
FOCUS NOTE

# THE USE OF QUICK-RESPONSE CODES IN PAYMENTS

Part of the World Bank Fast Payments Toolkit

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WORLD BANK GROUP

# CONTENTS



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# 1 SETTING THE CONTEXT

The World Bank has been monitoring closely the development of fast payment systems (FPS) by central banks and private players across the globe.[1] This comprehensive study of FPS implementations has resulted in a policy toolkit. The toolkit was designed to guide countries and regions on the likely alternatives and models that could assist them in their policy and implementation choices when they embark on their FPS journeys. Work on the FPS Toolkit was supported by the Bill and Melinda Gates Foundation. The toolkit can be found at *fastpayments.worldbank.org* and consists of the following components:

- The main report *Considerations and Lessons for the Development and Implementation of Fast Payment Systems*
- Case studies of countries that have already implemented fast payments
- A set of short focus notes on specific technical topics related to fast payments

This note is part of the third component of the toolkit and aims to provide inputs on quick-response (QR) codes from a payments perspective, with a focus on fast payments. This topic is of high relevance, as adoption of QR codes has been widespread in recent years, including as part of FPS implementations, owing to the multifold benefits that QR codes provide to both merchants and customers.

# 2 BACKGROUND

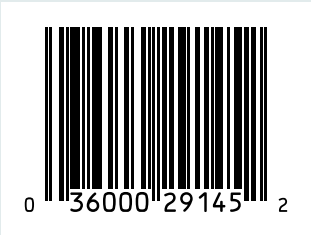
QR code is a two-dimensional (2D) barcode.[2] It consists of black squares arranged in a square grid on a white background. Imaging devices such as smartphone cameras can be used to read and interpret these codes.[3] QR code was created in 1994 by Denso Wave, a Toyota subsidiary, to assist in the manufacturing process by tracking vehicles and parts.[4] Efforts were made to enhance the barcode technology to facilitate increased information storage, and after various modifications, QR code took shape.

2D QR codes differ from traditional one-dimensional (1D) barcodes primarily with respect to their information storage and flexibility components.

Barcodes are scanned horizontally, so the data that can be stored is limited to the single dimension. 2D QR codes, on the other hand, have an additional dimension in which information can be written and scanned, thus increasing its data-storage capacity. 2D QR codes store data horizontally and vertically and can be read from any angle, making them more flexible. 2D QR codes are also known to be more secure and prone to fewer errors.

As mobile penetration increased, the initial push for QR code in payment services came from market players as a way to exchange the information required to initiate and/or receive payments. QR codes are used either to convey the account details of payees, or for payers to convey their payment account details to the payee. In the former case, once the information is captured, a credit transfer to the payee is initiated. In the latter case, a request to pay (RTP) is initiated by the payee.

**FIGURE 1** **Barcode and QR Code**




Barcode

QR Code

QR codes have been prevalent in China since the early 2000s.[5] Countries around the world have typically been introducing QR code as an overlay service to their existing mobile-payment options for cards and fast payments. QR code is becoming increasingly common both among merchants and customers, and it provides flexibility to support the needs of both. Merchants and acquirers are attracted to QR code primarily due to its low cost of acquisition and maintenance, in comparison with traditional point-of-sale devices or their equivalents. Smaller merchants typically used to observe price as a barrier for digital payments, and the introduction of QR code payments has lifted this barrier, leading to smaller merchants transacting digitally. The ongoing maintenance expenses for merchant-presented QR code are limited to reprinting the sticker in the event of wear and tear. Thus, the paper-based QR code (sticker) is cost effective.[6] Cost centers to operate QR codes would typically be similar to those seen in other acceptance infrastructure, such as technology maintenance, security and fraud management, and dispute management and resolution.

The success of QR code use cases depends on their ability to meet customer needs and enhance their experience. Scanning a QR code with a handheld device is easier than entering bank account details or using an alias, such as a mobile number. Moreover, QR codes provide the flexibility of invoking various other peripheral services, such as redirecting to a merchant's website or running promotional campaigns, apart from facilitating payments (for example, bill payments, invoice payments, installment payments). Such services attract both merchant and customer adoption of QR codes owing to enhanced customer experience. Additionally, customers without bank accounts/cards can also leverage the QR code as a means of making transactions through other payment instruments such as e-wallets.

Many financial institutions around the world, such as banks, have been leveraging QR codes for a range of activities, such as marketing and promotional initiatives in which QR codes link customers to additional details on a particular offer or scheme, provide details on social initiatives, and allow customers to download a particular mobile application to manage their bank account or credit card, among others. QR codes can also be used for nonfinancial applications within the payments application. For example, they can be used to link customers to entertainment portals and to assert their identity and authentication.

Regulators and central banks around the world observed success in select Asian countries and are working toward advancing QR payments to digitize cash and also promote financial inclusion. The Central Bank of Ghana recently announced the launch of the Universal QR Code in a step toward increased adoption of digital payments. PayPal has also recognized the benefits associated with QR codes and rolled out QR code payments via its mobile application.[7] Similarly, WhatsApp has also introduced a new payment feature that enables users to transfer money by scanning QR codes.[8]

QR codes have also seen increased uptake during the COVID-19 pandemic. Payments made via QR codes limit person-to-person contact and interaction and help comply with social-distancing norms. QR codes are being used to substitute for physical menus at restaurants, to provide access to information and forms to be filled out to enable contract tracing at restaurants and sporting events, and to allow access to and payment for public transportation.

**FIGURE 1** **Benefits of QR Codes**

**Low cost of acquisition and maintenance**

**User-friendly and provides enhanced customer experience**

**Flexible enough to invoke peripheral services**

**Limits person to person contact and facilitates social distancing**

# 3 QR CODE USE CASES

QR codes can serve as the initiation mechanism for both push and pull payments, including at physical merchants, in e-commerce transactions, for bill payments, and during person-to-person transfers. The nonpayment-related scenarios in which QR codes can be used include the following:[9]

1. Redirecting to a merchant's website
2. Running promotional campaigns
3. Allowing customers to download a mobile application to manage their bank account or credit card
4. Linking employees to entertainment portals
5. Authenticating ID cards of employees at workplaces
6. Substituting for physical menus at restaurants
7. Providing access to information and forms to be filled out to enable contract tracing at restaurants, sporting events, and other venues
8. Allowing access to and payment for public transportation
9. Securing product/initiative details
10. Initiating a service request with a business

While the use cases related to payments can be standardized from the perspective of a unified customer experience and security aspects, the nonpayment-related use cases can typically be proprietary.

# 4 CONSIDERATIONS

Despite the multiple advantages of QR code payments, the following considerations may inhibit the growth of this channel:

- QR code payments may be subject to legacy bias. While QR payments are gaining popularity in emerging markets, their growth has been slow in some more developed markets, such as the United States and Australia, where consumers and merchants have a predisposition toward card-based or tap-and-go payments. Nevertheless, there is growth potential in these markets, owing to the scope for innovation offered by QR codes.
- It is critical to establish the benefits of digital payments in general over cash to facilitate adoption by merchants. This could be accomplished by emphasizing the cost of handling cash versus digital payments—QR code payment costs are potentially lower, depending on how the acquirers structure their pricing—or by promoting additional merchant services in conjunction with QR payments, such as insurance and payment reconciliation, among others. In this regard, countries such as Mexico have introduced QR payments with no fees for the merchant, to replicate the perceived benefits of cash while encouraging merchants and consumers to enter the digital ecosystem.
- QR code merchant payments have several key enablers and interdependencies, such as device affordability, given the need for smartphones for the most seamless experience, internet connectivity, wallet/bank account penetration, and merchant distribution. These need to be addressed to enhance the success of this access channel.
- The lack of harmonization and interoperability of QR specifications could affect customer experience. Because multiple providers have their own QR codes, consumers are required to use multiple applications to transact with different merchants. This could be cumbersome and time consuming, and it could deter consumers from transacting via QR codes. There should also be a focus on user-journey standardization for both end users (registration, scanning, and final payment) and merchants (registration, payment confirmation, and final reconciliation), as the learning curve is significant when using the services of a particular payment service provider (PSP). This keeps users and merchants from switching to a different PSP and discourages healthy competition among PSPs.
- A delay in the onboarding process due to know-your-customer compliance, document collection, verification, and updates will apply for QR code-based acceptance and can be a challenge for prospective merchants and acquiring entities, such as payment aggregators and acquiring banks.
- Language and currency may be a constraint even with interoperable QR codes. Supporting multiple currencies and languages can be explored to ensure that customers in different countries can work in their native languages and currencies.[10]

