Payment and Settlement Systems Report - Annex

P S S R - A

Interoperability and Standardization in Financial Services in the Digital Age

Payment and Settlement Systems Report Annex Series

The Bank of Japan regularly publishes the Payment and Settlement Systems Report with the aim of providing an overview and evaluating the development of its payment and settlement systems. The report also introduces the engagement of the Bank of Japan and relevant organizations to improve the safety and efficiency of the payment and settlement systems.

The Payment and Settlement Systems Report Annex Series provide in-depth analyses of specific themes concerning those systems. This report focuses on interoperability and standardization in financial services in the digital age. It is a part of the Bank's ongoing work on "standardization of IT relating to digital currency," which was identified as one of the topics related to institutional arrangements regarding CBDC in "The Bank of Japan's Approach to Central Bank Digital Currency," released in October 2020.

Interoperability and Standardization in Financial Services in the Digital Age

Executive Summary

ISO 20022 is widely used as an international standard for the format of messages used to exchange data across financial services, including payment, securities settlement, and derivatives trading. It is characterized by (a) the adoption of a highly versatile and flexible message format, (b) a broad coverage of financial business processes that can be standardized, and (c) an open, accessible database on the web that registers the standardized messages. Due in part to these outstanding features, ISO 20022 has been introduced as an international standard to ensure interoperability in data exchange in many financial services around the world, including payment systems in major Western countries, since its establishment in 2004.

In the field of financial services, the recent progress of digitalization has led to changes in circumstances surrounding interoperability, including the unbundling of financial functions and the spreading of banking as a service, the diversification of features in financial products, the development of decentralized finance, and the trend toward cyber-physical systems.

In light of these changes, (a) active participation of new stakeholders and experts in standardization activities, (b) message format development focused on the functions of financial services, (c) model-oriented standardization activities, and (d) visualization and structuring of metadata will be key in order for ISO 20022 to continue to play a role in ensuring interoperability, which is desirable for financial services in the digital age.

ISO 20022, the main theme of this paper, is an international standard that also contributes to ensuring the interoperability of digital currencies, such as private digital money and central bank digital currency. The various know-how accumulated through ISO 20022 standardization activities will be useful in the standardization process, in which private payment service providers, central banks, and other related parties participate collaboratively.

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I. Introduction

Since releasing "The Bank of Japan's Approach to Central Bank Digital Currency (CBDC)" in October 2020, the Bank has been conducting experiments on CBDC and considering institutional arrangements. As part of the Bank's work on exploring the potential designs of CBDC, the Payment and Settlement Systems Department published "Standardization in Information Technology related to Digital Currencies" (Payment and Settlement Systems Report Annex Series) in May 2021[1]. The report points out three benefits of standardizing information technology related to digital currencies (i.e. ensuring interoperability, ensuring reliability, and bringing together and utilizing expertise), and illustrates international standards associated with message formats, identifiers, and security technologies that facilitate interoperability and reliability[2].

As introduced in the previous report, ISO 20022 aims to ensure interoperability in data exchange across financial services, including payment, securities settlement, and derivatives trading[3]. ISO 20022, as described below, adopts a highly versatile and flexible message format. Also, it covers business processes, which form the premise for the message format, and data item property (e.g. category, definition, condition, etc.). In addition, these standardized contents are registered in a database and made publicly available on the ISO 20022 website. Due in part to these outstanding features, ISO 20022 has been implemented as a message format standard for data exchange in many financial services around the world, including payment systems in major Western countries, since its establishment in 2004[4].

In recent years, ISO 20022 has been referred to in reports on improving cross-border payments by the Financial Stability Board (FSB) and the Bank for International Settlement (BIS) through its Committee on Payment and Market Infrastructures (CPMI). It is also mentioned in a report on the foundational principles and core features of a CBDC by the BIS and seven major central banks, including the Bank of

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[1] The Payment and Settlement Systems Department, Bank of Japan, is in charge of planning basic affairs related to the payment and settlement systems in Japan. It also serves as the secretariat of the Japanese National Member body of ISO/TC 68 on behalf of the Japanese Industrial Standards Committee (JISC), a Council under the Ministry of Economy, Trade and Industry (METI), and conducts research and analysis related to international standards. ISO/TC 68 is a technical committee (TC) of the International Organization for Standardization for financial services.

[2] See https://www.boj.or.jp/en/research/brp/psr/psrb210609.htm/.

[3] For recent developments of ISO 20022, see, for example, "The Role of International Standard ISO 20022 in the Next Generation Digital Society," (https://www.boj.or.jp/research/wps_rev/rev_2021/data/rev21j09.pdf), 2021-J-9, (available only in Japanese).

[4] For the implementation status of ISO 20022, visit the ISO 20022 website (https://www.iso20022.org/).

Japan[5]. Thus, ISO 20022 is becoming established as a crucial foundation for ensuring interoperability in data exchange in the field of financial services worldwide.

Following on from the previous report, this paper examines how standardization should be better promoted in order to realize smooth data exchange in financial services including digital currencies in the digital age, with a particular focus on ISO 20022. As digitalization is expected to have an impact on the interoperability of financial services, it would be useful to consider major challenges for ISO 20022 standardization activities while taking into account the role that ISO 20022 plays in supporting interoperability.

The structure of this paper is as follows: Section II describes the key features of ISO 20022 and discusses its positioning in ensuring interoperability in data exchange. Section III considers how the interoperability landscape is changing in the field of financial services under digitalization, and how the standardization activities of ISO 20022 should address these changes. Section IV concludes with a discussion on the interoperability of digital currencies.

