WORLD TRADE ORGANIZATION

WORLD ECONOMIC FORUM

The promise of TradeTech

Policy approaches to harness trade digitalization

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The World Economic Forum is the international organization for public–private cooperation. The Forum engages the foremost political, business, cultural and other leaders of society to shape global, regional and industry agendas.

About the World Trade Organization

The World Trade Organization (WTO) is the international body dealing with the global rules of trade between nations. Its main function is to ensure that trade flows as smoothly, predictably and freely as possible, with a level playing field for all its members.

Acknowledgements

This publication is the result of a joint effort of the World Economic Forum and the WTO. The lead drafters and coordinators were Ziyang Fan and Jimena Sotelo of the Forum and Kian Cassehgari Posada and Emmanuelle Ganne of the WTO. A full list of the contributors and reviewers can be found at the end. The publication was edited and reviewed by Ross McRae of the WTO.

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FOREWORD

Technology has always propelled trade. From the invention of the steam engine and steamship in the 1700s, the popularization of the standard shipping container in the 1950s, and the rise of the internet in the 1990s, technology has over the centuries profoundly changed the way we trade. Today, emerging technologies and digitalization are changing trade at a speed much faster than before – leading to both opportunities and challenges.

The COVID-19 pandemic has shown that digital trade and commerce has become a staple for survival for small and medium-sized enterprises all over the world, while the application of autonomous technologies – from robotics to artificial intelligence – have contributed to the operation of ports and warehouses with minimal staffing during lockdowns. According to a World Economic Forum business survey, the adoption of TradeTech – the set of technologies that enables global trade to become more efficient, inclusive and sustainable – has helped to ease supply chain bottlenecks across different industries.

As TradeTech adoption is moving fast and is largely driven by the private sector, there is an urgent need for trade policymaking to keep pace. For trade to work for all, TradeTech adoption must happen in the most efficient and inclusive manner across the globe and for all members of society. The benefits of TradeTech on efficiency and sustainability are highly promising. However, uneven deployment due to regulatory fragmentation could result in unintended consequences of unequal growth, threats to cybersecurity and a growing trend in techno-nationalism.

Leveraging technologies for trade requires more than technological innovation. The major challenge might actually be international policy coordination and coherence. The right ecosystem needs to be in place to drive global adoption and scalability. Trade agreements can play a key role in this regard. Recent trade agreements and plurilateral initiatives have started to explore the interplay between technology and trade. Yet, further input and analysis are needed on issues such as electronic transferable records, automated contracts, digital tokens, the interoperability of data models, and the digital identity of legal and physical persons and of physical and digital goods.

This joint World Economic Forum and WTO publication aims to shed light in this area, providing public, private and civil society's inputs on the building blocks for TradeTech policy adoption: the 5 Gs of TradeTech. This publication builds on the "Trade for Tomorrow" call to action put forward by both organizations last year, to bring trade to a new speed for all.

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EXECUTIVE SUMMARY

The promise of TradeTech – the set of technologies that enables global trade to become more efficient, inclusive and sustainable – is multifaceted, from trade facilitation to efficiency gains and reduced costs, to greater transparency and resilience of supply chains. Of particular interest for this publication is the potential of artificial intelligence (AI), blockchain and distributed ledger technology (DLT) and the internet of things (IoT) to shape the global trade ecosystem.

Although the technological innovation exists, the major challenge to the global adoption of TradeTech will be building international policy coordination. Here, trade agreements can play a key role. Trade agreements are generally technology neutral, and many existing trade rules apply to digital trade. Yet, developing explicit rules will be needed to provide further legal certainty as to how they apply in the digital field. Trade rules can:

- prevent a fragmented technological environment by encouraging international regulatory cooperation and by promoting regulatory harmonization and coherence;
- prevent governments from introducing discriminatory measures favouring local providers or measures that are unnecessarily trade restrictive;
- ensure transparency of regulatory requirements and procedures;
- enhance market access;
- facilitate foreign direct investment, such as investments in information and communications technology (ICT) to fortify TradeTech adoption.

Since 2010, regional trade agreements (RTAs) have increasingly integrated e-commerce and digital trade provisions. Recent RTAs, such as the United States–Mexico–Canada Agreement, cover a wider range of e-commerce issues than previously, including a chapter on e-commerce and digital trade. Governments have introduced digital-only trade agreements, such as the Singapore–Australia Digital Economy Agreement (SADEA) and the Digital Economy Partnership Agreement (DEPA) between Chile, New Zealand and Singapore, which address a wide range of digital trade issues. Furthermore, more than 85 WTO members also participate in the Joint Initiative on E-commerce.

Despite these ongoing efforts, there remain many unseized opportunities and unexplored policies. According to public and private-sector experts, five building blocks (referred to in this publication as the 5 Gs of TradeTech) play a critical role in supporting trade digitalization and wide-scale adoption of TradeTech:

- Global data transmission and liability frameworks
- Global legal recognition of electronic transactions and documents
- Global digital identity of persons and objects
- Global interoperability of data models for trade documents and platforms
- Global trade rules access and computational law

Although some of the 5 Gs are commonly covered by trade agreements, unseized opportunities remain in connectivity, data sharing and e-signatures. Other 5 Gs are either not discussed in trade agreements or only in a few recent agreements, and include electronic transferable records, automated contracts, digital tokens, interoperability of data models, and digital identity of legal and physical persons and of physical and digital goods. These new policy frontiers can help to bring trade to a new speed, and work for all.

1 | GLOBAL DATA TRANSMISSION AND LIABILITY FRAMEWORKS

End-to-end trade digitalization requires global access to reliable, affordable and fast connections as well as a legal framework enabling data transmission across borders in a trusted manner.

Advanced technologies such as AI, blockchain and DLT and IoT require the development of ICT infrastructure and wireless technologies to enable continuous connectivity. In addition to access

to digital infrastructure, information, which can be personal, sensitive or confidential, needs to flow across borders while preserving the rights of individuals (e.g. privacy), companies (e.g. business confidential information) and governmental entities (e.g. data requests for law enforcement or regulatory purposes).

However, multiple challenges need to be addressed to allow the development of a global data transmission ecosystem, including closing the digital divide, promoting international standards and mutual recognition schemes relating to cybersecurity, addressing regulatory fragmentation, and clarifying or adapting liability frameworks. Closing the digital divide in terms of access, bandwidth and skills is more urgent than ever. International cooperation should also continue to foster regulatory convergence by promoting international standards and mutual recognition schemes relating to cybersecurity. The regulatory fragmentation across the world and sometimes even across different agencies within the same territory on how the content of data is regulated also limits the cross-border exchange of information for trade purposes. Similarly, private-sector practices by some entities to lock in data hinder the flow of information within and across borders. Lastly, given the complexity of advanced technologies and the multiplicity of stakeholders involved in their ecosystem, tracing back specific harmful actions to specific human input or to decisions in the design will be extremely difficult for an end-user without the (expensive) assistance of legal and technical experts. Large-scale TradeTech adoption will require liability frameworks to be clarified or adapted or new frameworks to be developed.

Trade agreements have contributed to the far-reaching changes of the telecommunications market, both hardware and software, since 2010. Multilateral, plurilateral and regional efforts highlighted in this publication should be further pursued by governments to foster global connectivity for all. These efforts include, *inter alia*, market access commitments in telecommunications services, adoption of the WTO's Information Technology Agreement (ITA), and integration of the net neutrality principle in domestic telecommunications regulation. The WTO's Technical Barriers to Trade (TBT) Agreement also promotes global regulatory coherence (via sharing and discussion of international standards at the pre-implementation stage) and global regulatory cooperation (via good regulatory practices, equivalence and mutual recognition) with respect to cybersecurity rules on equipment, infrastructure, and software-enabled and network-connected goods.

Trade agreements can also play a key role in fostering regulatory convergence and interoperability, and in facilitating the exchange of information and good practices in areas such as privacy, law enforcement and regulatory oversight, competition and data-sharing mechanisms. Trade agreements could be leveraged to promote regulatory convergence and international regulatory cooperation and to foster interoperability of mechanisms, thus enabling the cross-border exchange of information while preserving the rights of individuals, companies and governmental entities. International cooperation should also facilitate the exchange of information among governments for law enforcement and regulatory oversight purposes as well as among companies for competition and innovation purposes. Trade negotiators could leverage the political momentum created by the negotiation of trade agreements to move on reforming mutual legal assistance treaties with a view to maintaining trust and timely access to remedies across borders. Similarly, trade agreements could encourage governments to exchange best practices on data-sharing mechanisms to mitigate market distortions arising from abuses of market dominance in digital markets, such as data services lock-ins.

2 | GLOBAL LEGAL RECOGNITION OF ELECTRONIC TRANSACTIONS AND DOCUMENTS

End-to-end trade digitalization requires a legal framework supporting the cross-border legal recognition of electronic trade documents and transactions.

The large number of documents involved in international trade places a heavy burden on businesses seeking to trade internationally, in particular micro, small and medium-sized enterprises (MSMEs). Due to burdensome documentary processes, it can take days to transfer and process trade documents and payments. TradeTech offers new opportunities to facilitate trade processes and automate trade transactions to increase efficiency and operational cost savings while enhancing the security and integrity of information. For governments, transaction and document digitalization can also contribute to better revenue collection. However, the cross-border use

of electronic transactions and documents is limited. Some governments have not yet recognized the legal validity and enforceability of electronic means when used in trade transactions. Those who have recognized them do not necessarily share mutually recognized criteria.

Governments could leverage trade agreements to support the global recognition of electronic transactions and documents (i.e. e-signatures and trust services, electronic transferable records, e-contracts) and to coordinate regulatory approaches on new emerging issues such as tokenization and smart contracts to avoid regulatory fragmentation. International standards and guidelines, such as the United Nations Commission on International Trade Law (UNCITRAL) Model Law on Electronic Transferable Records (MLETR), provide a useful basis upon which governments can work towards regulatory convergence. Systematically including a commitment to support these international frameworks in trade agreements would go a long way in facilitating the digitalization of trade. The sooner governments coordinate their regulatory approaches with respect to new TradeTech applications, such as tokenization or smart contracts based on autonomous systems, the less likely these national regulatory approaches will result in regulatory fragmentation. Governments should recognize that global regulatory alignment is one step towards the cross-border use of e-signatures and trust services and, more generally, of electronic documents and transactions.

3 | GLOBAL DIGITAL IDENTITY OF PERSONS AND OBJECTS

End-to-end trade digitalization requires a global approach to digital identities of natural and legal persons as well as of physical and digital objects sending or receiving electronic information to avoid creating digital identity silos.

In a digital environment, authenticating users electronically is necessary to establish confidence in user identities whenever the user interacts with a paperless trade system. Identity and trust lie at the core of any trade transaction. The move towards digitalization has led to an increasing number of digital identity systems being developed. While such systems contribute to greater transparency and predictability of and trust in supply chains, they often do not communicate with one another, creating silos and high frictional costs.

Governments could use trade agreements to avoid divergence of digital identity systems relating to legal and natural persons by leveraging international initiatives, setting up minimum identity attributes, and encouraging the development of a global certification framework. In particular, governments could leverage international initiatives aimed at fostering mutual recognition of identifiers and attributes, such as UNCITRAL Working Group IV (Electronic Commerce) on digital identity and trust services or the World Wide Web Consortium (W3C) Verifiable Credentials Data Model. They could lead by example by setting up a minimum level and type of business data (or identity attributes) that would be made accessible to all parties involved in real time and on demand. Trade agreements could encourage the development of a global certification framework whereby accredited digital identity operators would issue globally recognized digital identities.

With respect to physical and digital objects, governments could use trade agreements to promote the use of open, global standards for product identification linked to product classification systems, and encourage customs authorities to agree on a standardized treatment of IoT devices. Linking product identification systems with product classification systems, such as Harmonized System (HS) codes, could also prove very powerful and provide the global trading system with more information about products moving across borders and with new functionalities. To guarantee traceability of objects, trade agreements could also encourage customs authorities to agree on a standardized treatment of IoT devices to promote their use throughout supply chains.

4 | GLOBAL INTEROPERABILITY OF DATA MODELS FOR TRADE DOCUMENTS AND PLATFORMS

End-to-end trade digitalization requires common definitions and structures of data to understand information exchanged across borders in the same way and to ensure interoperability between platforms.

For parties to seamlessly exchange electronic data and documents in a digital environment, all information needs to be clearly defined and unambiguous. Reaching agreement on both the semantic content (i.e. data definitions) and the syntax of data (i.e. data structure or format) is critical to ensure trading partners wanting to exchange information all understand the information in the same way. It is critical to ensure interoperability between platforms as well. Various platforms being developed, be they private-sector-driven in areas such as trade finance, transportation or national single windows (NSWs), follow their own rules and still often operate in isolation. Building bridges between the various platforms or developing common cross-sectoral or cross-jurisdictional approaches is needed to enable global flows of electronic data and documents.

Governments could leverage trade agreements to promote the use of existing semantic libraries, support the development and interoperability of data models for trade documents, and encourage interoperability of single windows. Both the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and the World Customs Organization (WCO) have developed semantic libraries ("what means what"). Priority now needs to focus on promoting a much wider use of these existing semantic libraries to reach a critical mass of users. Further cooperation is also needed with respect to data models (the syntax). Many initiatives are underway to develop data models for trade documents, but they often evolve in silo, thereby undermining standardization efforts and in turn the exchange of electronic trade information. Trade agreements could support interoperability of data models for trade documents by encouraging the use of existing international guidelines and standards. Trade agreements have thus far encouraged the use of standards only for a limited number of trade documents, namely e-invoicing and e-certification for agricultural commodities. In the absence of guidelines or standards, trade agreements could encourage governments to accelerate standardization efforts at the global level. Trade agreements should recognize the critical issue of interoperability between NSWs. While many trade agreements, including the WTO's Trade Facilitation Agreement, support the use of NSWs to expedite the movement, release and clearance of goods, only a small number of recent trade agreements address the issue of interoperability between NSWs.

5 | GLOBAL TRADE RULES ACCESS AND COMPUTATIONAL LAW

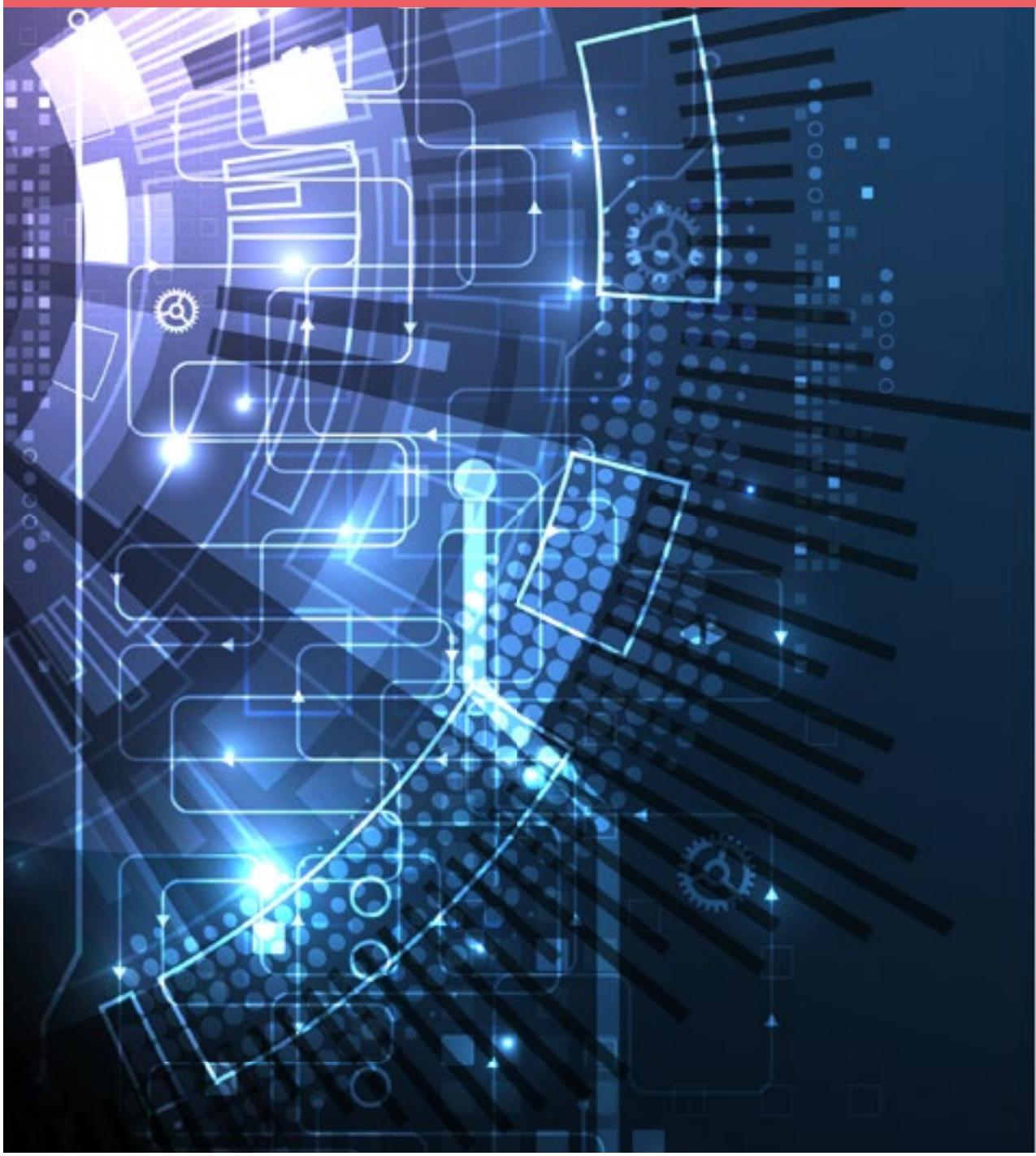
End-to-end trade digitalization supported by computationally expressed trade rules would boost trade efficiency and inclusivity.

With continual economic integration, the rules that apply in cross-border contexts are becoming more numerous, technical in nature, complicated to understand and difficult to implement, especially for MSMEs. Many small businesses remain unable to identify and comply with market access rules – both tariffs and non-tariff measures (NTMs) – or to utilize preferences, the result of lengthy trade negotiations that were intended to enhance enterprise internationalization and competitiveness. Recently, legal innovations have sought to address administrative barriers to trade by expressing natural language rules in conditional programming forms to automatically provide users with legal answers that depend on the input of concrete, trade-related parameters. Yet, such projects have so far focused on which rules apply, rather than on how to comply with the identified regulations. The automation of this 'operationalization' step through computational law for trade policy could advance trade digitalization.

Computational law can help to bridge the gap between legal and governance structures, information systems and users on how to comply with regulations. Computational law is the branch of legal informatics concerned with the codification of regulations in precise, computable form and the automation of legal reasoning. As an interface between businesses, consumers and governments, computational law can build bridges between the various entities and software systems used in trade, with the potential to enable accessibility, automation, standardization, interoperability, cost reductions, transparency, and modelling and testing the effects of regulations.

Trade agreements could encourage governments to publish official machine-executable packages of trade policies and domestic rules that affect cross-border transactions alongside the deposited natural language texts. The development of a body of computational law has the potential to greatly enhance transparency, beyond existing WTO provisions, and could be monitored under existing mechanisms, such as the WTO's Trade Policy Review Mechanism.

INTRODUCTION



A | THE PROMISE OF TRADETECH AND THE TRANSFORMATION OF GLOBAL TRADE

The interplay of technologies and trade is not new. From the invention of steamships, which fuelled the first industrial revolution, to the popularization of the standard shipping container in the 1950s and the rise of the internet in the 1990s, technology has over the centuries profoundly changed the way people interact and trade, leading to a significant expansion, optimization and sophistication of global value chains.

Technological advancements are enablers of change and key drivers of economies, and their impact on trade may well accelerate (see Box 1). To ensure that no-one is left behind, the further widening of the digital divide must be prevented, also in the trade space.