- PSPs need to bear in mind that, to expand into rural areas, they may have to spend more time, money, and effort disseminating training material and building awareness among merchants and customers.
- There may be restrictions on who can develop QR functionalities. For example, in Mexico, merchants and developers that want to develop solutions for CoDi (FPS service in Mexico) have to go through a special process that includes generating a letter of intent and a business case, signing a confidentiality agreement, and certifying the solution with Banco de México.[11]

### 4.1 SECURITY CONSIDERATIONS

Security aspects related to QR codes, including fraud committed by replicating the QR code, identity impersonation, and data protection, need to be carefully assessed. Investments in back-end security are necessary to ensure secure data transmission and storage. There should be adequate focus on monitoring and enhancing security at the physical, network, and application infrastructure levels.[12]

- Payment applications should provide users with a deeper understanding of security. The merchant name and masked credentials can be displayed in the app after scanning a QR code, to enable safe transactions.[13]
- Details of a payment transaction should be displayed for validation before a payment is processed. The service should also be complemented by real-time notifications to both the payer and the payee.
- Steps should be taken to verify the identity of the payee, particularly when the QR codes are used in an RTP framework.
- Third-party entities can conduct the security test and security audit of the application being used for QR code–based payments.[14]
- Person-to-business QR scans should display meaningful user-friendly names to the payer. Generic names such as "Verified Merchant" or "<Payment app> Merchant" make it difficult to build trust in the system and may lower merchant and customer experience.[15]
- EMVCo believes that the security principles for QR codes should be similar to those for any software-based mobile-payment mechanism. On this basis, the typical layered approach should be considered depending on the implementation itself, with data-at-rest security, data-under-processing security, and data-transmission security.
- To drive security and reduce fraud, similar to what happens with a contactless transaction, the EMV[16] QR code specification does not transmit any confidential information.

Additionally, Ant Group has been working with experts from different markets in ISO/TC68 Financial Services/SC2 Security/WG19 Security on aspects of code-scanning payment, to establish the new ISO 5201, an international standard on financial services for code-scanning payment security. The standard[17] covers security issues related to code-scanning technologies used for payments and includes an overview, a risk assessment, and minimum security requirements and extended security guidelines for code-scanning payment, where the payer uses a device to operate the payment transaction. The standard is applicable to cases where the code is both used to initiate a payment transaction and presented by the payer or the payee.

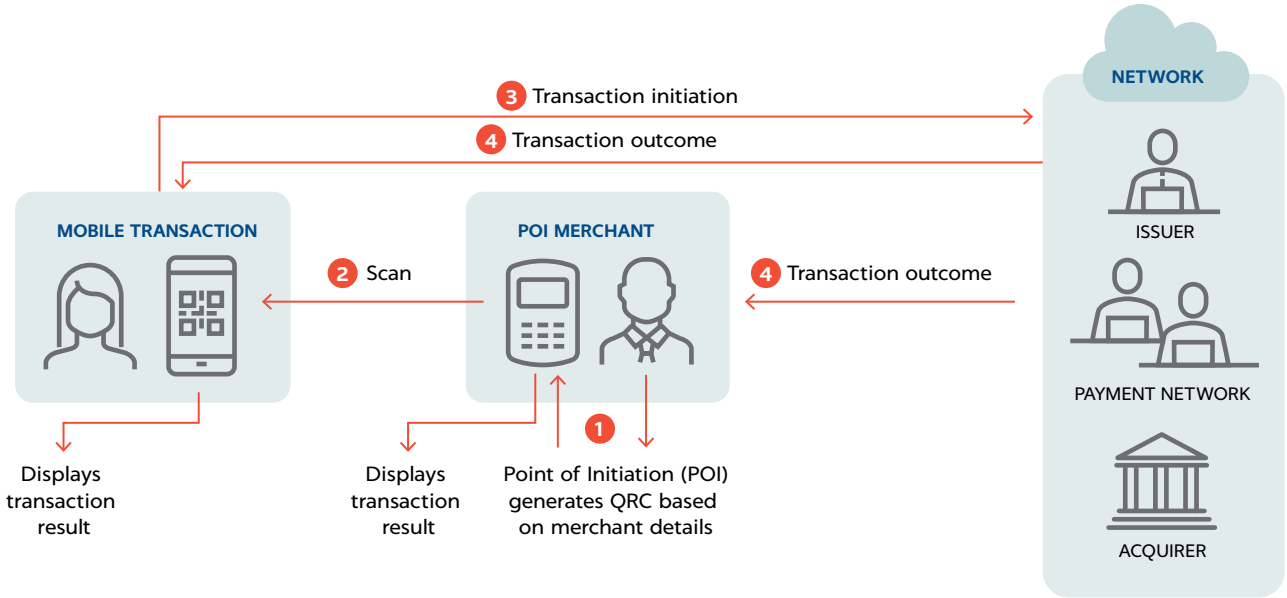
# 5 TYPES AND USE CASES

QR codes are classified based on two broad dimensions: the type of information (static or dynamic) and the presenter of the code (that is, merchant or consumer). The following types and use cases of the QRs are based on these dimensions.

- **Merchant-presented static QR code:** These QR codes contain a fixed (static) set of data and cannot be overwritten once generated. They are presented by merchants to consumers to initiate payments by scanning the QR code. QR code payments usually tend to kick-start with this category of QR codes, and they have been observed to be especially suitable for emerging markets and small merchants, as they are cost effective. (The cost is usually that of printing the QR code sticker.) In markets dominated by feature phones, customers who use feature phones that cannot scan QR codes can manually key in the number printed adjacent to the merchant's QR code sticker (for example, the merchant ID) to initiate a USSD dialogue to complete the transaction.[18] However, there are limitations with such stickers related to security and constraints for offering value-added services owing to their static nature. To overcome these limitations, dynamic QR codes came into force.
- **Merchant-presented dynamic QR code:** These QR codes are generated dynamically and thereby provide the option of customizing/changing data for each scan (for example, transaction-specific data such as the transaction amount and transaction cryptogram). Such QR codes are presented by merchants to consumers through a point-of-sale terminal or smartphone to initiate push payments by scanning the QR code. Dynamic QR is more secure, and cryptographic techniques and time stamps can be applied for verification. Select use cases have been highlighted below.
  - Merchant-presented dynamic QR codes could be used to prefill transaction-dependent data, such as the transaction amount and details of goods, to enhance the payment experience.
  - They could be used in promotional campaigns as promotional codes that are circulated via email or text message and entitle customers to a discount. The QR code can be displayed at a store, and the discount can be taken while making a purchase.
  - They could become an entry point to various kinds of value-added services, as merchants can push their own digital services using these codes. For example, scanning a QR code at a restaurant could lead to a menu through which customers could place their orders and make payments digitally.

While the use cases listed above are for merchants, similar use cases may also be used for person-to-person transactions. Specifically, QR codes can act as a person-to-person transfer code that allows one person to collect or request money from another person. QR codes are also becoming increasing popular in advertisements as means of offering access to additional product details, redirecting readers to a page with a video/trailer, and facilitating e-commerce trans-

**FIGURE 3** **Payment Flow for Merchant-Presented QR Code**




1. Merchant generates and displays QR code based on merchant details
2. Consumer scans QR code using a mobile application to initiate the transaction, with CDCVM if required
3. Mobile application sends the transaction initiation request to the Network
4. The Network processes the transaction and informs the Merchant and the Consumer of the transaction outcome

*Source:* EMVCo

actions. Consumers can scan QR codes displayed at checkout during an online transaction instead of providing card details. Consumers can also scan the QR code associated with a product in a store and save the code in their cart to purchase later. Social networks, such as WhatsApp, are also leveraging QR code scanning to make it easy for customers to initiate conversations with businesses that have official WhatsApp accounts.

