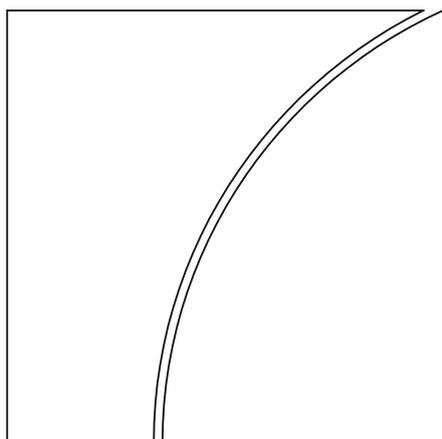


Committee on Payments and Market Infrastructures



Interlinking payment systems and the role of application programming interfaces: a framework for cross-border payments

Report to the G20

July 2022



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Executive summary

In October 2020, the G20 endorsed a roadmap to enhance cross-border payments, developed by the Financial Stability Board (FSB) in coordination with the Bank for International Settlements' Committee on Payments and Market Infrastructures (CPMI) and other relevant international organisations and standard-setting bodies. The G20 cross-border payments programme aims to address long-standing challenges in the cross-border payments market, including high costs, low speed, limited access and insufficient transparency. This programme comprises the necessary elements of a globally coordinated response in the form of a set of 19 building blocks (BBs), based on a CPMI report to the G20 (CPMI (2020a,b)).

Interlinking arrangements for payment systems are an important element of enhancing cross-border payments, as they can shorten transaction chains, reduce overall costs and increase the transparency and speed of payments. An interlinking arrangement allows banks and other payment service providers (PSPs) to transact with each other without requiring them to participate in the same payment system or use intermediaries (ie correspondent banks).

The topic is relevant for three reasons. First, enhancing cross-border payments is a complex challenge that will benefit from a multi-faceted approach. The options range from improving existing correspondent banking arrangements to a consideration of potential alternative models, including interlinking arrangements. Second, payment systems are increasingly seeking to interlink with each other. Twenty-six, or nearly 10%, of surveyed payment systems, reported their participation in an interlinking arrangement. In the light of increasing payment system linkages, this trend could continue, especially among the now around 60 fast (instant) payment systems (FPS) in the world. Third, while overcoming differences in technical standards and technologies across systems can be among the biggest challenges facing interlinking initiatives, recent trends in these realms have produced more favourable conditions for such projects. In particular, the growing use of application programming interfaces (APIs) and the adoption of the ISO 20022 financial messaging standard have opened up new possibilities for facilitating payment system interlinking.

This report, produced by the CPMI Cross-border Payments Interoperability and Messaging Workstreams and issued as part of BB 13 (pursuing interlinking of payment systems for cross-border payments) and BB 15 (harmonising APIs protocols for data exchange), aims to help payment system operators and authorities understand and evaluate the benefits, challenges and risks of interlinking arrangements. In doing so, it also provides an overview of important trends in interlinking arrangements and API adoption by payment systems, drawing on recent CPMI surveys.

There are numerous benefits to interlinking arrangements. Interlinking of payment systems can potentially enhance cross-border payments by shortening transaction chains, supporting the harmonisation of data formats and facilitating data exchanges through the use of dedicated applications, as well as by reducing funding costs, limiting redundant compliance checks, and increasing competition in the provision of cross-border payment services. Furthermore, depending on the design of the interlinked systems as well as the interlinking arrangement, cross-border settlement risk could be reduced.

Despite these potential benefits, interlinking may face challenges and risks that need careful consideration and planning by operators and authorities considering such arrangements. Challenges relate to the level of political support, possible high start-up costs, divergent legal, regulatory and oversight frameworks, misaligned access criteria, differences in service level requirements, and operational risk management. A range of risks could also be exacerbated by interlinking arrangements if not appropriately mitigated. These challenges and risks need to be carefully considered before establishing an interlinking arrangement and on an ongoing basis once the arrangement is in operation. Moreover, while APIs and the adoption of ISO 20022 hold great promise, the fragmentation of API protocols and the global

variations in the implementation of the ISO 20022 standard are still major challenges that impede a faster and more cost-effective interlinking of payment systems.

The report also provides payment system operators and authorities that are considering interlinking initiatives with some practical perspectives and considerations that they could reflect in their analysis of potential interlinking arrangements. These considerations focus on the different factors of an interlinking arrangement and include aspects concerning:

- 1) **Support by relevant public and private sector stakeholders** for the interlinking arrangement as an effective solution for enhancing cross-border payments.
- 2) **Conducive legal, regulatory and oversight frameworks** to limit legal risks and provide a strong, clear and transparent basis that is enforceable in the relevant jurisdictions, including adequate protection for system operators, participating PSPs and end users.
- 3) **Market viability** based on a comprehensive analysis of business needs that underscore the case for establishing the interlinking arrangement.
- 4) **Clear, objective and publicly disclosed access criteria and governance rules** that are consistent with the risk tolerance and the governance approach of the payment systems involved.
- 5) **Service levels and scheme rules** that define the scope, availability and quality of services to facilitate the transfer of value processed via the interlinking arrangement and the responsibilities of the parties involved in the interlinked payment systems.
- 6) **Operational setup to ensure the smooth functioning of the interlinking arrangement**, including alignment of clearing and settlement rules and processes, overlap of operating hours, the provision of ancillary services, and any relevant additional infrastructure components.
- 7) **Effective arrangements for foreign exchange conversion and settlement**, with the involvement of relevant authorities and other wholesale payment players.
- 8) **Close monitoring and effective management of the financial risk** potentially arising from the interlinking arrangement.
- 9) **Adequate operational risk management measures and controls** to ensure the continuity of operations according to the high resilience and availability standards agreed by participating operators.
- 10) **Leveraging of international technical standards** for common messaging formats and for APIs, to support straight through processing (STP) by increasing the automation of information-sharing and anti-money laundering/combating the financing of terrorism (AML/CFT) processes, as appropriate.

1. Introduction

1.1 Backdrop and why now

Cross-border wholesale payments today are typically processed through a chain of correspondent banks, while cross-border retail payments often rely on closed-loop systems.¹ This can result in long transaction chains, fragmented and truncated payments data, high capital costs and weak competition, all of which may negatively affect payment speed, cost, access and transparency. Several building blocks of the G20 cross-border payments programme seek to make the correspondent banking model more efficient, transparent and competitive, so that they offer an additional option to closed-loop systems (CPMI (2020b)).

Depending on the corridor, one alternative to using correspondent banks or closed-loop systems for cross-border payments might be to establish links between payment systems, aided by the adoption of new technologies and messaging standards to facilitate the technical interoperability of platforms.² This would make transaction chains simpler and shorter for cross-border wholesale payments and avoid “walled garden” ecosystems for cross-border retail payments (BIS (2020) and Shin (2020)). As a result, costs and fees associated with long transaction chains, the need to hold pools of liquidity in many jurisdictions and limited competition could be reduced (FSB 2020(b)). Both interlinking of payment systems and harmonising application programming interface (API) protocols for data exchange are important mutually reinforcing elements of the G20 cross-border payments programme.³

This topic is now attracting increased attention due to recent trends in the payment system landscape, especially the introduction of fast payment systems (FPS)⁴ around the world. The emergence of new technologies and an increasing degree of standardisation have also enabled greater technical interoperability, laying the groundwork for current and future interlinking arrangements. These trends herald the potential for such interlinking arrangements, especially among FPS, with the aim of considerably improving the speed, cost efficiency and transparency of cross-border payments.

¹ A closed-loop system is a single-platform connecting both payee and payer. In this case, the payment transaction is started and completed by the same PSP to bridge the two jurisdictions, eliminating the need for a connection between institutions or infrastructures in the two jurisdictions (CPMI (2018), FSB (2020b)).

² Besides correspondent banking, closed-loop systems and the interlinking of payment systems, other cross-border payment back-end arrangements include common or multilateral payment platforms connecting PSPs from different jurisdictions via centralised payment systems (which is the focus of building block (BB) 17) or peer-to-peer transfers, which cuts out an intermediary between the payer and the payee (CPMI (2018), FSB (2020b), CPMI (2020b)).

³ In 2019, the G20 finance ministers and central bank governors tasked the Financial Stability Board (FSB), together with the Bank for International Settlements' Committee on Payments and Market Infrastructures (CPMI) and other international standard-setting bodies, to develop a roadmap to address challenges with cross-border payments: high costs, low speed, limited access and limited transparency. Through a three-stage process, 19 BBs were identified to tackle these challenges and ultimately enhance cross-border payments. The CPMI has formed the Cross-Border Payments Interoperability Workstream and the Cross-Border Payments Messaging Workstream to work on BB 13 and 15, respectively. This report, produced by these two workstreams, represents the output of action 2 in BB 13 and it integrates the findings of action 2 and 3 of BB 15, by exploring the potential harmonised APIs can have for interlinking.

⁴ Retail fast payment systems (FPS) allow the processing of small-value (retail) account-based transactions so that funds are immediately available to the payee. Further, these FPS are available on a (near) 24/7 basis. FPS can have a significant impact on the domestic payment landscape, but can also be relevant for cross-border payments. FPS can be part of broader solutions in that they provide (near) 24/7 funds transfers in the “last mile” (or the “first mile”) of these payments (CPMI (2021)).

The growing adoption of APIs⁵ in payments may be a particular facilitator of interlinkages. By enabling automated data calls and real-time responses outside proprietary messaging networks, APIs can help to strongly improve the speed, cost and transparency of cross-border payments. The modularity of API designs may also reduce the development time, and thus cost, of establishing new interlinking arrangements. The continued migration of many payment systems to the ISO 20022 messaging standard⁶ in the coming years will generate further momentum towards API adoption, given the potential use of a common ISO 20022 data dictionary for APIs. Notwithstanding these trends and benefits, the interlinking of payment systems and adoption of APIs may face challenges and risks. Experience has shown that strong political support is often necessary for establishing interlinking arrangements, to provide investment reassurance given the potentially high start-up costs and to align possibly divergent legal, regulatory and oversight frameworks. This will be important to avoid spillover risks (eg of a financial and operational nature) between the payment systems of different jurisdictions. Moreover, foreign exchange (FX) settlement decisions and governance arrangements can involve thorny trade-offs. Finally, while APIs offer great potential, their adoption by payment systems is still at an early stage, and global harmonisation efforts will need strong backing to prevent fragmentation of API standards, which could undercut their effectiveness and slow their adoption.

This report, which sets out a framework for interlinking payment systems for cross-border payments and discusses the role of application programming interfaces, has three main objectives:

1. to provide an overview of important trends in interlinking arrangements and API adoption by payment systems, drawing on recent CPMI surveys;
2. to outline the benefits, challenges and risks of interlinking arrangements that would be important for payment system operators and authorities to consider before taking a decision on whether interlinking would be suitable for their jurisdiction; and
3. to offer payment system operators and authorities that are considering interlinking initiatives some practical perspectives and considerations as part of a framework, with accompanying questions to aid them in this process.

1.2 Organisation of report

The next section explains what is meant by payment system interlinking arrangements, how they provide a different means of cross-border payments than through the correspondent banking and closed-loop models, and the different types of interlinking arrangement. The report next takes a closer look at the current landscape of interlinking arrangements in Section 3 before discussing current trends in API use by payment systems in Section 4, including their perceived drivers, benefits and challenges. Section 5 discusses the drivers and benefits of the interlinking of payment systems. Section 6 focuses on the challenges and risks faced in interlinking arrangements. Section 7 lays out factors for consideration as part of a framework for payment systems considering establishing interlinking arrangements. Section 8 concludes.

⁵ APIs provide the technical means for a software application to request a specific piece of data from one or more other software applications, and for data transfer from the data-providing application(s) back to the requester, provided the original request was valid. In essence, they support the interoperability of different software applications or technology systems, allowing the cross-leveraging of functionality without the need for development of entirely new systems (see Box 5).

⁶ ISO 20022 is the International Organization for Standardization (ISO) standard for electronic data exchange between financial institutions. The standard applies to financial information transferred between financial institutions, including payment transaction information. A key benefit of the ISO 20022 standard is its enhanced payload capacity, which provides for richer, more detailed and more structured data than do more proprietary message formats and the SWIFT MT standard. These features support compliance screening and more automated, straight through processing (STP) of transactions (see Box 6).

2. What are interlinking arrangements?

2.1 Definition and differences with correspondent banking model

Interlinking arrangements for cross-border payments can be defined as a **set of contractual agreements, technical links and standards, and operational components between payment systems of different jurisdictions, allowing their respective participating PSPs to transact with one another as if they were in the same system.** Rather than requiring participation in the same system, PSPs' participation in their respective domestic system is leveraged.⁷ In other words, an interlinking arrangement allows PSPs participating in the payment system of country A to send payments to PSPs participating in the payment system of country B without the need for country A's PSPs to open accounts in country B or become a participant of country B's payment system. Interlinking arrangements can be a series of bilateral links each with their own rules or links under a common framework, sometimes even connecting to a common technical hub.

PSPs historically and to this day generally make cross-border payments to PSPs in different payment systems by using the services of local agents, or correspondent banks, in those payment systems. In a correspondent banking arrangement, the correspondent bank holds deposits owned by a bank in a foreign payment system (the respondent bank) and provides those respondent banks with payment and other services.