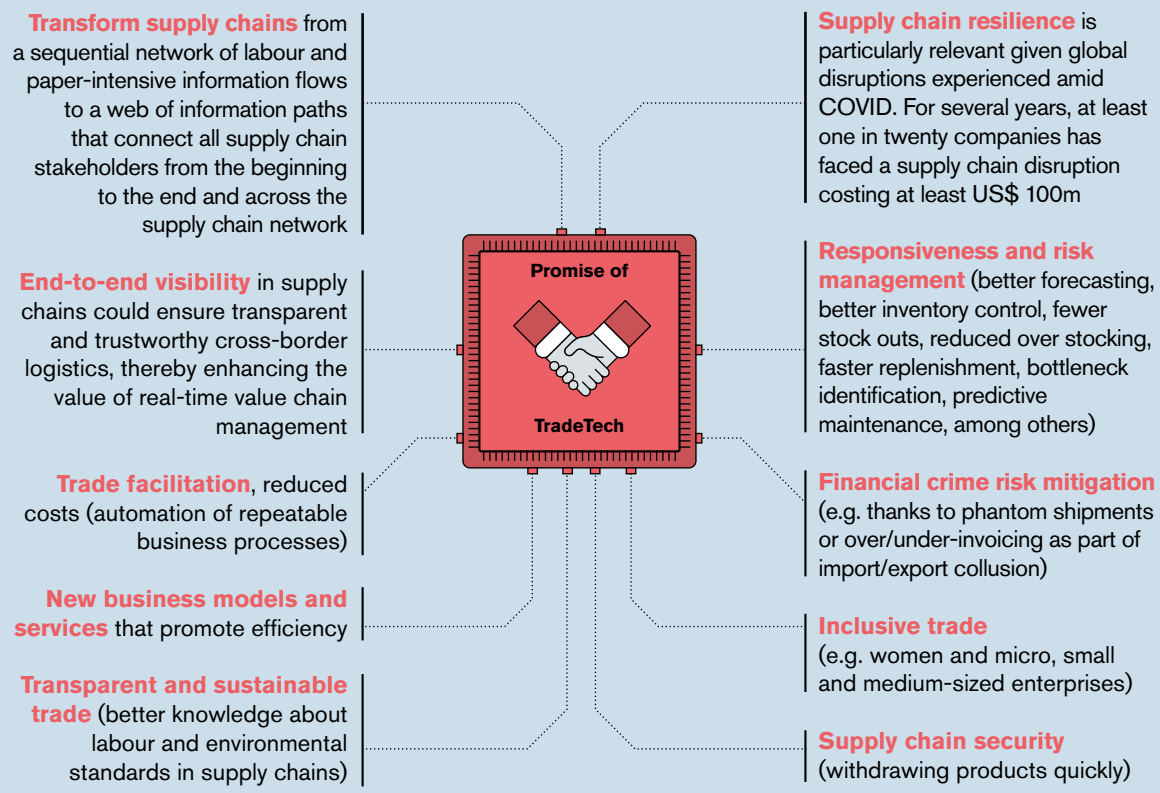
> **"TradeTech is the set of technologies and innovations that enable global trade to become more efficient, inclusive and sustainable."**

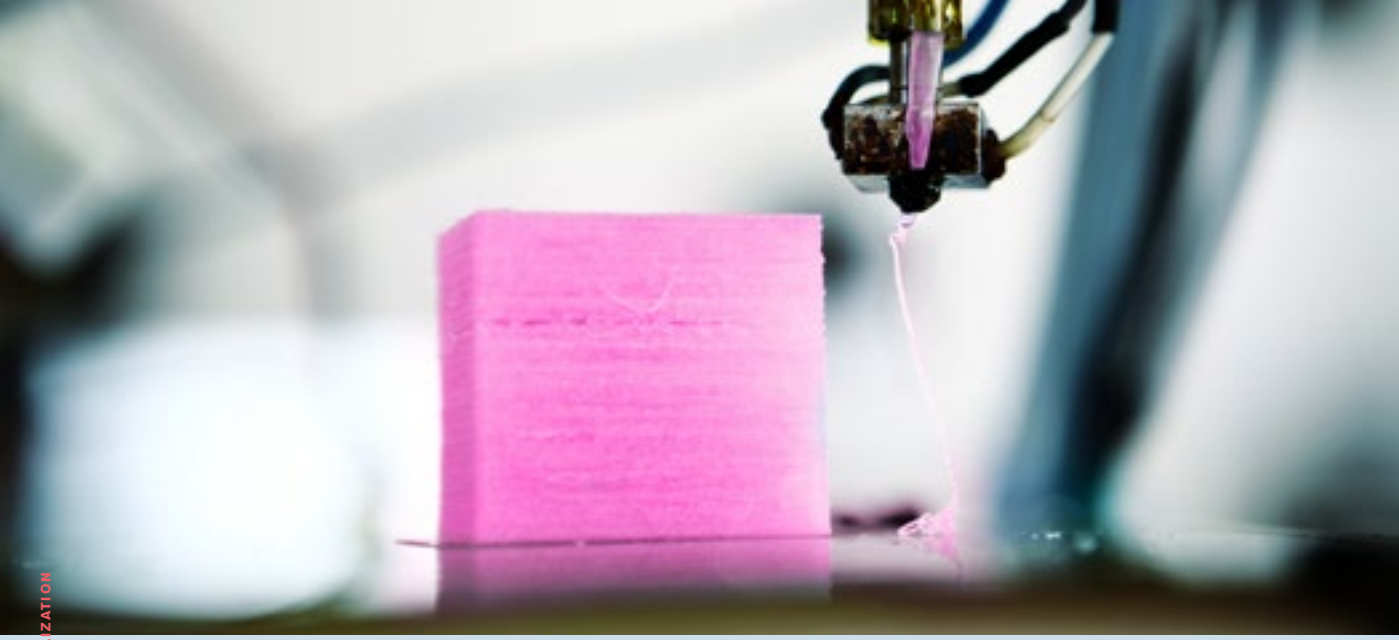
WTO members recognize in the Preamble to the Agreement Establishing the World Trade Organization that:

> "their relations in the field of trade and economic endeavour should be conducted with a view to raising standards of living, ensuring full employment and a large and steadily growing volume of real income and effective demand, and expanding the production of and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so in a manner consistent with their respective needs and concerns at different levels of economic development".

This publication explores how trade agreements could be a viable channel to advance the adoption of digital technologies and applications.

FIGURE 1
THE PROMISE OF TRADETECH





BOX 1

2030 – A TRADE ODYSSEY

A 3D-printed shoes company decides to export its products and finds a client with which it signs a contract electronically. To comply with local regulations, the company decides to use an online platform which automatically provides legal answers based on trade parameters entered. The platform is connected to paperless customs systems, with decentralized sharing of information. Thus the company can submit trade documents for compliance purposes in one electronic single window connected to and fully interoperable with electronic national single windows (NSWs).

Thanks to global alignment of digital identity credentials for trade and decentralized identity, the company can share its e-credentials safely and quickly with all trading partners and authorities, without having to re-submit information, while still retaining full control over how, when and with whom this information can be shared.

Back at the factory, 3D-printed shoes roll off the assembly line and are picked up by a robotic handler to be boxed and loaded onto freight containers. Autonomous forklifts load the containers onto self-driving trucks, which take them to the port, which a fleet of cargo drones then load onto an autonomous ship.

Meanwhile, customs clearances and payments have already been completed digitally and shared with all stakeholders involved. The company receives an e-bill of lading, which it converts into multiple shares (i.e. tokens) to finance its trade operation. The ship sets sail on an optimal route selected by artificial intelligence (AI), while providing real-time data of the containers and cargo, such as maritime from location, deck temperature and estimated arrival dates, to manufacturers, trading partners and end-users, all connected to a decentralized platform.

When the ship arrives at the destination, cargo drones unload the containers onto self-driving trucks, which deliver the cargo to a central warehouse where another fleet of drones take the containers to local distribution centres. They are unpacked by robotic handlers, which dispatch individual boxes to the end-user with delivery drones. During this entire journey, participants at the newly established Supply Chain Exchange could finance and trade different parts of this process as commodities.

Each pair of 3D-printed shoes is assigned an identity key, which enables end-users to retrieve the history of the shoes, where they came from, how they were made and traded and finally delivered.

The scenario may sound far into the future, but it is already reasonably close. Just as the shipping container changed world trade almost 70 years ago and enabled globalization, technologies such as fifth-generation cellular networks (5G), AI and blockchain and distributed ledger technology (DLT) could increase supply chain collaboration, changing the landscape of global production and trade over the next few decades.

TradeTech refers to the set of technologies and innovations that enable global trade to become more efficient, inclusive and sustainable (see World Economic Forum, 2020a, and Figure 1) and serves the following functions:

- It helps smooth trade facilitation.
- It creates new trade opportunities.
- It contributes to efficiency gains that could result in more inclusive and sustainable outcomes, from the inclusion of small businesses thanks to reduced entry costs to shipping companies cutting carbon emissions resulting from route optimization.
- It fosters transparent and trustworthy cross-border logistics through end-to-end visibility, which enhances the value of real-time value chain management.
- It strengthens supply chain security through better risk management practices thanks to data analysis.
- It provides resilience to supply chain disruptions, such as during the COVID-19 pandemic.

Evidence suggests that reducing supply chain barriers to trade could increase gross domestic product up to six times more than removing tariffs (World Economic Forum *et al.*, 2013). Trade and investment can contribute to the achievement of the Sustainable Development Goals (in particular SDG 9) by promoting inclusive and sustainable industrialization, increasing access to financial services and markets through integration in global value chains, and supporting domestic technology development and industrial diversification, to name a few.

While the term TradeTech covers a whole range of digital technologies and applications, this publication focuses on AI, blockchain and DLT and the internet of things (IoT). Of particular interest is the potential of these technologies to enhance transparency, efficiency and responsiveness of supply chains (see Box 2).

These technologies are often used in combination, for instance writing data collected through IoT devices onto a blockchain guarantees the integrity of the data on the chain, and AI can be designed to learn from abundant IoT data to make forecasts. Results are fed back into the forecasting algorithm to improve the model, so that over time the system becomes better at making more accurate predictions.

These technologies form a new class of targeted, user optimized and customized services (World Economic Forum, 2020a). For instance, the internet is an emerging logistics and supply chain management

BOX 2

TRADE APPLICATIONS OF AI, BLOCKCHAIN AND DLT AND IoT

Artificial intelligence

Thanks to evolving computing power and ever-growing big data, AI promises to provide access to predictive analytics (i.e. what will happen in the future) and prescriptive analytics (i.e. how to do better in the future), meaningful insights not otherwise possible. These insights can have multiple trade applications from predictive maintenance of equipment to routing optimization and risk management. For instance, AI can contribute to financial crime risk mitigation. Customs also use AI to predict and identify risks, thereby allocating their resources where there is more value added.

Blockchain and distributed ledger technology

Blockchain and DLT can create an incontrovertible and indelible record of supply chain transactions, from the purchase of raw materials to the sale and delivery of the final product. Used as a tool to guarantee the origins, processing conditions (including conformity with labour and environmental standards), and journeys of globally traded goods, such as fair-trade coffee, sustainable lumber and fish, blockchain and DLT can help trade to become more sustainable and inclusive. It can shorten the time required for verifying and processing documents and can help to reduce document-based fraud. Blockchain and DLT can also accelerate and secure payments through automation, which will enable money and documents to move across borders simultaneously for the first time, and contribute to the mitigation of payment risks associated with open account trade finance.

Internet of things

Central to digital supply chain implementation is IoT. At the heart of which are ubiquitous sensors, which measure and transmit data in real-time via the internet, capturing almost anything that can be quantitatively measured, such as temperature and humidity, location information in warehouses and supply depots, and transit tracking of trucks, containers and deliveries. This information can assist in making operating decisions, troubleshooting, emergency alerts and predictive management, among others.

concept that draws on different technologies, AI and blockchain and DLT to optimize logistics and management processes to make supply chains more efficient and sustainable. Through the internet, resources can be pooled in open, shared networks, connecting existing (company) networks.

"Since 2010, regional trade agreements have increasingly integrated e-commerce and digital trade provisions."

B | KEY ROLE OF TRADE AGREEMENTS

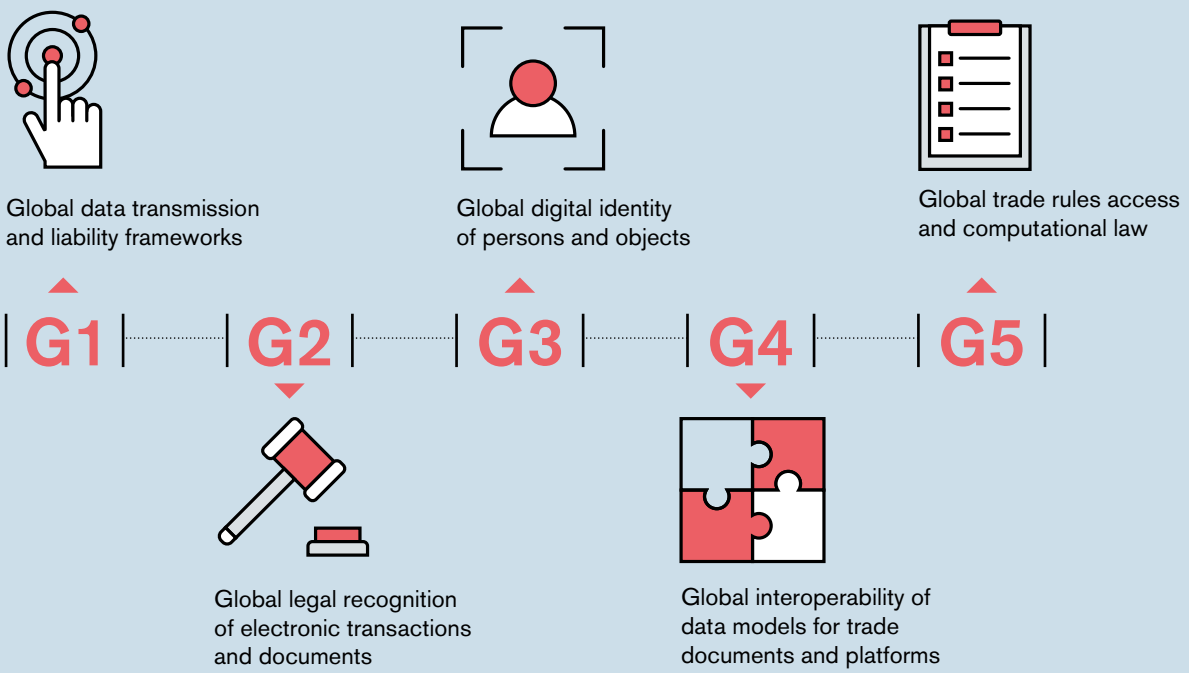
Leveraging technologies for trade requires more than technological innovation. The major challenge might actually be international policy coordination and coherence. The right ecosystem needs to be put in place to drive global adoption and scalability. Trade agreements can play a key role in this regard.

Legal frameworks have always had a hard time keeping up with the pace of technological development, and so have trade agreements. TradeTech issues are relatively new in trade agreements, compared to more traditional trade topics such as tariffs and non-tariff measures (NTMs). As trade agreements are generally technology neutral, many existing trade rules apply to digital trade. Yet, developing explicit rules may be needed for legal clarification on how they apply in the digital field.

In supporting global and inclusive TradeTech adoption, trade agreements can:

i. prevent governments from introducing discriminatory measures favouring local providers or measures that are unnecessarily trade restrictive;
ii. ensure the transparency of regulatory requirements and procedures for facilitating market access by foreign companies;
iii. prevent a fragmented technological environment by encouraging international regulatory cooperation and promoting regulatory harmonization and coherence;

FIGURE 2
THE 5 Gs OF TRADETECH



iv. enhance market access through commitments, such as the WTO's Information Technology Agreement (ITA), whereby participating governments agreed to eliminate tariffs and NTMs applicable to IT products;

v. facilitate foreign direct investment, such as investments in information and communications technology (ICT) to fortify TradeTech adoption.

Since 2010, regional trade agreements (RTAs) have increasingly integrated e-commerce and digital trade provisions. Recent RTAs, such as the United States–Mexico–Canada Agreement, cover a wider range of e-commerce issues than previously, including a chapter on e-commerce and digital trade. Governments have introduced digital-only trade agreements, such as the Singapore–Australia Digital Economy Agreement (SADEA) and the Digital Economy Partnership Agreement[1] (DEPA) between Chile, New Zealand and Singapore, which address a wide range of digital trade issues, which are welcome first steps in this regard. Furthermore, more than 85 WTO members also participate in the Joint Initiative on E-commerce. However, as discussed in this publication, there remain many unseized opportunities.

C | THE 5 Gs OF TRADETECH

According to public and private-sector experts, five building blocks (referred to in this publication as the 5 Gs of TradeTech) play a critical role in supporting trade digitalization and wide-scale adoption of TradeTech. The implementation of the 5 Gs depends on the legal and technological context of each member and are therefore not ranked (see Figure 2).

Although some of the 5 Gs are commonly covered by trade agreements, unseized opportunities remain in connectivity, data sharing and e-signatures. These issues and opportunities are indicated with the following icon.

Other 5 Gs are either not discussed in trade agreements or only in a few recent agreements, and include electronic transferable records, automated contracts, digital tokens, interoperability of data models, and digital identity of legal and physical persons and of physical and digital goods. These new areas are symbolized by the following icon.

These new policy frontiers can help to bring trade to a new speed and work for all.

Global data transmission and liability frameworks

End-to-end trade digitalization requires global access to reliable, affordable and fast connections as well as a legal framework enabling data transmission across borders in a trusted manner. Advanced technologies such as AI, blockchain and DLT and

IoT require the development of information and communications technology (ICT) infrastructure and wireless technologies to enable continuous connectivity. Closing the digital divide in terms of access, bandwidth and skills is more urgent than ever.

In addition to access to digital infrastructure, information, which can be personal, sensitive or confidential, needs to flow across borders while preserving the rights of individuals (e.g. privacy), companies (e.g. business confidential information) and governmental entities (e.g. data requests for law enforcement or regulatory purposes).

However, these cross-border flows of content are hindered by several factors, including regulatory fragmentation across jurisdictions and sometimes even across different agencies within the same territory, a lack of cybersecurity cooperation and private-sector practices by some entities to lock in data that could be shared with other companies with due respect to business confidential information. Global trade digitalization may require the development of new liability frameworks. Such initiatives should be coordinated globally to avoid regulatory fragmentation, trade barriers and consumer distrust.

Global legal recognition of electronic transactions and documents

End-to-end trade digitalization requires a legal framework supporting the cross-border legal recognition of electronic trade documents and transactions. The large number of documents involved in international trade places a heavy burden on businesses seeking to trade internationally, in particular small business. Due to burdensome documentary processes, it can take days to transfer and process trade documents. TradeTech offers new opportunities to facilitate trade processes and automate trade transactions to increase efficiency and operational cost savings while enhancing the security and integrity of information.

For governments, transaction and document digitization can also contribute to better revenue collection. However, the cross-border use of electronic transactions and documents is limited. Some governments have not yet recognized the legal validity and enforceability of electronic means when used in trade transactions. Those who have recognized them do not necessarily share mutually recognized criteria, with the risk of creating silos where the legal validity and enforceability are recognized in a limited geographical area.

> **"Five building blocks (the 5 Gs of TradeTech) play a critical role in supporting trade digitalization and wide-scale adoption of TradeTech."**

A global approach is needed to support wide-scale digitalization.

Global digital identity of persons and objects

End-to-end trade digitalization requires a global approach to digital identities of natural and legal persons as well as of physical and digital objects sending or receiving electronic information to avoid creating digital identity silos. Verifying a legal or natural person's identity is critical to undertake trade transactions and share documents with that person. Similarly, the ability to identify a product, container, consignment or shipment is fundamental to trace its history and location and to obtain useful knowledge about the products being transported (e.g. when, where, what, why and how).

The increasing number of digital identity systems for companies and objects contribute to transparency and predictability of and trust in supply chains. However, just as different documentation requirements and forms in the physical world hinder trade, the multiplication of incompatible digital identifiers creates silos and high frictional costs. Greater attention should be paid to ensuring greater consistency among identification systems and mutual recognition; otherwise, the risk is that physical fragmentation simply becomes digital fragmentation.

Global interoperability of data models for trade documents and platforms

End-to-end trade digitalization requires common definitions and structures of data to understand information exchanged across borders in the same way and to ensure interoperability between platforms. Trade documents are increasingly becoming digital, but digitizing trade documents is just the first step. The real revolution is to move from documents to data. A number of documents are required to perform cross-border trade activities and to achieve end-to-end visibility, including, *inter alia*, certificates of origin, packing lists, bills of lading, insurance policies, commercial invoices, bills of exchange and letters of credit. Trading partners wanting to exchange data need to understand the information in the same way. Both the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and the World Customs Organization (WCO) have developed semantic libraries ("what means what"). Priority now needs to focus on promoting a much wider use of these semantic libraries to reach a critical mass of users and on developing global data models (the syntax) and globally agreed methods for communicating and sharing data across heterogeneous systems such as application programming interfaces (APIs) and the exchange between systems of information about the syntaxes (data formats) being used[2]. Many initiatives are underway, but they often evolve in silo, thereby undermining standardization efforts and in turn the exchange of electronic trade information.

Global trade rules access and computational law

End-to-end trade digitalization supported by computationally expressed trade rules would boost trade efficiency and inclusivity. With continual economic integration, the rules that apply in cross-border contexts are becoming more numerous, technical in nature, complicated to understand and difficult to implement. Fundamentally, many small businesses remain unable to identify and comply with market access rules – both tariff and NTMs – or to utilize preferences, the result of lengthy trade negotiations that were intended to enhance enterprise internationalization and competitiveness. Legal innovations are seeking to clarify and streamline trade compliance through automation. However, these initiatives are developed in silos, and thus are not generally available to other systems, including within the same government or for external entities that may benefit from access. Without international cooperation, the future for computationally expressed trade rules could be limited.

ENDNOTES

1. To the extent that RTAs go beyond commitments made in the WTO, they can complement the multilateral trading system. These RTAs must be notified to the WTO. Arguably, "digital-only" trade agreements are not RTAs per se, given they are not notified and do not necessarily contain preferential trade measures beyond WTO rules. For simplicity, this publication refers to them as RTAs.
2. Syntax relates to the structure of the language, that is, the rules for writing in a programming language. It has nothing to do with the meaning of the statement.

