Possible options and models of data exchange for achieving cross-border paperless trade

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Note

This study report is prepared by the authors for contribution to discussion on mutual recognition mechanism for trade related data and documents in electronic form. This is a draft for review in the 8th Meeting of the Legal and Technical Working Groups on Cross-border Paperless Trade facilitation, not for circulation or citation. After incorporating comments received from review, it will be published as an ASIA-PACIFIC RESEARCH AND TRAINING NETWORK ON TRADE (ARTNeT) working paper.
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1. Introduction

As per the United Nations Global Survey on digital and sustainable trade facilitation, cross-border paperless trade implementation in Asia and the Pacific is 32% (figure 1). Further, as per the United Nations Trade Facilitation Survey report on Asia Pacific for 2019, among the six cross-border paperless trade measures, two measures – law and regulations for electronic transactions, and electronic exchange of customs declaration – are basic building blocks for enabling the exchange and legal recognition of trade-related data and documents not only among stakeholders within a country, but ultimately between stakeholders along the entire international supply chain. The other four measures are linked to the actual exchange of trade-related data and documents across borders in order to achieve a fully integrated paperless transformation.

![Figure 1. United Nations Global Survey on Digital and Sustainable Trade Facilitation, 2019](image)

Source: UN Global Survey on digital sustainable trade facilitation in Asia Pacific, 2019.

At the regional level, the implementation of these measures has been slow, except in the case of laws and regulations for electronic transaction where the implementation level is higher than 50% (figure 2). This is also compounded by a lack of mutual
recognition agreements to recognize cross-border exchanges of electronic data and documents.

**Figure 2. United Nations Trade Facilitation Survey report on Asia-Pacific, 2019**

The mutual recognition mechanism for cross-border paperless trade necessitates identifying the intersections between technology frameworks and legislation in order for such mechanisms to be effective and implementable.

Due to the lack of institutional and legal frameworks to support cross-border paperless trade as well as the lack of capacity to establish paperless systems in many developing economies, cross-border exchange of data and documents as part of international supply chains today is largely physical. A journey that involves moving physical interactions to digital ones need not mimic the existing paper-based workflows and can be simplified while trying to ensure straight through processing, integrity, authenticity and confidentiality of data. This requires rethinking the design, architecture, data models and exchange frameworks in the context of complying with legislation that enables such exchange.

For example, parties exchanging electronic messages must define information in a clear and unambiguous manner, both from a syntax and a semantic perspective. When this exchange involves multiple parties, a data reference model or dictionary may be needed in order to exchange this information.

*source: UN Global Survey on digital sustainable trade facilitation in Asia Pacific, 2019.*
This paper explores possible options and models of data exchange for achieving cross-border paperless trade, with a focus on understanding how open standards and interoperable data exchange models can help overcome the gap in the implementation of cross-border paperless trade measures as well as lower the cost of trade.

2. Cross-border data exchange requirements

Several models for data exchange have emerged over the years in international supply chains for different aspects of paperless trade. Much work has been done over the years by the United Nations; a case in point is the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT), which has worked on harmonizing paperless trade standards through trade document layout keys, a trade data element directory, code lists and the United Nations rules for Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT), which was the dominant messaging standard during the 1990s. Over time, UN/CEFACT has recognised the importance of newer interfaces such as API, web-based, mobile, etc. as well as data representation formats such as XML, JSON, QR Code etc. The work in these areas is part of its new portfolio. It has also updated its strategy for engaging in reference implementation to explore such newer options.

In terms of enabling electronic cross-border exchanges of data or documents, the following elements play a critical role:

- Data representation formats;
- Communication mechanism;
- Interface for exchanging data.

This paper explores in detail what each of these elements encompass in arriving at transitional measures or methods for going from paper to paperless.

2.1 Data representation formats

2.1.1 Electronic data interchange

Electronic Data Interchange (EDI) is the electronic interchange of business information using a standardized format through a process that allows one company to send
information to another company electronically, rather than on paper. Business entities conducting business electronically are called trading partners.

Many business documents can be exchanged using EDI, but the two most common types are purchase orders and invoices. At a minimum, EDI replaces the mail preparation and handling associated with traditional business communications. However, the real power of EDI is that it standardizes the information communicated in business documents, which makes possible a "paperless" exchange.

In the context of EDI and paperless trade, UN/EDIFACT messages provide wide coverage for the electronic exchange of information across an international supply chain, including contractual messages for logistics, forwarding and consolidation, booking and advice, or acknowledgements. These messages allow traders to book transport, receive updates on the status of their delivery, declare where containers are on a ship, declare when a ship is to call at a port, communicate when a container arrives or leaves a customs-controlled area, to give just a few examples.

A typical EDI implementation consists of systems that can translate accounting or other data into EDI specific syntax when they are sent or received via Internet EDI or through a direct peer-to-peer electronic document transfer. An example of how EDI works is outlined in figure 3.

**Figure 3. EDI data exchange framework**
EDI communications are generally done either: (a) directly, using point-to-point communications where two business partners exchange EDI format files, as in the case of large volume bi-lateral exchange of information; or (b) through an EDI Network Service Provider that provides a mailbox for sending and receiving EDI format messages with other business partners. Many legacy applications that originated during 1990s still use EDI even though new innovative tools and technologies (as discussed in this document) provide easy and cost-effective options. One of the predominant reasons for EDI’s existence is that the cost of migration to newer options is high. Although many EDI applications have migrated to an XML base and/or other solutions, more than few still operate in an EDI environment.

