			✓
Other		✓[1]		✓[2]	✓[3]

[1] The scope of FX instruments supported is subject to the direct participating banks' arrangements on how to use HK CHATS PvP settlement platform at the back end for the simultaneous settlement of two currency legs for relevant financial instruments, and is not stipulated in the Rules and Operating Procedures. [2] Same-day trades. [3] CLSSettlement settles bilaterally netted payment instructions related to OTC credit derivatives submitted on behalf of clients by the DTCC Deriv/SERV service.

Source: CPMI survey.

Direct participation in existing PvP arrangements

Table A2

	B3	HK CHATS	CCIL	CLSNow	CLSSettlement
Number of members	83	163	78	3	76
Proportion of members that are banks (per cent)	93	97	99	100	95
Types of requirement					
Locational requirement	✓ domestic only	✓ jurisdictions which participate in the PvP arrangement only	✓ domestic only	✓ jurisdictions for which CLS has received a satisfactory finality opinion	✓ jurisdictions for which CLS has received a satisfactory finality and netting opinion
Financial requirement	✓ minimum capital	✓ existing regulatory capital	× must be an authorised FX dealer	✓ existing regulatory capital and minimum rating	✓ existing regulatory capital and minimum rating
Operational requirement	✓ including meeting technical requirements, conditions and funding obligations	✓ including SWIFT connectivity, testing requirements and system setup	✓ including having a current account with the Reserve Bank of India and meeting minimum technical requirements	✓ including meeting technical requirements, testing requirements, and funding obligations	✓ including meeting technical requirements, testing requirements, and funding obligations
Fixed costs	Communications link, technology, data centre	None	One-time membership fee (INR 100,000)	Annual service fee	Account opening fee and annual account maintenance fee
Variable costs	Volume based	Volume based	Value based	Value based	Volume and value based

Source: CPMI survey.

Overview of responses to the call for ideas

Table A3

Abbreviation	Full name[1]	Geographical scope	Substance	Maturity
9th Gear	9th Gear	Global	Concrete Solution	In development
AusPayNet	Australian Payments Network	N/a[2]	Industry view	N/a
Baton	Baton Systems Core FX	Global	Concrete solution	Live
Buna	Buna Payment System	Regional	Concrete solution	Live[3]
Citi	Regulated Liability Network	Global	Conceptual proposal	N/a
CLSAlt	CLS Alternative PvP Service	Global	Concrete solution	In development
Fnality	Fnality International Limited	Global	Concrete solution	In development
FX Shield	FX Shield	Global	Concrete solution	In development
GFMA	Global Financial Markets Association	N/a	Industry view	N/a
IZZI	Project IZZI	Global	Concrete solution	In development
Jura	Project Jura[4]	Regional	Concrete solution	Prototype
Meridian	Project Meridian[5]	N/a	Concrete solution	Prototype
RTGS.global	RTGS Global Limited	Global	Concrete solution	In development
SC	Settlement Circle	Global	Concrete solution	In development
SWIFT	SWIFT	Global	Enabling service	N/a
Vanini	Luca Vanini	Global	Conceptual proposal	N/a

[1] The full name links to further details about each respondent if such information is publicly available. [2] Not applicable to all conceptual proposals, industry views and enabling services. [3] The Buna platform is live but its FX service and PvP mechanism were still in development as of March 2023. [4] Jura's contributors include Banque de France, the Swiss National Bank, the BIS Innovation Hub Swiss Centre and a private sector consortium. [5] Meridian's contributors include the Bank of England and the BIS Innovation Hub London Centre.

Source: CPMI survey.

Characteristics of foreign exchange settlement arrangements

Table A4

	9th Gear	Baton	Buna	CLSAlt	Fnality	FX Shield	IZZI	Jura	RTGS. global	SC
Settlement model										
Centralised			✓	✓		✓			✓	✓
Decentralised	✓[1]	✓			✓		✓[2]	✓		
Proposed account structure										
Central bank accounts					✓			✓	✓	
Commercial bank accounts	✓	✓								✓
Central bank or commercial bank accounts or a combination of both			✓	✓		✓	✓			
Eligible FX instruments										
Spots	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Forwards	✓	✓		✓	✓	✓	✓	✓[3]	✓	✓
Swaps	✓	✓		✓	✓	✓	✓	✓[3]	✓	✓
Same-day / real-time trades	✓	✓		✓[4]	✓	✓	✓[5]	✓	✓	✓
Settlement timing and availability										
24/7	✓	✓	✓		✓	✓[6]	✓	✓[3]	✓	✓[7]
Settlement session per currency pair				✓[8]						
Control over transaction timing	✓	✓			✓	✓	✓	✓	✓	
Netting options										
Multilateral	✓			✓[9]						
Bilateral	✓	✓[10]				✓[11]				✓[12]
Pre-netted FX payments									✓	
None (gross settlement)			✓		✓		✓	✓	✓	
Proposed users										
Commercial banks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Non-banks, eg PSPs and corporates	✓	✓	✓			✓	✓			✓
Retail users			✓				✓			
Types of requirements										
Central bank account for direct participation								✓[13]	✓[14]	
Involvement of nostros	✓[15]	✓[16]		✓[17]		✓[18]	✓[19]	✓[20]		✓[21]