II. Interoperability and ISO 20022

This section explains what interoperability means in the context of data exchange, discusses the positioning of ISO 20022 as an international standard that contributes to interoperability in the field of financial services, and then describes the outstanding features of ISO 20022.

(1) Positioning of ISO 20022

In general, "interoperability" refers to the property of being able to link different systems and mechanisms with each other. Interoperability has a technical aspect as well as an institutional aspect, and therefore what the term implies differs depending on which aspect is focused on.

This paper will discuss the technical aspect, namely interoperability in data exchange. Information systems are operated by computers consisting of many elemental technologies that are connected via networks and work together by communicating

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[5] FSB, "Enhancing Cross-border Payments: Stage 3 roadmap," October 2020.

BIS/CPMI, "Enhancing cross-border payments: building blocks of a global roadmap - Stage 2 report to the G20," July 2020.

The Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors of the Federal Reserve and Bank for International Settlements, "Central bank digital currencies: foundational principles and core features," October 2020.

with one another. Therefore, when evaluating interoperability in data exchange, it is necessary to look closely at how communication is established among elemental technologies, computer systems, and networks.

Taking verbal communication between two persons as an example, it is clear that communication is composed of many elements. In the process of interpersonal conversation, person A first identifies person B to speak with and vocalizes words in an appropriate tone, which person B listens to. They cannot understand each other's intentions without sharing linguistic elements such as syntax, meaning, and context[6] (Figure 1). Even casual conversations are realized by the harmonization of various linguistic and non-linguistic elements between people. Thus, human conversations are made possible by acquiring interoperable rules for communication, including these elements, through society and updating them on a daily basis.

Figure 1: Interpersonal Communication
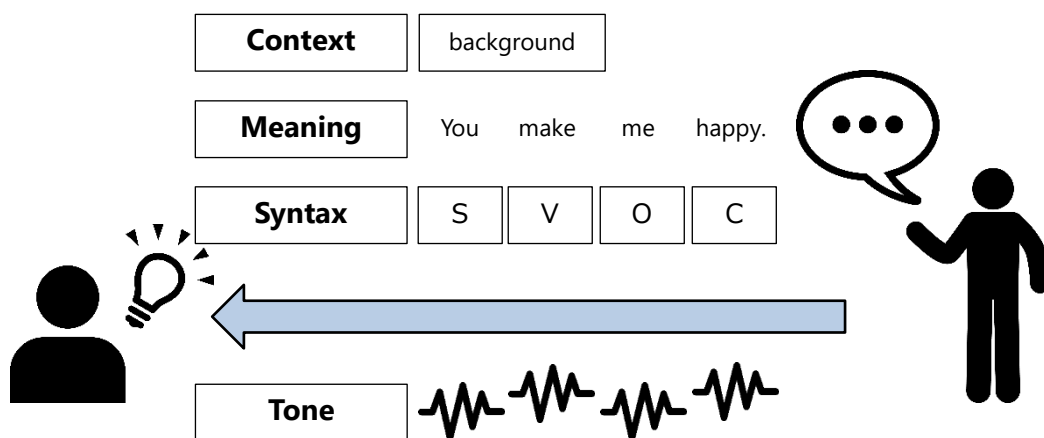
Similarly, interoperability between information systems is achieved when their users can correctly convey information and be understood by others through the network.

Communication between information systems may, however, not be as easy as human communication. For example, in addition to setting up a physical wired or wireless connection environment to transmit data in the form of electric or radio signals, it is necessary to establish detailed rules at each functional level in advance, such as what signal to send, what data to put in that signal, what information to give

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[6] The field of linguistics has several research areas, including phonetics, syntax, semantics, and pragmatics. In this paper, conversational behavior is described in a broadly decomposed manner for illustrative purposes.

to that data, etc. Protocol stacks, including the OSI reference model[7] and the TCP/IP model[8], describe the interoperable rules in a hierarchical structure that are required for smooth communication between information systems (Figure 2). In a protocol stack, each layer has its own independent rules under which its roles are assigned[9].

Figure 2: OSI Reference Model and TCP/IP Model[10]

OSI Reference Model		TCP/IP Model		Protocol Examples
7	Application Layer			
6	Presentation Layer	4	Application Layer	HTTP, HTTPS, SMTP, POP, FTP
5	Session Layer			
4	Transport Layer	3	Transport Layer	TCP, UDP
3	Network Layer	2	Internet Layer	IP, ICMP
2	Data Link Layer	1	Network Interface Layer	Ethernet, PPP, IEEE 802.11
1	Physical Layer			

For example, the TCP/IP model, which is used in the internet and similar computer networks, has four layers from bottom to top: the network interface layer is responsible for the transmission of signals between two devices that are connected on the same network; the internet layer offers the functional and procedural method for transferring data from one node to another with the help of various networks; the transport layer provides the reliable delivery of data along the transmission route; and the application layer deals with the processing procedures of the delivered data.

Among these layers, the widely used protocols that handle processing procedures related to user interfaces (UI), such as browsing the Web and using e-mail, belong

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[7] The Open Systems Interconnection (OSI) reference model was developed in the days before the internet in order to enable connections between different network devices. The model was standardized as ISO/IEC 7498-1 and ITU-T X.200 (international standards) as well as JIS X 5003 (domestic standard).

[8] The TCP/IP model is a structured protocol for the internet, and its specifications are compiled in Requests for Comments (RFCs) issued by the Internet Engineering Task Force (IETF), an internet-related standards organization.

[9] In principle, each protocol layer should be defined to have independent roles, based on the design philosophy of modularization and encapsulation. This enables clear responsibilities and tasks to be assigned to each layer, such as the development of network devices, building of a network, and provision of services on the network, thereby avoiding any adjustment between different layers.