A real-world example of a successful EDI-based application migrating to an XML-based environment exists under Pan Asia eCommerce Alliance (PAA). The PAA history goes back two decades when they initiated EDI-based cross-border data/document exchanges, but slowly migrated to an XML-based environment. The study captured the scenario in one of the members of PAA, i.e. Indonesia, where the domestic leg is still using EDI and EDIFACT but the cross-border arrangement operates under XML. Cross-border e-invoicing with mutual recognition is one of the PAA applications, which provides a framework for cross-border exchanges of electronic documents in the Asia-Pacific region through the use of PKI and cross-recognition agreements between participating service providers/users.

A typical cross-border scenario through the PAA alliance for exchange of invoices and other documents is outlined in figure 4.
Given the complexity involved in data translation, EDI exchanges often require expensive systems to be put in place that constantly need to be upgraded in line with syntax changes to message formats. A similar standard that has been in use in the United States is the ANSI X12 standard.

2.1.2 Extensible markup language

As an alternate approach to EDI-based data formats, Extensible Markup Language (XML) is now increasingly being used as a standard for exchanging electronic messages. XML is a powerful language that gives a great deal of flexibility in defining and constructing documents such as purchase orders, invoices or remittances by using a schema-driven approach that can also capture relationships between data elements that are part of a document.

A sample purchase order expressed in XML notation is given below:

There is a major structural difference between an EDI standards-based business document and one that is constructed using XML. The ANSI or EDIFACT document is based upon strict rules governing the position of data within a file, whereas the data in an XML file is not bound to a specific location but is instead identified by tags, such as “<quantity>300</quantity>” to indicate a quantity value of 300.

An example of how XML works is given in figure 5.
In figure 5, XML standards refer to XML Schema Definition, which is currently the de facto standard for defining and validating XML documents or messages.

Even in the case of XML, an intermediary system is required to convert a legacy message or data into an XML format. This can be validated against an XML schema or standards, and finally an XML document can be created and exchanged between two parties. Both XML and EDI offer the ability to exchange data either directly or through value-added networks, or by using other forms such as FTP.

While EDI is primarily intended for machine-readable communication, XML –because of its tags – can also be read by humans; however, it requires a schema mapped to machine language for automatic processing of data. Therefore, for automating workflows related to cross-border paperless trade, use of XML requires predefined schema mapping and understanding between parties exchanging XML data.

An example of an XML-based e-invoicing standard is XRechnung, an XML-based semantic data model that is currently being established as the standard for electronic invoices that are sent to public authorities in Germany. XRechnung was developed within the framework of the requirements for the electronic data exchange of public administration and it complies with the European standard EN 16931-1. The federal Government, the States and municipalities as well as other public sector organizations (such as universities and public utilities) will offer several administrative portals for billing organizations to use, where they will have to register with a user account. Invoice data can then be inputted, created and transmitted either manually or as an automated process. More information on XRechnung can be found at https://peppol.eu/what-is-peppol/peppol-country-profiles/germany-country-profile/.
2.1.3 JavaScript object notation

A format similar to XML called JavaScript Object Notation (JSON) is a lightweight text-based data-interchange format that is language independent and interoperable. It is an open source, supported by all browsers and programming languages. JSON data objects can be validated through a JSON Schema that allows for data type and rules to be defined to ensure data exchanges can be validated by the receiver. An example of a purchase order expressed in JSON notation is given in figure 6.

JSON offers a number of benefits over XML as it is much easier to parse; it is supported by a number of browsers and is ideal for transmitting numbers and string data. JSON can also be parsed into a ready-to-use JavaScript object.

JSON has ready support by a number of browsers that makes it attractive for data exchanges in client server communication. An example of how a JSON could be exchanged is detailed below (see also figure 6):

1. Importer X issues a purchase order through a procurement system A;
2. An intermediary system converts this purchase order into JSON format and serializes it;
3. Importer X now publishes this JSON object as part of their online eProcurement system B;
4. Exporter Y logs in to system B with provided login credentials to view the JSON purchase order in a format that is human readable;
5. Exporter Y can then download the JSON object and upload into his ERP through converters that translate JSON data into legacy system data.

**Figure 6. JSON-based data creation and exchange in a client server environment**
The use of JSON for automated data processing as part of cross-border paperless trade also requires predefined mapping and understanding of schema elements between two parties and their respective source systems.

An example of e-invoicing system based on JSON standards is the e-invoicing standard introduced in India which largely relies on JSON data formats for exchanging invoices within the country. A detailed case study on e-invoicing in India is outlined in the case study section of this document.

2.1.4 Quick Response Codes

Another interesting method of exchanging information is through Quick Response Codes (QR Codes), which are machine-readable and can encapsulate information about the item to which it is attached, either directly or through a uniform resource locator (URL). In practice, however, QR Codes often contain data for a locator, identifier or tracker that points to a website or application.

QR Codes can be regarded as the link between offline and online media for more effective product management and tracking experience. A QR Code can contain a range of information from product details, including part numbers, serial numbers, dates, batches, history and other relevant information.

Because of their interoperable nature, QR Codes today are widely adopted in supply chains for product labelling to indicate key information about product origin and content. QR Codes can also be used to trace provenance and ascertain authenticity of a product, thus providing the ability to counter fakes.

An example of end-to-end supply chain tracking using QR Codes is provided in figure 7.

Figure 7. Supply chain tracking using QR Codes
Another example of a QR Code applied to an invoice is provided in figure 8.