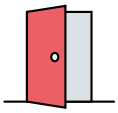
1 GLOBAL DATA TRANSMISSION AND LIABILITY FRAMEWORKS

Global data transmission is required:

- to realize trade activities (i.e. international provision of services, tracking international cargo across borders);
- to coordinate operations across global value chains (i.e. management of human resources, optimization of internal processes);
- to exchange trade-related information among supply chain stakeholders.

However, cross-border data flow can be limited by: (i) access to data transmission capacities at an affordable price, bandwidth and continuity as well as access to digital skills; and (ii) content regulation of data if regulatory fragmentation is not addressed through a global alignment on content and data regulation and on a liability framework. Global coordination will be required to ensure connectivity is fast and affordable, without compromising privacy, confidentiality and security.

A | DIGITAL INFRASTRUCTURE ENABLING GLOBAL DATA TRANSMISSION



With the growing number of connected devices, demand for broadband coverage keeps increasing (see Box 3). However, connectivity progresses at different paces around the world. The traditional digital divide between developed and developing countries in terms of internet connectivity, access and use remains high.

> **"The traditional digital divide between developed and developing countries in terms of internet connectivity, access and use remains high. While 90 per cent of the population in developed countries was using the internet in 2021, in least-developed countries it was only 27 per cent."**

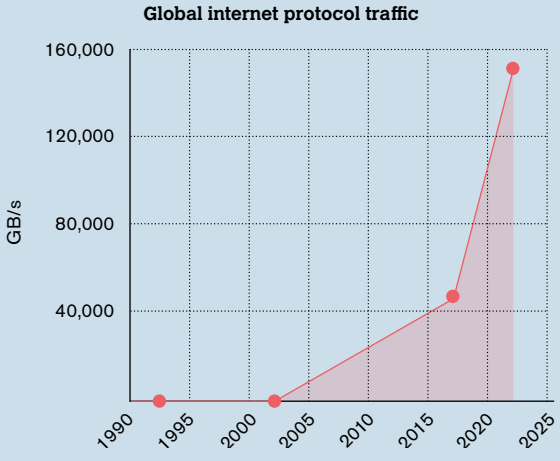
The most recent data of the International Telecommunication Union (ITU, 2021) estimates that 63 per cent of the world's population (4.9 billion people) were using the internet in 2021. While 90 per cent of the population in developed countries was using the internet in 2021, in least-developed countries it was only 27 per cent.

All countries experience a digital divide between urban and rural areas. While virtually all urban areas in the world are covered by mobile-broadband networks, there are many gaps in rural areas. The advent of 5G technology providing devices with broadband access might widen the digital divide, as devices using older generations, such as 3G, might not be able to access broadband.

BOX 3

INCREASED GLOBAL INTERNET TRAFFIC CALLS FOR A GLOBAL APPROACH TO DIGITAL CONNECTIVITY

Global internet protocol traffic, a proxy for data flows, has grown dramatically since 2000. From 100 gigabytes (GB) per day in 1992, 100 GB per second in 2002 to 46,000 GB per second in 2017, with global internet protocol traffic projected to reach 150,000 GB per second by 2022 (Cisco, 2018).* Demands for reliable and fast connections are expected to continue to increase given the growing number of IoT devices connected to the internet. One estimate suggests that the IoT will be made up of over 30 billion devices worldwide by 2025 (more than four objects per person), representing global growth of more than 150 per cent over five years since 2020.**



* *Source:* World Bank calculations and Cisco (2018). See https://wdr2021.worldbank.org/stories/crossing-borders.

** See https://www.statista.com/statistics/1101442/iot-number-of-connected-devices-worldwide.

> "Trade contributes to the transfer of technologies across borders and helps to bridge the digital divide."

High costs for internet access relative to income remain one of the main barriers to the use of ICT services worldwide. The average cost of a mobile-data basket of 1.5 GB in developing countries, least-developed countries, landlocked developing countries and small island developing States is substantially above 2 per cent of monthly gross national income per capita (target set by the Broadband Commission for Sustainable Development for 2025). In addition to affordability, the effective use of the internet can be hindered by factors such as:

- low level of education;
- lack of relevant content and in the local language;
- lack of digital skills;
- low-quality internet connection.

Strengthening competition in developing countries could increase the quality of international bandwidth. The ITU[1] reports that:

> "This challenge is compounded by the fact that some developing countries, and even whole regions, are not yet served by undersea communications cables, forcing them to rely on higher priced satellite access. The costing issue is exacerbated if the international gateway that carries IP data to other countries is available solely from a local incumbent monopoly that faces no competition on rates. … Consequently, prices tend to remain high."

What can trade agreements do to help alleviate the digital divide in terms of infrastructure?

Trade agreements have contributed to the far-reaching changes of the telecommunications market, both hardware and software, since 2010. Multilateral, plurilateral and regional efforts highlighted in the following subsections should be further pursued by governments to foster global connectivity for all. Trade, through all its forms, including foreign direct investment, can increase competition, driving down connectivity costs and increasing quality. Trade also contributes to the transfer of technologies across borders, thus helping to bridge the digital divide. Some trade agreements have made substantial contributions.

Market access commitments in telecommunications services

Over 120 WTO members have made commitments to open markets in telecommunications services, most of which apply to basic services such as fixed and mobile telephony and real-time data transmission. These commitments comprise guarantees regarding, for instance, the establishment of new telecommunications companies, foreign direct investment in existing companies and cross-border transmission of telecommunications services. However, many trade restrictions persist in telecommunication services (see Table 1) and procedures often remain complex and paper intensive (e.g. the number of documents needed to obtain a business permit ranges from two to 19). Further market access commitments could reduce these barriers.

Competition in telecommunications services sectors

Over 100 WTO members have committed to the regulatory principles spelled out in the Reference Paper distributed in 1996 by the Negotiating Group on Basic Telecommunications.[2] The competitive safeguards therein guarantee that data transmission services providers may interconnect their systems on reasonable and non-discriminatory terms in a regulatory environment that is impartial and transparent, thereby supporting the development of transmission networks in a territory and largely reflecting best practice in telecommunications regulation. Competition is a key driver to investment and, in turn, to bandwidth at an affordable price.

As another venue to foster competition, some RTAs have introduced competition safeguards with respect to internet access providers (e.g. SADEA) or to operators controlling international submarine cable systems (e.g. Comprehensive and Progressive Agreement for Trans-Pacific Partnership), thereby supporting interconnection on non-discriminatory and commercial terms. To stimulate connectivity infrastructure development, SADEA introduces transparency obligations and streamlines procedures for permits needed for the installation, maintenance or repair of submarine cable systems. At the WTO, members participating in the Joint Initiative on E-commerce are also discussing a possible revision of the WTO Reference Paper to include all telecommunications and internet access services.[3]

Net neutrality

Most recent RTAs have introduced a net neutrality principle to ensure that internet service providers treat

TABLE 1

ACCESS BARRIERS TO THE TELECOMMUNICATIONS SECTOR

Barrier description	Number of governments with such a barrier
There are limits to the proportion of shares that can be acquired by foreign investors in publicly controlled firms	18
Acquisition and use of land and real estate by foreigners is restricted	32
Quotas on independent services suppliers	10
Labour market tests for intra-corporate transferees	36
Labour market tests for contractual services suppliers	34
Public procurement: explicit preferences for local suppliers	23
Public procurement: thresholds above which tender is mandated conditions of competition in favour of local firms	20
National, state or provincial government control of at least one major firm in the sector	22

Source: Organisation for Economic Co-operation and Development (OECD) Digital Services Trade Restrictiveness Index database.

all data transmission equally. This outcome elaborates on the Annex on Telecommunications[4] contained in the General Agreement on Trade in Services (GATS), which states in Article 5 that:

> "(a) Each Member shall ensure that any service supplier of any other Member is accorded access to and use of public telecommunications transport networks and services on reasonable and non-discriminatory terms and conditions, for the supply of a service".

Systematically including net neutrality in trade agreements would help to ensure that the internet users access the internet on reasonable and non-discriminatory terms.

WTO's Information Technology Agreement

Initially signed by 29 WTO members in 1996, the ITA has contributed to the elimination of tariffs on IT products and covers 97 per cent of world trade in IT products (WTO, 2017). In 2015, over 50 WTO members concluded the expansion of the ITA, which now covers an additional 201 products. In 2020, world exports of both ITA and ITA Expansion products accounted for more than 20 per cent of global exports of manufactured products.[5]

Small businesses have a lot to gain from greater ICT access thanks to the ITA, as they see their competitiveness boosted and their chances to access the international market improved. Ezell and Wu (2017) report "that ICT-enabled firms in developing countries were twice as profitable, 65 percent more productive, and boosting employment 25 percent faster than firms that did not adopt ICTs."

This plurilateral agreement and the expansion are open to all WTO members, and several are looking into joining. In July 2021, the Lao People's Democratic Republic announced that they would join the ITA and the expansion, becoming the first least-developed country to accede to both of these agreements.[6]

It is important to note that market access gains from tariff liberalization may become meaningless if they are undermined by discriminatory or unnecessary NTMs. Simplifying and streamlining NTMs, such as conformity assessment procedures or labelling for IT products, should therefore be a key objective along with tariff liberalization.

Regulatory coherence and cooperation with regard to cybersecurity rules

There has been a recent increase in notified technical barriers to trade (TBT) measures dealing with the cybersecurity of IoT, 5G technology, 3D printing devices, drones and autonomous vehicles, which address potential abuses on the basis of public safety and national security, safety and performance of 5G products, and interoperability (Hoe Lim, 2021).

To improve the cybersecurity of equipment, infrastructure, and software-enabled and network-connected goods, governments rely to a large extent on certification and labelling schemes. While regulatory approaches to cybersecurity certification are generally envisioned as voluntary, there is an early trend in which schemes and corresponding requirements may become mandatory. Divergent regulatory approaches may hinder the transfer of technologies and thereby preventing the digital divide to narrow.

The TBT Agreement promotes global regulatory coherence (via sharing and discussing international standards at the pre-implementation stage) and global regulatory cooperation (via good regulatory practices, equivalence and mutual recognition). However, compared to other regulatory areas such as cybersecurity, international standards are often complemented by national regulations and standards, thus sustaining regulatory fragmentation.

Trade agreements could encourage the use and development of international standards and mutual recognition schemes, such as the Common Criteria (see Box 4), to foster regulatory convergence. Interoperability between international standards should also be considered. Like regulatory fragmentation, non-interoperable international standards will increase audit and compliance costs for companies.

The WTO Principles for the Development of International Standards, Guides and Recommendations aim to avoid conflicting standards.[7] The six principles were agreed upon by the TBT Committee in 2000 to provide guidance for WTO members when developing international standards:

1. transparency
2. openness
3. impartiality and consensus
4. effectiveness and relevance
5. coherence
6. development dimension

BOX 4

COMMON CRITERIA

The Common Criteria provides technical guidance for cybersecurity certification schemes of ICT products and systems. It is supported by the Common Methodology for Information Technology Security Evaluation (CEM), which describes how evaluations and assessments should be conducted. The Common Criteria Recognition Arrangement (CCRA) ensures mutual acceptance of security certificates internationally. IT products which earn a Common Criteria certificate can be procured or used without the need for further evaluation. In turn, these international standards contribute significantly to confidence in the security of IT products internationally. The CCRA was signed in 1998 and now has 31 parties.

At the regional level, an equivalent mutual recognition agreement (MRA) was signed in 1998: the Senior Officials Group Information Systems Security (SOG-IS) MRA includes 15 EU and EFTA member States.

Although these principles were adopted in the context of the TBT Agreement, which is concerned with trade in goods, they are relevant to international standards on digital trade in services. The six principles have become so widely accepted by WTO members not only multilaterally but also regionally, that a growing number of RTAs not only incorporate the six principles in their TBT chapters, but also make them mandatory (McDaniels *et al.*, 2018).

Some international standardizing bodies have also embraced these principles, such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

"Although the six Principles for the Development of International Standards, Guides and Recommendations were adopted in the context of the TBT Agreement, which is concerned with trade in goods, they are relevant to international standards on digital trade in services."

Using the TBT Committee to address trade concerns relating to cybersecurity rules could help to solve them without escalating them into WTO formal disputes, ultimately solving these issues more promptly for the sake of technology transfer and the closing of the digital divide.

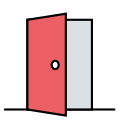
Transfer of technology

A number of provisions in WTO agreements refer to the need for a transfer of technology to take place between developed and developing country members. However, the modalities of such transfers are not specified. For instance, the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) aims to achieve the transfer and dissemination of technology as part of its objectives, and specifically requires developed country members to provide incentives for their companies to promote the transfer of technology to least-developed countries. Similarly, Article 6 of the Annex on Telecommunications in GATS states:

> "(d) Members shall give special consideration to opportunities for the least-developed countries to encourage foreign suppliers of telecommunications services to assist in the transfer of technology, training and other activities that support the development of their telecommunications infrastructure and expansion of their telecommunications services trade."

These provisions should be fully operationalized, and trade agreements could specify these modalities. Best practices on incentives aiming at closing the digital divide could be shared in the WTO Working Group on Transfer of Technology.[8]

B | GLOBAL ALIGNMENT ON CONTENT REGULATION OF DATA AND ON LIABILITY FRAMEWORKS TO SUPPORT CROSS-BORDER DATA FLOWS



The second source of obstacles to cross-border data flows is regulatory measures concerning the content of data (i.e. the actual information transmitted). The content of data can be personal, sensitive or confidential and can expose individuals and organizations to risks such as, *inter alia*: unauthorized access to and use of personal and business confidential information or a device connected to the internet; cyberthreats to critical infrastructure and information; a loss of connectivity; or price discrimination based on personal information.

Many incidents relate to cyber vulnerabilities, although some malicious cyberthreats can also affect companies through direct hacking (see Box 5) or by targeting an organization in its supply chain. As the number of people and machines communicating online increases, the likelihood of data-related risks and the severity of

BOX 5

HOW HACKING OR CYBER VULNERABILITIES CAN AFFECT INTERNATIONAL TRADE

Under an electronic release system, carriers provide, against bills of lading, computer-generated pin codes, which are sent in a release note via email to the receivers of their agents and the port terminal to take delivery of the goods.

Upon arrival, when an attempt is made to collect the containers, it is discovered that two of them have already been collected by unauthorized persons. It is not clear how the thieves accessed the codes – either from the recipient's or the sender's IT infrastructure.

Note: See the 2017 case from the England and Wales Court of Appeal between MSC Mediterranean Shipping Company and Glencore ([2017] EWCA Civ 365).

> "The different levels of cybermaturity of companies and economies need to be addressed to support the global adoption and scalability of TradeTech."

their consequences will also increase, especially for small businesses, who are the most vulnerable.

In the digital world, the vulnerabilities of one company impact the other companies sharing information in the same supply chain. More generally, the vulnerabilities of one economy might prevent foreign companies from offering their technologies to stakeholders in that economy. These different levels of cybermaturity of companies and economies need to be addressed to support the global adoption and scalability of TradeTech. Cybersecurity needs to be dealt with as if it were a global public good.

Advanced technologies make the application of data protection laws more difficult. For instance, identifying data controllers and data processors[9] can be very challenging in permissionless blockchain-based systems. Arguably, participants entering personal data in blocks of the ledger may be regarded as controllers of the data they provided or to which they have access through the system; unless they act as the technology service provider supporting the system, in which case they are likely to be characterized as a data processor.

As jurisdictions respond to these threats unilaterally, regulatory fragmentation could hinder global data transmission and ultimately affect market access for companies relying on data moving across borders. For consumers, this could result in fewer products, higher prices and lower quality (see Box 6).

How are governments dealing with content and data regulation while safeguarding cross-border data flows and legitimate objectives?

Many governments have introduced laws and regulations to mitigate these types of data-related risk, including personal data protection measures, cross-border data measures, product safety measures and cybersecurity measures. Regulatory fragmentation can create uncertainty for consumers and supply chain actors as to whether and how they can access remedies abroad and upon which liability framework they can rely (see Box 7).

Some laws and regulations apply across many sectors, such as the EU General Data Protection Regulation or the Cybersecurity Law of China relating to critical infrastructure sectors. Other laws are applicable to particular sectors or technologies, such regulations on AI, autonomous vehicles and drones.

Some measures use a risk-based approach, whereas others use a prescriptive approach. According to cybersecurity experts, given the evolving nature of cybersecurity threats, a risk-based approach may be more effective. Addressing cybersecurity in ICT by product-specific regulation might not be warranted, since any developments in technology would make such regulations obsolete very quickly (National Board of Trade Sweden, 2018). Risk-based regulatory approaches might be beneficial for companies (in particular small businesses) because it avoids disproportionate burdens. Indeed, the smaller the firm, the heavier the burden of compliance.

To regulate AI that uses personal data, some governments have adopted a risk-based approach. The European Commission proposes an ex-ante conformity assessment framework that would require firms to validate that their AI products and services adhere to certain EU-specific requirements before offering them on the EU market or putting them into service.

What can trade agreements do to foster content regulation of data that supports trusted cross-border data flows?

Different channels have been used from a trade policy perspective to support global data transmissions, but there remain unseized opportunities.

Regulatory convergence

Trade agreements play a key role in fostering regulatory convergence on flows of data. Some 105 RTAs call on governments to introduce domestic frameworks for personal data protection, of which 47 require governments to take into account international standards.[10] Similarly, many RTAs have cybersecurity provisions encouraging governments to strengthen cybersecurity capabilities and to support international cooperation. However, there remain many unseized opportunities.

BOX 6

DATA REQUIREMENTS BARRING ENTRY INTO NEW MARKETS

Dorae* offers a flexible software system to its customers to digitize trade documents, automate processes, and track the origin of raw materials and the manufacturing steps. Customers define which data they enter into the system, without any review by Dorae. For security and customer convenience, Dorae's system is cloud-based, with infrastructure in commercial data centres around the world.

As part of its growth strategy, Dorae assessed entry into a new market. A large part of which focused on data localization requirements in the target market. These required that certain types of data be stored in a specific manner and not be transmitted across borders due to security concerns.

Since customers define the data they enter into the system, Dorae could not be 100 per cent certain that proscribed information would not be handled. Yet, they would still be liable for any infringement.

To mitigate the risk, Dorae could: curtail functionality such as information sharing between customers; build additional infrastructure; or change local terms and conditions. However, these solutions were either incomplete, expensive or resulted in a reduced user experience incompatible with Dorae's reputation and product quality.

Dorae concluded that the upfront costs and unmeasurable legal risks outweighed the near-term growth prospects, so market entrance was put on hold. This was not just a missed trade opportunity for the company, but a missed opportunity for supply chain stakeholders that might have benefited from supply chains with greater visibility and transparency.

* See https://www.dorae.com.

BOX 7

LIABILITY

The ability to identify uniquely and without ambiguity the person liable for any damage is essential to guarantee access to remedies. Ideally, the transfer of responsibility must be facilitated whichever digital solution is used.

Due to the opacity, connectivity and autonomy of AI systems, which can involve several (often cross-border) complex contractual arrangements with many actors, determining who is liable by tracing back harmful actions of AI systems to a human input or design aspect is extremely difficult. Moreover, many machine learning models use incremental learning systems that are uninterpretable to humans, and existing regulation does not sufficiently address the dynamic nature of these machine learning models, which could be said to have "a mind of their own".

Another issue concerns potential glitches in or between the programming language and the executable machine code, which could lead to the code not doing what it was intended to do when executed. Arguably, the risk of a glitch exists in any computer program. The main challenge in ascertaining liability in (permissionless) blockchain systems is the difficulty in determining the relationship between the many parties involved: (i) the core group, which sets up the code design; (ii) the owners of additional servers running the DLT code for validation purposes; (iii) users of the DLT; and (iv) third parties affected by the system without directly relying on the technology.

Typically in permissionless blockchains, node owners will not even know who operates the other nodes. Consequently, there may be challenges in identifying a potential defendant from whom legal redress can be sought, let alone the actual identity. By contrast, permissioned blockchains have their own rulebook that defines liabilities. This poses problems, however, as different blockchain and DLT platforms may follow different approaches, which can affect interoperability. Clarifying these issues may be needed to support the wider adoption of blockchain and DLT in trade.

Many non-contractual liabilities may potentially arise with transactions through smart contracts (e.g. claims for fraud, unfair trade practices, insider trading, market abuse), which could be an area of risk of interest to insurance companies. However, conditions under which such insurance applies will be tricky to draft.

TradeTech will require existing liability frameworks to be adapted or new frameworks to be developed. Such initiatives should be coordinated globally to avoid regulatory fragmentation, trade barriers and consumer distrust. In that respect, some governments have considered extending their current domestic product liability and safety framework to software-enabled or network-connected goods. Clarifying the scope of product liability and safety frameworks with respect to IoT would provide consumers with more protection and greater legal certainty.

> **"Trade agreements play a key role in fostering regulatory convergence on flows of data."**

With regard to privacy rules, the general approach to regulate cross-border data flows is to ensure an adequate level of data protection in two or more territories. Regulatory cooperation between some governments has led to the introduction of equivalence schemes (e.g. adequacy decisions) and regional certification systems (e.g. Asia-Pacific Economic Cooperation (APEC) Cross-Border Privacy Rules System) to establish this equivalent level of protection, but these mechanisms remain limited in scope. Further international regulatory cooperation is needed to make them truly global.