By simply requiring that a respondent bank opens an account with a correspondent and establishes a way to exchange messages with it (typically via international financial messaging networks such as SWIFT), the correspondent banking model in principle allows cross-border payments to be made between any two banks in the world. But this versatility can come at the expense of speed and efficiency. While a respondent bank may maintain several correspondent banking relationships across different jurisdictions, the costs of maintaining several relationships in each jurisdiction may be prohibitive. Thus, if a respondent bank does not have a direct account relationship with the beneficiary bank, it would need to use intermediary banks, lengthening the transaction chain. For smaller banks or non-bank PSPs as well as PSPs from certain jurisdictions, it might be difficult if not impossible to find a correspondent bank. Finally, the processing of cross-border payments across a correspondent banking intermediary chain can be costly, time-consuming and opaque (eg due to data fragmentation, duplicative compliance screening or liquidity funding costs).⁸

2.2 Types of interlinking arrangements

While substituting for correspondent banking chains, the interlinking of domestic payment systems has taken various forms around the world. Interlinking payment arrangements can be differentiated by the following attributes:

- *Form of link (direct or intermediated):* Payment systems (wholesale payment systems, retail payment systems, and FPS as a special type of retail payment system) may be either directly connected to one another or rely on an intermediary or a payment infrastructure forming a hub for payment systems to connect;

⁷ Accordingly, cross-participation agreements linking domestic systems by allowing every participant of one system to hold an account in the other one do not fall under the definition of interlinking.

⁸ See stage 1 report of the G20 cross-border payments roadmap on frictions (FSB 2020(b))

- *Type of currency arrangement:* An interlinking arrangement may be a single-currency or a multicurrency arrangement, with or without currency conversion.

These characteristics are explained further below.

Features of interlinking arrangements

Table 1

Form of link	Type of payment system interlinked	Type of currency arrangement
<ul style="list-style-type: none"> • Single access point model • Bilateral link model • Hub and spoke model • Common platform model 	<ul style="list-style-type: none"> • Wholesale payment system • Retail payment system • Fast payment system (FPS)^a 	<ul style="list-style-type: none"> • Single-currency • Multicurrency • Cross-currency

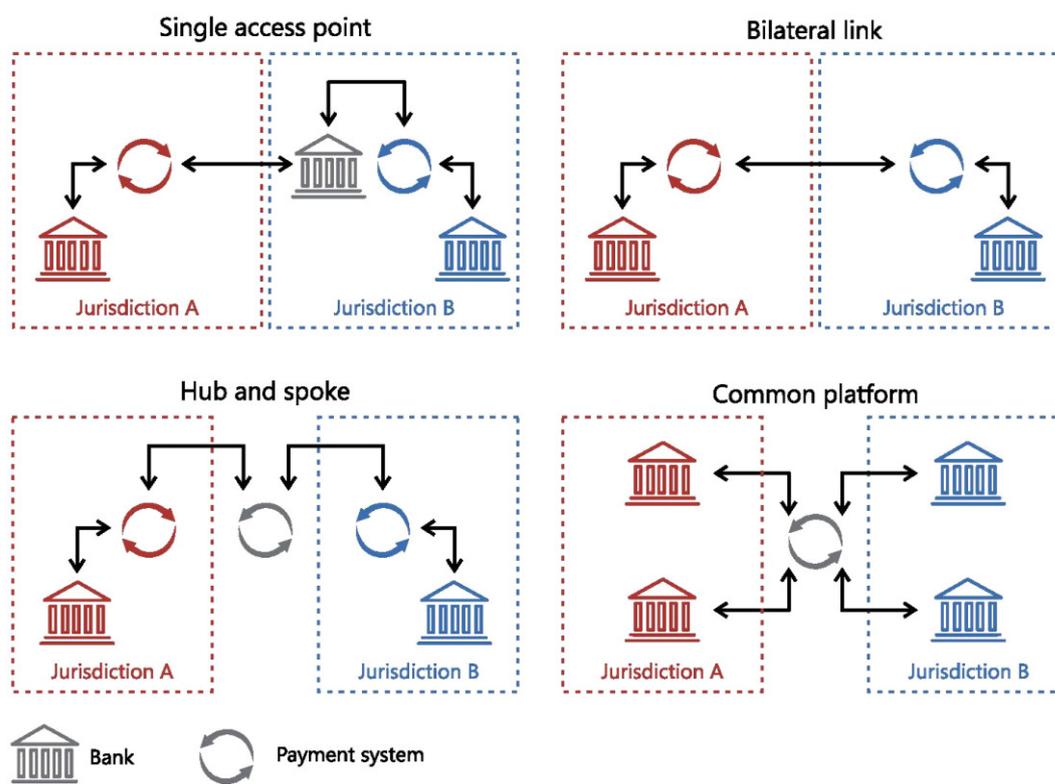
^a FPS are a subcategory of retail payment systems. However, in view of their unique features compared with those of other payment systems (eg crediting of funds to end users in (near) real time), their interlinking comes with requirements other than the interlinking of traditional payment systems.

2.2.1 Forms of link

Interlinking arrangements must be able to exchange information necessary to clear and settle inter-system positions between the linked systems. These connections can be categorised into four stylised models.

Stylised models for interlinking cross-border payment systems¹

Graph 1



¹ Examples include *Single access point:* euroSIC; *Bilateral link:* Directo a México; *Hub and spoke:* Regional Payment and Settlement System (REPSS) of the Common Market for Eastern and Southern Africa; *Common platform:* Southern African Development Community (SADC)-RTGS.

Source: CPMI.

Single access point model

Under a single access point model, participants in one (domestic) payment system have access to a foreign system through a single “gateway” entity that directly participates in the foreign system (Graph 1, upper left-hand panel).⁹ This model bears a resemblance to correspondent banking arrangements but differs in that it ensures access to the foreign systems based on common rules, service level agreements (SLAs) and access criteria. Despite simplicity and low cost, the single access point has scalability limitations (Boar et al (2021)).

One example of this model is euroSIC. Introduced in 1999, this system processes euro payments to, from and within Switzerland. euroSIC runs on the same technical platform as the domestic RTGS system for Swiss francs (SIC). Both systems are owned and operated by Swiss Infrastructure and Exchange (SIX), a private financial services company. Cross-border euro payments are channelled through Swiss Euro Clearing Bank (SECB), a subsidiary of SIX. SECB is a licensed bank in Germany and a participant in TARGET2. It acts as a single gateway entity for euroSIC members to all euro area jurisdictions through TARGET2.¹⁰ Another example is the Hong Kong’s RMB CHATS links with Mainland China’s payment systems.

Bilateral link model

Two payment systems can also be directly connected to each other (Graph 1, upper right-hand panel). This model typically enables participants in one system to directly reach *all* direct participants in the other (foreign) payment system instead of just the single gateway entity. Among other things, a bilateral link requires efficient mechanisms for accounting, clearing and settling inter-system positions between interlinked systems,¹¹ and this process is usually done through nostro/vostro accounts that linked systems hold with each other. Establishing a bilateral link can be relatively cost-effective and serve as an interim step towards a more centralised approach. However, a multitude of bilateral links results in complex processes, as multiple interoperability arrangements must be maintained (Boar et al (2021)).

An example of a bilateral link model is *Directo a México*, which was set up in 2005 between the United States and Mexico and links the Federal Reserve’s automated clearing house (FedACH) with the Mexican RTGS system (SPEI). Another example is the link between India (UPI) and Singapore (PayNow) (Box 2).¹²

Box 1

Bilateral link between fast payment systems – the India (UPI) and Singapore (PayNow) example

The interlinking arrangement between the FPS of India and Singapore, which is planned to become operational in the second half of 2022, is an example of a bilateral link model that makes extensive use of APIs. The UPI-PayNow link will enable participants of each FPS and their customers to make instant, low-cost fund transfers on a reciprocal basis without a need to participate in the other payment system. India is the world’s largest receiver of inward

⁹ A variant of this model is to establish a common agent that has membership/accounts in multiple payment systems in multiple countries. The common agent remotely accesses payment systems abroad. It provides multicurrency accounts to payment service providers, which use their accounts at the common agent to effect cross-border payments among themselves. Note that a common agent in this variant holds accounts at payment systems.

¹⁰ This model effectively allows banks in Switzerland to indirectly and remotely access TARGET2.

¹¹ As and when each individual transaction is processed through the link, each of the linked systems accumulates its positive or negative net position vis-à-vis other linked system (unless each transaction is settled between the systems on a gross basis).

¹² Under this arrangement, payments are allowed across two currencies (USD and MXP) and the Bank of Mexico provides the FX conversion (via an FX operator) based on near-wholesale rates. SPEI processes both retail and wholesale payments in Mexico.

remittance flows (an estimated \$87 billion in 2021 according to the World Bank) and enhancing remittance flows is one of the key drivers in India's pursuit of interlinking arrangements. The UPI-PayNow link is expected to provide a low-cost channel for remittance and other cross-border payments.

Role of APIs in the UPI-PayNow interlinking arrangement

The UPI-PayNow link leverages open banking APIs to ensure compliance with regulatory guidelines, flexibility in settlement arrangements, and reduction in transaction times, among other benefits. Some examples of the usage of APIs in the arrangement are:

Payee validation

The payer initiating the payment transaction enters a proxy identifier, in this case either the UPI identification number or mobile phone number of the payee. A customer validation API verifies whether the payee is valid. During this step, additional end user information is exchanged, based on the end user's consent, to conduct the necessary compliance checks before processing the payment transaction.

Payment execution

After payee validation, the payer is required to enter the amount to be transferred. The equivalent amount in the foreign currency is displayed to the payer. The payer authorises the payment and the payment gateway sends the payment information to various processing components (eg for AML/CFT compliance or fraud risk monitoring) before finally transferring the funds to the payee account. Upon the crediting of the payee's account the payer receives a confirmation.

Fetching FX Rate

The FX rate API automates the entire process of FX rate quotations, making it more efficient and less prone to errors.

Compliance Check

The compliance screening API enables real-time screening, which increases the speed and reduces the cost of cross-border payments.

Customer consent

UPI-PayNow APIs allow for the customers through their PSP apps to consent to the sharing of their personal information with an overseas party. The information is then communicated to payee banks to share the account details attached with a payment of an overseas party.

Source: Reserve Bank of India.

Hub and spoke model

A *hub and spoke* model is a multilateral interlinking arrangement capable of linking more than two systems (Graph 1, lower left-hand panel). In this model, the inter-system accounting and clearing are done at a common intermediary (the hub). In some jurisdictions, the hub itself could be qualified as a multilateral payment system,¹³ with the connected payment systems as participants. The hub can effect settlement on its own books or use a settlement agent.¹⁴ While it is assumed that the (domestic) payment systems connected to the hub are bound by the hub's rules, this is not necessarily the case for PSPs connected via a (domestic) payment system to the hub. The hub and spoke model is scalable, since with one connection to the hub a payment system can reach all other connected (foreign) systems.

An example of this model is the Regional Payment and Settlement System (REPSS) of the Common Market for Eastern and Southern Africa. REPSS has a common clearing house in the middle and

¹³ Indeed, hubs may be considered payment systems in their own right in the sense that they comprise a set of common rules and procedures for all participants, and a common technical infrastructure (CPMI-IOSCO (2012)).

¹⁴ A settlement bank can be a central bank or a commercial bank.

the Central Bank of Mauritius acts as a common settlement agent, which debits and credits the accounts of the participating central banks on its books.

Box 2

Cross-border instant payments via interlinked FPS – the Nexus example

The BIS Innovation Hub's Project Nexus provides a blueprint for a scalable cross-border payments network. Nexus would provide elements of a hub and connects FPS in multiple countries, enabling them to offer cross-border payments that reach their destination within 60 seconds (in most cases).

The interoperability of FPS connected through Nexus would be underpinned by software known as Nexus Gateways. Nexus Gateways manages the differences in data, functionality and processes between different FPS. Each FPS participant would need to adapt once to ensure compatibility with the Nexus Gateways, rather than trying to conform to the very different (and sometimes conflicting) features of each other FPS on a country-by-country basis. Compared with interlinking payment systems bilaterally, this multilateral approach should be lower-cost and faster.

As an example of the role of Nexus Gateways in accommodating differences between FPS, Nexus will ask each FPS operator to codify their scheme in a "service level description" (SLD). The SLD includes information such as whether aliases or proxies (eg a phone number) can be used to address a payment, the format of a local account number, whether IBANs are accepted, and the maximum payment value that can be sent to that destination. These SLDs are then shared across the Nexus network. When a customer initiates a payment, the sending bank will ask Nexus for the SLD of the destination country. This information allows the sending bank to ask the sender for the appropriate information and set up a payment instruction that will be accepted in the destination country.

Nexus's design leverages the latest advances in messaging standards and data exchange technologies. For example, Nexus makes extensive use of APIs for communication between Nexus, banks and payment service providers, and FX providers. Nexus is also designed to use payment instructions based on ISO 20022 messaging standards, which many FPS already use.

A detailed technical blueprint was published in July 2021 at nexus.bisih.org. A technical proof-of-concept will run until late-2022 and will connect testing instances of the FPS of Singapore, Malaysia and the euro zone (via TIPS). The BIS Innovation Hub aims to make the resulting software available to FPS operators, although further work would be needed on resilience, security and performance to make it ready for live payments.