**Figure 8. QR Codes embedded in invoices for machine readability**

While QR Codes can be embedded in product labels to ensure authenticity, equally they can be embedded in documents such as invoices, letters of credit etc., to ensure authenticity of documents and for automatically retrieving information as part of the paperless trade process.

In a way, QR Codes can act as an important online-offline bridge by allowing accurate data capture from documents in the absence of a complete automatic data exchange process. An example of this is the K Plus App promoted by Kasikorn Bank, Thailand’s
largest mobile banking provider, which uses interoperable QR Codes to empower cross-border payment capabilities in four countries in the Association of Southeast Asian Nations (ASEAN) region, i.e., Thailand, Singapore, Myanmar and Cambodia. More information can be found at https://www.kasikornbank.com/en/personal/digital-banking/kplus/pages/index.aspx.

2.2 Communication networks

As indicated above, data exchanges can rely on either direct transfer via private networks or public networks, depending on the volume and security requirements between business partners.

2.2.1 Private networks

Private networks are networks with restricted access and can be set up to exchange data between trading partners for enabling cross-border trade. These networks may involve direct connections instead of routing transactions over the Internet.

An example of a secure private network in the context of paperless trade is the regional domain as part of the ASEAN Single Window technology framework, which consists of a closed secure ASEAN Single Window and regional services that allow communication between member States and regional services. More information on the ASEAN Single Window can be found at https://asw.asean.org/.

2.2.2 Public networks

Public networks, such as the Internet, allow everybody to connect through a resource locator called an IP address, based on which information is sent or received. Even in public networks it is possible to create dedicated tunnels called Virtual Private Networks (VPN) through which trading partners can create restricted access for exchanging information.

The Internet is an example of a public network. It is a global system of interconnected computer networks that uses the Internet protocol suite to communicate between the networks and devices. The Internet has no centralized ownership and relies on two namespaces – the Internet Protocol Address (IP Address) and Domain Name System.
(DNS) that allow users to host information and present them to others in the form of websites. Examples of such websites include www.google.com.

An interesting example of the usage of public networks to exchange cross-border electronic information in an immutable and secure manner is through the use of Public Ledgers on Blockchain, which allows nodes (customs authorities, banks etc.) in various locations connected to the Internet to share and exchange necessary information for the purpose of exchanging data. Ripple is one such example of a cross-border payment network that uses public networks to exchange payment information between participating banks and financial intermediaries. More information about Ripple can be found at https://ripple.com/ripplenet/.

2.3 Interfaces

2.3.1 File transfer

File transfer is a methodology for pushing files directly from one system to another and leverages File Transfer Protocol (FTP), which is a communications protocol that is used to send files over the Internet or an intranet. An FTP requires an FTP client and server between which the files can be exchanged. In the context of cross-border paperless trade, FTP servers can be useful for exchanging large-volume files, such as trade documents, between one or more parties as part of a trading transaction.

While FTP generally involves human intervention in looking for specific files, there are ways in which FTP connections can be used to enable automated exchange of information.

2.3.2 Email

Email is another form of communication that is widely used to send and receive text with attachments. Email uses mailboxes associated with individuals or organizations using which information can be exchanged. Email mostly requires human intervention in order to receive or send information as well as interpret the information for further downstream processing.

2.3.3 Web-based interfaces

Web-based interfaces allow the ability to replicate paper documents using web forms that contain fields where users can enter information. Once all the relevant information
is added, the web form is automatically converted into a message that can be sent to a server or exchanged with other parties.

In their simplest structure, web-based forms allow businesses to create, receive, turn around and manage electronic documents using a browser. Web forms also provide the added benefit of imposing validation rules based on business logic to ensure that only accurate data are captured as part of the form-filling process.

2.3.4 Mobile interfaces

Mobile interfaces are similar to web interfaces but they leverage mobile applications installed on Apple, Android or other operating systems for offering functionality such as completing a purchase order or invoice while being out of office. Mobile applications offer benefits where supply chain transaction status can be made available to trading partners on the go.

The limitation of mobile devices is their screen size as a result of which extensive information or business rules based on that information may be difficult to be enforced. However, the advent of tabs or tablets is altering what can be achieved on mobile computing devices.

2.3.5 Application Programming Interface

An Application Programming Interface (API) is a set of programming instructions and standards for accessing web-based software applications that allow software platforms to communicate with each other. An API defines functionalities that are independent of their respective implementations; this is one of the chief advantages of APIs since they allow the abstraction of functionality between one system and another.

An API endpoint decouples the consuming application from the infrastructure that provides a service. As long as the specification for what the service provider is delivering to the endpoint remains unchanged, the alterations to the infrastructure behind the endpoint will not be noticed by the applications that rely on that API. This makes change management processing relatively straightforward without significant alterations to core IT systems as part of international supply chains.

API’s are now gaining wide attention for usage in cross-border paperless trade where they help automate a number of transactions such as requesting rates for freight or dispatching or tracking shipments. As much of this interaction can be made machine-
to-machine, an incredible amount of shipment data can be processed, analysed and acted upon without manual processing – all in real time. An example of how information can be accessed using a currency conversion website (xe.com) is shown in figure 9.

**Figure 9. Currency conversion, website xe.com**

To get a value for converting from one currency to another, a user:

1. **Types** xe.com;
2. **Enters** currency;
3. **Chooses** from and to currencies;
4. **Hits** ‘Go’;
5. **Sees** results.