Only a few RTAs facilitate the interoperability between cross-border data flow mechanisms. For example, Article 19.8 of the United States–Mexico–Canada Agreement refers explicitly to the APEC Cross-Border Privacy Rules System and recognizes it as "a valid mechanism to facilitate cross-border information transfers while protecting personal information." Article 4.2(10) of DEPA also encourages its signing parties to mutually recognize the other parties' data protection with the exact same wording in. Systemically supporting these mechanisms in trade agreements can help companies to become aware of their existence and to use them. Coordination at the multilateral level will be needed to prevent data transfer mechanisms from landing in silos.

The Osaka Track is a major international initiative on data flows, which was launched by heads of governments under Japan's G20 leadership in 2019. The framework "data free flow with trust" – the key underlying concept of the Osaka Track – maps a multidimensional architecture for international cooperation on data flows, between governments, as well as involving business, with recommendations to increase levels of governance trust and to build openness through trade rules and other tools (World Economic Forum, 2020b).

With respect to rules on AI, nascent international guidelines also intend to foster regulatory coherence, for instance:

- OECD principles on AI (OECD, 2022);
- G20 New Industrial Revolution Action Plan;
- G20's joint statement on human-centred AI and subsequent endorsement of the OECD principles on AI in the G20 Ministerial Statement on Trade and Digital Economy, June 2019;
- G7 Global Partnership on Artificial Intelligence (GPAI);
- Council of Europe Committee of Experts on human rights dimensions of automated data processing and different forms of artificial intelligence;
- Standardization in the area of AI by the ISO/IEC joint technical committee.

As governments fund AI development, it would be useful for some of it to be dedicated to interoperability. Only a few trade agreements, such as DEPA, include provisions in which the parties acknowledge the benefits of developing mutual understanding and ultimately ensuring that (see paragraphs 2 and 4 of Article 8):

> "ethical and governance frameworks for the trusted, safe and responsible use of AI technologies … are internationally aligned, in order to facilitate, as far as possible, the adoption and use of AI technologies across the Parties' respective jurisdictions … [and] … endeavour to take into consideration internationally recognised principles or guidelines, including explainability, transparency, fairness and human-centred values."

Trade agreements could promote international guidelines on AI governance before witnessing a national or regional silo-approach to AI regulation. Regulatory convergence would support the global adoption and use of AI technologies in trade. Otherwise, regulatory fragmentation will lead to more barriers.[11]

Cybersecurity cooperation and data exchange between governments for law enforcement and regulatory oversight

Before trade agreements include cybersecurity cooperation to address borderless threats, several key issues are still to be addressed. Around 50 RTAs contain rules that encourage capacity-building of national entities responsible for computer security incident response (CSIR) and workforce development through mutual recognition of qualifications, as well as the cross-border exchange of information to identify and mitigate malicious intrusions or dissemination of malicious code that affect electronic networks globally. However, these provisions focus on CSIR entities, thus disregarding the exchange of information between other governmental bodies, such as between law enforcement authorities. Provisions on cybersecurity are also being discussed in the context of the WTO Joint Initiative on E-commerce.

Cybersecurity cooperation should aim at closing the gap in cybersecurity capabilities of economies and companies. Given the difference in information assets and the knowledge and infrastructure used to protect them, some economies and companies are more vulnerable than others, which undermines internet reliability across borders. Building preventive capacities, rather than just being reactive to cyberattacks, is key to fostering cross-border reliability and to guaranteeing that regulatory responses (e.g. certification requirements) are enforced. There is little use in preparing, adopting and implementing (often complex and costly) regulatory responses unless there are effective enforcement processes in place. Trade agreements should encourage governments to strengthen enforcement capacities of stakeholders with cybersecurity responsibilities.

No trade agreement addresses the inefficiency of mutual legal assistance procedures. The long review process featured in mutual legal assistance treaties (MLATs) often defeats the purpose of data requests through this mechanism, as law enforcement agencies are unable to secure critical evidence within an appropriate time frame. As a result, some governments have turned to data localization measures as a way to expedite such access by reducing the reliance of the government of the localizing country on the foreign government in whose jurisdiction the relevant data are stored. To limit the proliferation of such measures, it is imperative for policymakers and other stakeholders to recognize the need for a more effective and efficient international data-sharing regime for law enforcement purposes than existing MLATs. To facilitate timely data exchange between governmental bodies for law enforcement purposes, trade negotiators could leverage the political momentum created by the negotiation of trade agreements to reform MLATs. In addition, trade agreements could authorize or encourage regulators to directly exchange e-documents among themselves rather than relying on the MLAT process.

Some countries are exploring alternative solutions unilaterally, which trade agreements could discuss, and potentially leverage – preferably at the multilateral level. One approach to facilitate government access to data for law enforcement purposes is the Kingdom of Bahrain's Legislative Decree No. 56 of 2018, In Respect of Providing Cloud Computing Services to Foreign Parties. With this law, data stored in data centres in the Kingdom of Bahrain are subject to the domestic law of the State where a consumer resides (or is incorporated in cases of legal persons) and are thereby subject to the jurisdiction of that State's courts and other competent authorities.

Collaboration and competition in data-driven markets

Cross-border data flows can also be hindered by some oligopolistic tendencies, which create customer lock-in for data services. Although data are generated across different markets, in some cases it is mainly stored, processed and commercially exploited in only a few regions. Choice and competition are key to ensuring that no single person, company, country or region controls important infrastructural digital components and the digitalization of global trade.

Around 40 RTAs agree to explore adequate approaches to promoting and protecting competition in digital markets and to strengthen collaboration mechanisms for identifying and mitigating market distortions arising from abuse of market dominance. However, only one RTA has so far explored solutions to address data services lock-ins. Paragraph 3 of Article 9.4 of DEPA encourages parties "to collaborate on data-sharing projects and mechanisms, and proof of concepts for new uses of data, including data sandboxes, to promote data-driven innovation." The issue of competition in digital markets is also being discussed in the context of the WTO Joint Initiative on E-commerce.

There are other governmental initiatives which could be leveraged by trade agreements, such as the cross-border regulatory sandbox between Abu Dhabi Global Market (ADGM) and the Association of Southeast Asian Nations (ASEAN) Financial Innovation Network, where start-ups and financial bodies can experiment with technologies and ideas while sharing data in a predictable and regulated environment, or the regulatory sandbox between ASEAN and ICT ministers whereby businesses can test their services without breaking data privacy rules or facing regulatory sanctions. Trade agreements could encourage governments to exchange best practices on existing data-sharing mechanisms and on how best to address related legal and technical challenges.

Coherent regulatory processes

Bilateral and international coordination across government agencies for the design and implementation of data governance regulation helps to foster regulatory coherence and thereby global data transmission. Uncoordinated regulation between these authorities not only creates legal complexity but also can unintentionally undermine the economic opportunities associated with data.

For instance, an approach to personal data protection that makes compliance difficult and costly can reduce

BOX 8

THE IMPACT OF DATA AND CONTENT REGULATION ON OCEAN SHIPPING VISIBILITY

Information on cargo volumes and positions enables traders to optimize logistics by predicting congestion and choosing shipping routes accordingly. Due to the COVID-19 pandemic, the surge in demand for goods and shortage of containers have created port disruptions around the world, making shipping data even more important to determine schedule times for shipments.

New regulations put in place in certain jurisdictions have led domestic providers of these jurisdictions to stop providing shipping information to foreign companies, thereby significantly impacting ocean shipping visibility.

Source: Saul and Baptista (2021).

the value of data sharing, such as in the delivery of cross-border services or the tracking of shipments, containers and products across supply chains (see Box 8). Similarly, governmental bodies working in the regulatory field of cybersecurity generally focus on safety, security and resilience of critical assets and infrastructure, and are not necessarily aware of the implications on openness, interoperability and trade. Like other digital economy policy and regulatory initiatives, data regulation needs to be designed in collaboration with multiple stakeholders, including trade policymakers.

Trade agreements could encourage governments to foster dialogue between their regulatory bodies and trade policymakers and to encourage the exchange of good regulatory practice. This would help to: (i) set a common vision; (ii) enhance coherent implementation and coordination; (iii) deliver value from data; and (iv) lower trade costs. This is especially important where there are several regulators pursuing data regulation, which could inadvertently result in new obstacles to trade.

ENDNOTES

1. See https://www.itu.int/en/ITU-T/studygroups/2013-2016/03/Pages/iic.aspx.
2. The Reference Paper is a set of regulatory principles that is legally binding for those WTO members which have committed to it by appending the document, in whole or in part, to their schedules of commitments. See https://www.wto.org/english/tratop_e/serv_e/telecom_e/tel23_e.htm.
3. See https://www.wto.org/english/news_e/news21_e/ecom_20apr21_e.htm.
4. The Annex on Telecommunications concerns public telecommunications transport networks and services: transport services refer to data transmission services; public refers to those telecommunications transport services that are required to be offered to the public generally. It refers to the ownership of a company.
5. See https://www.wto.org/english/news_e/news21_e/ita_02dec21_e.htm.
6. See https://www.wto.org/english/news_e/news21_e/ita_30jul21_e.htm.
7. See https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm.
8. See https://www.wto.org/english/tratop_e/devel_e/dev_wkgp_trade_transfer_technology_e.htm.
9. The definitions of data controllers and data processors vary across jurisdictions. Here, the terms should be understood in the context of the EU General Data Protection Regulation.
10. TAPED dataset dated 25/01/2022, available at https://www.unilu.ch/en/faculties/faculty-of-law/professorships/burri-mira/research/taped.
11. Some argue, for example, that the EU proposal for an ex-ante conformity assessment framework could become a barrier to AI-based digital trade even if the products are safely and effectively used in other jurisdictions (World Economic Forum, 2020a).

2
GLOBAL LEGAL RECOGNITION OF ELECTRONIC TRANSACTIONS AND DOCUMENTS

On average, a cross-border transaction requires the exchange of 36 documents and 240 copies (Fletcher, 2019). A shipment of roses from Kenya to Rotterdam can generate a pile of paper 25 cm high, and the cost of handling it can be higher than the cost of moving the containers (Allison, 2016).

A paper-based trade environment incurs inefficiencies. Goods can arrive at their port of destination while the documents are still making their way through the supply chain, leading to delays in cargo delivery. Payments can lag or be mismatched to documents. Cargo vessels spend between 60 per cent and 70 per cent of their port time at a berth (Lind *et al.*, 2019). This typically leads to additional costs to hold the cargo or to indemnify the carrier for delivering the cargo without a bill of lading. The Digital Container Shipping Association estimates that the industry could save more than US$ 4 billion per year if 50 per cent of bills of lading were digitalized.[1] In addition, a considerable amount of time and costly effort is spent for the transportation and administration of documents. According to Maersk, the cost of processing trade documents could be as much as 20 per cent of the physical transportation costs of a shipment (WTO, 2018).

In the field of trade finance, more than 20 parties are usually involved in a single transaction throughout the process, with data captured in 10 to 20 documents, creating approximately 5,000 data field interactions, the majority of which comprises simple actions, such as ignore/transmit to the next party (BCG, 2017). The COVID-19 pandemic has revealed the significant risk to supply chains of relying on physical documents. The ability of traders to import and export goods and services operating within traditional paper-based systems was hindered by lockdowns, health and safety procedures, and teleworking measures (Renard *et al.*, 2021).

Paper-based documents can easily be forged. Trust services guaranteeing the origin and integrity of paper-based documents, such as notary services, exist but they are generally not time and cost efficient.

Substituting paper with digital means has many benefits. First, it reduces processing time and enables companies to leverage data. AI, machine learning and natural language processing can optimize document processes and generate insights of how to facilitate and accelerate customs clearance by improving risk management processes. AI can also be used to auto-detect fraud patterns and to fight trade-based money laundering. The more data are available, the better the training results of an AI will become. The COVID-19 pandemic has also revealed the sanitary effects of digitalization, which minimizes physical contacts.

> **"The COVID-19 pandemic has revealed the significant risk to supply chains of relying on physical documents. The ability of traders to import and export goods and services operating within traditional paper-based systems was hindered by lockdowns, health and safety procedures, and teleworking measures."**

Second, it enables supply chain stakeholders to receive the same quality and consistency of information digitally and in real-time. Blockchain and DLT can guarantee the integrity and authenticity of information exchanged on a blockchain, thus adding an additional layer of trust among supply chain stakeholders and solving the double-spending problem that has been at the origin of various fraud scandals.[2] Last, but not least, TradeTech contributes to the automation of trade transactions, thereby minimizing contract management and enforcement costs as well as the likelihood of document errors.

According to the International Chamber of Commerce (ICC) United Kingdom and Coriolis Technologies[3], digitizing transferrable trade documents could:

- generate £25 billion in new economic growth in the United Kingdom alone and 25 per cent more small business trade by 2024;
- reduce the number of days needed to process documents by up to 75 per cent;
- generate up to £224 billion in efficiency savings;
- result in up to £1 billion to tackle the trade finance gap (estimated at £2.3 billion for 2020).

The sheer number of trade documents places a heavy burden on small business seeking to trade internationally. Hence, they are expected to benefit the most from the digitization of trade documents, which could lead to a 35 per cent improvement in small business efficiency savings and a 13 per cent increase in international business revenues.[4]

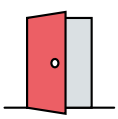
Despite these benefits, not all trade-related sectors have been able to integrate electronic transactions and documents into their practices. In maritime shipping,

despite more than two decades of digitalization efforts, e-bills of lading are rarely issued (fewer than 100 per year). In aviation, however, digital processes are now the norm and paper the exception. Electronic Air Waybill became the default contract of carriage for all air cargo shipments since the adoption of International Air Transport Association (IATA) Resolution 672, which removes the requirement for a paper Air Waybill.[5]

To support the global use of electronic transactions and documents in international trade, governments could:

- establish legal frameworks recognizing the legal validity and enforceability of electronic transactions and documents in a jurisdiction, including electronic transferable documents, as well as of trust services, such as e-signatures;
- align these frameworks with global standards to support cross-border recognition and use of electronic transactions and documents, such as electronic transferable documents, and of trust services.
- address in a coordinated manner the legal implications of different types of algorithm, which are increasingly used in conjunction with TradeTech, and which would avoid regulatory fragmentation.

A | E-SIGNATURES AND TRUST SERVICES



E-signatures are used to identify a person and to indicate that person's intention with regard to the information contained in an electronic message. Through cryptography, e-signatures provide an effective means of guaranteeing the authenticity and integrity of the message and can significantly improve security against malicious attacks.[6] Given that electronic files can also be manipulated, like paper-based documents, many jurisdictions require that digitally signed documents provide a guarantee of integrity, and in some cases be legally recognized[7], to be considered equivalent to a handwritten signature.

Beside e-signatures, other electronic or trust services can provide assurance of certain qualities of a data message (e.g. integrity or origin), including, *inter alia*: electronic seals; electronic time stamps; website authentication; electronic archiving; and registered electronic delivery services.

According to the EU eIDAS Regulation on electronic identification and trust services for electronic transactions,[8] an e-signature is a type of trust services.

The draft United Nations Commission on International Trade Law (UNCITRAL) Model Law on the Use and Cross-border Recognition of Identity Management and Trust Services follows the same approach. Access to these trust services would be essential to support digitalization processes in trade, such as emerging paperless trade systems or electronic transferable records.[9]

Across the globe, some 60 countries have established their own laws and standards regarding e-signatures, ensuring that signatures on documents and contracts should not be denied legal effect or ruled unenforceable simply because of their digital nature.[10] For instance, the EU eIDAS Regulation stipulates what an electronic identification and trust services for electronic transactions in the internal market should be.

While these are welcome developments, cross-border use of electronic services and trust services remains limited. There are different reasons for which governments can play an influencing role. Without a global alignment of national regulatory approaches, the legal validity and enforceability of e-signatures and trust services abroad is uncertain. Compliance costs for companies to obtain legally recognized e-signatures and trust services will be high.

BOX 9

THE EIDAS REGULATION AND THE BALTIC STATES

Despite a very similar shared legal context in terms of the eIDAS Regulation, cross-border use of e-signatures and trust services in the Baltic States remains limited. A study on Nordic-Baltic Trust Services by Hinsberg *et al.* (2020) provides several reasons for this.

First, although trust services fall under the eIDAS Regulation, the legal meaning differs. While the eIDAS Regulation defines a qualified e-signature as "an advanced electronic signature that is created by a qualified electronic signature creation device, and which is based on a qualified certificate for electronic signatures", some EU member States recognize the legal effects of lower levels of e-signatures. "Other trust services within the meaning of the eIDAS Regulation and their legal meaning are usually not defined", thus creating different legal meanings in EU member States.

Second, countries* involved in the Nordic-Baltic eID Project (NOBID) have different "digital maturity … in doing business, conducting transactions, and using e-services online." This stresses the importance of capacity-building to support market adoption of cross-border trust services.

Third, trust services providers use different semantics and formats, hindering interoperability between systems.

Fourth, consumption habits differ: "If the Baltic states are generally more dependent on qualified trust services and require a high level of assurance of electronic identity, then Nordic countries use … advanced e-signatures instead of qualified e-signatures."

* Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway and Sweden.

UNCITRAL has adopted various instruments to facilitate such cross-border recognition. Many States have adopted the UNCITRAL functional rule on e-signatures and trust services, but not all. The UNCITRAL Model Law on Electronic Commerce (MLEC) and the United Nations Convention on the Use of Electronic Communications in International Contracts (Electronic Communications Convention), which entail the adoption of the UNCITRAL functional rule, have been adopted by 78 and 15 parties, respectively. The UNCITRAL Model Law on Electronic Signatures (MLES) builds on the fundamental principle underlying article 7 of MLEC and establishes criteria of technical reliability for the equivalence between electronic and hand-written signature to foster cross-border use of e-signatures. At present, however, national legislation based on or influenced by MLES has been adopted by only 36 States.[11] The draft UNCITRAL Model Law on the Use and Cross-border Recognition of Identity Management and Trust Services will define what outcomes are expected from each trust service and methodological requirements to guarantee the reliability of a trust service. Global adoption will be essential.

Even when legislation exists, it may not be sufficient to foster cross-border use of e-signatures and trust services, as the case of the Baltic region demonstrates (see Box 9).

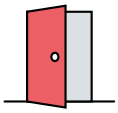
What can trade agreements do to foster cross-border use of e-signatures?

Twenty-one RTAs refer to MLEC and ten to the Electronic Communications Convention, which support the functional equivalence between electronic and hand-written signatures. No trade agreements refer explicitly to MLES, which contains criteria of technical reliability for the equivalence between electronic and hand-written signatures as well as basic rules of conduct that may serve as guidelines for assessing duties and liabilities for the signatory, the relying party and trusted third parties intervening in the signature process. This common framework is essential in international trade.

Recognition of e-signatures and other electronic authentication methods is also being discussed in the context of the WTO Joint Initiative on E-commerce, in which more than 80 WTO members participate, among which 69 members have already signed RTAs including provisions on e-authentication or e-signatures. Governments could leverage trade agreements to support the global adoption of international frameworks for e-signatures and trust services. International standards and guidelines provide a useful basis upon which governments can work towards regulatory convergence.

Governments should recognize that global regulatory alignment is one step towards the cross-border use of e-signatures and trust services and, more generally, of electronic documents and transactions. Other barriers include, *inter alia*, different digital maturity levels and data models.

B | TRANSFERABLE DOCUMENTS AND INSTRUMENTS



A transferable document or instrument entitles the holder to claim the performance of an obligation indicated in the document and to transfer the right to perform that obligation through the sale or disposal of the document. Transferable documents are used extensively in international trade, such as in shipping, logistics and finance (e.g. bills of exchange, invoices, bills of lading, promissory notes, warehouse receipts).

The availability of transferable documents in electronic form may greatly facilitate e-commerce. It can improve speed and security of transmission, permit the reuse of data and automate certain transactions through smart contracts. Electronic transferable documents can make an important contribution to trade facilitation. Digitizing transferable documents is an essential step towards trade digitalization, but it is not sufficient. To be used in cross-border trade transactions and transferred across borders, electronic transferable documents need to be recognized as functionally equivalent to paper documents.

To support global legal recognition of electronic transferable documents, UNCITRAL adopted in 2017 the Model Law on Electronic Transferable Records (MLETR). The MLETR establishes a method for an electronic transferable record to become functionally equivalent to a paper-based transferable document or instrument. This method is used:

A. to identify that electronic record as the electronic transferable record so that multiple claims of the performance of an obligation indicated in this record would be avoided. This requirement implements the principle of **singularity**.
B. to render that electronic record capable of being subject to **control**[12] from its creation until it ceases to have any effect or validity.
C. to retain the **integrity**[13] of that electronic record.

MLETR is technology neutral and so can be implemented with any technology.

BOX 10

MODEL LAW ON ELECTRONIC TRANSFERABLE RECORDS AND DOMESTIC LEGISLATION

Abu Dhabi Global Market*

In February 2021, the ADGM enacted the Electronic Transactions Regulations 2021, based on the MLETR. The Regulations affirm that e-signatures, contracts, records and documents are as legally enforceable in ADGM as traditional, non-electronic (i.e. physical) versions, and thereby enable the reliable and efficient electronic transfer of signed documents, contracts and financial instruments within the United Arab Emirates and internationally.