[10] In this figure, we place the layers of each model that have similar roles next to each other, although there is no clear corresponding relationship.

to the application layer (Figure 3). In the field of financial services, message exchanges over the internet are executed on this layer.

Figure 3: Commonly Used Protocols

		Sending and Receiving E-Mail	File Transfer	Web Browser
	User Interface			
4	Application Layer	SMTP, POP	FTP	HTTP, HTTPS
3	Transport Layer	TCP, UDP		
2	Internet Layer	IP, ICMP		
1	Network Interface Layer	Ethernet, IEEE 802.11, PPP		
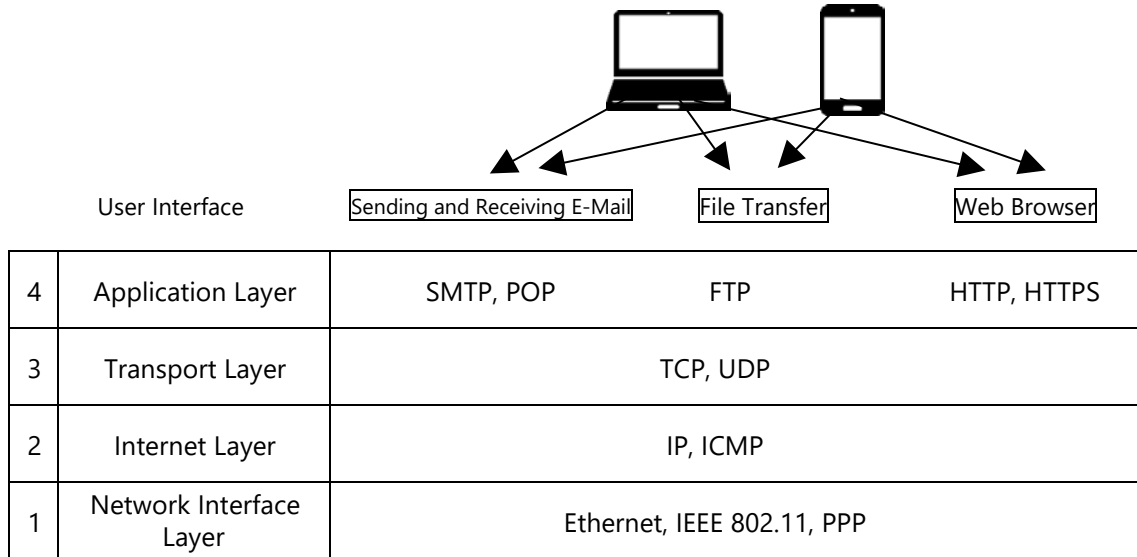
What role does ISO 20022 play in relation to such a hierarchical structure of protocols?

Comparing data exchange between information systems to human communication, protocol stacks are like the most basic foundation of interpersonal conversation. For system users to figure out what the transmitted data contains, the information systems that they use must share a data exchange format with a common "syntax" and "meaning." It is also important to share "context" (background knowledge) in order to properly recognize the meaning of data.

ISO 20022 provides a common language for the message formats[11] used for data exchange between information systems in the field of financial services so that users can correctly understand each other's data[12] (Figure 4).

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[11] This relationship is also said to be "ISO 20022 starts where the OSI-model ends."

[12] By using terminal devices of information systems that exchange data in the ISO 20022 message format, users can correctly understand each other's data. The ability to share and use data processed by information systems within the organization to which the user belongs depends on the degree of data integration within the organization or between the organization and others.

Figure 4: Interoperability in Communication

Human Communication		Communication between Information Systems
Conversational Contents	Linguistic elements (context)	Message Format Standard (ISO 20022)
	Linguistic elements (meaning)	
	Linguistic elements (syntax)	
Conversational Foundations	Non-linguistic elements (tone, etc.)	Protocol Stack

(2) Features of ISO 20022

ISO 20022 has three distinct features. First, it adopts a highly versatile and flexible message format. Second, it covers business processes and the data item property to be transmitted. Third, the standardized messages are registered in a database, called the ISO 20022 Repository, which is available on the ISO 20022 website.

Versatile and flexible message formats

ISO 20022 employs general-purpose data description languages (XML schema, ASN.1), and can flexibly define data items to be transmitted by appending "metadata[13]" to indicate their meanings. In recent years, the adoption of JSON, which is used mainly in APIs, has also been under consideration (Figure 5).

Metadata, which describes the meaning of data items in a data description language, is useful for both human understanding (human readability) and system processing (machine readability), facilitating information system development and intersystem coordination. In short, ISO 20022 adopts a "syntax" that is easily understandable for not only humans but also information systems.

The standards of message formats (ISO 7775, ISO 15022, etc.) prior to ISO 20022 were in principle proprietary ones with fixed message lengths and data items. In contrast, ISO 20022 allows users to select a message format from multiple data description languages and define data items by using metadata at their disposal,

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[13] Metadata is data that defines and describes other data. It enriches the data with information that makes it easier to find, use and manage. In the ISO 20022 XML format, metadata called a "tag" is used to indicate the meaning of the data (example: <ID>12345678</ID>, where <ID> and </ID> indicate that the number in between is an ID).

thereby responding to the diverse needs of financial services more flexibly.

Figure 5: ISO 20022-related Languages for Data Description

Language for Describing Data	Main Features
XML (Extensible Markup Language) schema	Data description language used for defining the XML-style message format, published by W3C, the main international standards organization for the World Wide Web, in 1998. XML has high flexibility and scalability, and its dependence on platform is relatively low.
ASN.1 (Abstract Syntax Notation One)	Data description language used for defining the structure of data carried by messages exchanged between communicating entities, standardized by a joint technical committee of ISO and IEC (ISO/IEC JTC 1) and the International Telecommunication Union - International Telecommunication Standardization Sector (ITU-T).
JSON (JavaScript Object Notation)	Lightweight data description language mainly used in APIs. As a language-independent data interchange format, JSON is used to transfer data across web applications.