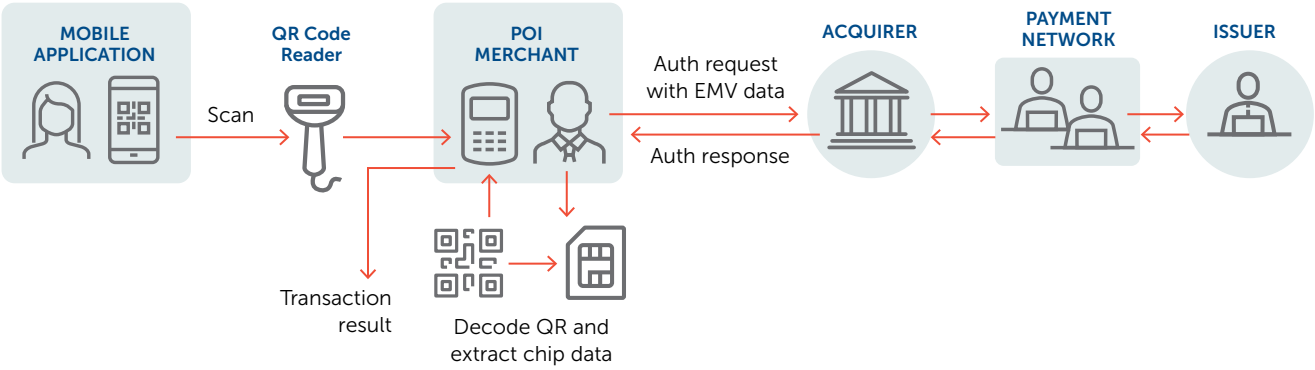
Typically, only a few steps are involved on the merchant's end to generate and display a QR code. As an illustrative example, the following steps are involved for a merchant to generate the Bharat QR Code (India):

1. Have a bank account
2. Link bank account with the BHIM application[19]
3. Generate unique Bharat QR Code from the BHIM application
4. Print the QR code and paste it inside the store in a place where it is clearly visible and convenient for customers to scan using their mobile phones

- **Consumer-presented QR code:** These QR codes are generated by consumers (payers) on their smartphones, and the merchant uses an optical scanner to scan them. The consumer-presented mode (CPM) has fewer operational steps on the consumer side and brings more control on the merchant side. It is important for consumer-presented QR codes to be dynamic and to have short expiration times, to prevent fraud and control risks. This mode may be less suitable for regions with low smartphone penetration. Select use cases have been highlighted below.
  - Consumer-presented QR codes can be used to make payments for transportation, such as on buses or trains, by placing the QR code in front of an installed scanner.
  - Large merchants that wish to upgrade to newer devices for scanning 2D QR codes or that wish to reuse existing barcode-scanning equipment to scan 1D barcodes[20] prefer this type of QR code implementation.

**FIGURE 4** **Payment Flow for Consumer-Presented QR Code**

*Consumer presented*




*Source:* EMVCo

1D barcodes have been adopted in multiple markets, typically in combination with a 2D QR code containing the same information, so that merchants can accept digital payments using the most convenient equipment. China is an advanced market where 1D barcodes for consumer-presented modes of payment are widely accepted, and the use of both merchant-presented and consumer-presented QR codes is expanding as well.

Merchants accept payments through one or a combination of the above types. While the static QR codes offer basic functionalities, dynamic QR codes expand the offerings and provide heightened security. Additionally, the dynamic merchant-presented mode (MPM) has the potential to offer richer services and functionalities, whereas CPM reduces the steps on the consumer side. Overall, the merchant-presented QR code has been taken up more prominently in countries around the world, while the consumer-presented QR code is more common in urban areas of more advanced QR markets, such as China.

The QR code solution provider can provide the option of using different sources of funds to make payments. The wallet/mobile app used by consumers typically asks them to select their preferred payment method. In India, the BHIM QR code can be used to make payments via a mobile wallet or a bank account linked to the wallet, while the Bharat QR Code can be used to make payments through a bank's application via a debit or credit card offered by the bank.

Some QR codes have a four-party scheme, where four roles are involved in the payment flow: a customer, the provider of the consumer digital wallet, the acquirer of a merchant, and the merchant. If the digital wallet and the acquirer are different institutions, it is called the four-party scheme. Others have a three-party scheme; when the digital wallet provider and the acquirer in the payment flow are the same institution, it is called the three-party scheme.

# 6 QR CODE COMPONENTS

The data components of QR codes differ for card transactions, for mobile-money payments, and for fast payments. The differences in the payment methods can be elaborated with the following scenarios:[21]

**Card-based transaction:** In the case of the UnionPay solution used in China (card token) pertaining to CPM, both barcode and QR code are supported. In the case of EMVCo solution, only QR code is supported, but card token and chip information can be used.

**Mobile-money (or wallet-based) transaction:** An MPM code contains the merchant's identifier, and a CPM code contains the user's account token. When making a payment, users can choose from different sources of funds accessible from their mobile-wallet application—for example, a wallet balance, a debit card, a credit line, promotional benefits, or a combination.

**Fast Payments:** In the case of PromptPay (Thailand's QR code), which supports only MPM, the bank account of the payee is contained in the code. The payer can choose from their linked bank accounts to pay. Inter-bank transfer and collection is possible based on PromptPay network infrastructure.

# 7 QR CODES IN THE CONTEXT OF FPS

QR code is an access channel that can accommodate different types of payments, which are cleared in different types of systems and not limited to FPS. QR-based payments are predominantly used in the retail environment—that is, where a consumer pays a merchant for goods/services provided (usually in store yet possibly online). For such payment flows to add value, the merchant should receive a (nearly) instant confirmation of payment to be willing to hand over the goods/services to the consumer. The most evident way to accomplish this is the scenario in which instant confirmation follows the actual instant transfer of funds—that is, as is the case in a FPS.

Over the last few years, FPS globally are introducing QR code as an access channel. As early as 2011, Alipay launched a code-scanning payment product in China. Due to its low usage cost and good user experience, it soon became popular in China and has been adopted by more and more digital wallets. Subsequently, in 2014, WeChat also launched a code-scanning payment product, further popularizing QR code in China. Countries such as Australia, Bahrain and Mexico offer merchant-presented QR capabilities, while a few countries, such as China, India, Malaysia, and Thailand, offer both merchant-presented and consumer-presented QR capabilities. Mexico and Hong Kong SAR, China are considering consumer-presented QR codes in their road map. Adoption of this channel is observed to be picking up in most developing countries.

An advantage that QR codes offer is that they lie at the interface. They allow the flexibility of following a phased, modular approach and making changes and innovations at the interface without making many changes at the back end, due to their limited link with FPS. Many countries have included the QR code access channel as an overlay service or an application over the FPS. Countries that offer the QR code access channel through overlay mobile applications include Australia (Osko), Mexico (CoDi), and Singapore (PayNow).

The security of the physical point of sale has been strengthened over time, and similar security measures for QR codes are evolving. One of the techniques adopted for ensuring security is checking for modifications in the QR code by comparing merchant data on the server side and seeking confirmation from the customer that the merchant is the one the customer wishes to pay. A similar technique is applied in India's Unified Payment Interface (UPI) using a signed QR functionality, wherein the QR code signed by the merchant using its private key is verified using the merchant's public key in UPI, and the customer is notified in case of discrepancies. It is important that security measures are applied at the back end through risk engines that analyze transactions that have passed through the system. Security risks should be identified throughout the entire process of scanning and making payments. Adequate focus should also be given to application and back-end payment system security.

# 8 QR SPECIFICATIONS

Various QR specifications are being adopted by different systems (for example, FPS, mobile-money operators, and card schemes). Some FPS, such as PromptPay in Thailand, FPS in Hong Kong SAR, China, PayNow in Singapore, and Osko in Australia, have based their QR specification on EMVCo's QR specifications.

EMVCo's specifications are publicly available for countries to adopt and flexible enough to accommodate different use cases and to cater to local and business needs. The specifications can be adapted to many payment systems and are available royalty free on the EMVCo website.[22] For example, in Singapore, by reading the same QR code, a consumer can select the best way to pay from eight payment systems, both international and domestic. (See figure 5.) The brand logos indicate to the consumer which payment system/application can be used for the QR code.

**FIGURE 5** **Example of QR Code in Singapore**


There are predefined data fields for the transmission of data between the reader and provider. The EMV merchant-presented QR code specification defines existing fields, including card-based and account-based payments, and allows other payment-solution fields to be added to accommodate different use cases. Another key reason for using EMVCo's QR specification has been enabling future interoperability, as these specifications are being adopted by various operators and participants.

Similar to chip transactions, EMVCo defines a set of data that could be included in QR codes (merchant presented and consumer presented), but the data always depends on the use case and the implementation.

