

Interoperable Payment Systems and the Role of Central Bank Digital Currencies

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Abstract: I explain the meaning of an interoperable payment system and why interoperability is crucial for efficiency. I review some alternative approaches to interoperability, including central bank digital currencies (CBDCs), hybrid CBDCs, and two-ledger upgrades of bank-based payment systems.

Keywords: Digital currency, payment system, interoperability

1 Introduction

Innovative payment technologies are transforming monetary systems, commerce, and banking. When new payment systems lack interoperability with each other or with important legacy payment systems, however, the result can be highly inefficient. Whether customer-to-business, business-to-business, or peer-to-peer, user costs and delays rise with the multiplicity of non-interoperable payment methodologies. Infrastructure costs grow. Complexity increases. Financial intermediaries and financial market infrastructure may lose significant netting of inflows against outflows when using weakly interoperable payment systems, and may therefore require inefficiently high cash buffers.

In this short note, I explore the essential meaning of interoperability and its implications for innovative payment systems, including hybrid or synthetic CBDCs. For brevity and focus, I abstract from [many important policy factors](#) such as financial inclusion, privacy, anti-money laundering and other legal issues, competition for payment services, monetary policy transmission, financial stability, and disruption of banking franchises.

While market forces associated with scale and network economies create incentives for convergence onto common or interoperable payment platforms, there are also “walled-garden” incentives for firms to limit interoperability, sacrificing payment-system efficiency in order to raise customer switching costs. Further, interoperability tends to be a public good on which individual market participants can free-ride, an additional cause of under-investment. This situation presents an opportunity for central banks and other official-sector players to regulate standards for interoperability, or to provide their own general-purpose payment systems.

When every agent in the economy makes and receives payments in a common safe digital currency, interoperability is more easily achieved. For example, with a general-purpose CBDC in the form of central bank deposits, interoperability is dramatically simplified. Alternatively, with a CBDC held on ledgers operated by private-sector payment service providers, the central bank can enforce standards for maintaining interoperability. Yet the introduction of a CBDC raises a host of tradeoffs that have caused central banks to hesitate. Among these concerns are the [disruption of the legacy commercial banking sector](#) and the responsibility of the central bank for monitoring the legality of transactions and for securing private information. I will outline alternative feasible approaches for a highly interoperable and efficient payment system.

2 The meaning of interoperability

To get at the meaning of interoperability, we can think of a payment system as a collection of multi-account ledgers that record the funds available to account holders. Each ledger is capable

of instant transfers of funds between any two accounts on that ledger. Two different ledgers are interoperable if there is always at least one intermediary holding accounts on each of the two ledgers that automatically meets legal requests to transfer funds from any account on one of the ledgers to any account on the other. For example, a request to transfer from an account on ledger A to an account on ledger B is met by a transfer from the source account on A to an intermediary's account on A , and an equal transfer from the intermediary's account on B to the destination account on B . For interoperability to be effective at supporting payment system efficiency, transfers should be done at negligible or nearly negligible latency and user cost. The definition of interoperability is extended by calling two different ledgers interoperable if they are elements of a network of interoperable ledgers.¹

A conventional two-tiered bank-based payment-system, as depicted in Figure 1, offers a degree of interoperability. The inner tier consists of a central bank (CB) and banks b_1, b_2, \dots, b_n holding deposit accounts at the central bank. In the inner tier, banks make most of their payments to each other by transferring deposits held in their accounts at the central bank. The outer tier consists of the banks and their customers, c_1, c_2, \dots, c_k , who direct payments from their own bank accounts to accounts at other banks. The account ledgers of two different banks are thus interoperable via an inner-tier settlement system, such as [Fedwire](#) in the U.S. or the [Eurozone's Target2](#). In practice, however, the degree of interoperability is reduced, often significantly, by user costs and fees of various types, significant latencies (often more than a day), and limited time-of-day access. Some payment system authorities, including those of the United Kingdom and the Eurozone, have reacted by introducing "fast payment systems" that offer almost instant transactions, around the clock, with extremely low user fees. Still, however, fast payments are not dominant in the U.K. and the Eurozone, and are in a much earlier stage of development in the United States.