The same information can be presented via an API:

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3 See [https://www.unece.org/uncefact/34thccforum-conf-webapis.html](https://www.unece.org/uncefact/34thccforum-conf-webapis.html)
The results are exposed through a JSON notation as part of an API that is accessible via a web URL (see http://data.fixer.io/api/latest?access_key=89aae4bb97079f6e159730ad3f000538&base=EUR&symbols=JPY,AUD).

APIs are therefore programmable URLs that act as gateways for retrieving information from various systems without the need to duplicate storage of information. APIs are building blocks of various modern websites and are excellent for machine-to-machine exchanges of information.

In the case of trade facilitation, a consignment resource can be exposed as an API as illustrated in figure 10.

**Figure 10. Examples of how APIs function**

Such an API provides links to sources of information and offer a paradigm shift from document exchange (as in the case of EDI and other data exchange formats) to data discovery (retrieving information from sources of truth). APIs also allow security
aspects such as authorization, access control, consent to be taken care of as part of the process of providing access to data.

A key aspect of exchanging data through APIs is the need to support two mechanisms of data exchange – a Push and Pull mechanism. Both mechanisms support real time exchange of information and can be built using API's.

A Push is generally used in cases where data are transactional and when multiple upstream data need to be transferred to destination systems based on predefined data formats of destination systems, and when further change in the upstream data system is not expected to be transferred to the destination system.

An example of a Push API system that is extensively used in India is the Unified Payments Interface (UPI), a technology stack for powering payments in an interoperable manner through Push APIs that are exposed by banks, intermediaries and the National Payment Corporation of India. The UPI has been a big success and had seen more than 10 billion transactions sent through the system by the end of 2019. More information on UPI can be found at https://www.npci.org.in/product-overview/upi-product-overview.

A Pull is generally used in cases where information is retrieved on demand, such as from a data repository, and multiple destination systems can connect to the source system to retrieve information based on data formats that the source systems support.

An example of a Pull API being used in cross-border trade is the DHL eCommerce API that is available for retrieving key shipment tracking information in an automated manner. The API details are available at https://developer.dhl.com/.

In the context of cross-border trade, Push systems are better suited for transactional messages such as payments, and invoices to a Single Window based on data standards. Because transactions in such cases generally tend to be sent one at a time, recipient systems of Push instructions need to be designed for a large volume of transactions hitting their systems at any given point in time through the usage of message queues.

Pull systems, on the other hand, are used for retrieving data in bulk from source systems such as a large number of invoices. They need to be designed to cater to requests for bulk data, which requires the ability of systems to process and send a
large volume of data at any given point in time either through real time or batch channels.

2.4 Models for data exchange

2.4.1 Direct or point-to-point

In direct or point-to-point connections, business or trading partners establish secure direct lines between themselves, either privately or over the Internet. In this approach, an organisation must communicate with each business partner individually, which can mean managing several separate connections, communication standards and protocols.

While this approach could work for large business partners with a high volume of trade between them, it can become quite complex and resource-intensive if different business partners are using different communication protocols. Figure 11 provides an example of a scenario using point-to-point connection in the context of EDI.

![Figure 11. Point-to-point exchange of data using EDI](image)

By choosing a direct connection model, the business partner will also need to implement a software solution that enables use all of the agreed protocols such as Applicability Statement 2 (AS2), SSH File Transfer Protocol (SFPT) and File Transfer Protocol Secure(FTPS). Further, the following needs to be agreed upon with each of the trading partners:
• Usage of communication methods or protocols;
• Specific protocol settings to be used when exchanging information.

With the advent of the low cost, high-speed Internet and the ability to create secure tunnels such as VPN, very few businesses today connect directly with all of their business partners.

An example in this context could be where automotive manufacturers need to exchange purchase orders and invoices with their component manufacturers or suppliers who supply large volumes on a repeated basis. In such cases, a direct or point-to-point connection is ideal as it allows standardization of information receipt and allows substantial automation of the process. The downside of this model is that when a component manufacturer has to deal with multiple automotive manufacturers; in such as case, separate point-to-point connections need to be set up and costs need to be justified against benefits.

2.4.2 Value-Added Networks

Value-Added Networks (VAN) were the predominant mode of information transfer for EDI formats prior to the introduction of the Internet. A VAN, from its genesis, is a secure network where EDI documents can be exchanged between business partners. Each business partner is provided with a mailbox and document are sent or received from there. Business partners check their mailbox periodically to retrieve their documents.

Some of the value-added services provided by these EDI networks include:
• Full mailbox service where messages are automatically routed to the correct mailbox;
• Verification of business identities and validation/authentication of messages;
• An audit trail for all messages sent and received through the network;
• Alerts for new messages received;
• Other services such as integrations and providing services.

As Value-Added Networks were originally built on the concept of a mailbox and designed primarily for EDI documents, some of the downsides of some such networks could be their inability to support the latest standards and the fact that they could be expensive to implement. Over time these VAN services started providing more
intelligent services, thereby providing the translation of services from one standard to another.

The Republic of Korea’s KTNET is a living example of an intelligent VAN service provider having translation facility from one standard to another. Yet, some traditional VAN service providers in the developing world continue to provide single standard EDI service. However, a VAN service provider with a translation facility is today’s required service.

