

# Implementation of real-time settlement for banks using decentralised ledger technology: policy and legal implications

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*A wave of innovation is occurring in financial technology, affecting products and services offered to consumers and businesses as well as financial market infrastructures such as payment and settlement systems. These innovations taken together have the potential to vastly lower the cost of financial transactions, resulting in a qualitative shift analogous to the advent of the Internet in the 1990s, supporting international financial inclusion and enhancing global systemic stability. The authors refer to both the current set of innovations bringing about the shift they describe, as well as future innovations built on these new technologies, as the Internet of Value (IoV).*

*Just as the internet ushered in an era of rapid innovation, economic growth and productivity gains, the potential promise of the IoV includes greater prosperity, financial access, stability and further innovation; however, appropriate industry, regulatory and policy support will be needed in order to achieve this promise.*

*This article examines one recent financial innovation, decentralised ledger or blockchain technology, and considers the legal and policy ramifications of one of its most widely-discussed use-cases: real-time settlement in bank-to-bank payments. Authors' analysis focuses on two elements, trust and coordination, both of which are fundamental to current payments laws and rules. Decentralised ledger technology replaces certain operational and even legal elements of the current payment system; yet trust and coordination continue to be relevant considerations. Creation and adoption of appropriate policy and legal frameworks are key to optimising the potential benefits of this technology.*

That a technology-driven revolution is occurring in the global financial sector is a commonplace, repeated so often its meaning has dulled. What is this “revolution” and where is it leading us? A series of innovations, including cloud computing; open protocols and application programming interfaces (APIs); and enhanced data storage, analysis and management capabilities, among others, have vastly reduced the time and cost of an individual financial transaction, with the potential for still greater efficiencies ahead. This quantitative shift in the cost of transacting has resulted in a qualitative shift: an explosion of new companies, incubators, initiatives, and innovation labs producing new products and services at an unprecedented rate, and aimed at a broader range of businesses and individuals than the industry ever attempted to reach in the past.

In this paper, we argue that the global financial industry is witnessing a change akin to the advent of the Internet in the 1990s. We refer to both the current set of innovations bringing about the shift we describe, as well as future innovations built on these new technologies, as the *Internet of Value* (IoV). The vision of the IoV is that value movement – financial transacting, writ large – will happen as seamlessly as information movement happens over the internet today.

Understanding the implications of a systemic shift like the advent of the IoV benefits from both a bird's-eye and a snail's-eye perspective. Without specificity, the IoV remains a mere conceptual generalisation, but without a higher level view, individual technical innovations lack context. For this reason, we consider some of the practical, legal and policy ramifications of IoV generally, but also through the very specific lens of how one innovative development is affecting one particular form of financial transaction, in this case the application of the Ripple protocol to bank-to-bank funds transfers in the cross-border context.

## II THE INTERNET OF VALUE

Just as the greatly reduced cost of information-sharing brought about by the Internet ushered in an era of rapid innovation, economic growth and productivity

gains, corresponding reductions in the cost of financial transactions through the development of the IoV will predictably bring wide-ranging changes to the global financial system. The potential promise of these changes include prosperity, financial inclusion, stability and innovation.

**Prosperity** – Lowering the cost and time of transacting reduces friction and creates the possibility for many more transactions, and thus greatly increased economic activity. The truism that lowered costs can lead to more transacting can seem unremarkable, so to arrive at a concrete sense of the IoV's potential to drive economic growth, it can be instructive to consider the impact of the advent of the internet on communication. In the United States, the use of first class mail peaked in 2001, when 103.7 billion pieces of mail were sent in a single year.<sup>1</sup> By contrast in 2014, global email traffic averaged more than 190 billion individual emails, every day of that year.<sup>2</sup> A parallel evolution in the financial world would imply an increase of several orders of magnitude in the global number of financial transactions. While we are still at the very early stages of the IoV, recent developments point to the likelihood of this type of increase: for example, following the partial implementation of the Faster Payment System in the United Kingdom, the number of non-cash transactions rose significantly.<sup>3</sup>