The EMV merchant-presented QR code includes the following information:[23]

- The conventions used for the QR code content, such as the Payload Format Indicator, which defines the version of the QR code template and hence the conventions on the identifiers, lengths, and values
- Merchant account information, including information about the merchant account
- Additional information about the merchant, such as its name, city, and postal code
- Information about the transaction value, if known, such as the amount and currency
- Additional data in support of various use cases, such as the bill number, mobile-phone number (of the merchant or customer), and the purpose of the transaction

**BOX 1 EMVCo's QR CODE SPECIFICATIONS**

EMVCo is an organization that facilitates interoperability and secure payment transactions. Its activities are overseen by its six member organizations: American Express, Discover, JCB, Mastercard, UnionPay, and Visa. EMVCo commenced its QR code payment activity in 2016. It has developed QR specifications for QR code payments to promote global interoperability and security. Dozens of organizations from around the world participate as EMVCo associates and subscribers, contributing their knowledge and expertise to the EMV specifications. EMVCo's CPM and MPM specifications support both static and dynamic QR codes. For CPM, the solution is compatible with EMVCo's existing payments ecosystem and infrastructure. The specifications for the two modes are different. The CPM is in line with EMV's four-corner model, where the QR code is used to transmit consumer data, similar to how it is done with a mobile phone/contactless card. The MPM does not necessarily follow the four-corner model, and the list of data to be transmitted is different. However, the high-level format for the two is the same: IDLV (IDentifier, Length, and Value). Many countries have already established or are in the process of establishing their QR specifications based on EMVCo's specifications and incorporating their own country-specific customizations. EMVCo has seen growing interest in the EMVCo specifications in Africa, Europe, Asia, and South America.

In the case of EMVCo's CPM,[24] the high-level functionality of various components of the QR code-processing architecture on the consumer device is summarized below.

- **Mobile application/wallet:** A consumer-facing user interface application provided by the issuer, merchant, or a third-party and provisioned to the consumer's mobile device. It includes the functionality to encode the payment credentials based on this specification and then displays the resulting QR code.
- **QR code payload:** The payload, consisting of a permanent account number, payment token credentials, and/or other data, converted to base 64[25] and encoded in a QR code.

The merchant device has the following two components:[26]

- **QR code reader:** Scans the QR code, decodes it, and sends the data recovered to the point-of-interaction system. This data constitutes the base 64–encoded QR code payload.
- **Point-of-interaction application:** The application developed by the point-of-interaction vendor to process the base 64–encoded QR code payload. Its functions include decoding the base 64 payload, parsing the data, checking the content and format, and processing the transaction.

In India, Bharat QR Code is based on EMVCo merchant-presented QR standards, which allow interoperability across banks and card schemes. It supports all card payment network credentials and has provisions for domestic payment methods, such as UPI/proprietary payment methods.[27] A similar case is that of the QR code standards established in Nepal.[28]

In Hong Kong SAR, China, EMV QR standards were adopted because they are well established and ensure easier interoperability. They would make it easy for other PSPs to migrate their QR code standards to the one common QR code. Not much localization or customization is needed to the EMV standard QR code. EMVCo focuses on the data transmission. The format specified by EMVCo provides a way to encode QR code data that is flexible, to accommodate all needs, including the support of proprietary QR code. EMVCo's specifications are flexible enough to add as many data fields that a country may wish to add. The company also has a process in place to adapt specifications to specific needs, and it is open to discussions with stakeholders when needed. EMVCo will consider any changes to or customizations of specifications, to avoid a negative impact on interoperability and security. EMVCo's QR specifications also have scope to accommodate future requirements. The specifications are dynamic and can be updated based on market needs and feedback received.

## 8.1 CUSTOMIZATION OF EMVCO'S SPECIFICATIONS

Customization of EMVCo's QR code, in the MPM, includes customizations of the merchant ID, merchant category code, transaction currency, and language. Customization also refers to, and varies according to, each payment system supported. Details of select QR code payment platforms with customized specifications have been provided based on findings from stakeholder interviews.

For instance, custom-built specifications were preferred for Mexico's CoDi, to cater to customized needs. While the strengths of existing specifications, including those prescribed by EMVCo, were acknowledged, CoDi developed its specifications to account for enhanced security measures. Existing specifications were observed to be designed to cater to the needs of more developed countries with limited fraud. The main differences between CoDi specifications and EMVCo's specifications are the encryption capability and representation format (json). Complete data encryption is not supported by EMVCo. To avoid the alteration of data, including the account number and recipient's name, CoDi's QR codes are encrypted and generated only by previously validated users. Given that CoDi's QR codes are encrypted, the payee is required to send a request to the CoDi platform for validation in order to process the payment. As part of that process, the CoDi platform also validates that CoDi's QR codes correspond to the agent that requested the payment by validating the key on it. The transaction flow for a CoDi QR code payment is below.

Payee generates an encrypted CoDi QR code, which contains an RTP message, using an app previously registered and certified by Banco de México. Encryption involves the use of a key available only to the payee's RTP-generation app and CoDi's platform.

i. Payer scans a QR code using a financial app.

ii. The payer's financial app is incapable of decrypting the scanned QR, so the payer's financial app sends the encrypted QR code to CoDi's platform (web service).

iii. CoDi's platform decrypts the QR code and validates its content.

iv. If the validation is successful, the payer's financial app receives an encrypted message (only visible on the payer's financial app and CoDi's platform) including a key to decrypt the QR code generated previously by the payee. The key is valid for the decryption of only this particular QR code.

v. Payer's financial app displays the payment information generated in the payee's RTP.

vi. Payer validates and accepts the payment for the RTP; thus, the transfer order is generated.

vii. The transfer order is settled—through the Interbank Electronic Payment System (SPEI) or in the financial institution's core system if the payer and payee accounts are in the same financial institution—and the financial institutions for the payee and payer are notified.

viii. Payee's financial institution notifies CoDi's platform when the payee's account has been credited.

ix. CoDi's platform sends a push notification to the financial institution's apps (payee and payer).

The specific security aspects on which Banco de México focused included enhanced security to avoid the impersonation of an individual or business entity; enhanced security to avoid an information security breach through the encryption of RTP messages; the elimination of the possibility of a name change in an RTP message by carrying out onboarding through an electronic certification; and higher message sizes in ISO standards compared with proprietary standard. CoDi's specifications support both static and dynamic merchant-presented QR code. The development of consumer-presented QR code is in their future road map.

Although both Singapore and Thailand are using EMVCo's standards to define QR specifications, the countries have made several customizations based on local requirements. This limits interoperability between the two QR specifications.[29] As per the EMV QR code specification for MPM, merchant account information values 26 to 51 are reserved for any payment networks. On this basis, there are some customizations on Thailand's QR specifications. However, the allocation of these values is out of scope for EMVCo and must be agreed between the local payment systems that need such a value. Thus, payment systems using EMVCo specifications should locally align to ensure that there is no conflict with other payment systems using EMVCo specifications.

## 8.2 ALIPAY'S SPECIFICATIONS

In China, QR code payments are made through two of their most popular mobile-payment platforms: Tencent's WeChat Pay and Alibaba's payment arm, Alipay.[30]

Typical scenarios where an Alipay QR code is used have been included below.[31]

- **Online payment:** A user of KakaoPay (the biggest digital wallet in South Korea) makes a purchase on AliExpress or Bigo (an e-commerce website). The merchant displays the QR code for the user to scan with KakaoPay to complete

**BOX 2 ALIBABA'S ALIPAY QR CODE STANDARD**

Alibaba's Alipay QR code standard refers to a set of universally adopted barcode standards. Both a digital wallet and a merchant's acquirer can issue codes. Currently, the Alipay QR code standard has been widely applied in three-party and four-party schemes for online payment and cross-border in-store payment scenarios. Alipay's QR specifications support static and dynamic QR codes, as well as merchant- and consumer-presented QR codes. Different types of QR codes address different needs and provide the opportunity to innovate. For example, the consumer-presented QR code is used during transportation and to transact using digital wallets, while the merchant-presented QR code is usually displayed at merchant shops. Alipay's specifications are compatible with both 2D QR codes and 1D barcodes. Its specifications follow the minimum data concept to reduce the cost of upgrading and enhance flexibility, where the QR code holds minimum data and the remaining data is extracted and processed at the back end through a unique ID. For example, an identifier consisting of two parts—a code-issuer ID (that is, merchant, acquirer, and so forth) and tokenized user account information that enables the code issuer to identify the user account—is stored in the consumer-presented QR code, and the remaining data is processed at the back end. Similarly, data in the merchant-presented code is positioned as an identifier to access/direct to the merchant's online resources or services. Alipay's specifications are suitable for both domestic and cross-border scenarios. Alipay can customize its technical solutions to support other QR code standards for compatibility. For example, Alipay's QR code specifications are compatible with other specifications such as Singapore Quick Response Code, which is based on EMVCo's specifications.

the payment. AliExpress or Bigo as a merchant presents the QR code issued by their acquirers according to Alipay's QR code standard. After the user scans the code, KakaoPay gets order information upon decoding by the acquirer and guides the user through the remaining payment process.