Source: BIS Innovation Hub.

Common platform model

In a *common platform* model, PSPs from one jurisdiction can directly reach PSPs in other jurisdictions through one common payment system, which runs on a single integrated technical platform. While the common platform model can lead to the same results as interlinking, it is in a strict sense not interlinking since PSPs are participating in one and the same payment system. Hence, the common platform model is not discussed in detail in this report, but will be the focus of a separate report on multilateral platforms, which will be published in the second half of 2022.

As a common platform requires the harmonisation of many attributes, it is technically the most complex model, since it requires a fully fledged payment system to be set up (see Graph 1, lower right-hand panel).¹⁵ SADC-RTGS is an example of this model.¹⁶ This system is hosted by the South African

¹⁵ Common platforms qualify as multilateral payment systems and are the subject of another workstream (BB 17) of the G20 cross-border payments programme.

¹⁶ Originally known as the SADC Integrated Regional Settlement System (SIRESS).

Reserve Bank (SARB) and runs on the same infrastructure as the SARB's domestic RTGS system (SAMOS).¹⁷ The system currently settles payments only in ZAR and its participants (ie banks from different SADC jurisdictions) have ZAR accounts directly in the SADC-RTGS.

While these models help to categorise existing interlinking arrangements and differentiate them from other arrangements, some practical implementations incorporate elements similar to those that characterise the different models, with the aim of processing cross-border payments in a multicurrency setting (see Box 3).

Box 3

Possible settlement models in a multicurrency setting – the TIPS example

TIPS (TARGET Instant Payment Settlement) is a service that aims at providing a European-wide solution for the settlement of instant payments in central bank money. This is accomplished either by PSPs sending payments directly to TIPS or by PSPs authorising their automated clearing house (ACH) to send and receive instructions to/from TIPS on their behalf.

TIPS ensures pan-European reachability for instant payments. All PSPs can settle instant payments across the entire euro area via TIPS without depending on bilateral agreements between ACHs. In this regard all ACHs participate and compete in TIPS for the provision of instant payment services, with no exposure to credit risk for cross-ACH transactions. Each PSP may decide independently (i) where to instruct (in an ACH or in TIPS) and (ii) where to hold its liquidity and settle (in an ACH or in TIPS). The choice of each PSP in this respect does not condition the choices of other PSPs. ACH accounts can be funded/defunded from central bank money accounts in TIPS at any time. This also facilitates moving liquidity from one ACH to another without any time limitation, which can be particularly valuable during long weekends.

TIPS is by design a multicurrency platform, capable of processing other currencies as well as the euro. As of May 2022, instant payments denominated in Swedish kronor can be settled in TIPS. The agreement signed between Sveriges Riksbank and the Eurosystem allows Sweden's central bank to provide a new service for instant payments, RIX-INST, for which TIPS represents the technical solution.

In its role of the service provider of the TIPS platform for the Eurosystem, the Bank of Italy started investigating how TIPS could support the settlement of instant payment transactions across different currencies and launched a first proof-of-concept for interlinking the platform with other payment systems. Two concrete options for supporting cross-currency instant payment solutions have been identified: one option leverages TIPS as a common instant payment infrastructure, connecting currencies other than the euro to the platform;¹⁸ the other option entails the settlement of cross-currency payments between TIPS and other technical platforms. With regard to the latter option, the interlinking of TIPS and another system is achievable both through direct links and by involving intermediaries.

The direct link between TIPS and another payment platform allows, by means of cross-currency technical accounts belonging to central banks, the processing of a cross-currency payment with one transaction only, debiting the account of the PSP originating the payment and crediting (in a different currency) the beneficiary PSP account. One and only one cross-currency technical account is defined in TIPS and the other directly connected systems for each currency. The central bank responsible for the RTGS system related to a given currency is the

¹⁷ Banks from the following countries can participate in the SADC RTGS: Angola, Botswana, the Democratic Republic of Congo, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, Namibia, the Seychelles, South Africa, Tanzania, Zambia and Zimbabwe.

¹⁸ In this case, TIPS is qualified as a common platform and therefore outside the scope of this report.

central bank accountable for the cross-currency technical account.¹⁹ A cross-currency technical account is debited (or credited) each time a cross-currency payment credits (or debits) the account of a PSP with the same currency.²⁰

According to the solution whereby PSPs in TIPS have access to another system through an intermediary, a participant of both systems is defined as a cross-currency PSP. Acting as intermediary, the cross-currency PSP is the link between TIPS and the other payment system, holding accounts in both: one account expressed in the currency of the PSP originating the payment and the other in the currency of the beneficiary PSP. The processing of a cross-currency payment would result in two transactions, the former between the originator PSP and the cross-currency PSP (in the currency of the originator), the latter between the same cross-currency PSP and the beneficiary PSP (in the currency of the beneficiary). The cross-currency PSP would ensure that the final settlement of the first transaction occurs if and only if the final transfer of the second transaction takes place.

Source: Bank of Italy.

2.2.2 Type of currency arrangement (single-currency, multicurrency or cross-currency)

A *single-currency arrangement* transaction is executed using one currency as the settlement asset, which can be either the currency of one of the interlinked jurisdictions or another currency (typically, an international currency such as the US dollar and the euro). In this case, the conversion from any other currency to the settlement currency is provided by the payer's and/or payee's PSP outside the arrangement. Swiss euroSIC and SADC are examples of this model.

In a *multicurrency arrangement* transaction, the interlinking arrangements process different currencies in parallel, which can be the currencies of the interlinked jurisdictions and/or other currencies (typically, an international currency such as the US dollar and the euro). In this case, the conversion from one currency to the settlement currency is provided by the payer's and/or the payee's PSP outside the arrangement, cross-currency transactions via the link are not possible. TIPS is an example of this model.

In a *cross-currency arrangement*, the conversion from one currency to another takes place through the interlinking arrangement allowing the payer to be debited in one currency and the payee credited in the other currency. Such models envisage an FX conversion mechanism and may be equipped with PvP functionalities. An example of a cross-currency interlinking arrangements is Directo a México. The Gulf Cooperative Council RTGS system AFAQ, a central platform launched at the end of 2020, has cross-currency features too.

2.3 Impact of different interlinking models on cross-border payment frictions

The interlinking models may influence the frictions that slow cross-border payments in different ways. Cross-border payment frictions are factors that add to the costs or reduce the speed or transparency of cross-border payments, or hinder access to them (FSB (2020(b))). The G20 cross-border programme has identified seven such frictions: fragmented and truncated data formats; limited operating hours; legacy technology platforms; long transaction chains; funding costs; complex processing of compliance checks; and weak competition (a more detailed analysis of the pros and cons of different interlinking models via-a-vis frictions in cross-border payment is presented in Annex 2).

¹⁹ The ECB is responsible for the euro-denominated cross-currency technical account in TIPS.

²⁰ According to this approach, central banks provide the FX conversion, buying and selling currency as an infrastructure provider. The cross-currency transaction will result in a negative position in the beneficiary currency for the central bank on the beneficiary's side and a surplus in the originator currency for the originator's central bank. An alternative to this approach is to configure each payment system as direct participant in the others, enabling PSPs participating in each system (and not the central bank) to provide FX conversion and thus the liquidity on the relevant cross-currency technical account.

Variations in data standards and formats can result in *fragmented and truncated data* that reduce the accuracy and completeness of underlying payments data, leading to additional processing costs and delays. The bilateral link and hub and spoke models could provide stronger incentives for harmonising messaging standards across interlinked systems than a single access point model does. This is because, in a single access model, only the gateway entity is required to implement the arrangements to achieve technical interoperability between the interlinked systems.

Limited operating hours of the underlying payment settlement system can create delays in clearing and settlement of cross-border payments since payments are processed only during operating hours. The bilateral link and the hub and spoke models may be more likely to require an overlap of operating hours between interlinked payment systems. By contrast, single access point arrangements could be more likely to simply warehouse payments received outside operating hours, with little impact on this friction. By type of interlinked payment system, interlinking arrangements between FPS can benefit from overlapping operating hours since they usually operate on a 24/7/365 basis (although final settlement in central bank money may be unavailable during certain times due to more limited RTGS system operating hours). Wholesale payment systems typically close for maintenance windows and end-of-day procedures (eg related to minimum reserve regimes), limiting their possibility to extend operating hours. Similarly, cutoffs in retail payment systems and their reliance on the RTGS might further restrict the possibility of overlapping operating hours. The type of currency arrangement is likely to materially affect the frictions related to the mismatch of operating hours across time zones, as cross-currency arrangements embed conversion mechanisms that may make FX conversion faster and ensure the timely completion of end-to-end processing of cross-border payments even in the case of limited overlap in operating hours.

Legacy technology platforms are a friction in cross-border payments because they create delays and add costs to cross-border payments as a significant proportion of cross-border payments are processed using legacy technology that may rely on batch processing, lack real-time monitoring, and have limited data processing capacity (CPMI 2020(b)). In terms of interlinking models, more centralised approaches requiring development of infrastructure from scratch (eg hub and spoke and common platform models) are likely to use newer technologies such as APIs. Moreover, newer payment systems (eg FPS or newly implemented or upgraded RTGS systems) are less likely to be weighed down by legacy technologies.

Long processing chains at correspondent bank intermediaries are a fundamental friction in cross-border payments as costs and delays at the individual intermediary level are multiplied by the number of intermediary banks in an end-to-end payment. While all interlinking models potentially shorten processing chains, more centralised models (eg hub and spoke and common platform) are likely to involve fewer intermediaries compared with the direct link or single access point models.

Weak competition in cross-border payments is also a fundamental friction. All forms of links may potentially enhance competition by offering alternatives to correspondent banking and closed-loop arrangements, hence facilitating the entry of new providers for cross-border payment services and increasing end-user choice. However, some issues could materialise in the case of the single access point model if the entity providing access is also competing with PSPs making use of the access.

3. Trends in interlinking of payment systems

An increasing number of payment systems have established interlinking arrangements with other payment systems over the past decade. While most payment systems do not directly interlink with others, a diverse range of interlinking arrangements are now in operation. Moreover, some payment systems have indicated the possibility of pursuing interlinking arrangements in the next five years. These payment systems are perhaps encouraged by the greater opportunities afforded by the advent of new technological solutions and continuing advances in technical interoperability.

A CPMI survey on interlinking arrangements was conducted in early 2021 and completed by 82 central banks, covering 289 payment systems. The survey asked respondents on the extent to which they have enabled interlinking with other payment systems, their plans to establish any links in the next five years, benefits and risks and a range of operational, policy and legal considerations around interlinking.

3.1 Current state

3.1.1 Number and geography

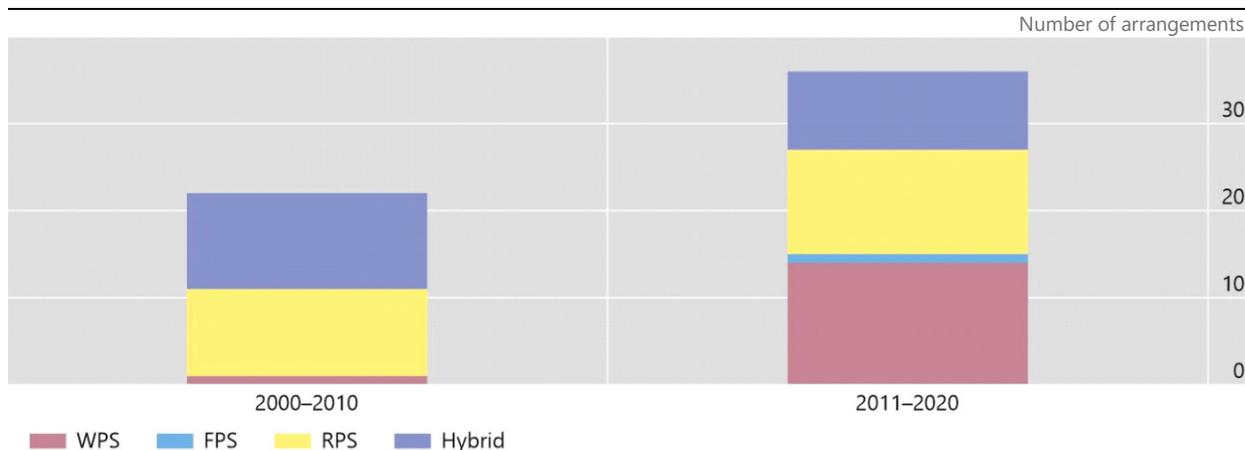
For 26 payment systems (covering 22 jurisdictions), or nearly 10% of the payment systems covered in the survey, the responding central banks reported that interlinking arrangements have been established with foreign payment systems. Payment systems with interlinking arrangements are widely geographically distributed across the globe. Several maintain more than one interlinking arrangement, with the number of arrangements totalling over 50. Europe and Asia were the regions with the greatest number of payment systems involved in interlinking arrangements.

Existing interlinking arrangements tend to be regional in nature. This may reflect a variety of possible reasons tied to the incentive and the operational ease of establishing an arrangement. This can include stronger economic and financial links at the regional level; closer personal ties and associated remittance flows, and the greater overlap of payment systems operating hours at the regional level.