**Financial inclusion** – Changing the cost structure and creating new rails for delivering financial products can transform financially excluded individuals and entities into potentially valuable customers. To date, many financial inclusion initiatives have structured themselves as essentially charitable efforts. While many of these programs have made impressive strides in broadening the reach of financial services, in the absence of a profitable business model, such efforts are not self-sustaining and struggle or disappear without outside funding. After investing considerable research in the question, the Gates Foundation's Financial Services for the Poor has concluded that the most effective way to significantly expand the access of people in the world's poorest regions to formal financial services is through digital means.<sup>4</sup> By automating and reducing the cost of processes involved in the global provision of financial services, the IoV holds out the promise of greatly expanded, sustainable financial inclusion.

<sup>1</sup> United States Postal Service, *First class mail volume since 1926*, <https://about.usps.com/who-we-are/postal-history/first-class-mail-since-1926.htm>

<sup>2</sup> The Radicati Group, *Email Statistics Report, Executive Summary at 4*.

<sup>3</sup> See Greene et al. (2014), noting that significant increase in FPS volume did not result in decline in volumes of other non-cash payments.

<sup>4</sup> See Gates Foundation.

**Stability** – Greater participation in the global financial system by a wider variety of entities promotes systemic strength by reducing over-reliance on a small number of large entities. Policy makers are increasingly recognising the role that financial inclusion can play in supporting global financial stability.<sup>5</sup> Automating systems that were previously manual can also reduce operational risk on a systemic level.

**Innovation** – Lowered costs help create the conditions for the creation of new products and services, and just as industry participants and policy makers in the 1990s could hardly have predicted the advent of smartphones, GPS mapping applications or social media, we cannot know exactly how the IoV will evolve in the decades to come. What we can say with some degree of confidence is that exponential change in the global financial system's capacity to support transactions will likely fuel new sectors and industries. Already, innovations in-development that harness the IoV include applications for the integration of physical and technological systems (often referred to as the *Internet of Things*) that would permit functionalities such as enhanced collateral management and greater automation of trade finance; smart contracts that can streamline processes such as escrow arrangements and mortgage origination, and services such as payment account selection (e.g. paying with loyalty points).

We open this paper with a discussion of the promise of the IoV by intention. Its potential for expanded commerce, opportunity, economic growth and the prosperity it naturally brings about runs counter to the oft-repeated and, in our view, distorted narrative of “disruption”, “disintermediation” and “winners and losers” that often frames the public discussion of technological change in the financial services world. While it would be naïve to suggest that all players will inevitably benefit from technological change, the changes we are discussing are likely to result in a rapidly growing pie, with great potential rewards for those who engage skillfully with that change, be they established players or new entrants.

## 2| BLOCKCHAIN TECHNOLOGY AS A PAYMENTS MECHANISM

To consider the IoV in more concrete and practical terms, let us turn to one specific manifestation of

the global benefits of the IoV: the application of the Ripple protocol to bank-to-bank cross-border funds transfers. Despite rapid innovation in technology over the past several decades, cross-border payments remain a complex and imperfect experience. Fragmented payment systems limit interoperability, force reliance on a shrinking pool of intermediaries, and add costs and delays to settlement. By modernising the underpinnings of payments infrastructure, blockchain technology can reduce these structural inefficiencies and make instant, lower cost, and secure cross-border payment services accessible to a greater number of individuals and businesses.

### 2|1 The Ripple protocol as an example of blockchain technology

Simply put, blockchain technology is a decentralised ledger or shared public database that verifies and permanently records transactions. Transactions on this database are cleared using a *protocol*, or set of automated rules, rather than requiring a central counterparty to execute and confirm transactions. Protocols are widely used in maintaining the Internet, and most people interact with protocols on a daily basis. For example, email is sent using a protocol, SMTP, which directs the email message as it moves from the sender's outbox to the recipient's inbox.