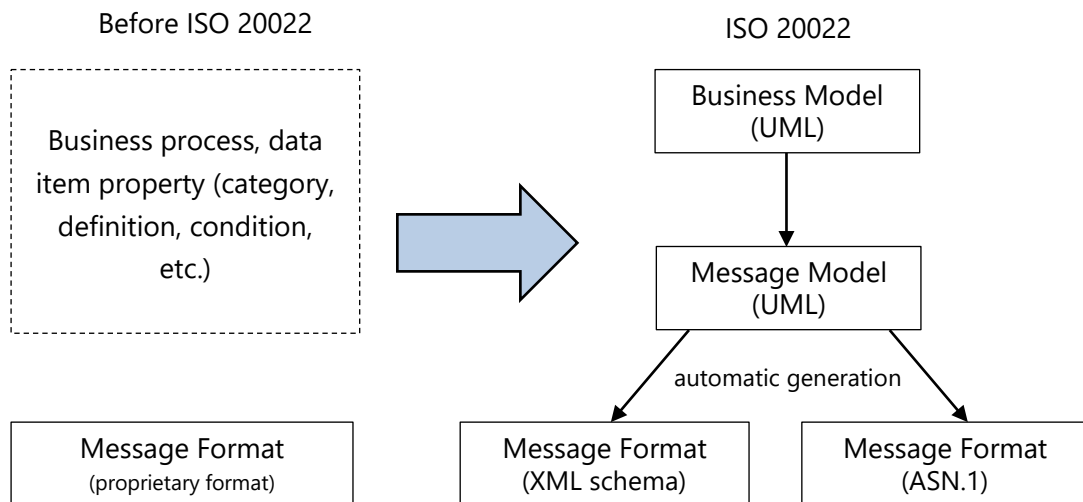## Broad coverage of standardization

ISO 20022 covers not only the message format but also the message model, which describes the data item property (e.g. category, definition, condition, etc.) for the format to be transmitted, and the business model, which describes the business process where data exchange takes place (Figure 6). In light of these features, it can be argued that ISO 20022 makes it easier to share both "meaning" and "context" as in human conversation.

Figure 6: ISO 20022 Standardization Coverage

Standardization Coverage	General Description
Business Model	Description of business process
Message Model	Description of data item property (e.g. category, definition, condition, etc.) to be transmitted
Message Format	Message format used for transmitting data between information systems

Prior to the introduction of ISO 20022, business processes and data item property were described in standardization documents, albeit not in a systematic or structured manner, to help to understand message formats. In contrast, ISO 20022 formulates the business process and data item requirements as a business model and a message model respectively, and automatically generates a message format from the business model and message model. To enable this mechanism, the Unified Modeling Language[14] (UML) has been adopted for describing the business model and message model (Figure 7).

Figure 7: Pre-ISO 20022 and ISO 20022 Standardization Coverage

Before ISO 20022	ISO 20022
Business process, data item property (category, definition, condition, etc.)	Business Model (UML)
	Message Model (UML)
	automatic generation
Message Format (proprietary format)	Message Format (XML schema) · Message Format (ASN.1)

Open database available on website

The standards of the business model, message model, and message format are registered in the ISO 20022 Repository, and anyone can access the latest information via the ISO 20022 website (https://www.iso20022.org/)[15]. The repository functions, so to speak, as an "evolving dictionary" for sharing, revising, and reusing common "syntax," "meaning," and "context" among the parties involved.

The tasks associated with registering and revising the standards are handled by Standards Evaluation Groups (SEGs) in accordance with the procedures set by the

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[14] UML is a description language suitable for modeling and describing systems. UML has many types of diagrams, which are broadly divided into two categories: structure diagrams and behavior diagrams. The former shows the static structure of the system, while the latter shows the dynamic behavior of the objects in a system. UML is a standard managed by the Object Management Group, or OMG.

[15] The ISO 20022 Repository is managed by SWIFT, which serves as the ISO 20022 Registration Authority. Prior to ISO 20022, all standards for message format were written in paper form.

ISO 20022 Registration Management Group (RMG), which manages the overall ISO 20022 registration process. SEGs have been established in five business domains of financial services to address the needs of each business area, and many stakeholders are involved, including financial institutions, non-financial firms, and financial authorities (Figure 8).

Figure 8: ISO 20022-related Organizations

ISO 20022 RMG (Registration Management Group)		
SEGs (Standards Evaluation Groups):	Payments	
	Securities	
		Derivatives
	FX (Foreign Exchange)	
	Trade Services	
	Cards and Related Retail Financial Services	
TSG (Technical Support Group)		
RTPG (Real-Time Payments Group)		
CSH (Cross SEG Harmonisation Group)		

(3) ISO 20022 from a data quality perspective

As we have discussed, ISO 20022 serves as a common language connecting users of information systems in the field of financial services. At the same time, linguistic elements, such as syntax, meaning, and context, are also important in ensuring the "data quality" of financial services. In order to manage data efficiently and effectively throughout its life cycle[16] from creation and acquisition to storage, maintenance, utilization, and disposal, it is necessary to ensure "data quality" that meets the expectations and requirements of users from the early stages in the cycle.