2.4.3 Electronic Hubs

A hub is an electronic intermediary that hosts software to mediate transactions among businesses. Such a framework provides the ability to create one source where domestic and/or international business partners can submit and exchange information. An example of such a hub is the Single Window system, which allows business partners to submit documents such as customs declarations, applications for import/export permits and other supporting documents such as certificates of origin and trading invoices. This service can be considered as additional maturity to the VAN service providers, especially in the context of B2G and G2G interfaces in trade facilitation. This paper only deals with this scenario. However, It is pertinent to mention that Internet-based intermediaries that host electronic market places (in a B2B environment) and facilitate transactions among businesses using Electronic Hubs are generating considerable interest. Therefore, in this context, the electronic hub is a B2B market place which offers a new commercial website that provides coordination and synchronization services for electronic commerce, its users or partners. A visual representation of a Single Window is provided in figure 12.

Figure 12. Single Window as an electronic hub for trade facilitation
Electronic Hubs offer numerous benefits as they reduce the complexity of information exchange and provide simple and easy-to-use web/mobile or other interfaces for business partners to submit and exchange information. Electronic hubs can also be designed to ensure interoperability by allowing data exchange in formats such as JSON, XML among others, to ensure easy translation of cross-border information exchanges.

The ASEAN Single Window (ASW) is one such framework, which is mostly based on an Electronic Hub. A pictorial representation of the ASW is shown in figure 13.

Figure 13. The ASEAN Single Window as an example of an electronic hub
2.4.4 Payment gateways

Payment gateways are designed for the specific purpose of facilitating the transfer of payment information between a portal such as a website and a processor such as a bank or other authority. Payment gateways facilitate the routing of information from the source to the destination for the purpose of payment processing and settlement. As part of this routing, the payment gateway may put in mechanisms to ensure identity verification, security and standardization, and real time confirmation of message delivery. Some of the top payment gateway providers globally include Paypal, Stripe and Alipay, among others. How typical payment gateways work is shown in figure 14.

**Figure 14. Payment gateway system**

![Diagram of payment gateway system]
2.4.5 Machine-to-machine

Machine-to-machine (M2M) is the name given to technology that enables network devices to exchange information and perform actions without the manual assistance of humans. M2M is the foundation of IoT data exchange where data from sensors or connected devices are automatically transmitted over a network that is either public or private. An example of M2M communication in logistics is the use of sensors, communication links (WiFi etc.) and automatic computing software for the purpose of asset tracking and monitoring. M2M is vital in the automation of warehouse management and supply chain management in Industry 4.0.

3. Summary

In summary, the list of data elements and models that encapsulate exchange of electronic information, and their pros and cons can be outlined as shown in table 1.

Table 1. Data elements and models that encapsulate exchange of electronic information

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Data Exchange Model</th>
<th>Support Interface</th>
<th>Data Representation Formats</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Point-to-Point</td>
<td>FTP, Email</td>
<td>EDI, XML</td>
<td>Suitable for large organizations that exchange many documents</td>
<td>Long deployment cycles, expensive and rigid data formats</td>
</tr>
<tr>
<td>2</td>
<td>Value-Added Network</td>
<td>Mailbox</td>
<td>EDI, XML</td>
<td>Suitable for many businesses to with support for validation, interpretation, audit trail</td>
<td>Minimal support for latest data standards and could be expensive</td>
</tr>
<tr>
<td>Route</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Electronic hubs</strong> (API, Web-based, Mobile) <strong>EDI</strong>, <strong>XML</strong>, <strong>QR Codes</strong> Based on modern open web standards and therefore supports interoperability. Implementation requires multiple parties coming together to connect to such hubs to offer their services through the hub.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Payment gateway</strong> (Web-based, Mobile) <strong>XML, JSON</strong> Based on modern open web standards and therefore supports interoperability. Aggregation of services across a range of processors to be offered in a single interface for a business.</td>
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<tr>
<td>5</td>
<td><strong>Machine-to-machine Sensors</strong> (IoT) data formats Enables automated exchange of data with support for standards. Interoperability needs to be addressed given IoT ecosystems are diverse.</td>
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Given the widespread adoption of new technologies such as API, XML and QR Codes in general Internet information exchange, they can also help overcome some of the barriers that existed in existing EDI systems, one of which is the accompanying business process change in enabling cross-border paperless trade.

Existing business processes built around paper handling in the context of cross-border paperless trade may or may not be suited for EDI and would require changes to accommodate automated processing of business documents. For example, a business may receive the bulk of its goods by one- or two-day shipping, and all of their invoices by mail. The existing process may, therefore, assume that goods are typically received before the invoice. With EDI, the invoice will typically be sent when the goods ship and will, therefore, require a process that handles large numbers of invoices for which the corresponding goods have not yet been received.

While EDI has been around for a long time and is well-established, newer implementations can make use of emerging technologies, such as JSON/XML and
APIs, which allow exchanging relevant information on demand rather than relying on batch exchanges of data.

A combination of JSON/XML and APIs that support the Push and Pull mechanism for data allows the creation of information repositories such as “Electronic Hubs” with the ability to maintain a “single source of truth” that both upstream and downstream systems can rely on. These frameworks could be based on open standards and open source with huge community support for software and skills development. Thus, the overall cost of implementation can be significantly lower and deployment cycles can be shortened as countries and agencies transition to cross-border paperless trade.

Given that EDI has been around for a long time, enterprises working with EDI connections are not going to change their systems given the risks of such a transition. This introduces interesting transition and migration challenges and the need for bridging gaps in the context of various legal and technical constraints that are part of cross-border paperless trade. Any such transition will require careful planning at the government level and a capacity-building strategy that trickles down to enable industry to address such a transition.