At its heart, blockchain technology represents a mechanism for establishing trust among parties without the need for a single central authority trusted by all. The protocol developed by Ripple is one such example.

The Ripple protocol employs a shared public ledger that bilaterally clears and settles payments among banks and payment systems instantaneously. This ledger tracks the accounts and balances of participants, and new transactions are authorised and processed through a process called consensus, a process native to Ripple by which a collection of authorised counterparties validate transactions through a distributed network of servers. This process entails a supermajority of servers mutually agreeing that a transaction within the network is valid before

<sup>5</sup> See, e.g. Lagarde (2014), GPMI (2012) and Morgan and Pontines (2014).

updating the ledger.<sup>6</sup> Servers do so by employing cryptography to securely verify transactions. It is this process of consensus that enables fast and secure settlement through decentralised ledgers.<sup>7</sup>

## 2|2 Using blockchain technology to support cross-border payments

Traditional payment systems rely on trusted, central third parties to process payments securely. Trust is imperative for cross-border payments in particular, which call for multiple parties in different jurisdictions to take a series of coordinated actions. Blockchain technologies allow a payment system to establish trust and operate in an entirely distributed way, without traditional intermediaries such as correspondent banks. The Ripple protocol can be adapted to payment systems without necessarily involving the use of a digital currency, instead using fiat currencies (such as US dollar, euro, or yen) to settle cross-border transactions.

Suppose that Alpha Corp based in the United Kingdom wishes to make a payment of JPY 5,000 to Beta Corp based in Japan for products that it purchased and makes that payment by wire transfer. In a typical funds transfer, Alpha Corp (the originator) instructs its bank (Alpha Bank) to pay, or cause another bank to pay Beta Corp (the beneficiary). Thus, Alpha Corp and Beta Corp would be only two of the many parties to that payment. They likely would not share the same bank, and as a result, the transaction would also involve Alpha Bank and Beta Corp's bank (Beta Bank) and, if neither maintains an account with the other, even more intermediaries (adding still more parties). A foreign exchange transaction must also be executed, perhaps with a third-party foreign exchange dealer, in order for Alpha Corp's British Pound Sterling-denominated funds to be used to make a Japanese yen – denominated payment to Beta Corp. These parties must take a series of coordinated steps in order for the payment to Beta Corp to be made: each bank in the payments chain must credit the bank downstream and receive a credit from the bank

upstream. These debit and credit entries must offset each other such that at the end of the transaction, all that remains is the increased balance in the account of Beta Corp with its bank and the decreased balance in the account of Alpha Corp with its bank.

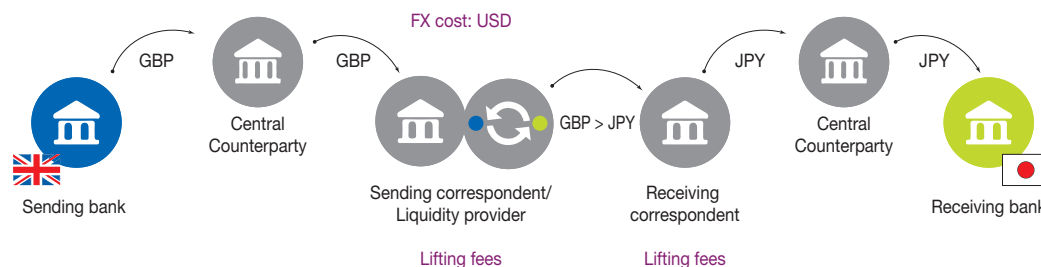
This coordination requires trust, which payment systems have achieved through trusted third party banks, namely common correspondent banks. In the example above, Alpha Bank and Beta Bank would rely on a third party with which they both maintain accounts to settle with each other. This reliance on a common correspondent bank, let's call it Sigma Bank, requires trust that Sigma Bank will, among other things, properly authenticate the transaction and perform appropriate checks (e.g. sufficient funds), credit Beta Bank's account and debit Alpha Bank's account at the right time and in the correct amount, and do this in a secure manner. More generally, Alpha Bank and Beta Bank trust Sigma Bank to maintain a ledger that represents the definitive record of their balance of funds and that Sigma Bank will maintain this record in a reliable, accurate, and honest way. At the heart of this well-established arrangement is a central ledger, with settlement taking place on the books of Sigma Bank.