In 2015, ISO 8000-8 was formulated as an international standard on data quality. It has three criteria for evaluation: syntactic quality, semantic quality, and pragmatic quality. First, syntactic quality refers to the degree to which data conforms to its specified syntax, such as requirements stated by metadata, and it is ensured by message format in ISO 20022. Second, semantic quality means the degree to which data corresponds to what it represents, and it is ensured by message model in ISO 20022. Finally, pragmatic quality refers to the degree to which data is found suitable

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[16] For the lifecycle of data, see, for example, DAMA International, "DAMA-DMBOK: Data Management Body of Knowledge: 2nd Edition," 2017, section 2-5-9.

and worthwhile for a particular purpose, and it is enhanced by business model in ISO 20022 (Figure 9).

Thus, ISO 20022 also plays an important role in ensuring data quality, through standardization of message format, message model, and business model, in the field of financial services.

Figure 9: ISO 8000-8 Data Quality Criteria and ISO 20022

ISO 8000-8		ISO 20022
Type of Data Quality	Data Quality Criteria[17]	Standardization Coverage
(1) Syntactic Quality	Degree to which data conforms to its specified syntax	Message Format
(2) Semantic Quality	Degree to which data corresponds to what it represents	Message Model
(3) Pragmatic Quality	Degree to which data is found suitable and worthwhile for a particular purpose	Business Model

III. Standardization desirable for financial services in the digital age

The previous section looked at the key features of ISO 20022, touching on interoperability in data exchange. Since its establishment in 2004, ISO 20022 has adopted advanced ideas to achieve interoperability in the field of financial services. It also plays an important role in ensuring data quality. Meanwhile, changing circumstances in recent years such as the progress of digitalization have posed new challenges to ISO 20022 standardization activities.
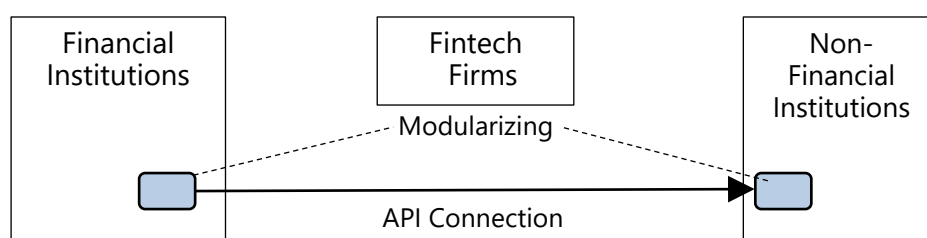
(1) Financial services in the digital age

Unbundling of financial functions and spreading of banking as a service

Digitalization and financial deregulation have brought about changes to the ways financial services are provided, such as the unbundling of financial functions and the spreading of banking as a service. For instance, some financial services traditionally provided by banks are now being provided by non-banks, including payment service

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[17] "Syntactic quality" and "semantic quality" are to verify that specified requirements have been fulfilled, while "pragmatic quality" is to validate that the requirements for a specific intended use or application have been fulfilled.

providers and fintech firms. Recently, so-called "embedded finance" has begun to spread, in which fintech firms modularize some of the services offered by financial institutions, such as settlement, lending, financial product trading, and insurance, and non-financial firms incorporate them into their own services through APIs[18] (Figure 10). New forms of financial services have become more available as a result of technological progress and financial deregulation[19].

Figure 10: Embedded Finance

Diversification of features in financial products

The digitalization of financial products and the emergence of various digital assets in recent years have led to the diversification of features of financial products. In the field of payment, stablecoins have emerged as a new type of digital money using blockchain technology, some of which are given programmability that enables more functions in addition to executing, for example, simple fund transfers. In securities settlement, funding through the issuance of digital securities based on blockchain technology is beginning to take place—this is often referred to as security token offering. In this way, an increasing number of financial products bear features that do not fit into the traditional dichotomy of payment and securities.

Development of decentralized finance

Recently, there has emerged "decentralized finance" (DeFi), which utilizes a smart contract[20] mechanism on a public blockchain. DeFi allows information systems participating in the network to process data, which is related to transfer of rights and values, in an autonomous and decentralized manner—traditionally, such processing has been undertaken by a single legal entity like a financial institution.

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[18] API is a set of definitions and protocols that can allow one application to communicate with another application.

[19] For example, in Europe, the Payment Services Directive 2 (PSD2) entered into force in 2016. In Japan, the Payment Services Act has also been enacted and amended, as well as the amended Banking Act.

[20] Smart contracts are programs stored on a blockchain that run when predetermined conditions are met. They typically are used to automate the execution of an agreement.

The novel characteristic of DeFi is that it helps to generate brand-new financial services and monetization opportunities, which may lead to the creation of spin-off markets and demands.

Trend toward cyber-physical system

In addition, recent digitalization has led to the development of the cyber-physical system (CPS), a social system where cyber space (virtual space) and physical space (real space) are highly integrated, broadening the possibility of deeper data integration between the financial service sector and other sectors in the longer term.

For example, in the manufacturing industry, efforts have been made on the so-called "digital twin," in which companies collect a series of data on products and their manufacturing processes through IoT (Internet of Things) devices and use it for product design and development, quality control, etc. Similar approaches have also been taken in the field of financial services, such as car insurance that statistically uses customers' driving data acquired through IoT devices. There is also a growing movement toward managing and distributing rights and values in cyber space by linking with those in physical space, an example of which is non-fungible tokens[21] (NFTs). Climate change issues are another area where cross-industrial data integration is required. Given the spread of the IoT, the rise of NFTs, and efforts to address climate change, the financial sector will increasingly need to share data with other sectors (Figure 11).