The payment systems that have interlinking arrangements in place are relatively new, with the majority (71%) having been introduced since 2000. This probably reflects that it is easier to interlink systems with more modern technologies and more standardised data formats than legacy platforms.

Newly established interlinking arrangements by payment system type

Graph 2



FPS = fast payment systems; Hybrid = Combine one or more features of different payment systems types; WPS = wholesale payment systems; RPS = retail payment systems (other than FPS).

Source: CPMI survey.

3.1.2 Form of link

Survey respondents pointed to a range of bilateral connections. They also highlighted several multilateral regional arrangements, systems and schemes supporting interlinking, such as the Single Euro Payments Area (SEPA), the Arabian Gulf System for Financial Automated Quick Payment Transfer (AFAQ) cross-currency service (also known as GCC RTGS) covering the Gulf Cooperation Council countries, and Sistema

de Inteconexión de Pagos (SIPA).²¹ With a few notable exceptions (eg the CHATS systems in Hong Kong), jurisdictions tend to have only one or two systems that link to another particular jurisdiction.

3.1.3 Type of payment system

Interlinking arrangements are currently most common for retail payment systems, which account for most interlinking arrangements, whereas only four wholesale payment systems and four “combined” systems (the HKD, RMB, EUR and USD CHATS in Hong Kong SAR) reported interlinking arrangements. This may be because retail payment systems are newer and have been able to adopt more recent technological innovations, including APIs, to support the establishment of links. To the extent that large-value payment systems interlink, they have typically adopted a central platform model.

3.1.4 Type of currency arrangement

While a majority of interlinking arrangements are single-currency models, nearly 40% of arrangements are capable of processing multiple foreign currencies. Moreover, recently established interlinking arrangements are increasingly capable of cross-currency conversion.

3.1.5 Perceived benefits, risks, and challenges

Operators of payment systems with interlinking arrangements have generally indicated a range of benefits from these arrangements. For example, several respondents pointed to improved settlement efficiency and increased STP as helping to reduce the costs of cross-border payments. Improved reachability and accessibility to counterparts in foreign payment systems as a result of interlinking were also frequently mentioned. Other reported benefits included cost-sharing for participants, reduced settlement risk thanks to shorter time lags in settlements, expanded markets and services for participants, and support for regional integration efforts.

In terms of risks, interlinked payment systems cited risks around a single point of failure (ie the interlinking platform) and contagion (eg that a cyber attack or fraud in the interlinked payment system might affect the domestic one).

While the migration to ISO 20022 by many payment systems was viewed as highly conducive to payment system interoperability, differences in the implementation of the ISO 20022 standard was cited as an ongoing challenge in implementing interlinking arrangements. In this regard, harmonised implementation of ISO 20022 for cross-border payments was viewed as highly desirable.

3.2 Trends

The earliest bilateral payment system link reported was established in 2000 and the majority (56%) have been established since 2015. Over the past decade, the establishment of new interlinking arrangements has accelerated, with 36 set up between 2011 and 2020 compared with 22 in the 2000–10 period. By payment system type, newly established interlinking arrangements since 2011 have been roughly evenly split between wholesale payment, retail payment and hybrid systems. Only one FPS reported an interlinking arrangement, although this may reflect that FPS have been set up only recently; since the survey was conducted, several more FPS have announced new interlinking arrangements (see Box 4).

²¹ SIPA is a regional platform linking the national payment systems of the central banks of Central America and the Dominican Republic. To the extent that these arrangements qualify as multilateral payment platforms, they are considered further under BB 17.

3.3 Future plans

Systems in a wide range of jurisdictions have indicated the possibility that they might pursue further interlinkages. Fourteen payment systems reported that they could establish (additional) international links with other payment systems within the next five years. These represent a wide range of jurisdictions and regions across the globe and a wide range of payment system types. Payment systems of all types have indicated near-term intentions for interlinking. An indication of the likelihood of establishing international links with other payment systems over the next five years was correlated with the age of the payment system itself; more recently established payment systems (eg FPS established between 2016 and 2021) were more than twice as likely to report a near-term possibility of establishing an interlinkage than older payment systems were (eg ones set up between 1980 and 2005).

Box 4

New interlinking arrangements in Southeast Asia

ASEAN Payment Connectivity initiative

A number of countries in Southeast Asia (including Singapore, Thailand, Malaysia, Indonesia and the Philippines) have recently established, or are in the process of establishing, connections between their national payment systems under the ASEAN Payment Connectivity initiative. The initiative aims to increase the interoperability of standardised QR code payments (eg in-person transactions by foreign tourists) and enable fast peer-to-peer transfers across member countries.

PPPN: the PayNow-PromptPay linkage

In April 2021, the fast payment systems of Singapore (PayNow) and Thailand (PromptPay) were linked and established PPPN, the first connection of two domestic fast payment systems in the world. Prior to the establishment of the PPPN arrangement, transfers between Singapore and Thailand required a multi-step internet banking process, which incurred high fees and FX charges, and typically took 1-3 days to reach the recipient. To facilitate the peer-to-peer transfers, the system operators of the two countries developed cross-border payment gateways with common criteria for messaging and data exchange. The gateways route proxy lookup messages and convert ISO 20022 domestic messaging to agreed harmonised formats for the cross-border section of the transaction. The technical development for the cross-border transactions also involved the synchronisation of the turnaround times of the domestic payment systems to avoid timeouts and message failures, while the settlement of PPPN is performed twice daily via a correspondent banking model. Both countries appointed single settlement banks on either side and net their cross-border obligations via accounts held with the settlement banks. The settlement banks execute local interbank transfers to ensure domestic netting of obligations is performed. The fast nature of the PPPN transfers adopted specific AML and CFT risk mitigation measures to address the risk of funds being paid out ahead of checks by the sending or receiving banks. Such measures included the adoption of daily transaction amount limits, and the development of real-time name screening modules and workflows to deal with screening hits. Under the PPPN arrangement, transfers are executed within seconds or minutes and can be made with a mobile or internet banking application which requires minimal data input. Transfers under PPPN, enable customers of participating banks in the two countries to transfer funds up to amounts of SGD1,000 or THB25,000 per day (~USD750), incur low or no fees and have low FX markups. While the initial phase of the linkage between banks focused on peer-to-peer transfers and remittances, efforts to enhance its offerings are underway and aim to expand participation to include non-bank transfer providers, widen transfer use cases, raise transaction limits, and increase the reach and functionality of the linkage.

Sources: Monetary Authority of Singapore, "Singapore and Thailand Launch World's First Linkage of Real-time Payment Systems", 29 April 2021, <https://www.mas.gov.sg/news/media-releases/2021/singapore-and-thailand-launch-worlds-first-linkage-of-real-time-payment-systems>.

4. Use of application programming interfaces (APIs) by payment systems

4.1 Payment system interoperability and the role of APIs

Interoperability is the technical, semantic and business system compatibility that enables one system to work seamlessly with others (Boar et al (2021)). Similarly, payment system interoperability allows participants in different systems to execute, clear and settle payments or financial transactions across those systems (BIS (2020)). Payment system interoperability may be fostered through a variety of channels such as alignment of business rules, regulatory frameworks, and service level agreements and schemes. At a technical level, the interoperability of payment systems is a pre-condition for interlinking arrangements. Interlinking two payment systems can be a challenging and complex undertaking in absence of interoperability as it may entail connecting separate infrastructures with different legacy technologies and technical standards.

Box 5

What are application programming interfaces (APIs)?

Basic function

APIs enable a software application (eg a mobile phone app) to request a specific piece of data from one or more other software applications (eg a banking platform installed on a server in a bank's data centre), and for data transfer from the data providing application(s) back to the requester, provided the original request was valid. Put another way, APIs are the "messenger" that runs with an instruction from the requestor to the information provider, and back again with the answer. In doing so, the API specifies the required rules, language, vocabulary and security of those requests to ensure that the receiver of the request can always quickly, easily and accurately understand the request and provide the answer in a way which the requestor can immediately understand. Importantly, often no direct user intervention is required to initiate or respond to individual information requests; such requests are automatically initiated as part of the broader functionalities invoked by end users. This greatly improves the efficiency of the request and response function of data exchange, especially as data requirements increase in scope and complexity.

Enablers of value added digital services

By facilitating communication between software applications, APIs also enable applications to expand their functionality by leveraging the data and functionality of other applications. Applications using APIs do not need to replicate the functionality or services already provided by other applications but simply need to be able to interface with them. The ability to apply the capabilities or data of other applications through APIs is a key driver of value creation, new markets and enhanced user experience in the digital economy. In this way, APIs resemble the connective studs and tubes of a Lego brick that enables the creation of structures of various formations depending on the builder's creativity and specific user needs and preferences.

Source: CPMI.

While payment system interoperability is not strictly dependent on APIs (and indeed several interlinking arrangements do not use them), the use of APIs, and particularly harmonised APIs, can make payment systems more interoperable. APIs are open-source, simple to implement, less restrictive and well-tested in payments. These attributes allow APIs to support the interoperability of different technology platforms, including those used by payment systems.

APIs can also provide a network-neutral means for the exchange of financial data. Payment systems today use a variety of messaging networks allowing PSPs to exchange financial data with each

other, including SWIFT, which is the predominant channel for cross-border payment messages. With the appropriate security features in place, an API may enable the exchange of financial data across virtually any telecommunication financial messaging network, public or private, including the internet. APIs do not require dedicated environments and therefore do not require ongoing network connections to support their operation.

Harmonised APIs can provide even greater support for payment system interoperability. Harmonised APIs are widely adopted configurations of technical specifications related to an API's rules (protocols), languages (formats), data dictionaries and security features. For example, in the interlinking context, an API-based solution can facilitate the exchange of payment data across jurisdictions with materially lower development costs than a traditional message-based solution, without necessarily increasing the complexity or risk of the product. This can facilitate the exchange of higher payment data volumes, thus supporting interlinking arrangements. These benefits could be further enhanced in more centralised, multilateral interlinking models (ie the hub and spoke models), requiring developers to implement a single standardised set of APIs rather than customised APIs for each bilateral connection between payment systems. This could lead to a significant reduction in development costs and time to market.

4.2 Adoption of APIs by payment systems

In 2021 the CPMI conducted a dedicated survey to better understand current and planned implementation of APIs by payment system operators around the world. The survey was completed by 55 respondents, representing a diverse range of payment system types, jurisdictions and level of economic development. The survey found that many payment systems already use or plan to use APIs. A key driver for API adoption has been perceived benefits in terms of helping to overcome the speed, access and cost challenges in payment processing. A lack of standardisation (eg of rules (protocols), languages (formats), data dictionaries and security features) was cited as the most significant challenge both for payment system operators and for the industry at large contemplating adoption of APIs. This suggests a need for greater international collaboration to prevent fragmentation of standards at the global level.

4.2.1 Use of APIs by payment systems

A large majority of payment system operators, broadly distributed across regions and level of economic development, indicated that they currently use APIs (65%; 36 respondents) or planned to use APIs in the future (20%; 11 respondents). This suggests that the use of APIs is already widespread among payment systems around the world and that they continue to embrace APIs for future applications.

4.2.2 API usage in payment processing

Payment system operators use or plan to use APIs for a broad range of functions in payment processing and value added payment services. The most frequently cited use of APIs (60% of respondents) across all categories of payment systems was for account balance enquiries, followed by account validation (53%) and funds transfers (40%). These are typical processes in interlinking arrangements, suggesting interlinking could be supported by the use of APIs. However, nearly three quarters of respondents across all categories of payment systems indicated they use APIs for a range of other purposes, varying from customer and transaction screening processes to data and price queries. Examples of other payment functionalities enabled by APIs include customer identification, credit confirmation, status checks, management of static account data, customer due diligence, real-time FX rate quotation request for payments and transaction screening (eg sanctions, AML/CFT, fraud).

4.2.3 Drivers and benefits of adopting APIs

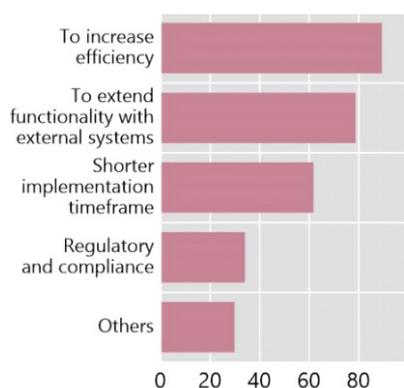
Payment system operators indicated a range of drivers for adopting APIs (Graph 3, left-hand panel). The most often cited reason for adopting APIs was to increase efficiency (89% of the respondents). This reflects a key feature of APIs: their automated data request and response feature, which obviates the need for frequent manual interventions and validations. Indeed, a very high proportion of respondents across all categories (87%) indicated that APIs have helped overcome cost, speed, access and transparency challenges related to payments processing (Graph 3, centre and right-hand panels).²² A high percentage of respondents also perceived extending payment functionality through interfacing with external systems (79%) and shorter implementation time frames relative to other application development solutions (62%) as significant benefits from adopting APIs. This probably reflects that the use of APIs can help to connect applications and facilitate data exchange seamlessly without the need for additional system developments. This approach ensures quick implementation and easy interfacing with other systems (as typically required by interlinkages between payment systems).