The Regulations are based on the MLETR, as this was considered the most minimalist and proportionate approach to address the needs of stakeholders as well as any risks. Having adopted the MLETR, the AGDM is now developing proofs-of-concept to demonstrate how the MLETR can foster trade between firms and facilitate trade finance.

Kingdom of Bahrain

In November 2018, the Kingdom of Bahrain became the first country in the world to enact the MLETR after collaborating with UNCITRAL to create a modern, efficient and effective legal framework for a more enhanced digital economy. As part of a plan to digitally transform trade, attract investment and increase transparency among local and international stakeholders, the Kingdom of Bahrain introduced a number of technologically friendly laws and regulations. Examples include the Law of Electronic Communications and Transactions, which aims to facilitate e-transactions and contracts by reducing red tape and improving the reliability of digital payment systems. To further buttress facilitation of cross-border trade with the rest of the world, the Kingdom of Bahrain acceded to the Electronic Communications Convention in February 2020.

The strategy to enact the law was based on close collaboration with different parties and leading experts. This included the introduction of an accreditation mechanism, not contemplated in the MLETR, to enable operators of information management systems to offer electronic

transferable records in the country. This was an innovative solution to enhance oversight, prevent fraud and build trust in electronic transferable records.

Although the Kingdom of Bahrain is a pioneer, more progress is still to be made. Mindful of the need to develop regulations that are technologically neutral, the Kingdom of Bahrain is studying the marketplace in terms of evolving technologies, before embarking on developing regulations for the accreditation of operators of an information management system for electronic transferable records. This system is used for the issuance, transfer, control, presentation and storage of electronic transferable records in accordance with the law. Even though an electronic transferable record would still be recognized by law in the absence of an accredited operator, the use of one gives users an added benefit with respect to the reliability of the electronic transferable record, such as the acceptability of the method used to secure recognition and achieving unique control and possession. This is because the method used by an accredited operator would be presumed to be reliable under the law unless there was evidence to the contrary.

Singapore

On 1 February 2021, Singapore became the second country to adopt the MLETR into domestic legislation in a move which may have been in response, at least in part, to fraud scandals linked to trade documents.

Agencies such as the Infocomm Media Development Authority, the Maritime and Port Authority of Singapore, Singapore Customs, the Monetary Authority of Singapore and the Ministry of Trade and Industry were involved in the development of the legislation, and all actively promote global adoption of the MLETR. The agencies worked with industry through a series of public consultations to meet the challenges of domestic adoption of the MLETR.

Key impediments to electronic transferable documents and instruments have been to establish what constitutes an "original" document and its "possession" in an electronic environment. Technological advancements have made it possible to meet these requirements where existing and new commercial e-bills of lading have demonstrated that stakeholders can use e-bills of lading with trust, through the use of technologies such as title registries and blockchain and DLT. Singapore had to amend legislation and pass the Electronic Transactions (Amendment) Act 2021, with provisions that set out specific requirements that an electronic record must meet to be recognized as the electronic functional equivalent of a paper transferable document or instrument. Companies can decide to change the medium from an electronic transferable record to a physical transferable document or instrument and vice versa.

In an effort to give such foundational functionalities to the international community so that systems can be kept open and interoperable, the Infocomm Media Development Authority conceived the TradeTrust** framework and has made its software components freely available for implementers on open source licensing terms.

* See https://www.adgm.com/media/announcements/adgm-enacts-electronic-transactions-framework.

** See https://www.mas.gov.sg/-/media/MAS/News/Media-Releases/2021/Annex-B---TradeTrust-Factsheet.pdf.

> **"Digitizing transferable documents is an essential step towards trade digitalization, but it is not sufficient. To be used in cross-border trade transactions and transferred across borders, electronic transferable documents need to be recognized as functionally equivalent to paper documents."**

UNCITRAL model laws need to be adopted into national legislation to have full legal bearing. As of March 2022, however, only Abu Dhabi, the Kingdom of Bahrain, Belize, Kiribati, Paraguay, Papua New Guinea and Singapore had adopted the MLETR into domestic law (see Box 10). Other jurisdictions may have legislation in line with the principles of the MLETR. Germany, for example, enacted legislation in 2013 (before the MLETR) that is compatible with the principle of equivalence of the MLETR.

The MLETR is a uniform model law and, as such, may be adapted to domestic legal needs. The United Kingdom, for instance, chose to follow a flexible approach to the MLETR provisions to strike an effective balance between international alignment and domestic legal tradition. Indeed, in a world where laws were drafted for paper-based processes, legal recognition of electronic transferable documents is not as simple as it may first appear, in part due to the notion of possession limited to tangible objects (see the example of the Law Commission of England and Wales in Box 11). However, and similar to other uniform law texts, the MLETR benefits from uniformity in enactment, application and interpretation.[14] Uniformity ensures legal predictability and reduces transaction costs.

More movement is needed on this front for electronic transferable documents to be recognized across borders on a global scale. If only a few jurisdictions adopt the MLETR, the benefits from its application and trade digitalization will remain limited. Digitalization of cross-border trade is a classic collective action problem. If the exporting jurisdiction has an enabling legal environment but the destination jurisdiction does not, then parties are likely to continue using paper documents (ICC UK, 2021).

The Infocomm Media Development Authority and the Monetary Authority of Singapore, in collaboration with the ADGM Financial Services Regulatory Authority, have introduced the first cross-border digital trade financing platform using the TradeTrust framework, which is aligned with the MLETR (see Box 12). This platform facilitates the transfer of e-documents used in trade finance between their jurisdictions. It "enables trading counterparties and transacting banks to validate documents digitally and securely even when they are on different trade finance platforms, and allows such documents to be exchanged with another party in real-time", which

BOX 11

LAW COMMISSION OF ENGLAND AND WALES: REDEFINING THE NOTION OF POSSESSION

Under the current law of England and Wales (Scotland has its own legal system), electronic trade documents cannot be possessed and therefore cannot have the same effects in law as their paper counterparts. The Law Commission has been considering how best to achieve reform.

One way in which the Law Commission's approach distinguishes itself from the MLETR is in the role played by the concept of control. The MLETR adopts (exclusive) control as an analogue of, or functional equivalent to, possession, without defining it. Instead of stipulating that control is analogous to possession, the Law Commission has proposed that an electronic trade document that can be controlled can be possessed. This will allow electronic trade documents to be plugged automatically into other possession-based concepts in English and Welsh law, including bailment, the tort of conversion and possessory securities such as pledges.

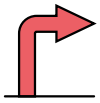
A second difference is that the MLETR deals explicitly with some matters which the Law Commission considers are sufficiently covered in existing law, such as writing requirements. An important outcome from the Law Commission's work is that other jurisdictions wishing to align with the MLETR should consider a flexible approach to its provisions to achieve the same legal outcomes in ways which fit to their own domestic laws. Although the Law Commission's approach is designed to fit to the law of England and Wales, its proposals and draft Electronic Trade Documents Bill align closely to the principles and concepts in the MLETR and achieve the same practical result.

helps to mitigate the risk of fraud, reduce costs and improve trust and efficiency; with TradeTrust, "businesses large and small can now authenticate their digital trade documentation and transact seamlessly in the digital economy."[15]

How can trade agreements support the cross-border use of electronic transferable documents?

A limited number of trade agreements contain provisions which refer to electronic transferable documents. DEPA and SADEA provisions require or encourage governments to consider the MLETR. Systematically including a commitment on MLETR transposition in trade agreements, including in the context of the WTO Joint Initiative on E-commerce, would go a long way in facilitating the digitalization of trade. As of March 2022, only seven governments had adopted the MLETR into their domestic framework. At a meeting in May 2021, members of the G7 agreed on a framework that will champion the work of UNCITRAL and promote the adoption of the MLETR in 2022 or 2023. They agreed to map domestic legal barriers to the use of electronic transferable documents and to establish actions to address these barriers.[16]

C | AUTOMATED CONTRACTS



Automated business models and processes greatly benefit companies by minimizing contract management and enforcement costs as well as the likelihood of document errors. Contrary to what their name suggests, smart contracts are not smart (there is no cognitive or AI component to them) and might not be contracts in a legal sense. They translate contractual obligations, in whole or in part, into computer code to improve efficiency through automation. Smart contracts are pieces of computer code designed to start carrying out tasks automatically in response to external triggers (e.g. automated payments in trade finance or customs processes).

Blockchain and DLT bring a new dimension to smart contracts – immutability of information. Transactions by a blockchain-based smart contract are intended to be final, unless blockchain governance is able to reverse them. Hence, blockchain and DLT help to increase the likelihood of trusted data. This ability to capture trusted data gives rise to a whole new evolution of automated business models and

BOX 12

EXAMPLE FRAMEWORKS FOR ELECTRONIC VERSIONS OF TRANSFERABLE DOCUMENTS

TradeTrust*

TradeTrust adopts a multi-pronged approach and is developed as: (i) an interoperability framework that supports the different trade documentation requirements needed to achieve paperless cross-border trade; (ii) a digital utility for system implementers to use without any additional modification; and (iii) as a reference implementation with an intuitive user interface to demonstrate the core capabilities of the framework and serve as a neutral mechanism for users to self-check for interoperability.

Enigio**

Enigio AB is a Swedish technology company that leverages DLT to create digital documents with the same functionality and properties as paper documents and can distinguish an original from a copy, prove possession and transfer ownership. Enigio's solution is interoperable with legacy systems and coexists with paper-based documents. This enables documents to be transferred freely and transparently, without requiring the recipient to have any particular software besides a standard web browser.

FQX***

FQX uses DLT to digitize promissory notes – a negotiable instrument that enables companies and individuals to obtain finance based on an unconditional promise to pay. The eNote platform allows businesses to issue, transfer and close electronic promissory notes for financing and investing. These eNotes can be sold and transferred to any third party (i.e. an investor). Pending wider adoption of the MLETR, eNotes are based on Delaware's Uniform Electronic Transactions Act, which states that "A record or signature may not be denied legal effect or enforceability solely because it is in electronic form." This legal rule states the principle of non-discrimination contained in UNCITRAL texts.

* Further details can be found on the factsheet available at https://www.mas.gov.sg/-/media/MAS/News/Media-Releases/2021/Annex-B---TradeTrust-Factsheet.pdf.

** See https://enigio.com.

*** See https://fqx.ch.

processes. For instance, smart contracts can be used to document and certify the transaction.

The UNCITRAL Model Law on Electronic Commerce (MLEC) and the United Nations Convention on the Use of Electronic Communications in International Contracts (Electronic Communications Convention), provide a standardized approach to the legal validity and enforceability of contracts formed by the exchange of data messages (i.e. e-contracts) or by the interaction of automated systems (or electronic agents) without human involvement (i.e. automated or algorithmic contracts)[17]. Their rules assume that the setting of parameters is performed by an operator. However, UNCITRAL and UN instruments do not provide a reference point to address errors involving truly autonomous or probabilistic systems (i.e. systems that have a mind of their own). Computing techniques such as deep learning in AI operate as black boxes and are perceived as increasingly more autonomous or probabilistic (i.e. neither deterministic nor autonomous, but based on a probability that something is the correct answer). To which extent the various types of algorithm fall under UNCITRAL rules might be a question for future UNCITRAL work. In the meantime, this silence creates legal uncertainty. Although UNCITRAL and UN texts provide solutions for attributing the acts of automated and deterministic systems, the attribution process when AI systems are used is unclear.[18]

BOX 13

INTERNATIONAL INSTITUTE FOR THE UNIFICATION OF PRIVATE LAW (UNIDROIT)

The UNIDROIT Digital Assets and Private Law Project develops international standards to enable jurisdictions to take a common approach to legal issues arising from the holding, transfer, use and the taking of security over digital assets. The project follows a neutral approach, seeking to accommodate diverse types of asset and technology, together with various legal cultures. The principles identified embody best practices and international standards and enable jurisdictions to take a common approach to legal issues arising from the transfer and use of digital assets. A variety of digital assets are covered, including cryptocurrencies (e.g. Bitcoin, Ethereum) and digital tokens linked to external non-digital assets.

Source: See https://www.unidroit.org.

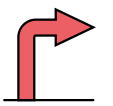
The underlying technology and practices are still evolving and may benefit from international cooperation helping governments who can come up with joint approaches to update regulations in a coordinated manner (see Box 13). Global regulatory convergence relating to smart contracts would promote greater cross-border transactions by allowing parties to sign contracts with greater confidence (OECD, 2020).

What can trade agreements do to ensure regulatory convergence regarding automated contracts?

Although some trade agreements have integrated provisions to support the use of e-contracts in international trade, none addresses legal challenges associated with the use of AI in contract formation. Twenty-three governments currently refer to the MLEC in their RTAs (including 20 participating in the WTO Joint Initiative on E-commerce) and 22 governments (including 19 participating in the WTO Joint Initiative on E-commerce) have explicitly referred to the Electronic Communications Convention.

Discussions on the legal effect of e-contracts are also underway in the context of the WTO Joint Initiative on E-commerce. That said, none of these trade agreements discusses the legal implications of different types of algorithm (e.g. deterministic, probabilistic, autonomous), thereby increasing the likelihood of distinct national regulatory approaches and thereby of regulatory fragmentation. Trade agreements could encourage governments to update existing international instruments, such as UNCITRAL model laws and UN texts, and to support in a coordinated manner other initiatives addressing the legal gaps more broadly in the area of transactions in digital assets, such as the UNIDROIT Digital Assets and Private Law Project (see Box 13). International cooperation will avoid regulatory fragmentation and in turn support the cross-border use of all types of algorithm in trade transactions.

D | TOKENIZATION



Different types of tokens have different uses and finding a common definition is challenging. There has been little agreement on the definitions and classification of various tokens, but commonly used categories are given in Box 14. Some governments have issued guidelines or norms to classify token types, but their classification differs (see Box 15). The concept of tokenization was coined in the

BOX 14

COMMONLY USED TOKEN CATEGORIES

- Utility or consumption tokens (i.e. used to provide digital access to an application or service, e.g. a voucher for goods or services offered by the issuer).
- Security tokens (i.e. used to participate financially in real physical underlyings, companies or earnings streams, or an entitlement to dividends or interest payments).
- Payment tokens (i.e. used as a means of payment, e.g. electronic money).
- Commodity tokens (i.e. tokens backed by assets that already have an independent value, e.g. gold, oil).
- Non-fungible tokens (NFTs), which represent a physical or digital asset (e.g. a document of title) and can be used for trade documents which are assets (e.g. account receivable or bills of lading) and can be traded on secondary markets.

early 2000s to describe a way to protect sensitive credit-card data to comply with industry standards and government regulations. The advent of blockchain and DLT has opened a whole range of new opportunities and applications.

The use of tokenization in trade is still in its infancy and its full potential for trade is still some time away, but potential applications are numerous, from the transfer of documents along the supply chain to payments, and fractional ownership[19] (see Box 16 for some examples of how tokens are used in international trade). Possible benefits include efficiency gains driven by automation (through the use of smart contracts) and disintermediation, transparency and improved liquidity which is particularly scarce for small business (OECD, 2020). While in international trade the flow of money and documents are traditionally distinct (taking place in parallel, but not necessary simultaneously), converting trade documents, such as bills of lading

BOX 15

EXAMPLES OF TOKEN CLASSIFICATION

Although some governments have issued guidelines and norms on classifying tokens, differences in approaches creates legal uncertainty, increasing trade risks.

Malta

Malta follows a negative list approach. According to the Virtual Financial Assets Act 2018, which establishes a classification system for virtual financial assets for issuers and services providers (e.g. exchangers, brokers, custodians), a virtual financial asset:

> "… means any form of digital medium recordation that is used as a digital medium of exchange, unit of account, or store of value and that is not -
> (a) electronic money;
> (b) a financial instrument; or
> (c) a virtual token; … [which] means a form of digital medium recordation whose utility, value or application is restricted solely to the acquisition of goods or services [i.e. utility tokens], either solely within the DLT platform on or in relation to which it was issued or within a limited network of DLT platforms".

Switzerland

The Swiss Financial Market Supervisory Authority (FINMA) reports that:

> "FINMA categorises tokens into three types, but hybrid forms are possible:
> - Payment tokens are synonymous with cryptocurrencies and have no further functions or links to other development projects. Tokens may in some cases only develop the necessary functionality and become accepted as a means of payment over a period of time.
> - Utility tokens are tokens which are intended to provide digital access to an application or service.
> - Asset tokens represent assets such as participations in real physical underlyings, companies, or earnings streams, or an entitlement to dividends or interest payments. In terms of their economic function, the tokens are analogous to equities, bonds or derivatives."

Source: See https://www.finma.ch/en/news/2018/02/20180216-mm-ico-wegleitung.

BOX 16

EXAMPLES OF TOKENIZATION OF TRADE DOCUMENTS

TradeFinex

TradeFinex enables bank and non-bank trade finance entities to transform their trade documents (i.e. bills of lading, invoices) into tokens, which can be sold in secondary markets and generate liquidity. These sales transactions are written into smart contracts. Since the industry lacks widely accepted and comprehensive smart contract standards*, TradeFinex decided to refine smart contract standards (based on XinFin Blockchain) to provide not just the standardized datasets for tokens but to also meet know-your-customer and anti-money-laundering requirements. TradeFinex is an ADGM-based software provider entity. The ADGM jurisdiction has a defined framework for settlement, custody and exchange of digital assets in secondary markets through clear guidelines for digital assets.

2Tokens**

The 2Tokens Invoice Market aims to make invoicing more efficient by creating an NFT that will represent individual invoices. By tokenizing invoices on blockchain, Invoice Market transforms invoice data from analogue to digital and in turn synchronizes processes between different parties (e.g. suppliers, debtors, factoring companies, insurance, institutional investors). Digitizing payments as part of the invoice token can increase operational efficiency and lower barriers for small business in supply chain and trade finance industries. Tokenizing invoices can create a new investable asset class: individual invoice tokens can easily be sold to factoring companies or pooled together and sold to institutional investors looking for credit risk exposure in small business.

Tradeteq***

Tradeteq, a technology provider for trade finance asset distribution, completed in September 2021 what it says is the world's first trade finance-based non-fungible token (NFT) transaction. Launched in 2018, Tradeteq's platform enables originators to package trade finance products into standardized investments that can be bought and sold through private distribution networks and settled like common fixed-income products. The trade finance NFT transaction was conducted on the Singapore-based XDC network operated by XinFin. Trade finance assets were repackaged into NFTs using the network's blockchain technology. According to participants in the transaction, NFTs significantly shorten the settlement time, enhance traceability and fractionalize investments, making it possible to tap into a larger investment base to create liquidity in the trade finance market.

* While there were proposed standards on Ethereum-based smart contracts, these standards did not address know-your-customer and anti-money-laundering requirements. See https://www.tradefinex.org.

**See https://www.2tokens.org/invoice-markets.

***See Wragg (2021) and https://www.tradeteq.com.

or invoices, into tokens and coupling them with smart contracts could allow documents and financial flows (via cryptocurrencies) to move simultaneously, thereby enhancing efficiency and speed and facilitating the sale of these documents in secondary markets. Tokenization can also be used as an incentivizing tool. For instance, vendors can earn tokens (monetary incentives) depending on performance within supply chains.

Despite the trade benefits of tokens, their cross-border use is hindered by the absence of an international definition. At present, there is no recognized terminology for the classification of tokens internationally. This absence creates legal uncertainty with regard to applicable rules and potentially increases trade costs if businesses have to comply with distinct regulatory regimes. Divergent regulatory regimes could lead to market fragmentation, hampering competition and negatively affecting industry growth.