Figure 11: Data Linkage between Physical Space and Cyber Space

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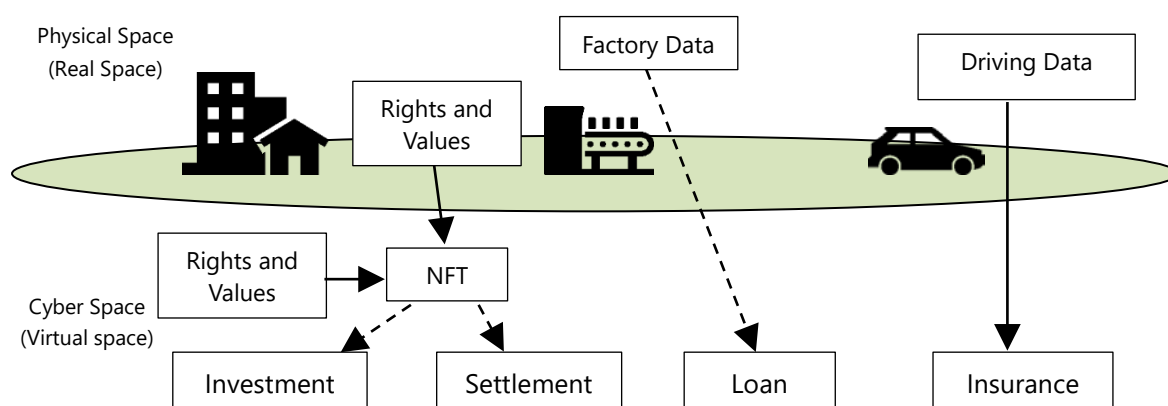
[21] NFTs are unique cryptographic tokens that exist on a blockchain and cannot be replicated. Each token is uniquely identifiable, and thereby NFTs are different from blockchain-based crypto assets (example: ERC-20, a standard for fungible tokens). ERC-721 is a standard for representing ownership of NFTs.

(2) Standardization desirable for financial services in the digital age

As described above, the circumstances surrounding interoperability in the field of financial services have changed, especially (a) the unbundling of financial functions and the spreading of banking as a service, (b) the diversification of features in financial products, (c) the development of DeFi, and (d) the trend toward CPS. In light of these changes, the following discussion focuses on the major challenges to be addressed by ISO 20022 standardization activities in order for the international standard to continuously play a key role in ensuring interoperability in the field of financial services[22].

Participation of new stakeholders and experts in standardization activities

All of the above-mentioned changes suggest the need for more active participation of new stakeholders and experts in ISO 20022 standardization activities.

In the past, standardization activities were typically motivated by the initiatives of payment systems in Europe and the United States and/or responses to regulatory requirements (Figure 12). Against this backdrop, standardization activities were led mainly by standardization bodies, financial market infrastructures, and financial authorities, in addition to SWIFT, the registration body that manages the ISO 20022 Repository.

Figure 12: ISO 20022-related Major Initiatives, Regulations, etc.

Financial Services	Major Initiatives, Regulations, etc.
Payment	SEPA (Single Euro Payment Area) ISTH (International Standards Team Harmonisation) T2 (Target 2) Fedwire / TCH
Securities settlement	MiFID (Markets in Financial Instruments Directive) EMIR (European Market Infrastructure Regulation) T2S (Target 2 Securities)

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[22] ISO/TC 68 has been discussing revisions to ISO 20022 since 2020 to adapt to recent technological changes.

However, the stakeholders of financial services have expanded to include new players, such as payment service providers, fintech firms, and others involved in DeFi. Therefore, it would be desirable for such new stakeholders and experts in the field of financial services to participate in the standard-making activities for ISO 20022.

In the longer term, standardization activities should go beyond the financial sector and extend to other sectors, such as the manufacturing and retail sectors. Ensuring interoperability across industrial sectors will lead to a broader base of potential service providers, making it easier to achieve economies of scale and network effects. In addition, some argue that more private firms will be able to improve the quality of their products and services, for example, by utilizing machine learning of data with due respect for privacy, and that consumers can benefit from such improvements[23].

Entities have an incentive to participate in standardization activities because they may be able to have their intentions reflected in a standard. However, such incentive may not always work, especially when the implementation of a standard is highly voluntary or costly. This reality is well reflected in the fact that the implementation of ISO 20022 standards took place primarily when initiatives of payment systems were carried out and/or regulatory requirements mandated the use of international standards. In order to achieve greater participation by stakeholders in ISO 20022 standardization activities and outreach beyond the financial sector, it will be important to intensify activities for facilitating the implementation of standards. To this end, one idea would be for a public entity to take the initiative. Another idea is to establish an organization within the ISO 20022 framework that aims to promote smooth implementation of standards.

In particular, the smooth implementation of standards requires a balance between the flexible introduction of standards in response to changes in circumstances and the stable provision of existing financial services. Recent progress in digitalization, such as blockchain technology and decentralized finance, has accelerated the application of new elemental technologies in the field of financial services. So, it is also necessary for the ISO 20022 framework to flexibly update standards based on emerging technologies and encourage their implementation according to the needs of the parties concerned. On the other hand, the appropriate timing for building up and updating information systems varies from entity to entity. To enhance the

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[23] This effect is sometimes called "feedback effect" (see Viktor Mayer-Schönberger & Thomas Ramge, "Reinventing Capitalism in the Age of Big Data," Basic Books, 2018).

effectiveness of implementing ISO 20022 standards, it will be necessary to carefully consider the timing and methods of promoting the introduction of standards, based on the needs of the parties concerned and the value to be added. At the same time, care is required to ensure that financial services are provided in a continuous and stable manner.

In addition, in order to encourage participation by a wide range of stakeholders, it is imperative to lower the hurdle for technical expertise that is required for ISO 20022 activities. Although the search function of the ISO 20022 Repository has been improved, additional efforts could be made to contribute to a better understanding of Unified Modeling Language (UML), which is used to create business models and message models, and the languages for describing data (e.g., XML schema), which are used in developing message formats.