Key drivers and benefits of adopting APIs

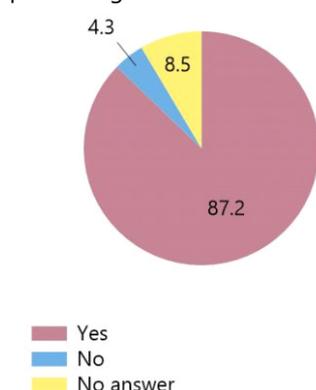
Share of respondents using or planning to use APIs

Graph 3

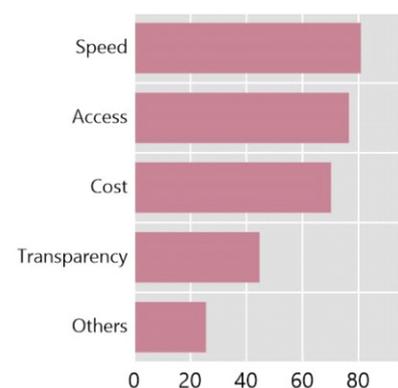
What were the key drivers for the API adoption/implementation?¹



Has API implementation helped overcome any of the challenges in terms of cost, speed, access and transparency of payments processing?



If API implementation has helped overcome some challenges, please select the challenges overcome by implementing APIs¹



¹ Results may not sum to 100 as respondents were permitted to select multiple answers.

Source: CPMI survey.

4.2.4 Challenges in adopting APIs

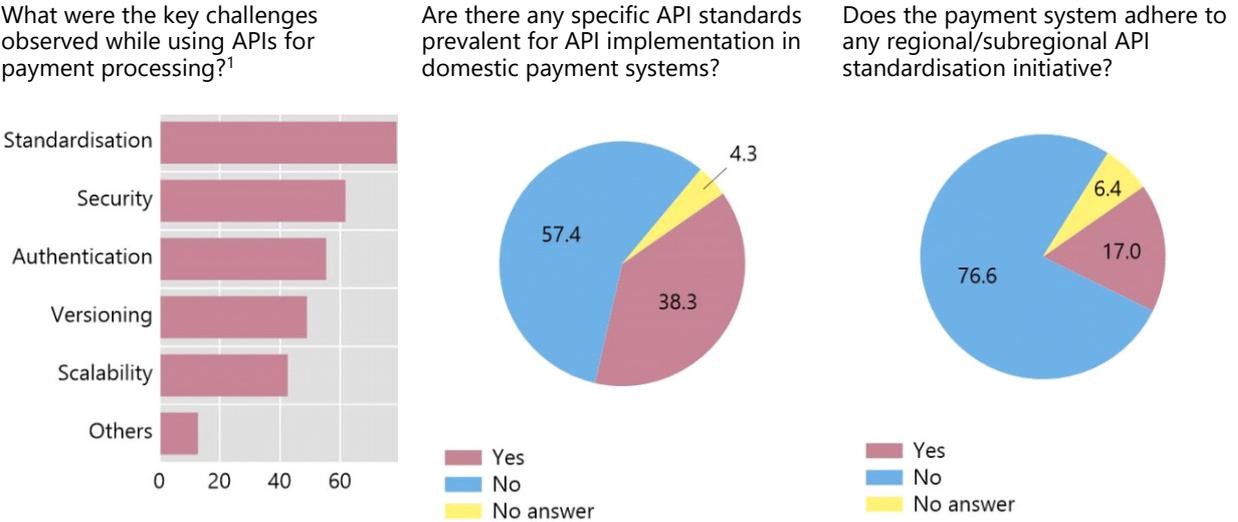
The lack of standardisation was the most frequently cited challenge in implementation of APIs by all respondent categories (79%). Absence of domestic API standards has been a major reason, with only 38%

²² When asked to elaborate on how APIs helped overcome speed challenges, several respondents noted a significant reduction in processing time due to real-time validations and confirmations. In terms of helping to solve access challenges, some respondents noted APIs allowed their payments system to open access to a range of different organisations, especially fintech firms wanting to access the real-time payments infrastructure. On the cost dimension, the reduced development time and ease of integration with other applications was a major factor cited by several respondents, as well as greater STP and reduced reliance on manual processes. On the transparency dimension, several respondents noted that APIs enabled real-time payment tracking and easier querying of transaction status.

of payment system operators indicating the existence of domestic standards for APIs.²³ Furthermore, the survey highlighted a lack of consistent standards across jurisdictions for API implementation. The overwhelming majority of respondents (77%) indicated that they did not make use of any regional API standardisation initiative (Graph 4, right-hand panel). For the handful of respondents that did use API standards, nearly all cited challenges in adhering to such standards, suggesting a tendency towards fragmentation even with the existence of a standardised API menu. The absence of standardisation initiatives and the lack of harmonised APIs are confirmed by a significant fragmentation of the technical specifications for implemented APIs.

Challenges in adopting APIs

Share of respondents using or planning to use APIs Graph 4



¹ Results may not sum to 100 as respondents were permitted to select multiple answers.

Source: CPMI survey.

Harmonisation challenges

The challenges for the harmonisation of APIs in a global context, where the technical standards are likely to be more disparate and legal and political challenges more complex, are expected to be even more acute than the harmonisation of APIs at the domestic level. This is particularly the case given that payment systems in different jurisdictions are at different stages of API development and may have legacy systems that have already implemented their own proprietary standards and requirements.²⁴ Challenges in harmonising API standards are likely to be manifold:

- *Technical challenges to implementation.* The CPMI survey responses reveal the challenges involved in a common technical implementation of APIs for cross-border payment purposes. Prime among them is that existing domestic implementations have featured a wide variety of

²³ Countries where respondents noted the presence of domestic API standards included Indonesia (Standard National Open API) and Korea (Korea Financial Telecommunications & Clearings Institute).

²⁴ Or these may have been burdened by legacy infrastructures that are incompatible with the real-time functionality of API data exchanges (eg net deferred settlement or batch payment systems). There may thus not be a compelling business case to modernise and enable real-time payments processing for these systems via APIs.

technical standards and message formats.²⁵ However, the strong movement towards the adoption of the ISO 20022 messaging standard by payment systems and financial institutions worldwide should help to overcome this challenge (see Box 6).

- *Seeing the bigger picture:* Another challenge is that developers of APIs need to be willing to sacrifice some freedom and autonomy in favour of the “greater good” that API standards can bring at an industry level. Many API developers might be used to designing APIs that fit the capabilities and constraints of their back-end systems precisely, making and releasing new versions of APIs as and when they choose. Operating in a standardised setting requires a different discipline and mindset: accepting design decisions made by others and cooperating with other organisations to move specifications forwards.
- *Legal challenges to implementation.* The experience of jurisdictions so far indicates that legal issues have been a big challenge for domestic implementation of APIs in payment systems. This becomes exponentially more complex when considering APIs for cross-border payments across jurisdictions, where there is no single authority, or even a common legal basis. Authorities could facilitate the development of a harmonised API standard, but are likely to face coordination challenges, since responsibilities at a domestic level might be dispersed across different authorities. This points to a wider issue with implementing a standardised approach, given that regulators will need to coordinate with payment system operators.
- *Idiosyncratic challenges to implementation.* Finally, there are challenges related to the particulars of working across jurisdictions. For example, there is a challenge regarding which characters to incorporate within a harmonised API standard. Without a clear policy regarding which character set is required to be read and processed by APIs, there is a risk of data truncation or inadmissible requests emerging across jurisdictions. Working groups would need to be constituted to address issues such as these and other potential future challenges.

Box 6

The ISO 20022 messaging standard and its relationship with APIs

Background on ISO 20022

ISO 20022 is the International Organization for Standardization (ISO) standard for electronic data exchange between financial institutions. The standard applies to financial information transferred between financial institutions, including payment transaction information (eg for customer credit transfers, financial institution credit transfers, payment status etc). SWIFT oversees the ISO 20022 financial message repository as the formal Registration Authority on behalf of ISO, publishing and maintaining ISO 20022 message definitions and safeguarding the standard’s quality. However, unlike some other financial messaging standards, ISO 20022 is open for all to use, free of charge.

Because ISO 20022 covers a broad range of financial services, it enables a common understanding and interpretation of information, as well as the ability to reuse components across all messages regardless of the original application, so that individual components of a message to facilitate securities settlement can be used for payment, for example. Such interoperability enables automated transfer and straight through processing (STP) across entire processing chains. Another major benefit of the ISO 20022 standard is its enhanced payload capacity, which provides for richer and more detailed data, as well reference data that are more structured than those of

²⁵ For instance, there is no common approach to a standard data format; while the JSON and XML formats are the most widely used, neither is currently being used by most respondents. Furthermore, there are challenges with defining a common security standard, given that responses to the CPMI survey revealed a real mix of security standards for domestic implementations, with no approach being used in more than 25% of jurisdictions

more proprietary message formats and the SWIFT MT standard for cross-border payments. These features also support compliance screening and STP across processing chains.

Major reserve currency payment systems have adopted or are in the process of adopting the ISO 20022 messaging standard (eg TARGET2, Fedwire, FedNow, CHAPS and BOJ-NET). Moreover, many large financial infrastructures and user groups are already using ISO 20022 in payments and securities settlement, and it has become the standard for real-time payments. A spur to the global adoption of ISO 20022 has been SWIFT's decision to adopt ISO 20022 for cross-border payments and to end support for the MT messaging standard in cross-border payments exchanged across its private messaging network by November 2025. Thus, even payment systems that have chosen not to adopt the ISO 20022 standard will need to map their proprietary messaging standards to the ISO 20022 standard for cross-border payments. Reflecting these trends, a CPMI survey on ISO 20022 adoption by payment systems revealed that only a handful of the approximately 70 payment systems surveyed did not plan to migrate to ISO 20022 in the coming years.

International work is also currently under way to ensure the interoperability benefits of the ISO 20022 standard are preserved even as the standard is implemented differently across jurisdictions. In particular, central banks are collaborating with industry through a CPMI task force to standardise ISO 20022 message requirements and data elements used in cross-border payments. The outcome of these efforts will feed into high-level guidance for the harmonised use of ISO 20022 messages and elements in an end-to-end cross-border payment transaction, supporting interoperability and STP.

Relationship of ISO 20022 with APIs

When seeking to harmonise APIs, there are strong reasons to ensure that the underlying data standard or model (ie the semantics of the formatting language) of an API data exchange is consistent with that used by existing payment messaging systems. Many payment systems supporting cross-border payments either already use or have chosen to implement ISO 20022. The value of the ISO 20022 messaging standard comes from providing for consistency of data in payment messages. Standardised APIs can build on the data model developed for the harmonised cross-border ISO 20022 messaging standard. Utilising the data dictionary used to support ISO 20022 messaging will ensure that the data exchanged via APIs are themselves harmonised with the data submitted to payment systems via traditional messaging routes. It will therefore be possible to transfer payments data readily across different messaging channels, without the need for manual intervention and with minimal use of or investment in translation services. The migration of payment systems to a standardised ISO 20022 data model for cross-border payments is a strong enabler for realising the full benefits of API harmonisation.

Source: CPMI.

5. Drivers and benefits of interlinking of payment systems

5.1 Drivers of interlinking

Where interlinking arrangements have been established, a common driver has been a motivation to deepen regional economic and financial integration. This may lead economic agents to demand more efficient and cost-effective cross-border payment services. It may also reflect a desire on the part of PSPs for new growth opportunities and markets (World Bank (2014), ITU (2016)). Regional economic integration remains an important driver in recently established interlinking arrangements.

Technological innovation and the development of new infrastructure in recent decades have also enabled the interlinking of payment systems. The emergence of an API ecosystem in the financial services sector has opened up scope for interlinking that did not exist in prior periods when payment systems were tied to proprietary messaging networks and other legacy technology systems. The establishment of FPS, many of which leverage latest technologies (including APIs), has also opened up an opportunity to offer fast cross-border payments based on the interlinking of domestic FPS.

Moreover, the adoption of the ISO 20022 messaging format has played a key role in driving interlinking arrangements in many instances (eg in Europe). The adoption of ISO 20022 at the outset of newly established payment systems has removed a barrier to technical interoperability affecting older payment systems that use legacy proprietary message standards.

5.2 Benefits of interlinking

Interlinking of retail payment systems – both retail (including FPS) and wholesale (such as RTGS systems) – allows PSPs to interact more directly across borders through their linked infrastructures, reducing their reliance on traditional correspondent banking. Enhanced interoperability of different payment systems can help make cross-border payments cheaper and faster for end users.

5.2.1 Shorter transaction chains

A cross-border payment travelling through a correspondent banking chain must undergo back-end processing at each link of the correspondent banking chain. Shorter transaction chains mean shorter processing times, and thus lower end-to-end transaction costs, for cross-border payments.

The use of APIs can amplify the benefits of shorter transactions chains in an interlinking arrangement. In particular, direct links between payment systems through APIs may enable pre-validation of payments prior to the sending of cross-border payment messages. This can increase the likelihood of successful processing of a payment instruction, limiting the number of costly rejections. APIs may also support more efficient, automated and real-time message repairs and investigations (eg requests for further information), which are currently conducted with respect to the next intermediary bank in the correspondent banking chain. Today, the time-consuming and costly linear one-to-one passing of investigation requests along a correspondent banking chain is a major source of delays in funds being received by beneficiaries. APIs allow for more direct, automated and standardised data exchanges between the originating and intermediate banks for message repairs and investigations.