- **In-store payment:** An Alipay China user makes purchases at merchants in Japan. The user displays the QR code or barcode in the wallet, and merchants of many different acquirers can scan the code to initiate the collection process. After the merchant scans the QR code, it then passes the code value to the corresponding code issuer through its acquirer. The code issuer verifies the code and deducts from the corresponding user account.

## 8.3 EMVCO AND ALIPAY—A QUICK COMPARISON

Alipay and EMVCo's QR specifications have certain differences. Alipay's standard is based on the Unified Modeling Language (UML) format, while EMVCo's format is the Interactive Data Language (IDL). For MPM, the payload data elements are similar for both specifications. The differences are mainly in the code design philosophy—that is, whether to put all the data elements or minimal data (just the address and identifier to access online resources) into the code and obtain the payload data elements from a trusted server. For the CPM, the payload data elements needed for Alipay's QR code and EMV's QR code specifications are the key difference. In terms of infrastructural differences between the two specifications, for MPM, the scanning capabilities of mobile devices are the same for both EMVCo's specifications and Alipay's specifications. For CPM, on the other hand, Alipay's code can be processed by 1D barcode scanners and 2D QR code scanners, whereas EMVCo's code can be processed only by 2D QR code scanners.

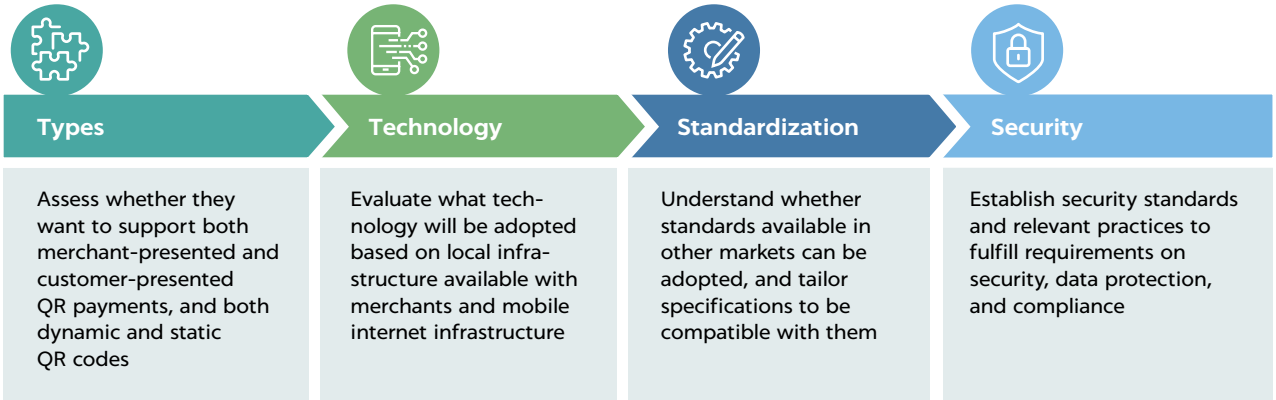
Industry collaborations help EMVCo accommodate all other specifications through constant feedback. As per EMVCo's knowledge, EMVCo's specifications are flexible enough to support all other formats. So far, EMVCo has not received feedback that its specification does not cater to a particular region's desired format.

EMVCo's format is flexible enough to accommodate Alipay's format (example in Singapore). The approach is different for CPM and MPM payments. These have been described in the appendix.

## 8.4 CONSIDERATIONS WHILE ARRIVING AT QR CODE SPECIFICATIONS

It is imperative to note that the QR code specifications are highly tailored to specific business requirements. On the one hand, this has allowed newer services to be offered through QR codes. On the other hand, it has

**FIGURE 6** **Factors for Arriving at QR Code Specifications**




created a proliferation of QR codes in the market, harming compatibility and customer experience. Hence, harmonizing QR specifications has become the need of the hour. Achieving harmonization through standardization will improve service levels and user experience, heighten security, lower cost, and provide interoperability between players in different markets, and it will encourage more and more smaller merchants to go digital. While deciding whether to support static or dynamic QR codes, factors such as the availability of the supporting infrastructure, the penetration of mobile devices and technology, and the penetration of smartphones need to be assessed. In developing countries, the static QR code has had a more prominent uptake due to lower associated infrastructural expenses and ease of use. Similarly, the merchant-presented QR code can be considered in jurisdictions with limited literacy levels and where the willingness to experiment is limited. Consumer-presented QR code can be introduced as a follow-on to merchant-presented QR code when the need arises, or in more digitally advanced markets with high smartphone penetration.

Additionally, before building a QR specification, it's important for the standard setter to define clearly its QR payment business models, including what the target market segments are and what the business requirements are, including application scenarios (for example, in-store and/or online to offline payment, transportation, promotion) and cross-border scenarios. Based on the targeted business model, corresponding standards and specifications should be built.

**TABLE 1 Detailed Considerations for QR Code Specifications**

| | STATIC | DYNAMIC |
|---|---|---|
| **MPM** | 1. Low implementation cost and convenient deployment<br>2. Save cashier's efforts<br>3. Applicable scenarios: Static codes are applicable to merchants who can use sticker materials. Merchants do not need to participate in the payment process but only need to receive payment notification and confirm the payment results, which makes it especially convenient for small and micro merchants to conduct in-store payment businesses at low cost. In some scenarios, static codes are also used as the entry point to a series of experiences, such as shopping cart, checking out, obtaining promotional benefits, and redeeming benefits. All these diversified application scenarios are supported by URL-based QR code. The URL-based code standard has unique advantages here, as it's widely supported by underlying internet applications. | 1. Higher requirement for point-of-interaction terminals<br>2. The merchant generates an order containing the payment amount. After scanning the code, the user needs only to confirm the order information without entering the payment amount. This makes the experience smoother and reduces the error rate.<br>3. Applicable scenarios: Dynamic codes are applicable to terminals with a display screen, and order codes better suit scenarios such as vending machines. |
| **CPM** | No application due to security concerns. | 1. Wallets need to have the ability to generate code in online and offline environments (with higher technical requirements).<br>2. The CPM barcode displayed by a user is a payment token generated with the user's authorization. The code is refreshed regularly, and each token can be used only once at most to improve payment security.<br>3. Merchants participate in transaction confirmation, which reduces the error rate.<br>4. Merchants must have a scanner, which can be any device with optical recognition capability, such as a smart point of sale, a "small white box," or even mobile phones or tablets in which a merchant code-scanning collection app has been installed. For 1D CPM barcodes, a traditional barcode scanner can be reused. Hence, for most supermarkets, no additional investment is needed.<br>5. The interaction is faster. It is suitable for small-amount and high-frequency traffic scenarios that are speed sensitive.<br>6. Applicable scenarios: Large and medium-sized merchants with code-scanning ability. |

*Source: Own elaboration*

# 9 APPROACH TO STANDARDIZATION

Standardization is necessary both at the country level and globally. One critical target of standardizing QR code specifications is enabling interoperability, so that merchants enjoy a unified solution to reach more consumers while consumers enjoy a unified payment experience at more merchants. To fulfill this requirement, it's necessary to build unified standards to identify payment code issuers, rules for routing transactions, and standardized information exchange and processing. Interoperability can also produce cost efficiencies and enable superior risk management. On a global level, countries have recognized the need to adopt standardized specifications. Standardization of a specific channel is delinked from the way different payment systems are connected; thus, the standardization of the QR code can be addressed independently. It is important for providers to work toward harmonization and build compatible platforms at this stage. QR code interoperability can be achieved by harmonizing QR code specifications, as is the case with different EMVCo-compliant QR codes, and through harmonization via API and/or back-end integration.[32] The harmonization of QR code specifications is at the front end, while API harmonization is at the back end. Interoperability can be achieved using either of these two mechanisms.