Message format development with a focus on financial service function

The above-mentioned changes in circumstances have increased the need to emphasize an approach focusing on the functional aspects of financial services in developing message format standards consistent with ISO 20022.

Currently, ISO 20022 is divided into five separate financial service areas (payment, securities settlement, foreign exchange, trade finance, and card and retail settlement). Each area has message sets, and each message set contains several to several tens of messages. Each message has several tens to several hundreds of data items with metadata being attached (Figure 13).

Figure 13: Examples of Message Sets and Messages
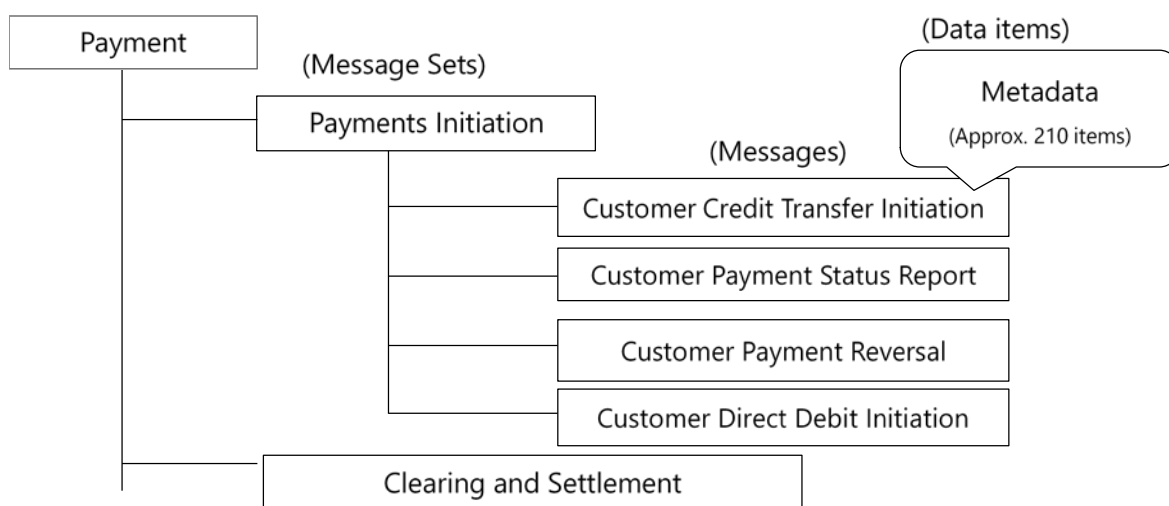
Since ISO 20022 was established in 2004, standardized messages have been developed in response to market needs at the time, and their number has now reached approximately 730 in total (Figure 14). While some of these message sets bear regional characteristics, many have been adopted by payment systems around the world because of their general-purpose features, and have literally served as international standards.

Figure 14: ISO 20022 Message Sets and Messages (as of end of February 2022)

Financial Services	Number of Message Sets	Number of Messages
Payment	19	
Securities	28	
Foreign Exchange	3	729
Trade Finance	5	
Card and Retail Settlement	5	

ISO 20022 allows us to reuse existing message sets and/or messages that are registered in the repository when developing new message sets. Therefore, it is only necessary to create missing messages and add them to existing messages that are selected for reuse.

Thanks to the cross-reference search function of the ISO 20022 Repository, it is easy to specify the candidates for message sets and messages to be reused. Also, the definitions of basic concepts common to financial services (date and time, subject, account, asset, obligation, etc.) have been gradually standardized to promote reuse of these concepts beyond the financial sector. Furthermore, the backgrounds and underlying assumptions on which existing message sets and messages were developed are detailed in the message definition reports, making it easier to determine whether they are suitable or not. In sum, ISO 20022 is designed to produce new message sets for financial services as if assembling building blocks.

ISO 20022 is responsive to changes in circumstances surrounding financial services. But, the unification of terminology and standardization of concepts across business fields and operations are still a work in progress. Even for organizations using an ISO 20022 message format, there are cases where different business lines within the

organization cannot share and utilize data, or where the flow of data from outside the organization is fragmented. In addition, it is likely that more and more new message sets will be created by reusing existing messages rather than message sets to accommodate non-traditional financial services. This should lead to a greater unification of terminology and standardization of concepts across different business fields and operations.

In order to make messages more reusable, one possible solution is to create more granular messages—i.e., shorter messages that contain fewer functions—than conventional ones. This means that more choices of message combinations are available, thereby leading to more frequent reuse of the already registered messages. With new financial services emerging and more financial functions being modularized, there will certainly be a greater need for more granular messages.

Model-oriented standardization activities

As the creation of standards is focused on not only message sets but also individual messages, a deeper understanding of the underlying business model and message model behind existing messages will be crucial in ISO 20022 standardization activities.

Most importantly, we need to have a fundamental understanding that a message format is developed from a business model and a message model when making an ISO 20022 standard. It is undeniable that ISO 20022 was sometimes mistakenly perceived as a "message format" standard. This partially explains why ISO 20022 standardization activities tended to focus on the XML format. Also, it seems that some message formats are not based on either a business model or a message model, and others do not reuse existing message formats properly. Thus, we should recognize that message formats should be developed from the early stages of developing business models and message models with the involvement of practitioners with appropriate knowledge of business processes[24].