5.2.2 Fewer and more efficient compliance checks

Shorter transaction chains imply a reduction in the number of compliance checks by different entities along the chain. Interlinking arrangements may also adopt common compliance standards and effectively ensure that all pieces of information needed to meet compliance checks are available.

The adoption of APIs as part of a PSP's compliance screening programme could result in significant efficiency gains by facilitating access to relevant AML/CFT screening services offered by third parties. Similar to the efficiency gains for message repairs and investigations, APIs may also support a more efficient resolution of requests for information with respect to compliance investigations, which today can only be conducted via the next intermediary bank in the correspondent banking chain.

5.2.3 Improved data quality

Interlinking arrangements may improve data quality as a result of an underlying harmonisation of business and technical-operational rules and a shortening of the payment chains. Data can be fragmented by the sequential relaying of financial messages by correspondent banks as part of a cross-border payment, as well as differences in data standards, formats and content across jurisdictions. This often requires manual intervention, which hampers STP and payment reconciliation.

APIs can make cross-border payments more efficient by automating data exchange and eliminating the need for frequent manual interventions, thus facilitating STP.

5.2.4 Potentially lower funding costs

Supported by appropriate liquidity arrangements, interlinking arrangements can theoretically reduce the need for PSPs to hold funds with a variety of correspondent banks and/or payment systems, thereby reducing funding costs.²⁶ If the design of the linked payment systems foresees netting, this can further reduce liquidity needs.

5.2.5 Enhanced competition

Interlinking arrangements may enhance competition for cross-border payments by allowing direct interaction among participants across jurisdictions, reducing their reliance on correspondent banks. Interlinking arrangements that allow a wider number of institutions to operate cross-border or even to hold funds in foreign currency could potentially have the greatest effect in reducing the frictions of long transaction chains and limited competition.

5.2.6 Risk mitigation

Interlinking arrangements may include payment-versus-payment (PvP) functionalities, reducing the credit and settlement risk arising from foreign exchange (FX) transactions in a correspondent banking transaction. Real-time transfer/settlement between interlinked payment systems mitigates and, potentially, eliminates replacement cost risk by shortening the settlement time lag.

6. Challenges and risks in interlinking arrangements

Challenges and risks for establishing and operating interlinking arrangements affect several areas. What follows is a brief description of common challenges and risks related to the establishment of interlinking arrangements. If not appropriately addressed and mitigated in the implementation phase, these challenges and risks could have a bearing on the operation of interlinking arrangements and hence require continuous review and evaluation. The interdependencies with other elements of the G20 cross-border payments programme mean, however, that a number of these challenges and risks could be mitigated if progress is made across other relevant building blocks and in a coordinated manner.

6.1 Limited political support

Political support in the interlinked jurisdictions, which often comes from public support for broader regional economic integration and financial inclusion goals,²⁷ is an important factor for the success of an interlinking project, both in its establishment and ongoing operations. Political support can help overcome differences in legal, regulatory and oversight frameworks and facilitate payment integration. However, concerns about spillovers between the interlinked systems (eg in term of FX settlement risk), with undesirable macro-financial consequences, might limit political support.

²⁶ Many current interlinking arrangements often require PSPs to prefund their position – potentially across multiple currencies – or get access to foreign currency markets, which can increase funding costs. Interlinking models ensuring cross-currency conversions may require the intervention of central banks when the involved currencies are not sufficiently liquid or non-tradeable.

²⁷ The SEPA project, the SADC Payment System Project, the interlinking arrangement between the US FedACH and the Mexican RTGS system (SPEI) are only a few examples of payment integration projects that have benefited from political support.

6.2 High start-up costs

Potentially high start-up costs, which tend to vary depending on the interlinking model, can be a deterrent factor in the establishment of interlinking arrangements. Such costs may arise from the development of new technical interfaces, software development, processing platforms as well as other infrastructure requirements for new arrangements. For the private sector, and in particular for PSPs participating in the arrangement, these costs might be perceived as tangible and near-term relative to the benefits, which might be seen as more uncertain, longer-term and indefinite. High start-up costs will make it particularly difficult to get the support of market participants with a stake in the status quo (eg loss of market share by certain PSPs involved in cross-border payments). Further, to the extent market participants decide to invest in establishing interlinking arrangements, there is a risk that they may choose to pass on these high start-up costs to participating PSPs and, ultimately, to end users, which could offset any potential cost reductions from shorter transaction chains.

6.3 Divergent legal, regulatory and oversight frameworks

Divergent or incompatible legal, regulatory and oversight frameworks can pose significant challenges for establishing interlinking arrangements. For example, currency regulations prohibiting the trading of domestic currency across borders can prevent domestic systems from establishing cross-currency links with infrastructures operating in other jurisdictions. The regulatory framework could limit the range of possible designs, eg to single access point models through which foreign entities are entitled to participate only via a domestic access point in on-shore systems. Divergent regulatory frameworks, oversight regimes and systems rules may increase the legal risk incurred by the interlinked systems. Common issues are differences in default, settlement finality, netting, novation and collateral enforcement provisions as well as AML/CFT and fraud controls, cyber operational risk management practices and legal restrictions on data flows (eg data privacy requirements).

6.4 Misaligned access rules

Differences in participant eligibility to join payment systems between the two jurisdictions involved may increase legal, financial and operational risks. In particular, without proper risk management measures these differences could lead to regulatory arbitrage and the spillover of risks from one interlinked payment system to the other. Even when access criteria are aligned in an interlinking arrangement, different regulatory regimes and system rules may result in different risk profiles and give rise to the transmission of financial and operational risks from one system to another. Uncoordinated access criteria may also lead to an erosion of the level playing field across jurisdictions if access for certain types of PSP differs across participating jurisdictions.

6.5 Differences in service level requirements

Achieving agreement on service level requirements between payment systems that operate in different jurisdictions may be another challenge to establishing an interlinking arrangement. Lack of clarity in the agreements governing links could, however, lead to uncertainty about rights and obligations of payment systems operators, participants and end users, giving rise to conflict of laws issues, such as the question of when and which regulations apply once a payment order is in transit across systems. Agreeing on adequate service levels can also be complicated by time zone differences and lack of overlapping operating hours. Additionally, differences in the underlying scheme rules may affect the level of interoperability and the quality of service delivered through the interlinking arrangement. Such differences might arise, for example, when in one jurisdiction fast payments are "instant", settled within seconds, while in another jurisdiction the execution time for fast payments might be longer (eg minutes or hours).

6.6 Appropriate choice of currency conversion model

As the choice of the currency conversion model can affect how costs and risks are allocated among stakeholders and jurisdictions, it can be a difficult decision. Conversely, in arrangements with cross-currency conversions two main issues can prove challenging, especially for currencies affected by high volatility and in times of financial stress. These are (i) how and when the FX rate is defined and (ii) the choice of entities (central bank or commercial bank) that provide the conversion service and manage and/or bear the associated FX risk.

6.7 Different technical design features

The technical design features of domestic systems can often restrict the scope of potential interlinking models and arrangements, reducing their efficiency. Technical incompatibilities stemming from legacy IT systems can affect clearing mechanisms as well as message and data formats (in both the domestic payment system and at the participant level). Message and data formats misaligned in structure and content can (i) lead to operational risks that can arise from manual interventions; (ii) increase return and rejection rates; and (iii) drive data truncation.

6.8 Uncoordinated business continuity arrangements

Time zone differences and limited operating hours may give rise to difficulties in managing incidents (eg due to staff unavailability at the system or at the critical service provider level, or owing to lack of clarity on the respective responsibilities). Such issues are likely to be magnified when the interlinking arrangements involve several systems and jurisdictions.

6.9 Differing change-management procedures

The comprehensive identification and assessment of operational risks inherent in all material activities, processes and systems become more complex in the presence of interlinking arrangements, as changes in one system may have an impact on the smooth functioning of the interface between systems. Different time zones and limited overlapping hours can exacerbate this issue by limiting the time window for testing, implementing and releasing changes once the arrangement is established.

6.10 Misaligned information security protocols, policies and requirements

Ensuring data confidentiality and promoting data integrity in interlinking arrangements are essential. Uneven security measures may cause spillover risks from less secure to more protected systems, eg due to corrupted clearing and settlement data in interlinked systems. The reliance of interlinking arrangements on different types of legacy and emerging technologies, and in some cases the possible introduction of new third-party technology service providers, may increase operational and cyber risk on a cross-border level.

7. Interlinking arrangements: factors and components for consideration

This section outlines a framework of the factors and components that jurisdictions could consider when exploring the possibility of pursuing interlinking arrangements to improve cross-border payments. Some of these aspects and practical perspectives may also apply to interlinking arrangements on an ongoing basis. A set of related key guiding questions can be found in Annex 3.

7.1 Factors that enable interlinking

7.1.1 Strategic and political factors

For cross-border interlinking to be successful, the support of relevant public and private sector stakeholders for an appropriately designed interlinking arrangement in their respective jurisdiction is important.

Factors and practical perspectives to consider include whether:

- Relevant public and private sector stakeholders generally support interlinking as a concept and, based on a careful analysis of the market and the jurisdiction's particular needs, have determined that interlinking arrangements are an effective solution for enhancing cross-border payments.
- The respective interlinking arrangement aligns with domestic policies, is compatible with the relevant legal, oversight and regulatory landscape, and would have broader political support.
- Relevant public and private sector stakeholders support the interlinking arrangement and have a common understanding that it responds to the needs of the jurisdictions concerned, and its design appropriately reflects relevant market features.
- Central banks and relevant authorities have considered how to appropriately address any unintended consequences, such as risks to monetary sovereignty and financial stability, which could arise from interlinking.

7.1.2 Legal, regulatory and oversight factors

The relevant legal, regulatory and oversight underpinnings for an interlinking arrangement are important to consider given the cross-jurisdictional nature of these arrangements.

Factors and practical perspectives to consider include whether:

- The respective overseers of payment systems have determined that interlinking complies with the oversight principles, expectations and requirements of the relevant jurisdictions before such an interlinking arrangement goes in production.
- Applicable legal, regulatory and oversight frameworks address all relevant risks and provide for a strong, clear and transparent basis that is enforceable in all relevant jurisdictions as well as adequate protection for all stakeholders involved.
- These frameworks clarify the service and security requirements that their respective payment systems must meet, as well as their obligations to their participants and the linked systems.
- These frameworks provide a sound oversight approach and ensure effective cooperation between the relevant authorities, domestically and internationally (for example, by outlining the applicable oversight expectations for the respective payment systems and their interlinking arrangements to mitigate related risks).

- Legal certainty is achieved in an interlinking arrangement, eg if relevant regulatory and oversight authorities address inconsistencies in the applicable laws and if regulatory frameworks and payment system operators address inconsistencies in payment system rules applicable to linked systems.²⁸
- Oversight arrangements are sufficiently comprehensive to cover any functionalities of the interlinking arrangement that are outsourced to external providers or any intermediaries, in particular with regard to critical or important functions.²⁹

7.2 Components of interlinking arrangements

7.2.1 Planning and business components

It is important to consider whether there is a clear and sustainable business case for establishing the interlinking arrangement.

Components and practical perspectives to consider include whether:

- The connectivity model selected for the interlinking arrangement is scalable and aims to maximise value by planning with scalability in mind.
- There is active collaboration between payment system operators and their participants to reduce the costs of participation in the interlinking arrangement, including by ensuring that the running costs of the connectivity infrastructure are kept to a minimum, and that these savings thereby translate into competitive end user fees.
- Participant and transaction fees are designed to ensure fair access and encourage participation in the interlinking arrangement. Other considerations include whether fee models encourage innovation and promote competition among (existing and future) participants in the interlinking arrangement, and whether the related service charges incentivise usage and maximise competitiveness.
- The features and functionalities of domestic payment systems are extended via the interlinking arrangement to promote adequate participation by banks and other PSPs and encourage user adoption, as integral elements for the sustainability of a cross-border interlinking arrangement.
- Steps are being taken to engage and secure the involvement of partnering jurisdictions' banking and payments community.

7.2.2 Access and governance

The rules and risk management measures, including those for access and governance, are important to consider, given the cross-system and cross-jurisdictional nature of these arrangements.

Components and practical perspectives to consider include whether:

- Payment system operators interested in establishing a link have engaged in consultation with relevant authorities and other stakeholders to develop rules and a comprehensive access framework that is clear and transparent for potential participants and that can ensure cross-border links are consistent with domestic payment scheme rules.

²⁸ Stakeholders can refer to BB 4 work on the alignment of regulatory, supervisory and oversight frameworks.

²⁹ Such as those whose failure or discontinuance of which would pose a threat to financial stability, result in a material loss of revenue, profit or have a significant adverse impact on the operator itself or its customers.

- Access criteria enable access to a broad range of players in relevant jurisdictions and take into account proportionate risk-based aspects to protect the interlinking arrangements and the broader interlinked systems against risks stemming from misaligned access rules.³⁰
- An interlinking arrangement supports an efficient governance structure that provides for participation rules that promote appropriate representation of all relevant stakeholders, including fair and transparent voting rules as well as dispute resolution mechanisms.

7.2.3 Agreed service levels and scheme rules

Service levels and scheme rules, including how they define the minimum operational and technical requirements agreed between the interlinked payment systems for payments processed via the interlinking arrangement, are important considerations.