Of course this trust and coordination take place against the backdrop of the laws and rules that apply to international payments. The legal landscape surrounding international payments reflects the fragmented state of the payments networks themselves. While efforts have been made to establish uniformity in payments laws, in today's existing cross-border payment networks, different bodies of law can potentially apply to a single transaction, activity, or counterparty, possibly resulting in the application of a law different from that specified in a contract. In response to commercial pressure for greater certainty and uniformity in the legal rules governing large-value international transactions, the United Nations Commission on International Trade Law (UNCITRAL) finalised a Model Law on International Credit Transfers in 1992 for nations to consider enacting. The European Parliament and the Council of the European Union issued a directive

<sup>6</sup> For a more detailed discussion of the mechanics around consensus, see Schwartz et al. (2014).

<sup>7</sup> Decentralised ledgers are not synonymous with the particular distributed ledger used by bitcoin, also known as the bitcoin blockchain, or by other digital currency protocols. For one thing, reliance on the process called proof of work (that is, "mining"), employed by the bitcoin protocol, is not necessary to validate transactions. Validation need not rely on mining, which consumes a great deal of computing power, to verify transactions, nor is the network's robustness related to the amount of processing power devoted to it.

Chart 1



Note: The diagram above depicts a cross-border payment transaction using the traditional correspondent banking network, with the arrows depicting funds moving from the sending to the receiving bank. As can be seen from the break points in the arrows, the process is sequential and fragmented. Multiple steps involving manual processes due to the lack of interoperability between payment systems add delay, cost and risk to the transaction.

based on the principles of the UNCITRAL Model Law in 1997 (and amended in 2007),<sup>8</sup> with the goal of promoting efficiency with respect to cross-border payments within the European Communities. On a subnational level, the fifty States of the United States of America formulated in 1989 the Uniform Commercial Code Article 4A, a comprehensive body of law with respect to the rights and obligations connected with funds transfers.

Blockchain technology can revolutionise the age-old funds transfer framework, replacing the need for the trusted third party bank (Sigma Bank) positioned between Alpha Bank and Beta Bank. Particularly given the fragmented and intermediated state of today's cross-border payment networks (as illustrated in Chart 1 above), a common global infrastructure would bring new efficiency to financial settlement, with direct benefits to international trade and financial inclusion.

Using the example above of a JPY 5,000 payment from United Kingdom-based Alpha Corp to Japan-based Beta Corp, Alpha Bank and Beta Bank would replace the trusted, central third party (Sigma Bank) with decentralised ledger technology. Alpha Bank and Beta Bank would use the Ripple protocol to simultaneously effect a foreign exchange transaction and payment transaction through any entity that maintains an account with both Alpha Bank and

Beta Bank (a liquidity provider).<sup>9</sup> This liquidity provider can be any one of the many institutional customers of Alpha Bank and Beta Bank, like a hedge fund or broker dealer, willing to act in this capacity and authorized by Alpha Bank and Beta Bank to do so. Alpha Bank would sell British Pound and purchase Japanese Yen from the Liquidity Provider at an agreed-upon exchange rate. Virtual currency such as XRP, could also be used as an intermediary asset to bridge any currency pair. Decentralised ledger technology would then be used as a payment-versus-payment system that allows Alpha Bank to both settle the foreign exchange transaction with the liquidity provider and settle its payment obligation to Beta Bank in real-time, with transparency and atomicity.<sup>10</sup>