4. Case study

This section deals with a case study that highlights a use case that leverages the use of electronic hubs, information gateways and APIs in facilitating trade and the benefits of these emerging technologies in enabling electronic exchange of trade data for cross-border mutual recognition. The reason for the selection of the use case is to present usage of newer interfaces and data representation formats described in the report. The use case described below is known as e-invoicing, which is being rolled out in India.

India is currently rolling out e-invoicing that it has planned to be based on PEPPOL standards (used globally) in 2020, allowing businesses to create and register invoices. While the primary purpose of this massive exercise is to ensure ease of doing business as well as greater compliance by large and small businesses, by adopting a standards-based approach, e-invoicing offers an interoperable framework for exchanging invoice data.

More than 10 million businesses are expected to eventually use the e-invoicing system as adoption grows with more than 3.5 billion invoices hitting the system every month.
Once the e-invoicing system goes fully live and adopted by everybody, it is estimated that it will save the Government of India US$ 450 million. A representative data flow architecture is provided in figure 15.

**Figure 15. E-invoicing in India, based on JSON Standards**

The design of the e-invoicing system involves the following multiple stakeholders:

- The Indirect Tax Authority of the Government of India (Goods and Service Tax Network – GSTN). This is the central agency responsible for the functioning of the indirect tax portal and system for filing of taxes, matching and assessments. It acts as an Electronic Hub for multiple businesses to directly and indirectly make connection. It also supports connectivity with other systems, such as banks and customs authorities, for retrieving information that can be prepopulated;

- Invoice Registration Provider (IRP) – A technology body that acts as an API system and generates unique invoice numbers and acknowledges receipt of invoices;

- GST Suvidha Provider (GSP) – Licensed intermediary agencies that act as an information gateway with API connectivity to IRP and GSTN that provide technology platforms for businesses to allow the generation of invoices, filing of tax returns and other value-added services;

- Buyers and sellers;

- Technology providers – ERP, accounting systems that support day-to-day book-keeping, accounting etc.
Rollout of a platform of this scale, while ensuring simplicity and ease of use for buyers and sellers, means that the data formats and exchange methodology have to be based on:

- Interoperable global standards;
- Defined schema based on JSON/XML for validation;
- Use of APIs for secure exchange of information, validation and verification of data.

The rollout of the e-invoicing system in India will not only facilitate paperless transformation within India. It will also pave the way for cross-border paperless exchanges of invoice information as part of the international supply chain, where invoices that are created in India and sent digitally can easily be understood by counter-parties, banks and customs agencies in other countries.

5. Transition measures

It is expected that the transition measures will be based on technical, legal and capacity readiness assessments that focus on defining the current and setting baselines on which transition measures can be driven. The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has been facilitating such assessments for selected countries in the Asia-Pacific region as part of the initiative on cross-border paperless trade in Asia and the Pacific.

In the context of these assessments, with a view to “progressively automating” workflows as part of cross-border trade, some of the areas of focus could be:

- Improving the coverage of regulatory authorities that accept electronic documents and reducing paper documentation;
- Greater alignment of various local system standards with International technical and legal standards and best practices – for example, e-invoicing;
- Ensuring the gradual adoption of newer systems and standards through initial voluntary adoption and subsequent mandating where necessary.

While most have laws that recognize electronic transactions and signatures in developing countries, in many cases the scope of legislation does not cover the aspects of privacy, data protection, data sharing, retention etc. Further, there are no laws dedicated to the establishment of a paperless trade system or for cross-border
exchanges of electronic information. In addition, while federal laws generally work for G2G communication, the lack of sectoral adoption and guidelines – such as in banking – limits the ability of countries to switch completely to a paperless system with regard to B2G communication being a part of domestic or cross-border trade. In other examples, it has been observed that in many cases a country’s Customs Act prohibits data sharing, not only cross-border but also domestically with stakeholders.

With regard to technical gaps, the key gaps tend to be the lack of ICT infrastructure and systems needed to support automation in customs and paperless trade through electronic data acceptance, payments etc., while ensuring aspects of security, business continuity and data standardization.

In terms of a specific action plan, developing countries may need to implement the following frameworks and systems in order to begin their journey from paper to less-paper and then to paperless:

- Implementing electronic systems for customs, ports which can over time lead to implementation of a Single Window. An example of a Single Window system is outlined in subsection 1 (d) (iii) Electronic Hubs;

- Security and authentication mechanism for enabling B2G electronic communication and signatures. This includes business identity registries, online authentication mechanism, data security frameworks, trust service providers or certifying authorities for issuing digital certificates;

- Given that business identities themselves have evolved over the years, a key exercise is to standardize existing business identities and issue new ones digitally to provide a framework for easy identification of businesses as part of online transactions;

- Adoption of federal legislation by sectoral regulators, such as banking, invoicing etc., to facilitate electronic documents, contracts and signatures for G2G and B2G communication. An example of a VAN that supports the exchange and transfer of documents is outlined in subsection 1 (d) (ii) Value-Added Networks;

- Implementation of electronic payment infrastructure that includes payment gateways for facilitating online payments. An example of this is outlined in subsection 1(d) (iv) Payment gateways.
Under legal and technical constraints, the above systems at a minimum can:

- Be web-based or email-based systems;
- Provide ability for partial automation to allow businesses to register, identify, authenticate and share information online;
- Accept and process data submitted in electronic form, followed by physical submission, while a fully-fledged framework and system for accepting electronic documents is developed. This facilitates reduction in transaction time in the supply chain;
- Integrate with payment gateways or banks to facilitate electronic payments. To begin with, the system may allow hybrid processes to integrate a deposit account or integrate one local bank branch for payment until major banks and branches get integrated countrywide in interbank transfer/payment arrangements.