In the recent years, many countries have also realized the need to establish a standard QR specification for use across payment systems, owing to interoperability issues and the subsequent lowering of customer experience. The following approaches are being taken in this regard at different levels:

- In India, there are two QR specifications: Bharat QR and UPI QR. The two QR code specifications were launched at different times; hence, they coexist. Initiatives have been taken to make Bharat QR and UPI QR interoperable, so that customers can pay as per their will, regardless of the app they are using.[33] This has countered the inconvenience associated with multiple QR codes for different wallets, for the merchant as well as the customer. In October 2020, the Reserve Bank of India announced that payment system operators that use proprietary QR codes in India should shift to one or more interoperable QR codes by March 31, 2022, and that no new proprietary QR codes could be launched by any payment system operator for any payment transaction. This measure aims to reinforce the acceptance infrastructure, provide better user convenience due to interoperability, and enhance system efficiency.[34]
- In many countries, such as Malaysia, Thailand, and Singapore, regulators, central banks, or payment councils have taken a national approach to defining common QR specifications. Singapore recognized the need for standardization when consumers saw various e-payment solutions at merchant shops and had to check manually if their preferred method was accepted and merchants faced logistical constraints of supporting multiple QR codes. Thus, to promote interoperability, Singapore launched the Singapore Quick Response Code by setting up a task force comprising members from payment schemes, issuers, acquirers, banks, and government agencies to enforce standardization of e-payments in the country across providers. The code specifications are based on the specifications issued by EMVCo.[35]

- The regulator in Hong Kong SAR, China issued common QR specifications for retail payments for the MPM based on EMVCo's specifications to facilitate interoperability with the international standard. This standard was developed in consultation with industry players, but leeway is given to providers in terms of adoption, so that it can be driven by market needs and as per industry best practices and business considerations. The common QR code solution enables merchants,[36] especially small and medium-sized enterprises, to convert multiple merchant-presented QR codes that are in accordance with the standard into a single code for accepting different payment schemes, instead of displaying multiple QR codes to their customers, to enhance user experience and convenience. The common QR code enables each PSP to put its own relevant information in the combined QR code into a standard form. While this is the case, the common QR code itself would not enable payments across different payment schemes unless the concerned PSPs made both technical and commercial arrangements bilaterally or in a multilateral arrangement to enable interoperability. While merchants in Hong Kong SAR, China are not mandated to adopt the common QR code, to promote the wider use of mobile retail payments and bring greater convenience to customers and merchants, the Hong Kong Monetary Authority encourages relevant PSPs in Hong Kong SAR, China to adopt and support the standard. Any PSPs, including those that are not participating in FPS, merchant acquirers, or merchants may adopt the standard.
- Additionally, a common national QR code mobile application (Hong Kong Common QR Code), which is a technical solution, has also been launched in Hong Kong SAR, China. Various QR codes can be fed as input to generate a common QR code as an output for scanning by consumers, thus addressing the issue of multiple QRs without standardizing all the specifications, therefore encouraging compatibility. The application follows the rules and requirements as set out in the standard to combine the QR codes provided by participating PSPs as listed in the mobile application. So merchants may contact their PSPs and request QR codes that conform to the standard and use the mobile app to create a common QR code.
- In Thailand, Mastercard, UnionPay International, and Visa have introduced a Standardized QR Code for payments to support the Bank of Thailand's cashless agenda to drive innovation, interoperability, and security in payments. To pay, consumers holding a Mastercard, UnionPay, or Visa card simply use a mobile application that supports the Standardized QR Code to scan the merchant-presented QR code.[37] Based on these specifications, which were developed through industry collaboration, MyPromptQR was launched in September 2019.[38]
- In Australia, while the EMVCo-compliant QR codes of New Payments Platform Australia and BPay have penetrated the market to some extent, uptake of QR codes has not been as significant as in markets such as China and other Asian countries. Australia is experiencing a large uptake in tap-and-go payments due to the convenience associated with them. Consequently, the demand for QR hasn't been large.
- Mobile-money providers are also expanding the value of their specifications by expanding their footprint and collaborating with other providers. For example, Tencent has announced that it is sharing a common QR code system for mobile payments with China's state-owned UnionPay, under a new partnership. With the common QR code system, merchants could provide the same code for making payments to users of WeChat Pay and UnionPay's Quickpass.[39]
- To enable Chinese Alipay consumers to pay in different markets with their home wallet, Alipay has worked out multiple technical solutions to support the QR specifications of different countries with minimal impact on the customers' payment experience.
- Under MPM, Alipay started issuing the Singapore Quick Response Code according to the Alipay standard in 2018 and the standard for the Network for Electronic Transfers of Singapore (NETS) in 2019.
- Different CPM QR/barcode specifications can cause compatibility issues for consumers when paying, which means they have to switch to different codes in different countries. To address this, Alipay has designed a CPM QR/barcode standard to support both local and international scenarios, so that consumers can use one CPM code at more merchants in different markets.

While the standardization wave is making its way across the globe, the challenge for achieving standardization is that the payments ecosystem is very large, and it is critical to onboard all operators, switching companies, and regulators to achieve complete standardization. Isolated solutions will eventually limit adoption and functionality. A collaborative approach across governments and ecosystem players would benefit the community at large. To achieve that, various factors must be taken into account to incorporate the requirements of such players as card schemes, mobile-money players, and others while arriving at the common specification. The following aspects will have to be considered:

- All underlying payment instruments, such as cards, mobile money, and e-wallets, need to be included. For example, since the data requirements for card and mobile payments differ, achieving interoperability between specifications will be a challenge because of redundant data fields and different ID numbers, which increase the overhead. Hence, minimum common data requirements may be needed, as well as flexibility to incorporate any additional requirements over and above these common specifications.
- A simplification of the format and data interaction between the merchant and customer, and the right balance of data to be handled at the interface and back end, would need to be arrived at considering requirements of all ecosystem participants.
- Consensus would be required on security aspects and their incorporation.
- Different messaging standards follow different methodologies for defining merchant codes, acquirer codes, and so on. Scheme owners further define the acquirer ID and issuer ID. However, common identification codes and formats would be needed to achieve complete standardization.
- The different types and uses cases would also need to be taken into account to arrive at the common specifications.

Regulatory aspects and the markets' commercial/business requirements would also have to be considered. For emerging markets that would like to enable digital payments and quickly improve financial inclusion across the market, MPM static QR code payment will be a reasonable starting point, but a signed QR code is recommended to address security risks. For larger merchants with better integration capability to generate dynamic codes or with the equipment to scan CPM codes, MPM dynamic code and CPM dynamic code specifications will be more suitable.

For each business scenario, there are different aspects to focus on, including the QR code format standard, usage rules, presentation standards, and relevant security standards. A CPM QR code payment would require certain equipment standards. And to minimize merchant implementation costs, Alipay adopts the 1D barcode format for CPM code, so that merchants can reuse existing barcode scanners and start accepting mobile payments easily. In addition, since URL-based QR code is being used for many other payment-related scenarios, such as red packet code (scanning code to obtain promotional benefits before payments) and O2O code (scanning code to access offline services and make payments online), different formats might be considered under different business scenarios.

From both a regulatory and customer-service point of view, a security standard is also especially important for QR code payments.

# 10 CROSS-BORDER PAYMENTS VIA QR CODES

Cross-border payment interoperability has increasingly been making headway. Such payments require additional considerations in terms of supporting payment systems to enable cross-border connectivity, the methodology for identifying common-code issuers, and so forth across the markets. The following are examples of cross-border initiatives that are underway:

- Thailand is aiming at cross-border QR payments with Singapore and Cambodia.[40]
- Malaysia's OCBC Bank has introduced OCBC OneCollect, Malaysia's first merchant cross-border QR code-collection service, which enables those who use the mobile app of banks participating in Singapore's PayNow ecosystem to make QR payments to OCBC merchants in Malaysia from their Singaporean bank accounts.[41]
- A pilot demo of BHIM UPI QR-based payments was held in Singapore in November 2019. The project is being developed jointly by the National Payments Corporation of India and NETS. This QR code-based system would allow anyone with a BHIM app to scan the Singapore Quick Response Code at NETS terminals for payments in Singapore.[42] Since the pilot, the system has gone live in both Singapore and Bhutan.
- Eleven mobile-payment providers have come together through an association, the European Mobile Payment Systems Association, to unify the payment landscape across Europe by establishing and implementing a cross-platform framework that connects all association members and allows for payment processing for customers. The initiative aims to allow users of the participating digital wallets to make QR code-based payments with their home apps to local merchants in all participating countries.[43] The European Mobile Payment Systems Association covers Belgium (Bancontact Payconiq), Germany and Austria (Bluecode), Denmark and Finland (MobilePay), Portugal (SIBS/MB WAY), Slovenia (Bankart), Sweden (Swish), Switzerland (TWINT), Norway (VIPPS), Italy (BANCOMAT and Plick), and Poland (BLIK).[44] Alipay has partnered with mobile-wallet players Bluecode, ePassi, momo pocket, Pagaqui, Pivo, and Vipps in Europe to adopt a unified QR code that will enable payment interoperability for travelers in Europe and China.[45] The detailed process describing how the unified QR code is being created and how the different underlying national schemes are identified in the QR code format has been presented in the appendix.