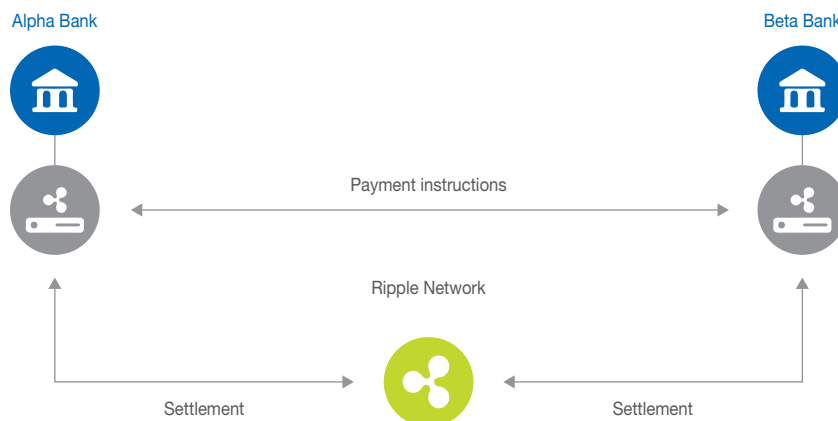
Just as with a transaction effected over the traditional correspondent banking network, described in the example above, this funds transfer would involve Alpha Bank debiting Alpha Corp's account on its books and Beta Bank crediting Beta Corp's account on its books. As between Alpha Bank and Beta Bank – instead of settling with each other through Sigma Bank, they will use the distributed ledger to coordinate certain account entries. Specifically, Alpha Bank would increase the balance it owes to the liquidity provider in the amount of British Pound it is selling to the liquidity provider and, at the same time, Beta Bank would decrease the balance it owes to

<sup>8</sup> Directive 97/5/EC of the European Parliament and of the Council of 27 January 1997 on cross-border credit transfers; Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market.

<sup>9</sup> It should be noted that unlike certain "trustless" blockchain protocols, Ripple incorporates trust in a number of ways. In this example, trust plays a role in that (1) a liquidity provider must be an account holder at both the sending and receiving banks in order to play its role in the transaction and (2) the Ripple protocol itself contains an authorisation feature which permits participants to specify the entities with which they are willing to transact.

<sup>10</sup> The term "atomicity" is a term used in the technology world to denote actions that are inherently linked. Unlike today's payments systems, which operate with delayed settlement and sequential processing, payments in Ripple are either fully and simultaneously settled in real-time or they do not occur at all.

Chart 2



Note: The diagram above depicts a cross-border payment transaction using the Ripple protocol. Unlike today's systems, which operate with delayed settlement and sequential processing, payments in Ripple are either fully and simultaneously settled in real-time or they do not occur at all – a process called atomic payments. This eliminates or reduces many of the risks that plague today's reliance on intermediaries for cross-border payments, including credit and operational risk.

the liquidity provider in the amount of the payment obligation (which is the amount of Japanese Yen that Alpha Bank had purchased from the liquidity provider). The Ripple protocol executes all of these transactions simultaneously. Alpha Bank and Beta Bank thus use the blockchain to communicate, coordinate, validate, and record their credit and debit to the liquidity provider's accounts.

### 3| POTENTIAL RISKS AND BENEFITS OF BLOCKCHAIN TECHNOLOGY IN THE CROSS-BORDER CONTEXT

In essence, this decentralised, cryptography-based payments solution cuts out the centralized common correspondent sitting between the originator's bank and the beneficiary's bank. In so doing, its overall effect is to reduce the risks inherent to any intermediated banking system. Blockchain technology eliminates the risk to Alpha Bank and Beta Bank that Sigma Bank may become insolvent with a large amount of money owed to its payment counterparties (credit risk) or not have the funds to settle a required payment at a particular moment in time (liquidity risk).<sup>11</sup>

By replacing dependence on a dwindling number of common correspondent banks with reliance on a diverse and robust network of many liquidity providers, blockchain technology also lowers systemic risk. The dependence of the world's financial system on a concentrated pool of private central counterparties heightens these credit and liquidity exposures arising from the existing intermediated system. The global financial system is particularly vulnerable in light of the recent “de-risking” trend in international banking – that is, the trend among certain banks to reject customers in risky regions and industries and terminate correspondent relationships with certain other banks they work with in globally sending money.<sup>12</sup> Rising costs and uncertainty about diligence requirements are among the main reasons cited by banks for this trend.<sup>13</sup> As a result, the number of banks with sufficient global reach to perform correspondent banking services is shrinking, with debilitating effects on global financial inclusion and access to international financial services.