A CBDC that is based on central bank deposit accounts for every user has only one ledger. With a broadly used CBDC, interoperability is therefore not an issue, given the relative ease of arranging for low-cost instant transfers across the entire economy.

Alternatively, a high degree of interoperability can be achieved by upgrading a conventional two-tiered bank-account-based payment system, of the sort depicted in Figure 1, by introducing a single common account ledger for the customer accounts of all banks in the system. This single outer-tier ledger is interoperable with a single inner-tier ledger, containing the accounts of all banks at the central bank. In this [two-ledger system](#), each bank is responsible for meeting its own deposit liabilities and is able to observe only the account information of its own customers. Although this two-ledger approach has not yet achieved significant adoption, it is

¹A network is a connected graph. In our setting, the nodes of the graph are multi-account ledgers and the links are defined by pair-wise interoperability.

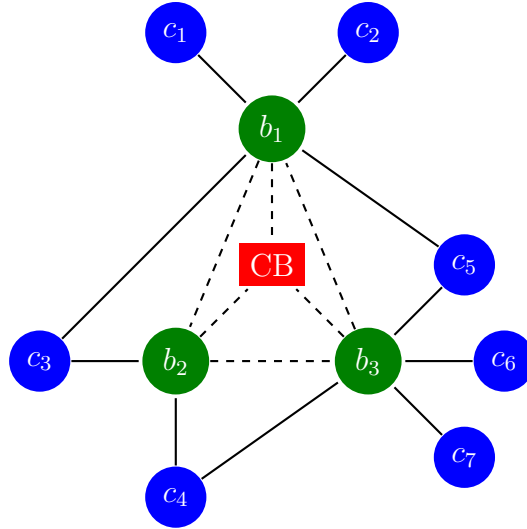


Figure 1: A schematic of a two-tiered payment system. The inner tier consists of a central bank and banks. Banks make most of their payments to each other by transferring reserves held in their deposit accounts at the central bank. The outer tier of the payment system consists of banks and their customers, who can direct payments from their own bank accounts to the bank accounts of others.

already technically feasible and seems to satisfy the criteria of central banks that wish to improve the efficiency of their payment systems while maintaining a bank-account-based payment system architecture, thus avoiding a general-purpose CBDC.

3 Interoperability with CBDC

Until now, most central banks have shied away from providing CBDC directly to everyone in the economy. But there have been serious prototypes and proposals for “hybrid” or “synthetic” CBDC, by which private-sector actors would be responsible for payment services associated with one or more digital currencies backed by the central bank. Of the proposed variants of this model, two are prominent:

1. The central bank issues CBDC “tokens” to one or more payment service providers who redistribute the tokens to a broad set of customers, along with payment apps and other infrastructure. The CBDC tokens are analogous to paper currency, as direct claims on the central bank, but are transferred electronically. Token holdings are recorded in ledger accounts maintained by the central bank or by payment service providers. The payment service providers could be banks or technology firms. Interoperability requires that all actors in the economy are able to seamlessly transfer the CBDC to each other, implying a common payment technology or strong standardization. [The Peoples Bank of China has begun to test a related form of CBDC](#) called DC/EP (digital currency/electronic

payment). [The Bank of England has published design principles](#) for a similar approach to CBDC.

2. As an alternative, which [Adrian and Mancini-Griffoli \(2019\)](#) call “synthetic CBDC,” payment service providers can be permitted to back their own private-sector digital currencies 100% with deposit accounts at the central bank. In effect, each of the resulting private-sector digital currencies takes the form of narrow payment-bank deposits.² In this case, interoperability requires not only interoperable payment technologies, but also perfect fungibility of the various resulting private digital currencies. This raises additional technical challenges that deserve a lengthier discussion.

4 Final Remarks

Fast highly interoperable payment technologies of some form are very likely to dominate some major economies within the next decade. These new technologies will be based on next-generation bank-account-based payment systems, central bank digital currencies, or some hybrid or synthetic form of CBDC.

Most developed-market central banks continue to show a preference for increasing the efficiency of bank-account-based payment systems over the deployment of CBDCs, but have also become more open to discussing the potential benefits of the introduction of a CBDC.

²I am a member of the board of directors of a proposed narrow bank, TNB Inc., which is not a payments narrow bank.