One notable approach to avoid asset classification issues is Liechtenstein's Tokens and Trustworthy Technology Service Providers Law on blockchains, which entered into force in January 2020 and amended civil law to allow tokenization. The Liechtenstein Blockchain Act introduces the concept of Token Container Model. Under the Act, a token acts as a container that can hold rights of all kinds, such as ownership rights. By differentiating between the right and the asset on one side governed by existing laws and the token "running" on a blockchain-based system on the other side, Liechtenstein's approach fits tokens into existing laws: the token is governed by the rules that apply to the rights and assets contained in the token. Under this approach, "a security token is nothing else than a security (with all the rules, licenses, duties etc. applying to it) technically 'packaged' into the token which loads the security like a container".[20]

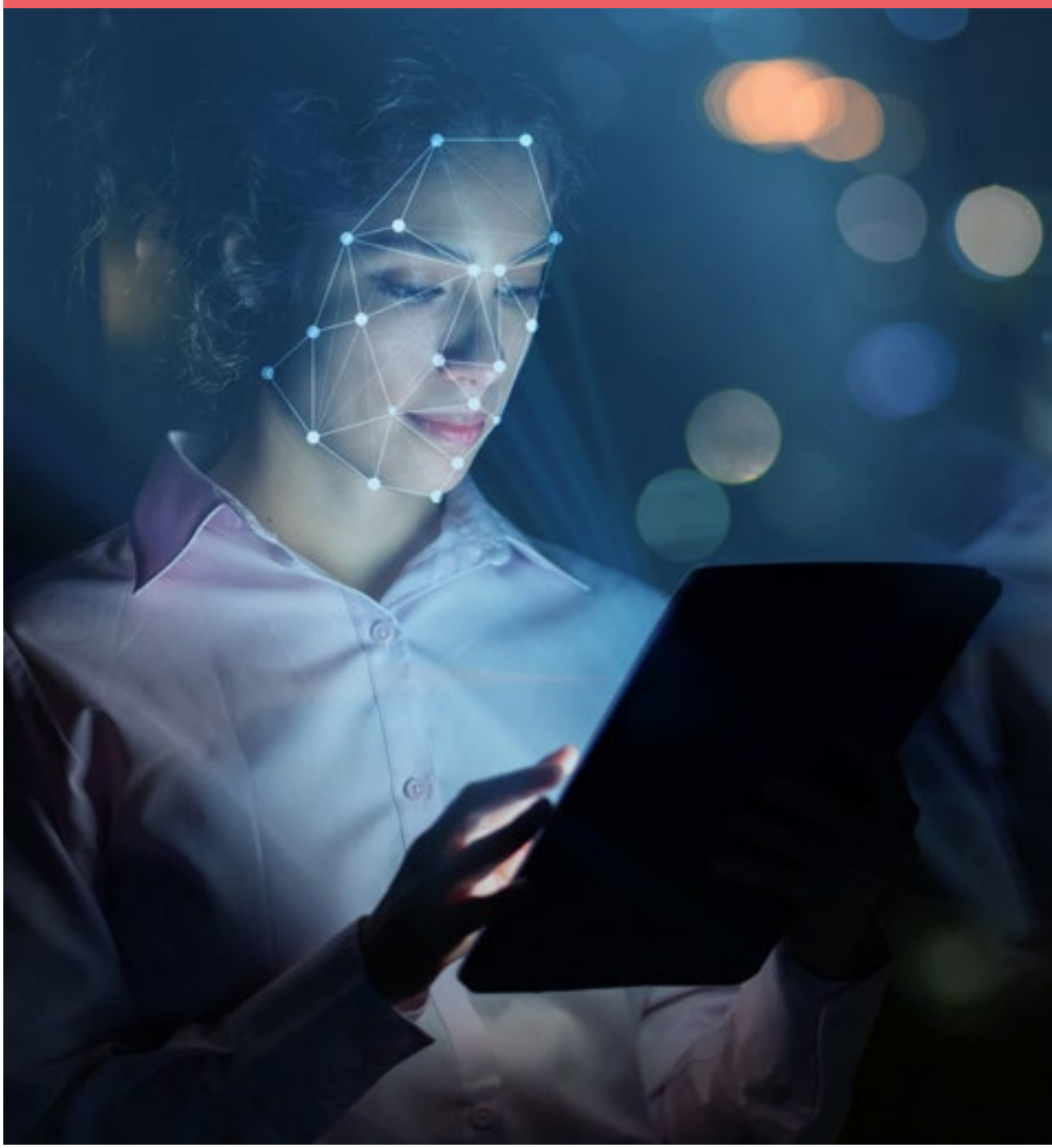
How can trade agreements support the global adoption of tokens in international trade?

Given the novelty of the subject, it is not surprising that trade agreements have yet to refer to tokenization. Arguably, existing, more general collaboration clauses of some RTAs could apply to discussions on any issue, including tokenization. That said, explicit provisions could provide legal certainty. To support the global use of tokenization, trade agreements could encourage governments to coordinate regulatory approaches to tokenization to avoid the emergence of inconsistencies among regulatory regimes applicable to tokens.

ENDNOTES

1. See https://go.dcsa.org/ebook-ebl.
2. See https://www.gtreview.com/news/asia/analysis-little-hope-for-banks-caught-up-in-agritrade-collapse.
3. See https://cdn.shopify.com/s/files/1/2992/1976/files/ICCUK-Coriolis-MLETR-Alignment-UK_Business_Case.pdf?v=1619683679.
4. *Ibid.*
5. See *Form of Multilateral e-Air Waybill Agreement*, IATA Resolution 672, 10 March 2013.
6. It is important to note that there are different types of e-signature with different levels of reliability (see the UNCITRAL Model Law on Electronic Signatures, MLES).
7. In the European Union, trust services need to be recognized to have legal effects. Recently, there was a case of a Swiss company signing with a Swiss qualified e-signature that adheres to the same technical standard as EU eIDAS signatures and a court in Vienna did not accept it because it was not eIDAS-recognized (see https://www.railway.supply/en/court-overturns-stadlers-victory-in-grand-obb-contract).
8. See *Regulation (EU) No. 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC*, 28 August 2014.
9. In practice, it is expected that electronic transferable record management systems will use the services offered by trust service providers (ICC UK, 2021).
10. See https://rightsignature.com/legality.html.
11. See https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_signatures/status.
12. Control is a fundamental notion of the MLETR, since it represents the functional equivalent of possession of a transferable document or instrument. In particular, the possession requirement is met with respect to an electronic transferable record if a reliable method is used to: (a) establish exclusive control of that electronic transferable record by a person; and (b) identify that person as the person in control.
13. In UNCITRAL texts, maintaining integrity of a data message is a requirement for functional equivalence with the paper-based notion of "original" (see https://undocs.org/pdf?symbol=en/A/CN.9/WG.IV/WP.158).
14. See article 3 of the MLETR.
15. See https://www.mas.gov.sg/news/media-releases/2021/worlds-first-digital-trade-financing-pilot-between-mletr-harmonised-jurisdictions.
16. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/986162/Annex_4__Framework_for_G7_collaboration_on_Electronic_Transferable_Records.pdf.
17. See *Revised Draft Legal Taxonomy: Revised Section on Artificial Intelligence and Automation Section*, UN document A/CN.9/1064/Add.1, 24 May 2021.
18. See *Exploratory Work on Legal Issues Related to the Digital Economy: Reports of Events*, UN document A/CN.9/LIII/INF/2, 15 May 2020.
19. Fractional ownership is a method in which various unrelated parties own a percentage share of an asset. An asset, such as a bill of lading, can be converted into different pieces or tokens and sold to several persons, thus enlarging the pool of potential buyers and investors, and increasing liquidity.
20. See https://philippsandner.medium.com/liechtenstein-blockchain-act-how-can-nearly-any-right-and-therefore-any-asset-be-tokenized-based-389fc9f039b1.

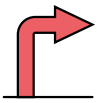
3
GLOBAL DIGITAL IDENTITY



Identity and trust lie at the core of each trade interaction. As global value chains become increasingly digital, organizations need to ensure that they can trust the digital identity of legal and physical persons[1] or products they deal with, and can efficiently link that digital identity with a real organization, specific product or device (see Box 17).

This process of dynamically verifying counterparts is a critical step in onboarding suppliers and establishing trust in trade (World Economic Forum, 2019). The global nature of value chains requires a global approach to digital identities to avoid creating digital identity silos.

A | DIGITAL IDENTITY OF NATURAL AND LEGAL PERSONS



Accessing reliable information in order to verify a party's identity is a critical step for a wide range of international trade transactions and processes, including, *inter alia*: contract formation; exchange of data and e-documents; onboarding of new suppliers and partners; social and environmental compliance; know-your-customer processes; anti-money-laundering processes; counter-terrorist financing; ultimate-beneficial-owner processes; and customs clearance.

Both public and industry actors have developed digital identity systems for entities to help to identify the supply chain actors involved and gain insights into from whom the data message has originated. However, these systems are often sector-specific (e.g. customs, financial companies, business registration).

Hence, an entity's digital identity is traditionally held in different registries and is generally not recognized outside its system and across borders. For instance:

- The World Customs Organization (WCO), in collaboration with customs authorities and industry stakeholders, developed technical standards and guidance for establishing the trade identification number, which is commonly used by customs authorities to identify authorized economic operators (AEO). AEO programmes are trusted traders' schemes which aim at securing global supply chains and facilitating customs processes for companies deemed trustworthy.
- The Global Legal Entity Identifier was established in 2011 by the G20 in the wake of the financial crisis, with oversight provided by the Financial Stability Board. Now administered by the Global Legal Entity Identifier Foundation, the legal entity identifier (LEI) is a 20-digit code based on ISO 17442:2020[2] standards, which provides a unique identification to participating parties (see Box 18).
- Business at OECD and the B20 Saudi Arabia Secretariat submitted a joint proposal to the G20 on a global value chain passport.[3] The passport aims at proving that an entity complies with relevant financial regulations and requirements, thereby avoiding the burden of having to prove identity multiple times across borders.
- Industry stakeholders have also developed their own initiatives. The Data Universal Numbering System (DUNS) is a proprietary system developed and managed by Dun & Bradstreet, which assigns a unique numeric identifier (a DUNS number) to a single business entity. Global Location Number (GLN) is managed by GS1 and enables organizations (i.e. business entities) and their subgroups (i.e. departments, divisions) to be able to identify themselves anywhere in the world by using an unambiguous, globally unique identifier that can be safely used by any other organization in the world. GLNs are currently used by millions of organizations in various sectors.

> **"Blockchain and DLT bring a new dimension to digital identities, allowing physical and legal persons to manage their own identity."**

BOX 17

DIGITAL IDENTITY

A digital identity comprises attributes and identifiers, just as in the physical world. It is a digital representation of the information known about a specific individual, group, organization or product.

A digital identity ensures that you know with whom you are interacting and thereby fosters trust throughout supply chains. It involves authentication ("Who are you?") and authorization ("What are you allowed to do?") processes. The concept of digital identity can apply to natural and legal persons, as well as physical and digital objects.

BOX 18

LEGAL ENTITY IDENTIFIER

Each LEI contains information about the company – "who is who", "who owns whom" and soon "who owns what". A uniform global LEI system will make it easier to identify legal entities and to verify their status. Global adoption of LEIs would help banks:

- to conduct know-your-customer due diligence;
- to mitigate the risk of correspondent bank relationships being cut (i.e. de-risking – an action observed by banks in many regions today);
- to increase access to finance for small business in emerging markets by easing the flow of reliable information about small companies;
- to promote the development of emergent technologies such as blockchain, thereby reducing costs.

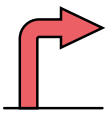
Without a unique and globally harmonized identifier, finding information about a small business in a sea of metadata is difficult, if not impossible (Patel and Ganne, 2021). LEIs make this process workable and help to realize the potential of financial technology to make finance more accessible. LEIs can drive more transparency and underpin the promise of financial technology to deliver greater inclusion of small businesses in the global economy. However, adoption of LEIs remains limited. By the end of 2020, only 1.8 million companies in over 250 jurisdictions had acquired an LEI. In order to encourage adoption, the ICC has recently established a working group on mass LEI adoption.

Blockchain and DLT bring a new dimension to digital identities, i.e. decentralized identity systems (see Box 19 for a description of the various types of digital identity systems). Systems based on blockchain allow physical and legal persons to manage their own identity (i.e. self-sovereign identity). These decentralized systems enable companies to limit the sharing of identity data to what is strictly necessary for the provision of a service or for the access to goods and online public and private services.

Various decentralized identity systems are already in production, although they currently have limited commercial use. The Sovrin Network, for example, is a public-permissioned blockchain designed to support self-sovereign identity and verifiable claims, and is used by the British Colombia and Ontario's Verifiable Organizations Network.

Despite their usefulness in fostering transparency and trust throughout supply chains, the number of identities and the commercial costs to manage them increase as companies reach foreign markets. Existing identity silos make supply chains less efficient and agile and may be challenging for small business to handle, as they do not have the resources to deal with multiple systems. Global alignment on what attributes matter and constitute an identity is needed to promote mutual recognition and to break existing silos.

B | DIGITAL IDENTITY OF PHYSICAL AND DIGITAL OBJECTS



Traceability is the ability to identify and trace the history, distribution, location and use of containers, consignments, shipments and products from end to end. It enhances planning and risk management, and the greater transparency that this brings to supply chains' operations can play a key role in mitigating the impact of supply chain disruptions, such as those experienced during the COVID-19 pandemic.

Traceability of sustainability credentials can also provide greater insight into the environmental footprint and social impacts of final and intermediate goods in global value chains. Increasingly, governments require companies to ensure that their products be produced according to minimum standards (e.g. legally logged timber, legal employment). Governments may deny the entry of goods which fail to meet requirements.

Traceability and transparency can make it easier and cheaper to show both regulatory conformance and that production standards meet the expectations of customers (e.g. organic methods, environmentally friendly goods, fair wages). This requirement is increasingly reflected in intergovernmental initiatives, such as the United Nations Economic Commission for Europe (UNECE) and the United Nations Centre for Trade Facilitation and Electronic Business

BOX 19

DIGITAL IDENTITY SYSTEMS

Digital identity systems typically fall into three types:

- centralized: one entity manages identities centrally;
- federated: users can use the same verification method for access to various applications;
- decentralized: users manage their own identity (i.e. self-sovereign identity).

The difference between the types is who controls the identity — an intermediary or the physical or legal person itself. Each type has a fundamental structure that sets them apart, with implications for adoption and trust levels, and advantages and challenges for users.

(UN/CEFACT) initiative Enhancing Traceability and Transparency for Sustainable Value Chains in the Garment and Footwear Sector (see Box 20). With the rapid growth of online trading, correctly identifying products and accurately providing all the relevant information online are vital for consumer confidence and brand reputation. Traceability can also help to monitor the lifecycle of a product with a view to reducing fraud and theft or to assessing its contribution to a global circular economy.

TradeTech opens new opportunities to identify and track physical and digital objects. For instance, IoT devices can collect and monitor information in real-time. According to experts, around 20 per cent of cargo now has a device attached for tracking international shipping, collecting diverse information (e.g. location, temperature, speed, humidity) and even estimated time of arrival.

The use of blockchain and DLT to store IoT data guarantees the quasi-immutability of the data, thereby fostering trust in supply chains. Used on its own, blockchain makes it possible to track transactions recorded on the ledger in a highly secure environment. AI can be used to optimize inventory management systems by estimating orders, thereby avoiding inventory over or under-stocking as well as missed responses to trends.

Various object identification systems exist,[4] and stakeholders have developed proprietary databases,

> **"Integrating multiple identities and attributes from different sources about a given product can improve traceability."**

with both public and private records, that contain a product history in digital form. However, existing systems and proprietary ledgers are not always compatible. Objects traced can thus have multiple identities stored in different places, creating redundancy and high frictional costs for reconciliation and verification of disparate identities. Because product classification is a manual process even among very large global companies, it is a constant source of risk and complexity for trade teams, and dealing with multiple countries intensifies the complexities and manual burden.

The lack of consistent identification and traceability of objects significantly limits the potential of traceability and automatic tracking from one end of the supply chain to the other. Integrating multiple identities and attributes from different sources about a given product can improve traceability.

In addition to enhanced transparency of sustainable practices of stakeholders involved in international trade the "use of industry standards leads to better supply chain outcomes for all stakeholders such as improved product traceability and visibility across international borders; seamless sharing of regulatory documents

BOX 20

TRADETECH APPLICATIONS PROVIDING OBJECTS WITH A DIGITAL IDENTITY

UNECE Blockchain Pilot for Traceability and Due Diligence in Cotton Value Chains*

Traceability and transparency in the garment and footwear sector have become a priority for consumers, governments and the industry due to the environmental footprint and social impacts resulting from decades of unsustainable consumption and production practices. In 2020, UNECE launched a pilot project to develop a blockchain system for traceability and due diligence in the cotton value chain, from field to shelf. The pilot aims to provide governments and companies with a set of tools to advance traceability, transparency and sustainability in this industry and to support the identification and coding of the key data to assess the sustainability performance of products, processes and facilities.

The pilot tests a selected set of sustainability claims, identified jointly with partners, which concern origin, content (organic and recycled), use of chemicals, and compliance with due diligence requirements. Partners have also been asked:

- To identify those products and materials (traceable assets) to which one or more of the selected sustainability claims should be applied;
- To collect and exchange relevant information and documents with business partners (e.g. shipping documents, delivery notes, invoices) and sustainability certificates and inspection reports that are collected at relevant nodes of the value chain.

Traceability is ensured by the application of DNA markers. A public, permissionless, Ethereum blockchain, which allows for the running of smart contracts, is used to increase the trustworthiness of the data as well as the connectivity, cost-efficiency, scalability and transferability of the solution. Later, the transfer of data from existing systems will be allowed through an application programming interface (API). The following considerations and recommendations are emerging from the ongoing implementation of the pilot:

- Need for an enabling environment for engagement and collaboration of all upstream and downstream value chain actors;
- Tailored policy and regulations which reference standards for data interoperability and take into account other evolving technologies (i.e. AI, IoT, big data and cloud computing);
- Open source, inclusive solutions and capacity-building for scaling up, particularly with small business;
- Support of frameworks for data security, privacy and governance as preconditions for accelerating adoption;
- Data models for inspection reports, certificates and credentials based on international standards for information exchange (e.g. UN/CEFACT e-business standards).

Naveo – Navigation and Geocoding Technologies Ltd**

Naveo's platform, used by around 300 corporate clients in Africa and the Indian Ocean region, tracks fleets by capturing GPS locations, fuel tank levels, speed and engine status, among other sensitive vehicle-related information. Thermal sensors installed on vehicles monitor refrigerators transporting foodstuffs and medicines to alert any sudden rise in temperature. The data captured through IoT devices are sent in real-time to cloud databases. The model mines data along food supply chains, from farms and distributors to markets, such as the condition of vehicles, fuel consumption, the behaviour of drivers as well as recommendations for optimizing road routes. These analytics help businesses to be more productive and save money through the efficient use of transportation resources.

Other traceability initiatives

There are many initiatives to track the provenance of products, assert ethical, social or environmental claims, track counterfeit products or reduce supply-chain inefficiencies. Some companies active in this field include:

- Provenance, which has carried out several projects in the food and drinks and beauty and fashion sectors to assert the sustainable provenance of goods;
- Everledger, which tracks the movement of diamonds from mines to shores;
- Agridigital and Agriledger, which help agricultural businesses to solve supply chain inefficiencies and to track the origin of their products;
- Cardano, which works with a small Georgian winemaker (Baia's Wine) to enable end-to-end supply chain traceability for their organic wines;
- Minehub and Minespider, which use blockchain for traceability and responsible mining and mineral supply chains;
- Blockverify and Blockpharma, which help to fight counterfeit in pharmaceuticals and other sectors.

* See https://unece.org/trade/traceability-sustainable-garment-and-footwear.

** See https://www.naveo.mu/en/home.

and data accurately determining jurisdiction and risk profile for each product; and enhanced consumer safety related to unsafe, recalled or counterfeit products."[5]

Moreover, these product identification systems could be linked to product classification systems, such as Harmonized System (HS) codes, to enhance transparency of supply chains and help to increase border efficiency (see Box 21). However, digital identity of objects is not sufficient to support end-to-end traceability. Another issue mentioned by experts is the uneven customs treatment of IoT devices (see Box 22).

There is an urgent need for international alignment to break existing digital identity siloes. Some international initiatives are emerging to try and address this issue. The draft UNCITRAL Model Law on the Use and Cross-border Recognition of Identity Management and Trust Services accommodates different levels of reliability.

"There is an urgent need for international alignment to break existing digital identity siloes."