A return to standardization activities focusing on business models and message models would be beneficial in the rapidly changing financial services landscape under digitalization. Since business models and message models, which are abstractions of actual financial services, change relatively slowly, standardization at these modeling stages will help to avoid frequent revisions of message format

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[24] It is also said that the "business model," "message model," and "message format" reflect the perspectives of practitioners or customers, those of system designers, and those of system developers, respectively (see Thomas C. Redman, "Data Driven: Profiting from Your Most Important Business Asset," Harvard Business Review, 2008).

standards themselves. In addition, a close examination of business models and message models may lead to the discovery of entirely new business ideas and monetization opportunities in financial services. It is expected that those involved in standardization activities will secure areas of co-creation through message format standards while cultivating areas of competition through offering new financial services that are found during the standardization activities.

Visualization and structuring of metadata

It is important to visualize and structure the metadata that defines data items in order to support the development of appropriately structured, new message format standards. Visualization and structuring of metadata leads to visualization and conceptualization of relationships between messages and between message sets. It also helps to understand parts of the messages that do not necessarily relate directly to the business processes that one is concerned with.

In this regard, ISO 11179-2, an international standard for metadata management, illustrates the following means for promoting the visualization and structuring of metadata: (1) taxonomy, which classifies metadata; (2) thesaurus, which categorizes and organizes synonym/antonym relationships of metadata; and (3) ontology, which analyzes and organizes the conceptual relationships among metadata. In particular, the use of ontology[25] has gained more attention in recent years in fostering the digitalization of the manufacturing industry.

As mentioned earlier, the manufacturing industry has made efforts to promote the "digital twin," and this is where an ontology is utilized in order to examine what aspects of products and manufacturing processes in physical space should be extracted and converted into digital form in cyber space. A phenomenon that occurs in physical space comes to "exist" in cyber space only when it is converted into a form of data, and therefore, an ontology is critical in mapping the relation between concepts that exist in cyber space.

With regard to this point, the question of what to convert into data does not seem relevant to financial services at first glance, because so many have already been digitalized and/or systematized. However, it seems that not all digitization and systemization to date have been based on strategic thinking as to which parts of financial products and financial operations should be extracted and converted into data in cyber space. The fact that this issue did not emerge may have caused a delay

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[25] The term is originally derived from "Ontology," the philosophical study of being in general.

in digitalization. Hence, new added values would be created in financial services if practitioners who are familiar with business processes were more actively involved in data strategy and ontology development.[26]

Looking ahead to future situations where smart contracts, such as those used in DeFi, become more prevalent in financial services, the scope of ISO 20022 standardization may expand to include algorithms that describe a series of data processing. ISO 20022 has the potential to fulfill not only the function of "language" but also the function of "knowledge" of accumulating various schemes of financial services. In this sense, visualization and structuring of metadata that helps to understand messages, which constitute the message format, is considered to be of great importance.

IV. Conclusion

This paper discussed how standardization should be better promoted to realize smooth data exchange in financial services in the digital age, with a particular focus on ISO 20022.

The progress of digitalization in recent years has had an impact on standardization activities. Despite this, ISO 20022 will continue to be an essential framework for ensuring interoperability in data exchange because it incorporates various know-how that facilitates data exchange between information systems in the field of financial services.

ISO 20022, as discussed in the previous report, can contribute to ensuring the interoperability of digital money issued by private entities. One approach to facilitate interoperability between domestic payment instruments could be to implement a standardized message format for them. Another approach is for a third payment instrument, such as CBDC, to serve as a bridge. In either case, it will be crucial that domestic stakeholders such as payment service providers correctly understand the significance of standardization and proactively engage in standardization activities.

International efforts to improve interoperability of cross-border payments have been progressing mainly at the initiative of the FSB and the CPMI. One option for future consideration is a framework using CBDCs designed for cross-border

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[26] On February 24, 2022, the Payment and Settlement Systems Department of the Bank hosted a panel discussion (ISO panel: "Interoperability in Data Exchange: The Potential of ISO 20022") with experts on standardization in the manufacturing and financial sectors.
See https://www.boj.or.jp/paym/iso/iso_panel/isop220225.htm/ (available only in Japanese).

payments, in which case standardization to ensure interoperability among CBDCs would be necessary. In this regard, seven major central banks, including the Bank of Japan, and the BIS have been and will continue to collaborate on issues related to CBDCs, including interoperability.

According to the three categories of standardization (i.e., de jure, forum, and de facto[27]), standards created through collaboration among stakeholders, such as private payment service providers and central banks, are called "forum standards." Although de jure standards under the ISO 20022 framework usually follow such forum standards, the various know-how accumulated by ISO 20022 standardization activities should also be useful for the process of developing forum standards.

This paper also touched upon layered structures for ensuring interoperability in data exchange. Currently, most online services are offered through the internet, and information technologies with layered structures that support them ensure interoperability. The Bank has garnered valuable insights into the technological innovations under way at these layers, including those related to digital currencies, through discussions with experts at the "Future of Payments Forum: Digital Currency Subcommittee" series[28] hosted by the Bank. It is expected that promising information technologies will continue to support information networks and improve interoperability. From this perspective, it is desirable that domestic stakeholders who are involved in research and development of information technologies more actively participate in discussions regarding CBDCs and international standardization.

Although the Bank currently has no plan to issue CBDC, it has been conducting experiments on CBDC and exploring institutional arrangements in order to be able to respond to changes in circumstances in an appropriate manner from the viewpoint of ensuring the stability and efficiency of the overall payment and settlement systems. As part of the Bank's ongoing work, the Bank will continue to research and study the standardization of information technologies related to digital currencies.

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[27] Standards that are established by public international standardization organizations based on predetermined procedures are called "de jure standards." Other types of standards include "de facto standards," which become widely accepted through market competition among companies, and "forum standards," which are created by consensus among multiple companies in an industry.

[28] See https://www.boj.or.jp/paym/outline/mirai_forum/index.htm/ (available only in Japanese).