[1] Centralised as a third party platform used by mutual agreement of the counterparties to the trade but decentralised such that the users effect settlement of FX trades themselves. [2] For cross-currency payments. [3] Not part of the Jura experiment but feasible on the DLT platform. [4] To the extent that these are material in terms of notional value and directionality and where settlement windows are not early in the business day. [5] Designed to settle real-time cross-currency payments and real-time FX trades. The infrastructure can be used by PSPs to settle other instruments. [6] For confirmation/matching with payments restricted to RTGS operating hours. [7] For confirmation/ matching. [8] Windows aligned to local market liquidity conditions for currency pairs. Matching and status updates happen in real time; settlement occurs when funding is in place. [9] By currency pair. CLS has suggested bilateral netting may also be an option. [10] Participant defined and based on risk exposure or timing. [11] Netting timing is participant defined. [12] Participant defined. [13] Resident and non-resident regulated financial institutions approved by the central banks to hold and settle local wCBDC. [14] Central bank account access in home jurisdiction. [15] Funds transfer through correspondents. [16] Nostros provide funding and settlement accounts. [17] Local market commercial banks as nostros in each currency. [18] Omnibus accounts with correspondents but could also be supported by central bank accounts. [19] Any resident or non-resident bank or PSP can be a direct participant. If a direct participant does not have, or chooses not to use, its own central bank account, it can fund its payments via a nostro. [20] Non-resident regulated financial institutions without access to the local RTGS system use correspondents to transfer balances to a central bank technical account. [21] Accounts in prime correspondents in each currency.

Source: CPMI Survey.

Appendix 2: Cross-border Payments Foreign Exchange Workstream

Chair

Federal Reserve Bank of New York	Hampton Finer

Members

Reserve Bank of Australia	Matthew Boge
The People's Bank of China	Changchun Mu Lyu Yuan Xiaochen Zhang
European Central Bank	Robert Hofmeister*
Hong Kong Monetary Authority	Kwok-Hung Lee (until August 2021) Stephen Pang (since August 2021)
Reserve Bank of India	Sudhanshu Prasad
Bank Indonesia	Ahmad Arifin (until April 2022) Ratih Indrastuti (until April 2022) Rozidyanti (since April 2022) Sigit Setiawan (since April 2022)
Bank of Italy	Paolemilio Feleppa*
Bank of Korea	Gibaek Kwon Jaesung Park
Saudi Central Bank	Feras Bakhsh
South African Reserve Bank	Shaun Rayfield Jeannie Weilbach
Bank of England	Paul Bedford* (since November 2021) Michaela Costello* John Jackson (until November 2021)
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Federal Reserve Bank of New York	Zareera Bukhari* Emily Dougherty*

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Appendix 3: Acronyms and abbreviations

24/7	24 hours a day, seven days a week
AE	advanced economy
AML/CFT	anti-money laundering and combating the financing of terrorism
API	application programming interface
B3	B3 Foreign Exchange Clearinghouse
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CAD	Canadian dollar
CCIL	Clearing Corporation of India Ltd
CCP	central counterparty
CHATS	Hong Kong CHATS PvP Arrangement
CHF	Swiss franc
CLS	CLS Bank International
CNH	Chinese renminbi
CPMI	Committee on Payments and Market Infrastructures
DvP	delivery versus payment
EMDE	emerging market and developing economy
EUR	euro
FMI	financial market infrastructure
FSB	Financial Stability Board
FX	foreign exchange
G20	Group of Twenty
GBP	British pound sterling
GFXC	Global Foreign Exchange Committee
KYC	know your customer
OTC	over-the-counter
PFMI	Principles for financial market infrastructures
PLN	Polish zloty
PSP	payment service provider
PvP	payment versus payment
RTGS	real-time gross settlement
SME	small and medium-sized enterprise
SSS	securities settlement system
TRY	Turkish lira
USD	United States dollar
wCBDC	wholesale central bank digital currency