# 11 CONCLUSION

After the successful application in China, more and more PSPs and FPS around the world have launched their code-scanning payment solutions. This further promotes the use of code-scanning payments in different markets. FPS are typically the leading initiative to promote payment innovations such as code-scanning payments, giving more traction to QR code usage. To encourage the adoption of QR codes, banks can offer value-added services, and all relevant stakeholders can carry out media campaigns to improve awareness. Additionally, regulatory pushes can also drive adoption. While FPS offer QR code payments, the proliferation of QR codes poses challenges in terms of interoperability because each market player has its own specifications and customizations. A unified standard will help lower the implementation cost and improve each project's future reusability and interoperability. Many countries have adopted EMVCo's QR standards, while others have chosen to develop standards best suited to the needs of their own country. Countries have recognized the need to expand their offerings to other countries to facilitate the acceptance of QR code payments in markets abroad. On the one hand, interoperability between different providers in the same country is required, while interoperability to promote seamless cross-border transactions and make payments globally is also necessary. Thus, a focused approach is required, not only before launching QR codes as a channel in FPS but also before selecting specifications that ensure interoperability with existing modes and meet market-specific requirements. At a larger level across the world, while the need for standardization has been established, it remains a goal that global players continue to work toward.

# 12 ACKNOWLEDGMENTS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|---|---|
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# 13 APPENDIX

## 1. ACCOMMODATION OF ALIPAY QR CODE WITHIN EMV QR CODE

### a. Consumer-Presented Mode

To make a CPM payment, the merchant scans a code presented by a consumer with a scanner and initiates a payment request from the merchant side. Both EMVCo and Alipay have corresponding code standards. While EMVCo supports only 2D QR code, Alipay supports both 1D barcodes and 2D QR codes.

**TABLE 2** **Payload Format for an EMVCo Code**[46]

| TAG | VALUE | | | LENGTH | FORMAT | PRESENCE |
|---|---|---|---|---|---|---|
| '85' | Payload Format Indicator | | | 5 | an | M |
| '61' | Application Template | | | var. | b | O |
| | 'xxxx' | Additional BER-TLV coded data objects | | var. | b | O |
| | '63' | Application Specific Transparent Template | | var. | b | O |
| | | 'xxxx' | Additional BER-TLV coded data objects | var. | b | O |
| '61' | Application Template | | | var. | b | O |
| | 'xxxx' | Additional BER-TLV coded data objects | | var. | b | O |
| | '63' | Application Specific Transparent Template | | var. | b | O |
| | | 'xxxx' | Additional BER-TLV coded data objects | var. | b | O |
| '62' | Common Data Template | | | var. | b | O |
| | 'xxxx' | Additional BER-TLV coded data objects | | var. | b | O |
| | '64' | Common Data Transparent Template | | var. | b | O |
| | | 'xxxx' | Additional BER-TLV coded data objects | var. | b | O |
| 'xx' | Other template | | | var. | b | O |
| | 'yy' | Another template or primitive data object | | var. | b | O |

The Payload Format Indicator (tag '85') defines the QR Code format version and is the first data project of the payload. In this version of the specification, the Payload Format Indicator has the value of "CPV01".

As shown in table 2, the EMVCo CPM QR code standard caters to bankcard-based transactions and contains data elements of the EMVCo integrated-circuit card standard.

The Alipay CPM QR/barcode standard includes both 1D and 2D barcodes, and the code information is minimal to ensure recognition and processing efficiency. Since most of the EMV card data elements used in the EMVCo QR code standard are not necessary for digital wallets, Alipay doesn't implement a compatibility solution in practice.

### b. Merchant-Presented Mode

Under MPM, a consumer scans a merchant's QR code with a digital wallet application in a mobile phone to initiate payment to the merchant. Both EMVCo and Alipay have MPM QR code standards, and the design rationale behind each is similar. An MPM QR code contains information that the consumer's digital wallet can recognize to process payment transactions accordingly—normally, the merchant information or an order information. When the digital wallet application scans the code, it should be able to obtain useful data elements from the QR code payload information. Therefore, when a merchant generates its own QR code, it can put Alipay QR code payload information into an EMVCo QR code, and vice versa. For example, putting Alipay QR code payload information into EMVCo MPM QR code fields 26 to 51 is shown in table 3.[47]

**TABLE 3** **Data Object ID Allocation in Merchant Account Information Template (IDs 26 to 51)**

| ID | MEANING | FORMAT | LENGTH | PRESENCE | COMMENT |
|---|---|---|---|---|---|
| "00" | Globally Unique Identifier | ans | var. up to "32" | M | An identifier that sets the context of the data that follows. The value is one of the following:<br>• an Application Identifier (AID);<br>• a [UUID] without the hyphen (-) separators;<br>• a reverse domain name |
| "00"–"99" | Payment network specific | S | | O | Association of data objects to IDs and type of data object is specific to the Globally Unique Identifier |

**TABLE 4** **EMVCo QR Code Payload Incorporated into Alipay QR Code**

| DATA OBJECT ID | | LENGTH | FORMAT | MEANING | PRESENCE |
|---|---|---|---|---|---|
| AMAD | | Var. | | Additional Merchant Account Data | |
| | 01–99 | Var., up to 99 | S | Other representation of the merchange account information which can be used by the partner of code issuers<br>The value of each subdata object complies with the template defined in Table 2.1.7. | At least one subdata object shall be present if this data object exists |

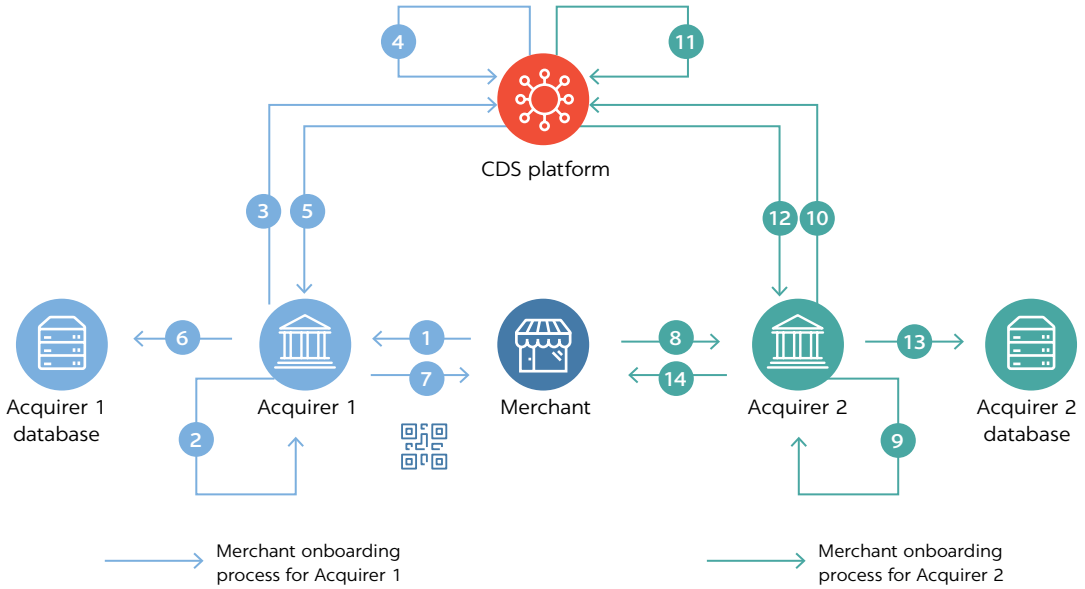
The data object AMAD indicates other identification information of the merchant which can e used by the partners of code issuers to identify the merchant directly. The value of each subdata object represents a partner repressentation of the merchant, and the format of each representation is defined by the code issuer or the partner for private use.

## 2. CREATION OF UNIFIED QR CODES BY ALIPAY

Each party issues its own codes in accordance with the unified code-scanning payment standards. The design of the code format as a part of the code standards can reflect information such as the issuer and applicable scenarios of the code. The codes issued by each wallet can be scanned and recognized by each other.