Components and practical perspectives to consider include whether:

- Service level agreements (SLAs) and schemes support end-to-end STP of cross-border payments and ensure consistent rules between cross-border and domestic arrangements to facilitate the processing of the initial or final leg of a cross-border payment.
- Ad hoc and common schemes, rules, protocols, procedures and technical standards are established to complement the SLA between interlinked payment systems, depending on the interlinking back-end arrangement and level of integration.³¹
- All relevant stakeholders are consulted in the process of specifying the features covered by the SLA and/or scheme.

7.2.4 General operations

Considerations for the timely processing and settlement of payments in the interlinked systems, and how the arrangement can facilitate secure, reliable, fast and cost-effective cross-border payments can affect the smooth functioning of an interlinking arrangement.

Components and practical perspectives to consider include whether:

- The interlinking arrangement aligns clearing and settlement rules and processes, provides for ancillary services and/or clarifies how it handles remaining differences.
- The chosen clearing and settlement model serves the objectives of the interlinking arrangement, as well as the needs of participants and the relevant policies.
- The chosen settlement model takes into account the relevant legal considerations (for example, finality might be defined differently in two participating jurisdictions) and risk considerations, particularly FX risk management.
- Any overlap in RTGS operating hours has been considered, given that final settlement in the central bank money of interlinked jurisdictions may be unavailable during certain times, which can give rise to liquidity and settlement risks. This includes interlinked FPSs that operate 24/7 but rely on an RTGS

³⁰ Each jurisdiction sets its own access rules and national authorities must decide for themselves the best approaches given their jurisdiction's particular circumstances.

³¹ Especially if a dedicated facility enables interoperability between interlinked payment systems

system that does not operate 24/7 for final settlement.³² Depending on the FPS configuration, there might also be limitations to its broad use for all types of cross-border transaction.³³

- Overlapping operating hours support operational reliability and smooth functioning of change management processes as they may be particularly important for the interlinkage of FPS that are 24/7 and settle in real time, and when transaction values increase and payment types broaden.
- Payment system operators can ensure appropriate staffing to support the establishment of interlinking arrangements, their ongoing operations (eg running and monitoring the arrangements as well as liaising with counterparts in the linked system), and to address operational issues (including out-of-hours).
- Ancillary services (eg for account validation, alias/proxy lookup services) can help to increase the speed, accessibility and user convenience of cross-border payments processed through the interlinking arrangement. The addition of these services could be considered to support a wider range of use cases, access channels and payment methods for cross-border payments. APIs may play a key supporting role for these value added services. In turn, these services may rely on additional infrastructure components (eg digital ID and digital resolution frameworks).

7.2.5 Financial risks and currency conversion

Potential financial risks arising from the interlinking arrangement are important to consider, particularly for an arrangement with a cross-currency conversion mechanism.

Components and practical perspectives to consider include whether:

- Interlinking arrangements are designed in a way that allows each of the interlinked payment systems to comply with the relevant regulatory and oversight standards, including those that are relevant to the management of financial risk.
- Payment system operators have identified and assessed all potential sources of risk arising from the interlinking arrangement, both prior to entering into an interlinking arrangement and on an ongoing basis once the arrangement has been established.
- Cross-currency interlinking arrangements use a payment-versus-payment (PvP) mechanism, where relevant. PvP arrangements should be well established in the interlinking arrangement's legal basis and enforceable in the relevant jurisdictions.
- Cross-currency interlinking arrangements take into account robust business continuity solutions for FX conversion services (eg through agreements with other cross-currency PSPs that are committed to step in if exceptional circumstances arise or in the event of central bank backstops).
- Cross-currency interlinking arrangements specify when and how the reference FX rates are chosen to ensure that the choice is based on risk and transparency as well as operational considerations.

³² But there are also cases where a FPS is not reliant on the RTGS system as such for final settlement. For example, in Australia a satellite RTGS system has been set up to enable the real-time settlement of FPS transactions..

³³ If the FPS has per transaction value limits, for example, these might limit its use to remittances and low-value cross-border retail payments.

7.2.6 Operational resilience

The operational resilience of interlinking arrangements is an important consideration, given the potentially broad reach of these arrangements and the potential impact of operational events on multiple jurisdictions.

Components and practical perspectives to consider include whether:

- Relevant payment system operators can identify and assess all potential sources of operational risk taking into account the type of link, the type of currency arrangement as well as the number of jurisdictions and systems involved, both prior to implementing interlinking and on an ongoing basis once the interlinking arrangement has been established.
- A high degree of consistency between operational resilience approaches, including business continuity management and disaster recovery plans, can be achieved since interlinking arrangements rely primarily on existing operational risk management frameworks to meet the operational resilience objectives established within each interlinked payment system.
- Clear procedures for implementing controls in interlinking arrangements are in place to mitigate operational risk, and to coordinate recovery and response actions in contingency situations, accounting for the risk tolerance and ability of each payment system to deliver critical operations through disruption.
- Appropriate cyber security and wholesale endpoint security measures are in place and aligned in order to prevent, detect, respond, contain and recover from incidents. Technical interfaces between systems can be designed with sufficient scalability to handle abnormal payments flows, or in case of an operational disruption.
- Change management policies of the interlinked systems take into account the added complexities that may arise in an interlinking ecosystem where (i) changes in one system may have an impact on the smooth functioning of the interface between systems and, thus, on the interlinking arrangement as a whole; and (ii) different time zones and limited overlapping may limit the time window available to test, implement and release changes (and address any deployment bugs).

7.2.7 Information and data exchange

Considerations for how to reduce development costs and shorten time-to-market of interlinking arrangements could include whether to adopt international technical standards, such as those for common messaging formats and APIs to support STP by increasing the automation of information exchange and AML/CFT processes, as appropriate.

Components and practical perspectives to consider include whether:

- Interlinking arrangements leverage international standards for cross-border data exchange, including for financial messaging and APIs to reduce complexities and costs, increase automation of AML/CFT tasks as appropriate, improve the interoperability between traditional banking data to avoid isolated systems and fragmented frameworks and optimise resources and output accuracy.
- Adoption of a harmonised ISO 20022 core message set with a common set of fields for cross-border payment messages could facilitate interlinkages and help to ensure payments-related data consistency across jurisdictions. International standards and implementation guidelines include those developed or currently being developed by industry-driven international standardisation working groups (eg the Payments Market Practice Group (PMPG)) and the CPMI.
- Adoption of APIs for interlinking can be based on common standards. While, in some jurisdictions and especially at the global level, these standards may not yet exist, some industry forums may already play a role in convening technical experts to develop such standards. Where this has not yet

occurred, authorities could consider whether it would be useful to convene such efforts in coordination possibly with authorities in other jurisdictions.

8. Conclusion

The correspondent banking model has traditionally enabled cross-border payments between distant corners of the globe, helping to overcome a general lack of interoperability between the world's payments systems. But the versatility and resourcefulness of this model may, in some cases, come at the expense of efficiency. Cross-border payments often involve long transaction chains, fragmented and truncated payments data, high costs of capital and weak competition. These frictions may negatively affect the speed, cost, access and transparency of cross-border payments, with the impact often being felt most acutely by end users. In recognition of these long-standing challenges, the G20 in 2020 committed itself to a multi-year programme to enhance cross-border payments and endorsed targets for cross-border wholesale and retail payments, as well as remittances, in 2021.

Against this backdrop, prospects for the direct interlinking of payment systems have increased in recent years as new payment systems have been put into operation, especially retail systems, leveraging the latest technologies and standards that provide for greater technical interoperability. In particular, payment systems are increasingly using APIs for a variety of payment functions and the ISO 20022 standard for messaging. Perhaps aided by these developments, more payment system operators intend to establish interlinking arrangements in the near term. The considerations underlying such payment systems are being driven by a range of potential benefits associated with interlinking, including shortening transaction chains, reducing transaction and funding costs, increasing payment speed and transparency, and improving competition in the provision of cross-border payment services.

Despite these potential benefits, operators and authorities considering the establishment of interlinking arrangements must plan for and carefully consider the associated challenges and risks and how these can be overcome. These may be related to limited political support, high start-up costs, divergent regulatory and oversight frameworks, misaligned access criteria, and differences in service level requirements. Financial and operational spillover risks can also be exacerbated by interlinking arrangements, if not appropriately managed.

In the light of the cost-benefit analysis that any such undertaking necessarily entails, this report seeks to assist authorities and payment system operators in their decision-making by providing a review of the interlinking arrangements, their benefits and challenges as well as a non-prescriptive, high-level framework for thinking about a number of foundational design, operational, policy and risk considerations for establishing interlinking arrangements. Ultimately, operators and authorities must consider their jurisdiction's unique circumstances in deciding whether an interlinking arrangement effectively serves the cross-border payment needs of its constituents.

For authorities and payment system operators who are either considering the establishment of links to other jurisdictions or adapting existing links based on the framework, action 3 under BB 13 calls for relevant bodies to provide technical assistance.

Finally, whether or not a payment system pursues an interlinking arrangement, greater harmonisation of financial messaging and data exchange standards can provide broad global benefits for cross-border payments, including through traditional correspondent banking channels. Multilateral efforts under the G20 cross-border payments programme to harmonise APIs and standardise implementation of ISO 20022 by payment systems are driven by this recognition.

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Annex 1 – Actions and milestones

The full actions and milestones for BB 13 and BB 15 based on the G20 roadmap and the progress made are listed below (FSB (2020c) (2021)). The dates for each milestone in the following table indicate the start and completion dates for the steps described in the milestone. For all actions in 2022: actions and dates are committed deliverables. The content of actions and the dates of milestones beyond end-2022 are indicative.

BB 13 - Pursuing interlinking of payment systems for cross-border payments

Action 1: Stocktake and analysis of existing and potential interlinking models and evaluation of the risks and benefits of each model

CPMI to conduct an analysis of and survey among selected central banks on existing/envisaged interlinking models, as well as relevant publications on interlinking models, including the pros and cons of the various models in relation to the identified frictions.

[Completed: May 2021. Findings formed the basis for the work on Action 2]

Action 2: Development and publication of a framework for interlinking

CPMI to develop and publish a framework for interlinking arrangements (both publicly owned and privately owned) for central banks and payment system operators considering links to payment systems abroad. The framework is likely to include the desirable end state, design, operational, policy and risk considerations.

[Completed: July 2022. Framework forms part of this report]

Action 3: Establishment of links between payment systems based on the framework

Relevant bodies to provide technical assistance to authorities and payment system operators considering establishing links to other jurisdictions or adapting existing links based on the framework.

From August 2022 onwards

BB 15 - Harmonising API protocols for data exchange

Action 1: Tech sprint to identify new applications of ISO20022 and APIs for data exchange to enhance cross-border payments

BISIH in cooperation with relevant stakeholders to host a tech sprint open to all developers and engineers working in financial sector to find ways to leverage ISO 20022 and APIs to enhance cross-border payments (including interoperability with formats not based on ISO 20022). [Joint effort with Action 1 of BB 14].

[Completed: March 2021. Hackathon information available [here](#)]

Action 2: Stocktake and analysis of existing message standards and protocols for data exchange supporting cross-border payments

CPMI in cooperation with relevant stakeholders to conduct in-depth analysis of existing messaging standards/existing protocols for information exchange in place for domestic and cross-border transactions, which will factor in building block 14, as well as the current initiatives on open banking and payment stacks.

[Completed: October 2021. Findings have been included in this report]

Action 3: Call for proposals for a set of harmonised APIs/API standards using (existing) API protocols for cross-border payments

CPMI in cooperation with relevant stakeholders (including data authorities), to call developers and engineers working in financial sector for proposals for a set of API standards that will utilise one of more of the (existing) protocols as appropriate to ensure interoperability of cross-border information exchange.

November 2021–June 2022

Action 4: Proof-of-concept implementation of API standards

BISIH in cooperation with volunteering operators to implement a harmonised protocol based on the framework and share their experience of the proof-of-concept or pilot. After assessing its effectiveness, possibly refine the arrangement and pursue implementation by operators who are volunteering.

April 2022–June 2023

Annex 2 – Pros and cons of different interlinking models vis-à-vis frictions in cross-border payment

Beyond the benefits and challenges discussed in this report, which are common to all the interlinking arrangements, the relationship between interlinking models and the frictions they affect can vary. The following tables show the current pros and cons of different interlinking models vis-à-vis frictions in cross-border payment according to the form of link, the type of payment system interlinked and the type of currency arrangement.