Once frameworks and systems are implemented at the national level using international standards, these can be extended to cross-border paperless trade; this may require elaboration of mutual recognition aspects that include laws, technical and operational arrangements, and acceptance and implementation of international standards to establish equivalence.

5.1 Transition plan

The implementation of the action plan outlined above can be mapped to a phase-wise transition plan for going from paper to paperless, as outlined in figure 16.
In terms of an action plan for going from paper to less paper to paperless, the key focus must be process simplification together with data harmonization using standards. This transition can be divided into phases as shown in figure 16, but much is dependent on level of preparedness of the stakeholders, which directly influences the methods for moving forward.

5.1.1 Phase 0

Phase 0 describes the status quo with regard to most least developed and few developing countries where most of the trade-related processes are paper-based, resulting in huge costs for creating and processing paper documents both domestically and across borders. As part of preparatory measures to transition to less paper, it is expected that the paper documents so selected would conform to the specifications of an international standard such as the United Nations layout key (UNLK) and United Nations code list. This would be the first step towards the adoption of standards and the transition to paperless trade.

5.1.2 Phase 1

In the first phase, stakeholders could consider converting paper-based processes into ones requiring less paper by leveraging existing technologies such as image scans and QR Codes, so that these documents can be exchanged electronically via email in a secure manner.
This can provide significant time and cost savings compared to traditional paper exchanges and the elimination of the need to physically visit public/regulatory offices to complete a trade process or to utilize a eGovernment service. A key aspect as part of such exchanges is the ability to ensure authenticity of message exchanges. For example, email as a method for data exchange may not be appropriate for high-value transactions such as payment instructions. As such, this phase envisions that paper exchanges could be eliminated through electronic exchange.

5.1.3 Phase 2

In the second phase, stakeholders could evaluate partial automation of paper exchanges for specific services as part of cross-border paperless trade. In this phase, the existing systems and the expected transition state can leverage electronic exchange of information through formats such as EDI, XML, JSON to support both data and document exchanges in an electronic and secure manner, with associated validation of data based on business rules or schema. In the case of certain legislative gaps, this phase could still involve physical/electronic exchange of documents for data interchange. With necessary legislative support, such exchanges can also be automated through the use of electronically signed documents.

This phase is still focused on the direct exchange of data between two parties and the use of payment gateways can be introduced in this phase to facilitate electronic payments required as part of trade transactions.

In this phase, the transition is still predominantly decentralized and may not enable automation of services that are interdependent such as sharing invoices across authorities, with banks, customs services etc. This phase may also, in some cases, co-exist in the hybrid mode of an automated and paper environment where paper documentation is required in the final stages of processing, or as a supporting document, in the absence of legislative backing for electronic documents.

5.1.4 Phase 3

In Phase 3, stakeholders reach a certain level of maturity with regard to the automation of processes, by planning the exchange of data and documents through the creation of models for data exchange, through the use of an Electronic Hub or a similar system.
This transition is more comprehensive and requires careful planning for the adoption of standards, and data and document exchanges through Electronic Hub systems with hooks to multiple services. This phase may lead to creating a combination of data formats and interfaces with the intent to capture accurate data, validate data for errors and exchange relevant information through APIs in a secure manner with the objective of electronically identifying and authenticating stakeholders and secure data and systems.

This phase paves the way for countries to integrate in a Single Window and effectively participate in a mutual recognition arrangement with other countries.

6. Gap and roadmap

The current adoption and operation of paperless trade systems in Asia and the Pacific varies from stakeholder to stakeholder, country to country and subregion to subregion and is based on a number of factors that include institutional and governance frameworks, automation, legislative acceptance at the national level, ICT and Infrastructure investments, security, business process re-engineering, data harmonization and capacity.

A recent United Nations survey indicates that the implementation of Single Windows is only about 40 per cent in upper-middle income countries, 20 per cent in lower-middle income countries and less than 10 per cent in lower income countries.\(^2\)

The gaps generally noticed in the implementation of paperless trade systems are detailed below:

- The major factor for ensuring the success of a cross-border paperless trade system is mostly dependent on the commitment of the head of the Government and the creation of strong institutional arrangements to steer such an initiative. This is necessary in order to address project issues such as financial support, coordination among public and private stakeholders, resolving inter-departmental issues and issues between institutions, manage amendments to various statutes to give legitimacy to re-engineered processes, procedure,

adoption of electronic documents as a valid instrument, and ensure strengthening of ICT and supporting infrastructure;

- Enabling the creation of legislative provisions for domestic and cross-border electronic data exchange with acceptance of electronic data within regulatory agencies, without requiring original paper documentation. This could include adoption and adaptation of model laws, such as the UNCITRAL Model Law on Electronic Commerce, into federal Acts and sectoral regulations that give enough ammunition to facilitate domestic and cross-border paperless trade;

- Infrastructural gaps such as the need for the integration of transportation, logistics, ports/airports to serve business communities and Internet/mobile penetration that allows businesses to exchange information electronically in a real time manner;

- Implementation of operational processes and appropriate technology to facilitate paperless trade processes that may or may not be mirror images of paper-based processes;

- Capacity gaps in the execution of such massive programmes, such as a lack of personnel with appropriate backgrounds or skills, or a lack of an appropriate institutional framework for handling such programmes.