In addition to reducing such credit and liquidity risk, blockchain technology mitigates systemic operational risk. Because blockchain technology is not dependent on a centralised party, it is more resilient to such risk. Centralised payment systems

<sup>11</sup> See Bank for International Settlements (BIS), Committee on Payment and Settlement Systems (CPSS) and Technical Committee of the International Organisation of Securities Commissions (TCIOSCO) (2012), *Principles for financial market infrastructures (PFMI)*, pp. 19, 36-45, 57-63.

<sup>12</sup> See Bank for International Settlements Committee on Payments and Market Infrastructures (2015).

<sup>13</sup> *Id.*

are susceptible to deficiencies in information systems or internal processes, human errors, management failures, or disruptions from external events that result in a reduction, deterioration, or breakdown of their settlement processes.<sup>14</sup> These operational failures may potentially lead to delays, losses, liquidity problems, and in some cases systemic risks and liquidity or operational problems within the broader financial system. In contrast, by virtue of being a decentralised ledger distributed across a network, Ripple and similar protocols inherently include a number of redundant backups as part of their core technology – possibly in the thousands, many more than a centralised payment system would typically operate. From a systemic risk point of view, blockchain technology has the potential to reduce risks to participants, fostering transparency and financial stability. A decentralised cross-border payments framework replaces the traditional hub-and-spoke model where a central counterparty's disorderly failure or inability to function as expected could lead to simultaneous systemic disruptions to the institutions and markets it supports. Particularly where cross-border payment services are concentrated among a small number of central counterparties for interconnected institutions and markets, these complex interdependencies raise the potential for disruptions to spread quickly, unexpectedly, and widely across markets.<sup>15</sup> In contrast, the blockchain connects all participant institutions to each other in a network, allowing each to promptly and effectively obtain a substitute for critical payments in the event that one fails. Moreover, the technology is designed to enable accessibility and promotes inclusiveness globally. Its neutral settlement structure supports and treats all currencies and participants equally regardless of size. The technology may also be integrated to interoperate with existing payment systems, reducing friction between participants and increasing efficiency. By giving institutions confidence to fulfill their payment obligations on time, even in periods of market stress and financial shocks, the blockchain can be an important source of strength in financial markets.

Of course, like any new technology, some residual uncertainty remains regarding the blockchain. There are always operational and technical risks

involved in integrating any new financial technology; however, the principal residual risk of decentralised ledgers lies in the application of relevant laws and regulations to transactions effected using this technology. Critical to a decentralised funds transfer framework is certainty and clarity as to the parties' rights and liabilities, including when certain rights arise and certain liabilities are extinguished.<sup>16</sup> As we have noted, cross-border payments currently take place in an environment that includes a certain degree of legal uncertainty. Absent a globally harmonised legislative or regulatory framework, private contract and private-sector payment system rules will fill the void at this time when blockchain technology remains new and adoption is at an early stage. However, the internationalisation and greater speed of commerce and finance brought about by the IoV will lead to commercial pressure globally for greater certainty and broader international harmony in the law governing these international transactions. This process of harmonisation will call for international participation and collaboration and, in the case of treaties and conventions, a national commitment to implement.

#### 4 | POLICY CONSIDERATIONS

The IoV needs the appropriate global policy, legal and regulatory framework in order to fulfill its promise in the most positive way. Currently, as governments are looking at manifestations of the nascent stages of the IoV, some are focusing on the risks of introducing new technology into the global financial sector, or considering what steps need to be taken to limit or control it. However, considering its potential for fostering prosperity, inclusion and financial stability, perhaps the greatest risk associated with the IoV is that discordant government action or global inertia could prevent it from fully meeting its potential.