Pros and cons of different interlinking arrangements vis-à-vis frictions in cross-border payments: form of links

Table A2.1

Frictions in cross-border payments	Pros and cons		
	Single access point	Bilateral link	Hub and spoke
Fragmented and truncated data formats	Less incentive to establish harmonised message format across domestic systems	Interlinking arrangements can provide conversion among domestic message standards and incentives to establish harmonised message formats across domestic systems	
Complex processing of compliance checks	Interlinking of systems does not affect multiple or conflicting compliance requirements		
Limited operating hours	Entities providing access may warehouse payments from/to/within a jurisdiction and overcome mismatches of operating hours	Need to accommodate an operational window able to optimise time overlap	
Legacy technology platforms	Entities providing access bear adaptation costs and ensure a bridge	Building on existing platforms may facilitate a fast establishment of interlinking but may restrict the range of possible payment solutions	
Funding costs	The form of link (direct or intermediated) does not affect and is not affected by operational costs to sustain cross-border prefunding		
Long transaction chains	Transaction chain shortened but entities providing access to other systems can be regarded as correspondent banks	Transaction chain shortened	
Weak competition	Competition issues may arise if entities providing access compete with those entities to which they provide access	Enhanced competition (by reducing reliance on correspondent banking service providers)	

Pros and cons of different interlinking arrangements via-a-vis frictions in cross-border payments: type of payment system interlinked

Table A2.2

Frictions in existing correspondent bank arrangements for cross-border payments	Pros and cons		
	Wholesale payment system links	Retail payment system links	FPS links
Fragmented and truncated data formats	Interlinking interfaces can provide conversion among domestic message standards. Interlinking arrangements provide incentives to use international message standards for domestic systems		
Complex processing of compliance checks	Interlinking arrangements do not impact multiple or conflicting compliance requirements but:		
	Absence of timeouts may mitigate time constraints	Cutoff times may lead to the rejection of instructions whose compliance checks are not finalised	Timeouts may lead to the rejection of instructions when compliance checks take time
Limited operating hours	Maintenance windows and end-of-day procedures may limit operational overlapping	Batch processing, cutoff times and reliance on RTGS systems may restrict operational window overlapping	They can be operational 24/7/365, eliminating any mismatch of operating hours
Legacy technology platforms	Building on existing platforms may facilitate the establishment of an interlinking arrangement but also pose challenges in term of processing capacity		
	At least minimum degree of harmonisation is required	Legacy technology may create barrier to modify existing cutoffs and batch processing	Reliance on latest technology is likely to soften legacy constraints
Funding costs	High prefunding needs for real-time settlement of wholesale payments	Deferred net settlement, if envisaged, may reduce prefunding needs	Threshold to fast payments may reduce liquidity needs
Long transaction chains	All forms of interlinking shorten transaction chains regardless of the type of system interlinked		
Weak competition	All forms of interlinking enhance competition by reducing reliance on correspondent banking service providers regardless of the type of system interlinked		

Pros and cons of different interlinking arrangements vis-à-vis frictions in cross-border payments: type of currency arrangement

Table A2.3

Frictions in cross-border payments	Pros and cons		
	Single-currency	Multicurrency	Cross-currency
Fragmented and truncated data formats	The type of currency arrangement does not affect and is not affected by communication standards		
Complex processing of compliance checks	The type of currency arrangement does not affect and is not affected by the cost of compliance across borders		
Limited operating hours	Neither directly impacted by nor impacting the arrangements		Conversion mechanisms may make FX conversion faster
Legacy technology platforms	The type of currency arrangement is not related to these frictions		
Funding costs	Amount of prefunding reduced by compensation of payments from different jurisdictions	Prefunding in multiple currencies is required	
Long transaction chains	All forms of interlinking shorten transaction chains regardless of the currency arrangement		
Weak competition	All forms of interlinking enhance competition regardless of the currency arrangement		

Annex 3 – Interlinking arrangements framework: key guiding questions

Factors that enable interlinking (7.1)

Strategic and political factors (7.1.1)

- Have all the possible solutions to improve cross-border payments been taken into account before taking the decision to establish an interlinking arrangement?
- Are there any pressing factors (eg a rapid decline in correspondent banking network) that may prompt the interlinking of payment systems [as opposed to developing more time-consuming solutions such as a new multilateral payment platform]?
- Is interlinking the most viable solution to enhance cross-border payments (taking into account the economic and financial needs of the economic marketplaces involved)?
- Which of the models identified in the report best meet the need of the project?
- Does the arrangement adopt a model that is not covered in the framework?
- Does interlinking support the broader political agenda in terms of (i) regional integration/cooperation; (ii) meeting the cross-border payment targets for certain corridors; (iii) central banks' and other authorities' policy stance; and (iv) de-risking?
- Have the costs and benefits of the interlinking arrangement (as well as their allocation among the stakeholders) been properly identified?
- Are there any third parties needed in the establishment or operation of the links?
- Are the operators of the interlinked payment systems or their critical service providers able to manage the potential increase in traffic, risk, incidents and reporting that may come with interlinking?
- Can any relevant risks to monetary sovereignty or financial stability be appropriately addressed?

Legal, regulatory and oversight factors (7.1.2)

- Is the legal basis of the interlinking arrangement enforceable in all the relevant jurisdictions? Does the legal framework applicable to the interlinking arrangement and to the linked systems provide certainty for each aspect of the arrangement functioning in all relevant jurisdictions? Are the rules, procedures and contracts governing the interlinking arrangement clear, understandable and consistent with relevant laws and regulations?
- What are the legal risks stemming from the interlinking (eg in terms of participants' default, settlement finality, netting, enforcement of collateral provisions, AML/CFT, fraud controls and data privacy requirements)? How are such risks assessed and identified? How can they be mitigated?
- Are there any inconsistencies/misalignments in the legal and regulatory frameworks (eg insolvency frameworks) in the jurisdictions involved?
- Do currency regulations allow/impose restrictions on the trading of domestic currency across borders?
- Do laws and regulations (eg location policy) limit the set of possible designs for the interlinking (eg single access point models through which foreign entities can only participate via a domestic access point in on-shore systems)?
- Is there a risk stemming from different legal and regulatory regimes (eg applied to the participants in the interlinked systems) and system rules that may result in different risk profiles and give rise to transmission of risk from one system to another through the interlinking?
- How is oversight organised and carried out?

- Can the links be overseen based on existing oversight principles that are applied to the systems concerned? If no oversight framework is applicable to the interlinking arrangement, does one need to be designed specifically? If a new framework needs to be designed, how can proportionality and avoidance of duplication be embedded?
- Is there a need for a cooperative oversight arrangement or can the oversight responsibility be assigned to only one of the relevant authorities?
- What are the additional risks associated with the link? In the case of multiple links, has the system ensured that the risks generated in one link do not spill over and affect the soundness of the other links and linked systems?

Components of interlinking arrangements (7.2)

Planning and business components (7.2.1)

- What are the use cases for the interlinking arrangement? Who are the expected users?
- Is the interlinking arrangement economically sustainable?
- What are the other critical success factors for the interlinking arrangement?
- Can the interlinking arrangement be established within a reasonable timeframe?
- Are key stakeholders (eg banks and other PSPs) supportive of the interlinking arrangement?
- Do the features and functionalities of the interlinking arrangement complement those of the domestic payment systems?
- Could a feasibility study, proofs-of-concept and/or pilot exercises be done before embarking on larger-scale connectivity exercises?

Access and governance (7.2.2)

- How can interlinking arrangements establish rules and a clear and transparent access framework that allows a wide range of cross-border payment service providers to participate?
- What should be the minimum content in those access rules for interlinking arrangements?
- Which are the key stakeholders that should be engaged in the drafting of these access rules? What kind of representation should they have in the proposed governance structure of interlinking arrangements?
- How can national regulators work together to overcome differences in domestic regulatory frameworks when analysing options to support a common set of rules for participants in interlinking arrangements?
- What are the key access requirements for participants in interlinking arrangements that could be subject to alternative standards vis-à-vis those applicable to domestic payment schemes?
- How can domestic operators implement a dual set of standards when participating in interlinking arrangements while at the same time continuing to process domestic transactions?
- How can interlinking arrangements support a strong and efficient governance structure?
- Which dispute settlement options could be explored to support stakeholder needs in interlinking arrangements (eg when consensus cannot be achieved by the agreed governance models)? How could these options resolve differences in the legal framework when stakeholders operate in different jurisdictions?

Agreed service levels and scheme rules (7.2.3)

- What are the types of transaction and the respective payment instruments in each jurisdiction that the interlinking project will involve?
- Are there any gaps, differences and inconsistencies that may hinder the correct processing of cross-border payments?
- How do domestic schemes tackle the processing of cross-border payments?
- Are there any inconsistencies between the scheme rules and the SLA covering the interlinking arrangement?
- To what extent do the provisions of the schemes that would be involved in cross-border payments in each jurisdiction differ?
- Based on the above gap analysis, what is the feasibility of setting up a common scheme to support such transactions?
- What would be the payment system rules and technical standards on which the parties could agree?
- How would it be ensured that all relevant stakeholders make the necessary adjustments to ensure compliance with the established new rules?

General operations (7.2.4)

- How is clearing and settlement organised?
- Are there any inconsistencies in the clearing and settlement process of the interlinked systems?
- How complex is the clearing and settlement process?
- What are the costs related to clearing and settlement? Does the clearing and settlement process meet the needs of the interlinked systems and of their participants, and the objectives of the interlinking arrangement?
- Which is the settlement asset used in the interlinking arrangement?
- What are the additional complexities to consider when designing/defining a settlement model for the clearing and settlement of cross-currency transactions?
- Is the overlap of operating hours consistent with the business and operational objectives of the interlinking arrangement?
- Does the overlap of operating hours introduce additional risks and are they consistent with the risk appetite for the interlinking arrangement?
- Does the interlinking arrangement require an expansion of operating hours?
- Has the need for additional staff and training required to support the interlinking arrangement been addressed?
- What (ancillary) services does the interlinking arrangement identify as critical to increase speed, accessibility and convenience? How does the interlinking arrangement support these services? What are the constraints to developing these services?

Financial risks and currency conversion (7.2.5)

- What are the potential sources of credit and liquidity risk that may arise from the interlinking arrangement, and how would these risks be mitigated?
- Have all the potential sources of credit and liquidity risk arising from the interlinking arrangements been clearly disclosed to the system participants?

- Could the interlinking arrangement impair in any way the interlinked systems' ability to observe oversight standards and how?
- If the interlinking arrangement relies on a private intermediary/settlement bank, how are the relevant financial risks being mitigated?
- How is the final settlement of the payment in a currency linked to the final settlement of the payment in the other currency? Have all the potential risks been considered and addressed?
- Which currency model has been adopted (single, multi- or cross-currency)? Have all the relevant factors been considered (eg currency liquidity, FX volatility, market practices, quality of services delivered to the final users)?
- In the case of cross-currency arrangements, who provides the FX conversion services? If the central bank provides the conversion, how does it recover the costs potentially stemming from FX mismatches? Have all the competition issues been addressed?
- If the private sector provides the conversion, what are the eligibility criteria (financial and operational) and the selection methods (private agreement, public tender)?
- If the private sector provides the conversion service, is there a sufficient number of current or potential conversion providers ensuring service availability, competition and business continuity? Is a business continuity plan (including the potential central bank step-in) in place in order to mitigate the risk of service been interrupted?

Operational resilience (7.2.6)

- Does the establishment of interlinking arrangements keep the payment systems involved compliant with the relevant regulatory and oversight standards, including the risk management and operational resilience framework?
- Are there any inconsistencies in the existing risk management frameworks and the operational resilience of the payment systems to be interlinked that would prevent them reaching the necessary degree of harmonisation?
- Are there obstacles that might stand in the way of cooperation between the operators of the respective payment systems as they seek to implement a consistent operational resilience approach?
- How would it be ensured that all relevant payment system operators make the necessary adjustments to ensure the desired level of harmonisation between operational resilience frameworks?
- What is the feasibility of setting a common operational resilience framework for interlinked systems?
- To what extent does reliance on a single or a small number of common agent(s) to link multiple jurisdictions/systems affect the current rules and operational procedure setup within the involved payment systems?
- What are the operational reliability objectives of the interlinked systems? What are the policies in place that are designed to achieve those objectives?

Information and data exchange (7.2.7)

- What are the peculiarities of the relevant domestic message and data formats (eg message customisations, policy/security requirements) that can be considered as main barriers/challenges to the adoption of the new standard to ensure consistency of messages and data for payments across jurisdictions?
- Is the adoption of the harmonised ISO 20022 standard feasible?

- What communications protocols (eg APIs, xml message) best serve business requirements related to cross-border payments? In which way?

Annex 4 – CPMI Workstream compositions

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Ilaria Mattei and Alexandra End (both BIS) provided data support to the workstream.

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** The access of the Central Bank of the Russian Federation to all BIS services, meetings and other BIS activities has been suspended.

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Ilaria Mattei (Bank for International Settlements) provided data support to the Workstream.

* Member of the drafting team.

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Annex 5 – Acronyms and abbreviations

ACH	automated clearing house
AML	anti-money laundering
API	application programming interface
B2P	business-to-person
BIC	Business Identifier Code
BIS	Bank for International Settlements
CFT	combating the financing of terrorism
CPMI	Committee on Payments and Market Infrastructures
CPSS	Committee on Payment and Settlement Systems
DNS	deferred net settlement
FMI	financial market infrastructure
FPS	fast payment system
FX	foreign exchange
gpi	global payments innovation
IMF	International Monetary Fund
ISO	International Organization for Standardization
LVPS	large-value payment system
P2G	person-to-government
P2P	person-to-person
PFMI	Principles for Financial Market Infrastructures
PSP	payment service provider
PvP	payment-versus-payment
RPS	retail payment system
RT	real-time
RTGS	real-time gross settlement
SCT Inst	SEPA Instant Credit Transfer
SEPA	Single Euro Payments Area
STP	straight through processing
TIPS	TARGET Instant Payment Settlement
SWIFT	Society for Worldwide Interbank Financial Telecommunication
WPS	wholesale payment system