6.1 A roadmap to address these gaps could be as follows:

- Involvement of institutional and governance infrastructure and bodies. A high-level governance body with participation by all stakeholders under the supervision of the head of the Government needs to be created to address project issues such as financial support, coordination among public and private stakeholders, the resolution of interagency/interdepartmental issues, manage amendments to various statutes to adopt new processes, procedures and technologies into the working of the state. Therefore, a strong national-level institutional arrangement needs to be created to steer this initiative of cross-border paperless trade and national Single Window.

- Addressing legislative gaps. Most countries have adopted UNICTRAL Model Laws into federal Acts that are called Electronic Transaction Acts or Information Technology Acts or their equivalent. This gives legislative backing to the use of
electronic records and electronic signatures, thus addressing all cyber security issues.

In the case of legislative gaps, for example, in India the Information Technology Act passed by Parliament in 2000 provides the necessary backing for usage of electronic records. Under the Act, to facilitate and regulate the usage of electronic or digital signatures, a statutory body called Controller of Certifying Authorities (CCA) was formed. The Office of the CCA was given powers to:

- Draft guidelines for accreditation of private certifying authorities and trusted third party infrastructure;
- Create or adopt technical standards for certifying authority operation;
- Be able to enter into agreements with other countries to facilitate cross-border paperless trade by accepting electronic documents from other jurisdictions subject to their systems maintaining equivalent level of reliability.

The Office of the CCA also worked extensively with sectoral regulators such as banking, capital markets, insurance, tax, customs and others to help them issue effective sectoral guidelines for wider adoption of electronic signatures in the country. Similarly, other statutory bodies were constituted to promote presence-less, cashless and paperless transactions. Some of these include:

- The Unique Identification Authority of India (UIDAI), which is responsible for issuing a digital ID to all citizens in the country;
- The Goods and Service Tax Network (GSTN), which is responsible for issuing a unique tax identification number to all business tax payers, and for managing the rollout of electronic invoicing system;
- The National Payments Corporation of India (NPCI), which facilitates the creation of a digital payment infrastructure and the adoption of electronic payments.

6.2 Assessing infrastructural gaps

Effective cross-border paperless trade can only be driven when countries have Internet broadband and mobile penetration that provides businesses access to electronic commerce, electronic payments and e-Governance services. Along with a well
penetrated telecom and Internet infrastructure with robust and secure data centres supported by Disaster Recovery (DR), countries must plan for development of integrated logistics hubs with a centralized customs system that provides businesses the ability to submit paperless customs and other regulatory declarations/certificates. This could over time be extended to become Electronic Hubs as outlined in Section 2.4 and then integrated into Single Window systems that are either regional, national or cross-border.

6.3 Implementation of operational processes and technology to promote paperless trade

Effective implementation will ensure:

- A design that enables coexistence of new and existing technology, such as EDI, with support for both data and document movement;
- The development of Electronic Hubs, such as Single Windows, with support for web/mobile forms, APIs, XML and JSON as outlined in models for data exchange and transition measures to support interoperability;
- Support for emerging technologies, such as Blockchain, to share information in a secure and real time manner while ensuring privacy.

Addressing capacity gaps as part of a plan to transition from paper-based processes to less paper and eventually paperless ones may require professional teams to run such programs and projects with following high-level responsibilities:

- Programme management – preparation of roadmaps, frameworks, guidelines, interagency collaboration and capacity management;
- Project Management – conceptualization, architecture, bid management, project monitoring and quality assurance

While challenges exist in the implementation of cross-border paperless trade systems, these are not insurmountable, but they do require a phase-wise transition plan under the aegis of a national and intergovernmental institutional framework.

7. Conclusion

Reducing trade costs and the time involved is essential for economies to effectively use trade as an engine of growth and ensure sustainable development. Digitalization
of trade procedures have taken on increased importance as evidenced by WTO Trade Facilitation Agreements. An important element in this digitalization process is the adoption of emerging technologies and newer data models that are interoperable and have the potential to lower the total cost and time of trade.

In this context, data exchange models such as Electronic Hubs, which leverage interfaces such as Web, Mobile and API with support for data formats such as XML, JSON etc., offer significant potential over existing systems in enabling faster implementation of cross-border paperless trade systems at lower costs.

In summary, the transition to paperless trade systems offers the following five broad benefits:

- Improved revenue for Governments – paperless trade allows more businesses to participate in e-commerce and global trade; resulting in improved revenue for countries;

- Simplified and cheaper trade procedures – savings from paperless trade are higher for small-value goods, enabling developing economies to integrate better into international supply chains;

- Greater transparency and higher compliance rates – administrative costs and overheads are lower and less revenue is lost to fraud and non-compliance;

- Business-friendly atmosphere – paperless trade allows Governments reduce administrative and operational overheads at the border and helps to ensure quicker clearance and creates a business-friendly atmosphere;

- Improved efficiency of supply chains – paperless trade that is driven through the adoption of standards provides businesses with predictability and the ability to integrate across the supply chain as it reduces the need for repeated data entry as well as the occurrence of errors and delays as a result of inaccurate or incomplete data. It also provides scope for machine-to-machine interaction through automated Push and Pull of data as part of international supply chains. As a result, this eliminates the need for human intervention in processes such as quotes, invoice matching etc., thus significantly speeding up the ability to provide and fulfill value-added services such as automated track and trace systems, monitoring of document processing and security.
Adoption of the Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific provides significant benefits to countries, especially developing and least developed economies, when they integrate themselves into the global supply chain with support from the United Nations and the developed economies. However, this requires careful planning in terms of assessing gaps, building a roadmap and carefully planning transition in a phase-wise manner as outlined in sections 4 and 5.