The governments of some EU member States (Finland, Germany, Spain), Canada (British Columbia, Ontario) and Latin America have also announced a digital identity wallet to link national digital identities with proof of other personal attributes (e.g. driving licences, diplomas, bank accounts) so that individuals and companies can prove their identity by using one single platform.[6]

Industry is also working towards interoperable digital identity systems. The World Wide Web Consortium (W3C) has developed the Verifiable Credentials (VC) Data Mode and Decentralized Identifiers (DIDs) protocol to provide a standard way to express

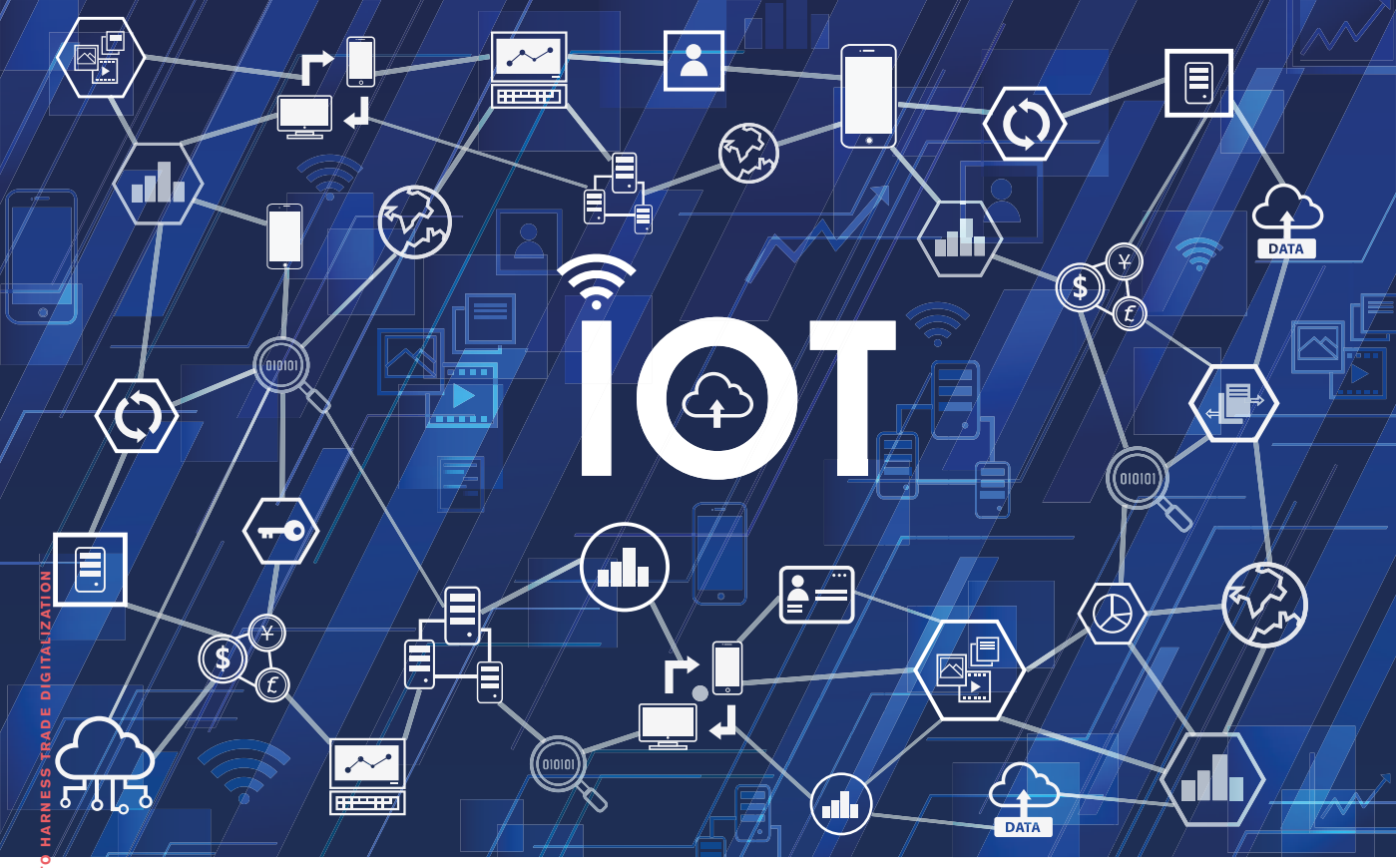
BOX 21

PRODUCT IDENTIFICATION AND CLASSIFICATION

The GS1 Global Product Classification (GPC) coding system and the Global Trade Item Number (GTIN, also known as UPC, EAN, SKU number, barcode number) are widely used in business to business exchanges to verify product data, including country of origin, product type and content, among other things. The GTIN uniquely identifies products both online and in-store, and border agencies are increasingly requiring traders to provide GTINs in addition to HS codes.

Linking global product identification systems, such as GPC and GTIN, and HS codes could prove very powerful and provide the global trading system with more information about products moving across borders and with new functionalities. It could simplify processes for economic operators, since the data from their systems would be recorded only once and eliminate (or significantly reduce) the need for a one-off manual data input.

Source: See https://www.unescap.org/sites/default/files/113%20Final-Team%20Patrik%20Jonasson-GS1.pdf.



BOX 22

UNEVEN CUSTOMS TREATMENT OF IOT DEVICES

In many countries, customs authorities treat the IoT device used in a container as a definite import (instead of temporary or in transit), and thereby impose duties or delay the release of the IoT device, even though the device is to be used in subsequent shipments and will eventually leave the country. Custom duties applied could be substantial considering the value of the devices themselves.

In many cases, these additional costs force companies to either store a large number of IoT devices to mitigate customs delays or risk not attaching IoT devices to cargo, ultimately harming companies' abilities to market IoT devices and to deploy transparency and security solutions for international trade. The use of a common temporary import regime, or transit regime, could encourage the re-usability of IoT devices, which are often discarded after one use in the destination market.

Diverging customs treatment of IoT devices undermines traceability, efficiency, safety and security of supply chains.

identity credentials online for any subject (i.e. person, company, physical or digital good or document). W3C provides standardized components constituting a verifiable credential (i.e. identity of an issuer) and a verifiable presentation (i.e. data shared with a verifier). These W3C credentials are used by both public and private stakeholders. For instance, the United States Department of Homeland Security is funding the development of DID-based verifiable credentials as a standard the United States Customs and Border Protection service can use for supply chain verification in response to the COVID-19 crisis. DID-based decentralized digital credentials are also being used by the IATA in relation to COVID-19 digital health passes. An important and business-friendly feature of the DID/VC technology stack is "selective disclosure", which is that a holder of a credential can choose to only disclose selected data to a recipient and select different data from the same credential to disclose to a different recipient.

Trade agreements have thus far focused on the identification of a person in the context of e-signatures and have largely disregarded the broader issue of digital identity of persons. With respect to identity of objects, trade agreements have focused on interoperability of product classification systems (e.g. HS codes) but disregarded interoperability of product identification systems

and linkages between product classification and identification systems.

As of 15 October 2021, none of the 350 RTAs currently in force and notified to the WTO addresses the issue of identity. They exclusively focus on e-authentication and e-signatures and do not cover issues relating to the management of identifiers and attributes, despite the increasing number of digital identity systems. Nor is digital identity discussed in the context of the WTO Joint Initiative on E-commerce.

DEPA and SADEA are two notable exceptions. These recent agreements include provisions on digital identities that call for interoperability and mutual recognition of digital identity systems and the exchange of best practices.

Where do we stand and what can be done from a trade policy perspective to address digital identity silos?

Governments could use trade agreements to avoid divergence of digital identity systems relating to legal and natural persons by:

- Supporting and leveraging international initiatives aimed at fostering mutual recognition of identifiers and attributes, such as the UNCITRAL Working Group IV (Electronic Commerce) on digital identity and trust services[7] and the W3C Verifiable Credentials Data Model.
- Leading by example through the setting up of a minimum level and type of business data (or attributes). Governments would ensure that updates to the legal status of an entity are continually maintained and immediately communicated. As soon as a legal entity changes status, the change would be made accessible to all parties involved in real-time and on-demand (see Annex for detailed suggestions).
- Encouraging the development of a global certification framework whereby accredited digital identity operators would issue globally recognized digital identities.

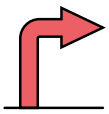
With respect to identities of physical and digital objects, governments could leverage trade agreements by:

- Promoting the use of open, global standards for product identification and data sharing across global value chains.
- Creating a linkage between product identification and classification systems, such as HS codes, UN/CEFACT data models, the W3C verifiable credential standard and product identification systems (e.g. GPC and GTIN). The GS1 Digital Link standard offers a method for achieving this linkage based on existing product, organization and object identifiers.[8]
- Encouraging customs authorities to agree on a standardized treatment of IoT devices to promote their use and contribute to better traceability of objects throughout supply chains.

ENDNOTES

1. The digital identity of individuals involves issues such as human rights or privacy concerns that do not apply to digital identity of companies. These issues are not discussed in this publication although they remain important for any digital identity project involving individuals.
2. Financial Services: Legal Entity Identifier (LEI), ISO 17442:2020.
3. See https://www.tradefinanceglobal.com/posts/global-executive-forum-b20-business-at-oecd-exclusive-gvc-passport and Business at OECD and B20 Saudi Arabia Secretariat (2020).
4. See https://www.ccpit.org/image/1331845279825047554/906569dc45284dfeb39dcbcce1d550e4.pdf.
5. See https://www.unescap.org/sites/default/files/113%20Final-Team%20Patrik%20Jonasson-GS1.pdf.
6. See https://ec.europa.eu/commission/presscorner/detail/en/IP_21_2663.
7. The Working Group is discussing legal issues relating to identity management and trust services with a view to introducing different levels of reliability of methods, processes and technologies used in the identification and authentication processes, as well as to specify the legal consequences attached to each reliability level.
8. See https://www.gs1.org/standards/gs1-digital-link.

4
GLOBAL INTEROPERABILITY OF DATA MODELS FOR TRADE DOCUMENTS AND PLATFORMS



In a digital environment, for parties to seamlessly exchange data and documents, all information needs to be clearly defined and unambiguous (World Economic Forum/UNECE, 2017). Reaching agreement on both the semantic content (i.e. data definitions such as whether the 'port of unlading' is the same as the 'port of discharge') and the syntax of data (i.e. data structure or format) is critical to ensure trading partners wanting to exchange information understand it in the same way.

It is also critical to ensure interoperability between platforms. Various platforms being developed, be they private-sector-driven in areas such as trade finance, transportation or national single windows (NSWs), follow their own rules and still often operate in isolation. Connecting the various platforms or developing common cross-sectoral or cross-jurisdictional approaches is needed to enable global flows of electronic data and documents.

Both UN/CEFACT and the WCO have developed semantic libraries ("what means what"). Priority now needs to focus on promoting their use and on developing standardized conceptual data models for all trade documents in a coordinated manner to permit information to be exchanged seamlessly from one end of the supply chain to the other.

A conceptual data model defines what data should be included in a document, independent of its syntax (which may change depending on technology or system). To support interoperability across systems, standardized methods for exchanging data using APIs need to be developed.

Initiatives aimed at developing standardized data models often evolve in silo, thereby undermining standardization efforts. Box 23 provides examples of standardization initiatives for electronic trade documents and processes. Some deal with particular sectors, such as the WCO Data Model, which is focused on information needed by customs authorities and other regulatory agencies for the release and clearance of products.

"The lack of alignment of data models and processes limits the cross-border exchange of trade documents and information."

"Connecting the various platforms or developing common cross-sectoral or cross-jurisdictional approaches is needed to enable global flows of electronic data and documents."

Other initiatives are more general and cover the entire supply chain (e.g. UN/CEFACT Buy – Ship – Pay Reference Data Model).[1] Some are spearheaded by large international organizations, others by private companies. Some initiatives also cover trade documents such as invoices. For some trade documents, however, no standard yet exists (e.g. for dry and wet bulk bills of lading); and overall, the rate of adoption of existing standards remains limited.

The lack of alignment of data models and processes limits the cross-border exchange of trade documents and information. For instance, despite government efforts to introduce NSWs to expedite the movement, release and clearance of goods, the exchange of information between NSWs continues to rely on physical documents to fulfil the requirements of trading partners, counterparts and authorities across borders. There is a lack of a common taxonomy and data elements contained in trade documents, and only a few RTAs (e.g. United States–Mexico–Canada Agreement) and regions (e.g. ASEAN, APEC) have worked on interoperability to link NSWs.

To address these interoperability issues, the ICC launched the Digital Standards Initiative (DSI) in 2020 with the support of Enterprise Singapore and the Asian Development Bank and with the participation of the WTO. The DSI seeks to coordinate standardization efforts across sectors to plug gaps, drive adoption of existing standards and ultimately allow the seamless exchange of data from one end of the supply chain to the other.

The DSI also aims to promote alignment of the platform rulebooks developed by the private sector. Membership is open to all organizations, regardless of sector or location, which support the DSI's core mandate. Similarly, some national standardizing bodies are working together towards the development of international standards (e.g. ASEAN–Australia Digital Trade Standards Initiative[2]).

BOX 23

EXAMPLES OF STANDARDIZATION INITIATIVES FOR ELECTRONIC TRADE DOCUMENTS AND PROCESSES

E-invoicing

UN/CEFACT has developed a cross-industry e-invoice data model derived from the UN/CEFACT Supply Chain Reference Data Model. As an invoice is potentially reused for multiple operations (i.e. sale, transport, clearance, fiscality, remittance, insurance), many actors will play the role of receiver (very often in different economies), which makes it important to use an international standard with clear semantic definitions. E-invoicing enhances efficiency, permits cost saving and minimizes the likelihood of document fraud. Other e-invoicing standards exist, such as the Peppol standard (see below). UN/CEFACT has developed many other standards for trade documents, including packing lists, delivery notices, bills of lading and waybills, certificates and inspection reports, dangerous goods and security declarations.

Business to business transaction management

GS1 has developed a semantic methodology to define a complete syntax-neutral dataset that can be shared in a transaction between business partners and then mapped to different syntaxes: (i) European Article Number Communication (EANCOM, a subset of the electronic data interchange for administration, commerce and transport (EDIFACT) ISO 9735 standard); (ii) GS1 XML; and (iii) external global data models, such as the UN/CEFACT Supply Chain Reference Data Model and the European Committee for Standardization (CEN) Core Invoice.

Government procurement

In e-procurement, Peppol provides a set of technical specifications and data models for facilitating the exchange of standards-based e-documents over the Peppol network (e.g. eOrders, eAdvance Shipping Notes, eInvoices, eCatalogues, Message Level Responses). Peppol is governed by a multilateral agreement structure which is owned and maintained by OpenPeppol, a non-profit international association comprising both public-sector and private members. SADEA explicitly refers to PEPPOL standards.

Logistics and transport

The Digital Container Shipping Association (DCSA) recently published an e-bill of lading standard for containerized shipments. Yet, there is still no e-bill of lading standard for bulk shipments within the commodities industry. The Baltic and International Maritime Council (BIMCO) has teamed up with the ICC to establish a globally accepted standard for e-bills of lading for dry and wet bulk shipping. Like the DCSA standard, BIMCO's standard will be fully aligned with the UN/CEFACT Multi-Modal Transport Reference Data Model to ensure seamless and transparent e-bill of lading transactions across borders.

The FIATA International Federation of Freight Forwarders Associations began creating standardized trade

documents more than 65 years ago, including the Forwarders Certificate of Receipt (in 1955), the Forwarders Certificate of Transport (in 1959), the Negotiable Combined Transport Bill of Lading (1970) and the Warehouse Receipt (in 1975). Standards on warehouse e-receipts are forthcoming.

The IATA introduced the ONE Record as a common model to facilitate real-time data exchange between cargo airlines, shippers, forwarders, ground handlers and other actors in the supply chain. This standard for air cargo data sharing aims to create a single record of a shipment.

Customs

The WCO Data Model includes datasets for different customs procedures and information needed by other cross-border regulatory agencies for clearance at borders. The model is consistent with other international standards, such as the United Nations Trade Data Elements Directory (UNTDED).

At the regional level, the ASEAN Single Window is a joint effort of the ASEAN-Business Advisory Council and the United Kingdom Foreign, Commonwealth and Development Office (FCDO). It links National Digital Trade Platforms (NDTPs) to a regional network that standardizes the digital exchange of private sector generated documents for ASEAN member countries and their key trading partners. A research team from International Economics Ltd, IMC Worldwide and the University of Sussex investigated the taxonomy and the different data elements contained in various trade documents, and recommended standards for different aspects relevant to digital trade data, ranging from semantics and syntax to communication and security.

NDTPs can enable harmonization by allowing all trading partners to interact via a single platform, lowering the barriers to entry for firms. They provide efficiency through the automation and simplification of processes, including real-time data exchange and a reduction in associated trade costs. They create transparency through the secure sharing of data directly between supply chain partners. Finally, NDTPs provide security due to the ability to authenticate parties and to digitally record transactions, leading to a reduction in inaccurate information and fraud.

How can trade agreements support the greater use of data models for trade documents and interoperability of platforms?

Despite the wide range of documents involved in trade transactions, trade agreements have so far encouraged the use of standards only for a limited number of trade documents, namely e-invoicing and e-certification for agricultural commodities. Agreements such as DEPA and SADEA encourage governments to work towards interoperability of e-invoicing systems through the adoption of international standards and guidelines on e-invoicing. SADEA also considers interoperability of electronic certification for agricultural products. Possible references to international standards are also being discussed in the context of the WTO Joint Initiative on E-commerce.

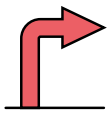
Trade agreements could extend this approach to all key trade documents where international guidelines or standards exist and encourage their use. In the absence of such guidelines or standards, trade agreements could encourage governments to accelerate standardization efforts at the global level, such as the ASEAN–Australia Digital Trade Standards Initiative.

Many trade agreements, including the WTO's Trade Facilitation Agreement, support the use of NSWs to expedite the movement, release and clearance of goods. Except a few recent trade agreements, however, none considers the critical issue of interoperability between NSWs.

ENDNOTES

1. The Buy – Ship – Pay Reference Data Model provides common data models used in the transport and logistics domain as well as the supply chain and procurement domain. These common data models are based on the UN Core Component Library, similar to many other standards (e.g. those of GS1). See https://unece.org/fileadmin/DAM/cefact/brs/BuyShipPay_BRS_v1.0.pdf.
2. See https://www.standards.org.au/engagement-events/international/asean-australia-digital-trade.

5
GLOBAL TRADE RULES ACCESS AND COMPUTATIONAL LAW



Businesses operate in an environment of increasing legal complexity. At a global level, trade compliance is particularly time consuming and costly, as enterprises need to be aware of and comply with rules under different international agreements as well as meet their contractual obligations.[1]

With continual economic integration (and in some instances devolution), the rules that apply in cross-border contexts are becoming more numerous, technical in nature, complicated to understand and difficult to operationalize (Atkinson and Schubert, 2021). Although trade policy transparency tools exist (e.g. ePing[2]), many small businesses remain unable to identify and comply with market access rules – tariffs and NTMs – or to utilize preferences.

Capacity to adhere to identity, tax and digital and data regulations can also play a role in limiting or facilitating cross-border commercial activity. Recently, however, legal innovations have sought to address administrative barriers to trade (see Box 24).

These digital solutions can be considered basic examples of computational law: they leverage natural language rules expressed in conditional programming forms (e.g. "if then, else" statements) so that computer software can automatically provide users with legal answers that depend on the input of concrete, trade-related parameters. Yet in such examples of tools where users obtain necessary information on which rules apply, they must still know how to comply with the identified regulations. The automation of this "operationalization" step represents the future of computational law for trade policy.

Computational law is the branch of legal informatics concerned with the codification of regulations in precise, computable form and the automation of legal reasoning (Genesereth, 2015). As such, this area of legal informatics is particularly applicable to trade rules. Emphasizing the capacity of machines to perform legal analyses and processes on behalf of humans, computational law also addresses the automation of private obligations (e.g. contracts, financial standards, business rules for pricing).

BOX 24

EARLY STEPS TOWARD THE APPLICATIONS OF COMPUTATIONAL LAW FOR THE BENEFIT OF SMALL AND MEDIUM-SIZED ENTERPRISES

In response to the difficulties that small businesses face in complying with rules of origin (RoOs) contained in RTAs, the European Commission introduced the Rules of Origin Self-Assessment (ROSA) tool. In ROSA's development phase, RoOs were expressed as "if, then" statements to enable SMEs to see whether their product meets criteria for preferential or duty-free access by answering clear and simple questions. The result of using ROSA is a tailored self-assessment report (i.e. eligibility/ineligibility) based on their answers.

Similarly, in the field of public procurement, more and more RTAs contain ambitious procurement chapters offering new business opportunities. A need for simpler, business-friendly advice on how to use these procurement chapters was stressed as a priority by EU-based exporting firms. The eligibility of a foreign trader to a public procurement opportunity depends on many parameters (e.g. level of government, goods versus services, thresholds, specific conditions, exceptions). Hence, getting a straight answer to a simple question by a trader such as "will my offer be considered on the same basis as the offer from a local company" can theoretically be one in over a million combinations.

Through computational law approaches, this process can be simplified. The development of the Access2Procurement tool also codifies procurement parameters into conditional statements to enable a single step-by-step web interface that only requires a few simple inputs before offering a straight answer.

Challenges still remain. Two in particular are noteworthy. Firstly, translating legal texts into an algorithmic form to give an SME a definitive answer is not always possible. Some RTA provisions do not lend themselves to simple "if then, else" type of algorithms that underpin the two online tools described above and leave a wide margin of interpretation for procurement entities. A second challenge relates to the SMEs themselves. There is still a considerable number of SMEs that are not fully aware of the existence of such tools or their usefulness. This lack of awareness may keep SMEs from being able to capitalize on lucrative commercial opportunities abroad.

Source: Cernat (2021).

> **"Computational law is the branch of legal informatics concerned with the codification of regulations in precise, computable form and the automation of legal reasoning."**

Computational law (sometimes known as algorithmic law) involves several approaches that include the production of natural language legal texts in machine-readable formats (e.g. XML formats) to augment computer and human interaction with content or the expression of rules in machine-executable forms (e.g. through traditional programming, natural language processing and logic programming methods) to enable code and data-driven automation of legal processes (see Hildebrandt, 2018; Genesereth, 2021).

As "calculators for the law" with conditions and electronic documents and data as context, computational rules can help non-experts to understand and comply with obligations. Well-known applications of computational law include tax software (e.g. TurboTax) to automate tax codes with data from employment records or the use of smart contracts to administer private written agreements.

While computational law is a relatively new field and continues to take shape, numerous compliance-focused solutions are in development or exist for, *inter alia*, privacy regulations, intellectual property rights management, and cross-border e-commerce (e.g. tax administration; Genesereth, 2021). Computational rule, norm and guideline specification standards (e.g. OASIS LegalRuleML v1.0) are also emerging. Ultimately, interest is growing in computational law because it can help to bridge the gap between legal and governance structures, information systems and the expertise of users.

Among 1,500 possible technologies, the *Gartner 2021 Hype Cycle for Emerging Technologies* features machine-readable legislation in its set of emerging must-know technologies and trends that show promise in delivering a high degree of competitive advantage over the next five to ten years. As an expected trigger for innovation, computational approaches are starting to influence the operational architecture of international commerce. Although a new term to many, computational law is becoming a driving force behind efforts to digitalize trade.