We suggest that global leadership make use of historical precedent in considering policy questions raised by the IoV. The Internet originally came about as the result of the collaborative efforts of government, academia and the private sector, and in considering the IoV, policymakers can make good

<sup>14</sup> See BIS, CPSS and TIOSCO, PFMI, pp. 20, 94-100.

<sup>15</sup> See BIS, CPSS and TIOSCO, PFMI, pp. 9-10, 18.

<sup>16</sup> See BIS, CPSS and TIOSCO, PFMI, pp. 18, 21-25.

use of this model. Unlike the leaders of the 1990s who were dealing with the initial advent of a truly global marketplace, today's policymakers are not forced to write on a blank page. High-level policy efforts from that time that could provide useful models today include:

- Open standards

A pivotal element in the development of the internet was open standards. Open standards like HTTP and TCP/IP are the basis for the Internet as we know it.<sup>17</sup> Now in the area of global finance, open standards like Ripple hold out the promise that similar advances can come to the financial world.

Open standards present a host of potential benefits for the financial world. They ensure interoperability; they are key for connecting bank ledgers and payments networks that currently can't talk to each other. Open standards are also more robust than proprietary solutions, supporting greater security and fraud-prevention methods. Open standards support market competition and create an even playing field so that innovators can develop products with the greatest possible reach.

Open standards support the creation of stakeholder-based rulemaking, and to a large degree, the Internet has been successfully governed, where necessary, by private, non-profit stakeholder-based groups. While stakeholder-based groups are not the perfect solution in every case, they do have the flexibility and agility to respond relatively quickly to changes in technology and markets as compared with governmental bodies. Policy support for expanding the use of open standards to the world of financial transactions is a principal way in which global leadership can support the creation of a robust IoV.

- Policy principles for an appropriate legal and regulatory environment

We are at the cusp of a major change in the global financial industry, and a progressive harmonisation of global standards and rules is needed to realise the full potential of this wave of innovation.

Global participation and collaboration are needed for international commercial law to keep pace with the innovation occurring in financial technology. Contrary to being "disruptors," many financial technology companies like Ripple are committed to working hand-in-hand with international stakeholders to clarify and strengthen consensus around the fundamental principles that can guide future policymaking efforts. In this regard, a set of principles and policy discussions that took place in the early days of the Internet provide a useful starting point.

Global leaders came to recognise the potential for economic growth that the internet could bring, and the 1990s saw coordinated efforts by policymakers around the world to ensure that the Internet would support a global marketplace for the benefit of all participants. These efforts were formalised in a Bonn declaration on global information networks,<sup>18</sup> as well as what was known as the Framework for Global Electronic Commerce in the United States.<sup>19</sup>

The aim of that initiative was to create a legal environment for commerce globally that was simple, predictable, pro-competitive, and consistent. It led to concrete, constructive efforts such as legal recognition of e-signatures<sup>20</sup> and the creation of the Internet Corporation for Assigned Names and Numbers (ICANN),<sup>21</sup> that supported the growth of the global electronic marketplace that exists today on the Internet. The basic principles outlined in the 1996 global initiative remain excellent guideposts to draw on in creating a global legal and regulatory environment for the IoV.

## 5| CONCLUSION

The potential for the IoV to bring the global economy to a new level of financial inclusion, prosperity, and systemic stability presents inspiring possibilities. Enhancements the global financial system, however, can only be achieved with the support of an appropriately harmonised global policy framework. Now is the time for policymakers to consider how best to set the stage.

<sup>17</sup> See Ito (2009).

<sup>18</sup> See European Union (1997).

<sup>19</sup> See White House, United States (1997).

<sup>20</sup> See Uncitral (1996).

<sup>21</sup> See Department of Commerce, United States (1998).



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