National schemes can also adopt the same standards to issue codes. Through code-issuer IDs, decoding parties can recognize which national scheme has issued the codes. Specifically, national schemes can indicate the code directory service (CDS) and code issuer in the code value as per the standard format of MPM code. When an acquirer issues the code to the merchant, the acquirer can also register the merchant on a CDS platform. After users scan the QR code with their wallets, the wallets can access CDS to obtain the merchant information and guide the users to complete the payment.

**FIGURE 7** **Code-Issuing Process**




**Merchant onboarding process for acquirer 1**

1. A merchant accepts a payment and provides its merchant information to acquirer 1 for verification.
2. Acquirer 1 verifies the data and confirms whether the merchant meets the eligibility requirements.
3. Acquirer 1 registers the merchant on a CDS platform.
4. The CDS platform assigns a merchant index number to the merchant and binds the acquiring information of acquirer 1 with this merchant index number.
5. The CDS platform returns the merchant CDS index number to acquirer 1.
6. Acquirer 1 assigns its own merchant identifier in its system to the merchant and binds the merchant information and merchant CDS index number with the merchant identifier.
7. Acquirer 1 puts the CDS platform identifier and the merchant CDS index number into CDS data in a general payload where some of the code-issuer reference data may also be included. Then acquirer 1 generates a store code and sends the store code to the merchant.

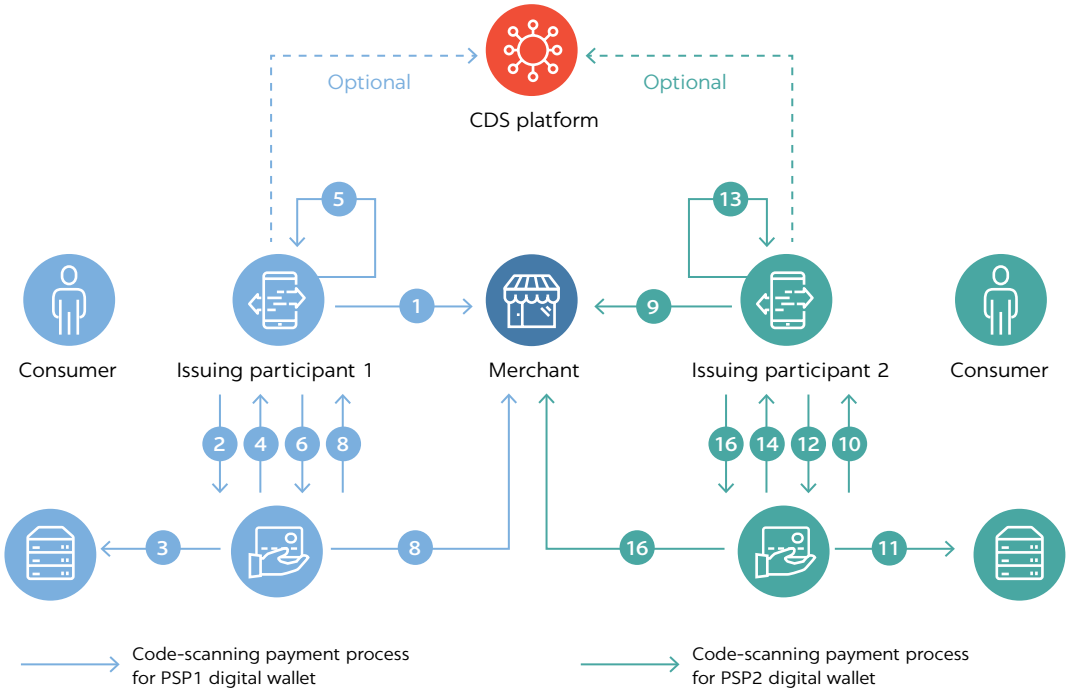
The store code can now be used by consumers using e-wallet apps to scan and pay.

**Same merchant onboarding process for acquirer 2**

1. The merchant accepts a payment and provides its merchant information to acquirer 2 for verification. Acquirer 2 identifies that the merchant has been registered on the CDS platform, and it can scan the store code to get the merchant CDS index number.
2. Acquirer 2 verifies the data and confirms whether the merchant meets the eligibility requirements.
3. Acquirer 2 uses the merchant CDS index number to request the binding of its acquiring information with the merchant on the CDS platform.
4. The CDS platform binds the acquiring information of acquirer 2 for the merchant with the merchant CDS index number.
5. The CDS platform returns the binding result to acquirer 2.
6. Acquirer 2 assigns its own merchant identifier in its system to the merchant and binds the merchant information and merchant CDS index number with the merchant identifier.
7. Acquirer 2 notifies the merchant that e-wallet apps that act as acquirer 2 partners can consume the same store code.

The same process applies for other acquirers who bind their acquiring information of the merchant on the CDS platform. The same store code is shared among acquirers on the CDS platform for consumers to scan and pay.

**FIGURE 8** **Payment Process Flow**




1. A consumer opens an e-wallet app 1 and scans a store code presented by a merchant.
2. The digital wallet app parses the code and sends the code data to its back-end server for processing.
3. The digital wallet server 1 processes the code data and extracts reference data from the code. If reference data does not exist, the server extracts the CDS data, and maps the data (the CDS platform identifier and the merchant CDS index number) with merchant information in the system.
4. The digital wallet server 1 finds the merchant information is bound with the merchant CDS index number in its system and returns the merchant information to the app.
5. The app renders the merchant information page and displays the page to the consumer for confirmation.
6. The consumer confirms the merchant information, enters the transaction value, and initiates a payment request.
7. The digital wallet server 1 processes the payment requests and decides whether to authorize the payment.
8. The PSP server 1 sends the payment result to the consumer and the merchant.

Note: In the processing between step 3 and 4, a digital wallet may use the merchant index number to obtain all the acquiring information of the merchant from the CDS platform and then choose the acquiring information of an acquirer.

Similar steps apply for the process of e-wallet app provided by digital wallet 2.

## NOTES

1. According to the Committee on Payments and Market Infrastructures, a fast payment can be defined as a payment in which the "transmission of the payment message and the availability of 'final' funds to the payee occur in real time or near-real time on as near to a 24-hour and seven-day (24/7) basis as possible."
2. QR Code is a registered trademark of Denso Wave.
3. Reserve Bank of India, *Report of the Committee on the Analysis of QR (Quick Response) Code* (RBI, July 2020), https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=1142.
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8. https://gadgets.ndtv.com/apps/news/whatsapp-how-to-send-transfer-money-scan-qr-code-payments-1828715
9. This is not an exhaustive list.
10. Reserve Bank of India, *Report of the Committee on the Analysis of QR (Quick Response) Code* (RBI, July 2020), https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=1142.
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12. A separate note in the Fast Payments Toolkit focuses on customer authentication.
13. Reserve Bank of India, *Report of the Committee on the Analysis of QR (Quick Response) Code* (RBI, July 2020), https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=1142.
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16. EMV® is a registered trademark in the United States and other countries and an unregistered trademark elsewhere. The EMV trademark is owned by EMVCo, LLC.
17. WG19 is working toward delivery of a draft international standard in the summer 2022.
18. GMSA, *QR Code Merchant Payments: A Growth Opportunity for Mobile Money Providers.*
19. BHIM is an aggregator for all UPI-based services offered by banks; UPI is India's FPS.
20. One-dimensional (1D) barcodes are linear barcodes. They consist of vertical lines of varying widths with specific gaps resulting in a particular pattern. 1D barcodes usually encode a string of numerals, such as product numbers, production dates, types, sizes, and so on. The QR code stores larger amounts of data, enabling more flexible usage.
21. Source: Ant Group.
22. https://www.emvco.com/emv-technologies/qrcodes/
23. https://www.emvco.com/emv-technologies/qrcodes/ and https://www.emvco.com/terms-of-use/?u=/wp-content/uploads/documents/EMVCo-Merchant-Presented-QR-Specification-v1.1.pdf
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25. Base 64 encoding is a way of encoding arbitrary binary data in ASCII text. In base 64 encoding, each six bits of the input is essentially encoded in a 64-character alphabet.
26. For more details, please see EMVCo, *EMV® QR Code Specification for Payment Systems* (EMV QRCPS): Consumer-Presented Mode (EMVCo, November 2020), https://www.emvco.com/terms-of-use/?u=/wp-content/uploads/documents/EMVCo-Consumer-Presented-QR-Specification-v1.1.pdf.
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