The difference between computational law and rules as code

The governments of Canada, France and New Zealand have each explored rules as code (RaC) initiatives. A recent OECD study (Mohun and Roberts, 2020) reports that the RaC concept "proposes that governments create an official version of rules (e.g. laws and regulations) in a machine-consumable form, which allows rules to be understood and actioned by computer systems in a consistent way."

For the computational administration of social benefits, the governments implemented RaC initiatives to enable greater functionality of administrative portals and other web services (e.g. benefits calculators) to improve citizen awareness of, access to and qualification for entitlements. As official sources in parallel to natural language legislation, RaC represents an application of computational law, yet not all computational legal methods fall into this category (see Box 25).

BOX 25

COMPUTATIONAL LAW VERSUS RULES AS CODE

Computational law

- the branch of legal informatics concerned with the automation of legal analysis and processes
- includes many approaches, such as the production of legal texts in machine-readable formats and the expression of rules in machine-executable forms

Rules as code

- can be considered as a subset of applied computational law
- typically refers to a variety of approaches to encode official, *de jure*, government rules in machine-executable forms

BOX 26

COMPUTATIONAL LAW IN PRACTICE: CHILE AND THE DIGITALIZATION OF TRADE POLICY

The Government of Chile is taking steps to advance the participation of small business in international trade. Aligned with national economic and social development strategies, the Subsecretaría de Relaciones Económicas Internacionales (SUBREI) of the Ministry of Foreign Affairs has launched a pilot programme in collaboration with the Xalgorithms Foundation to create a freely accessible online repository of trade rules in a human-readable and machine-executable "rules as data" form using tabular declarative programming.*

The emphasis of the pilot is, along with software, to enhance accessibility and functionality of trade rules that are presently written in complex natural languages and "legalese". Through its contributions, Chile aims to become the first jurisdiction to express and publish trade rules as "standardizable" data packages to the internet that can be picked up and used by any system, anywhere. Under the model, SUBREI will also assist Chilean academic institutions in joining the collaboration.

*See https://oecd-opsi.org/innovations/chiles-contribution-to-an-internet-of-rules-for-trade.

Source: Atkinson and Schubert (2021).

What are the features and possible benefits of computational law for TradeTech?

As an interface between businesses, consumers and governments, computational law can build bridges between the various entities and software systems used in trade, with the potential to enable accessibility, automation, standardization, interoperability, cost reductions, transparency, and modelling and testing the effects of regulations (see Box 26):

- Accessibility and automation:
  - For machines, access to computational rules can enhance the functionality of electronic systems for trade information (e.g. trade information portals, transparency notification tools, tariff calculators), operations (e.g. enterprise resource planning, transportation and logistics, e-commerce, banking and finance platforms) and facilitation (e.g. NSWs).
  - For humans, mediated by these systems, accessibility stems from greater inclusion: increased awareness and capacity of non-experts to automate compliance with regulations across jurisdictions. Similar benefits apply for public servants (e.g. customs agents) that can use computational law-enabled technologies to better understand the application and enforcement of their own rules.

- Standardization:
  - Trade compliance involves adhering to regulations by following processes for the import and export of goods. If the 'output' of these processes is achieving compliance, it requires inputs: (i) awareness of all rules that apply to a trade transaction; and (ii) operationalization of these rules through assembly, submission and processing requisite documents and data.
  - Standardization of the content of inputs for trade compliance has progressed rapidly. Examples include HS codes as the global ontology for classifying goods and the WCO Data Model to meet the procedural and legal needs of cross-border regulatory agencies (e.g. customs authorities, ministries of agriculture and health).
  - In leveraging the content of e-document formats (e.g. OASIS Universal Business Language v2.3) and messaging standards (e.g. UN/CEFACT EDIFACT), computational law creates an opportunity to standardize how computational rules are expressed for, discovered by (e.g. based on HS code, origin and destination data) and automated with computer systems.
- Interoperability:
  - The digitalization of measures for trade facilitation is not proceeding uniformly. For example, under Article 10.4 of the WTO's Trade Facilitation Agreement, members agree to implement a single window system for customs authorities. While UN/CEFACT Recommendation No. 33 provides guidance on the development of single window networks (UN/CEFACT, 2005), WTO members are free to implement these systems in different ways (see Figure 3).
  - In the most advanced systems, computational rules are encoded to suit a particular government solution, exist in silos and are not available to other systems (including within the same government or external public and private entities that may benefit from access).
  - Open access to standardized computational rules can support interoperability (i.e. the capacity of computer systems to "talk to each other") through the assembly of applicable "rule sets" from different sources. Fostering interoperability through a corpus of computational law would support more holistic approaches instead of the development of disparate, disconnected intranets.
- Cost reductions:
  - Official rules are costly for governments to maintain across systems and departments. By developing and sharing computational rule repositories (i.e. shared services), governments can reduce maintenance and system upgrading costs. For the users of rules, costs associated with trade compliance may fall or be eliminated altogether.
- Modelling and testing:
  - Before computational rules, especially trade policies, are made available globally, governments can model and simulate possible economic effects (e.g. agent-based modelling).
  - A step further, computational rules can also be tested in controlled environments (e.g. regulatory sandboxes) to better understand their impacts on markets and economic actors.

> **"The development of a body of computational law has the potential to greatly enhance transparency."**

How can trade agreements support global trade rules automation?

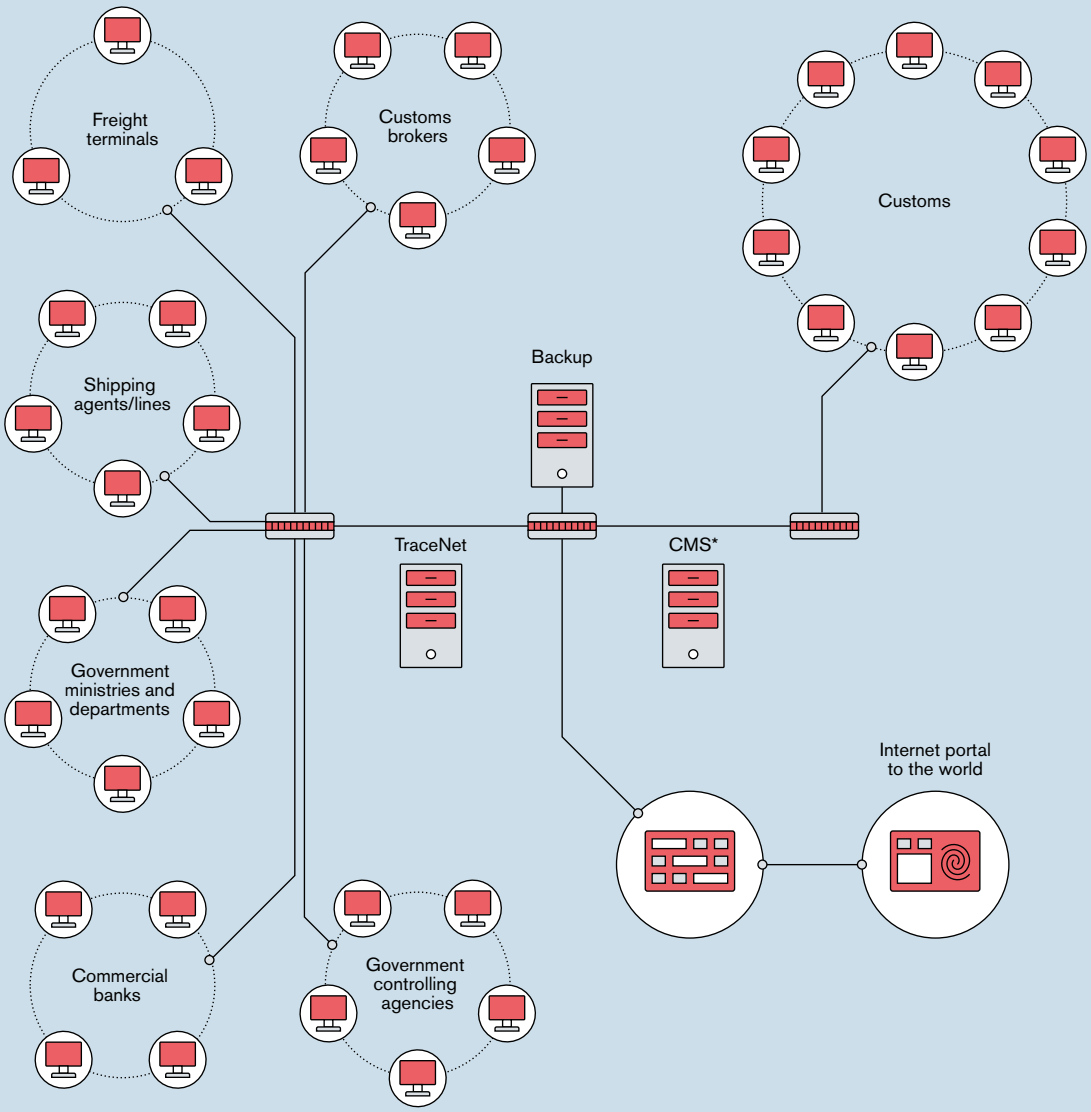
With a view to create a body of computational law that can be accessed by both humans and machines, future trade agreements can encourage governments to publish, alongside the deposited natural language texts, official machine-executable packages of commercial policies (i.e. trade and domestic rules that affect cross-border transactions) and necessary data sources to the internet.

As executable forms that can assist in compliance planning and automation, this goes beyond WTO obligations under GATS, the General Agreement on Tariffs and Trade (GATT) and other WTO agreements' provisions on transparency (requirement to make laws and regulations publicly available). It also goes beyond Article 1(2) (Information Available Through Internet) of the WTO's Trade Facilitation Agreement, which is currently the only WTO rule requiring members to publish trade information online.

When made available online (e.g. through APIs), in parallel to the natural language texts, computational rules and data sources are complementary to the development of single windows and systems for e-certificates of origin, payments, and digital identity, among others. This creates potential for the creation of tools by not only governments but through private sector innovation and developer community access to official computational rules and data sources.

FIGURE 3

EXAMPLE OF A SINGLE WINDOW "NETWORK OF NETWORKS" OF PUBLIC AND PRIVATE ACTORS



* CMS: customs management system.

Source: Based on https://tfig.unece.org/cases/Mozambique.pdf.

The development of a body of computational law has the potential to greatly enhance transparency. The WTO's Trade Policy Review Mechanism could include a section on computational law and provide all stakeholders with the real-time access to the rules of trade that are (or have been) in use during a period of national review.

ENDNOTES

1. See https://trade4devnews.enhancedif.org/en/op-ed/rules-data-21st-century-answer-trade-facilitation.
2. A joint initiative of the WTO, the International Trade Centre and the United Nations, e-Ping is a global online system that enables private and public stakeholders to access and discuss evolving product requirements (sanitary and phytosanitary, technical) and facilitates dialogue among the public and private sector in addressing potential trade concerns at an early stage.

CONCLUSION


826.04
356.94
200.84
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215.79
385.75
152.68
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292.76
356.94
210.42
741.74
818





In the Fourth Industrial Revolution, technological development and adoption is growing exponentially. The recent COVID-19 pandemic has accelerated the societal adoption and acceptance of digital technologies and has made one thing clear – the future of trade is digital and the 5 Gs of TradeTech are the engines.

Since the beginning of the pandemic, more and more cargo companies are issuing e-bills of lading, 60 chambers of commerce have adopted e-certificates of origin, and more countries are recognizing e-signatures and e-documents than ever before.[1]

While multiple policy initiatives are leveraging technologies for international trade, there remain many unseized opportunities and unexplored policy frontiers to support TradeTech and to foster a global approach. One reason the trade policy world is largely unprepared is that technologies give rise to policy issues spanning across different ministries and groups of regulatory authorities and stakeholders that do not intersect with trade traditionally (e.g. antitrust, data governance, cybersecurity, privacy, law enforcement, platform liabilities, digital taxation).

As World Economic Forum President, Børge Brende, speaking on trade reform overall, said "Trade policy needs an urgent update."[2] It is even more relevant for TradeTech.

To fully enable the 5 Gs of TradeTech and to bring trade to a new speed, the trade community and the technology community need to take the following actions:

- Agile policymaking: Implement a more agile and flexible approach to TradeTech policy that incorporates the following principles: forward-looking, openness, proportionality and fairness (World Economic Forum, 2020c). As discussed in this publication, DEPA is an excellent example of an agreement that catalyses international cooperation in the regulatory space to address new TradeTech issues.
- Nuanced approach: Whether digital identities, digital assets or data transfers, it is imperative to understand the basics of these concepts and how they operate, so trade policymakers can make nuanced and 'goldilocks' rules that carefully take into account the risks and can address the challenges.
- International regulatory cooperation: TradeTech policies must strive for coherence and avoid fragmentation. Combined with the overlapping of technology policy and trade policy, policymakers must work across borders and across sectors to achieve this goal. The recent establishment of the US–EU Trade and Technology Council is a step in the right direction.[3] More similar efforts are needed at a global level.
- Public–private partnership: The demand for public–private partnership is especially strong in TradeTech. The public sector needs technical expertise and innovations from the private sector, and the private sector needs to work with the public sector to co-design rules that foster innovation while serving the good of society. For example, business consulting groups of the G20, the OECD, the WCO or the WTO can provide policymakers with information on industry practices and digital trends to make real impacts.

> **"There remain many unseized opportunities and unexplored policy frontiers to support TradeTech and to foster a global approach."**

As WTO Director-General Okonjo-Iweala said at the 2021 WTO Public Forum, "Trade is about people." TradeTech is also about people. It is about using technologies to close the digital divide, to build trust, to reach more people, to lower costs and to reduce inefficiencies – especially for women and small business. TradeTech is not a means in itself, but a means to an end – greater inclusion, prosperity and sustainability for everyone in the global trading system.

ENDNOTES

1. See https://www.economist.com/finance-and-economics/2020/07/04/trade-finance-stumbles-into-the-digital-era.
2. See https://www.weforum.org/agenda/2021/10/we-must-reform-trade-to-build-a-sustainable-inclusive-global-recovery.
3. See https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/29/u-s-eu-trade-and-technology-council-inaugural-joint-statement.

ANNEX
EXAMPLES OF PROVISIONS ON DIGITAL IDENTITY THAT COULD BE INCLUDED IN TRADE AGREEMENTS[1]

ARTICLE 1: MUTUAL RECOGNITION OF TRUSTED DIGITAL IDENTITIES

1. The Parties recognize that trusted digital identity schemes contribute to more secure and agile supply chains and can be a catalyst in facilitating trade.
2. The Parties agree to develop or maintain an enabling legal framework for a trusted digital identity system. Such framework should be consistent with UNCITRAL principles and other relevant principles and standards already in existence.
3. The Parties agree on mutually recognized procedures for issuing and for proofing identities (legally incorporated entities in the Parties jurisdiction), including:
   (a) Agreement on the minimum level and type of information (or attributes) to be proofed and validated for issuing trusted identities. This "digital identifier"[2] will consist of one or more attributes that can uniquely characterize an entity.
   (b) Agreement on electronic information or data sources to be used to document that an entity is a legal entity under the Parties' specific jurisdiction.
   (c) All Parties must ensure that updates to the legal status of an entity are continuously maintained and immediately communicated. As soon as a legal entity changes status, this new information should be available online to all interested parties who intend to interact with the legal entity.
   (d) Each Party has the right to authorize an agency (trusted party) to approve the establishment of a legal entity within its jurisdiction.
   (e) Agree on which institutions can act as the trusted party (for instance financial institutions) that confirms the validity of a physical proof of incorporation (and subsequently issues a digital identity). These trusted parties need to be agreed as trustworthy by all Parties.
   (f) Proposed new trusted parties should be agreed upon by all Parties to the Agreement.
   (g) If a digitalization process is not already in place, the trusted authorities of each Party shall work towards digitalizing the process of legal entity incorporation as soon as practically possible.
4. Each Party shall endeavour to avoid any unnecessary regulatory burdens.
5. The Parties shall endeavour to recommend the use of existing standards where possible and develop and develop common standards where necessary.
6. All Parties should adopt or maintain laws and regulations for the protection of personal information provided. The trusted digital identity system should be executed in a way that allows involved institutions to protect sensitive data and recognize cultural and ethical expectations about data protection and privacy. It shall take into due consideration international standards of data protection.
7. Mutual recognition of trusted digital identity systems can be temporarily paused or altogether suspended if government identity issuance systems and processes are compromised or destroyed/corrupted. The Parties endeavour to assess alternatives or other mechanisms which can be available.
8. Nothing shall prevent a Party from adopting or maintaining measures inconsistent with the points above to achieve a legitimate public policy objective.
9. Authenticating a legal entity's identity is only a first step towards paperless trade. A second step would involve using the system for authorization and provision of trade documents such as licences and certificates. The parties may want to consider including language along the following lines in their RTA in addition to the provisions listed above.

ARTICLE 2: ENSURING TRUSTED DIGITALLY SIGNED TRADE DOCUMENTS

1. The Parties recognize the importance of ensuring that digitally signed trade documents are issued by an authorized agent, that they have not been tampered with and that only authorized entities have access to them.
2. The Parties mutually agree which public authorities or other organizations are authorized to sign trade documents, submit transactions, and issue such documents. These public authorities need to be identified as trustworthy by all Parties.
3. Regarding trade documents, the Parties mutually agree to accept e-signatures that are considered to have equivalent legal effect of a handwritten signature according to one Party's law unless a Party can demonstrate a reasonable doubt concerning the trustworthiness of the e-signature.
4. An agent in the importing country can verify that the exporting agent which has digitally signed the trade document is an authorized issuer of a specific document under the exporting country's jurisdiction.

ARTICLE 3: COOPERATION

1. The Parties shall endeavour to maintain a dialogue on regulatory issues raised by trusted digital identity schemes. In particular, they shall endeavour:
   (a) To exchange information and good practices on:
      (i) The functioning and management of trusted digital identity schemes;
      (ii) Policies, regulations, enforcement and compliance regarding how IT systems are secured.
   (b) To cooperate to address legislative, regulatory and technical barriers as soon as practically feasible.
2. The Parties will work together to assist SMEs to fully participate in such schemes.
3. The Parties affirm the importance of actively participating in relevant forums, including multilateral forums, to promote the development of trusted digital identity schemes and issuance of trusted digitally signed trade documents.

Consideration should also be given to including similar provisions in other trade agreements, starting with the new set of rules being developed in the context of the WTO Joint Initiative on E-commerce.

ENDNOTES

1. Based on https://www.unescap.org/sites/default/files/86%20Final-Team%20Hanna%20Norberg-Sweden.pdf.
2. A digital identifier is one or more attributes that uniquely characterize an entity in a specific context. It is used as the key by the parties to agree on the entity being represented (ISO/IEC 29115:2013).

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The TradeTech, or technologies for trade, initiative is a platform for creating and developing partnerships to co-design the norms and policies around incorporating emerging technologies into trade. The community focuses on improving our understanding of the changes currently taking place in digital trade and develops potential policy responses to help governments formulate forward-looking strategies.

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ABBREVIATIONS

5G ..... fifth-generation cellular network
ADGM ..... Abu Dhabi Global Market
AI ..... artificial intelligence
APEC ..... Asia-Pacific Economic Cooperation
API ..... application programming interface
ASEAN ..... Association of Southeast Asian Nations
DEPA ..... Digital Economy Partnership Agreement
DLT ..... distributed ledger technology
GATS ..... General Agreement on Trade in Services
GB ..... gigabyte
GPC ..... Global Product Classification
GTIN ..... Global Trade Item Number
IATA ..... International Air Transport Association
ICC ..... International Chamber of Commerce
ICT ..... information and communications technology
IEC ..... International Electrotechnical Commission
IOT ..... internet of things
ISO ..... International Organization for Standardization
ITA ..... Information Technology Agreement
ITU ..... International Telecommunication Union
MLEC ..... UNCITRAL Model Law on Electronic Commerce
MLETR ..... UNCITRAL Model Law on Electronic Transferable Records
MLES ..... UNCITRAL Model Law on Electronic Signatures
NFT ..... non-fungible token
NSW ..... national single window
NTM ..... non-tariff measure
OECD ..... Organisation for Economic Co-operation and Development
RTA ..... regional trade agreement
SADEA ..... Singapore–Australia Digital Economy Agreement
TBT ..... technical barriers to trade
UN/CEFACT ..... United Nations Centre for Trade Facilitation and Electronic Business
UNCITRAL ..... United Nations Commission on International Trade Law
UNECE ..... United Nations Economic Commission for Europe
W3C ..... World Wide Web Consortium
WCO ..... World Customs Organization

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http://onlinebookshop.wto.org

Report layout by Large Network.
Printed by the World Trade Organization.

Print ISBN 978-92-870-7101-9
Web ISBN 978-92-870-7102-6
Published by the World Trade Organization.

TradeTech – the set of technologies that enables global trade to become more efficient, inclusive and sustainable – is multifaceted, from trade facilitation to efficiency gains and reduced costs, to greater transparency and resilience of supply chains.

Although technological innovation exists, the major challenge to the global adoption of TradeTech will be building international policy coordination. Trade agreements can play a key role. Despite ongoing efforts to introduce digital trade provisions in trade agreements, many unseized opportunities and unexplored policies remain.

This joint World Economic Forum and WTO publication explores how trade agreements could be leveraged to advance the adoption of digital technologies and trade digitalization.