



How QR Codes Address 'the Last Mile' Adoption of Faster Payments at the Point-of-Sale

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1 Introduction

In its first white paper¹ the Faster Payments Council (FPC) QR Code Interface Work Group (QRCIWG) chronicled the development and attributes of QR codes in facilitating faster payments, addressing how this technology could provide the basis for new advances in payment transacting. The QRCIWG depicted the core nuance of QR codes as payment initiation by the merchant at the point-of-sale (POS) or by the consumer via their mobile phones.² It is widely recognized that QR codes offer the potential to bring faster payments to anyone in the United States within the 'last mile' of POS adoption by leveraging their flexibility, simplicity, and ease of use. But how does one know when, or if, that will happen?

Delving further into the details:

- Like other FPC work groups, the QRCIWG found ample evidence that QR code adoption helped to accelerate faster payment acceptance in the global market. Driving factors included coalescence driven by a monetary authority, participation of and interoperability for both banks and non-banks, ability to circumvent complex infrastructures with uniform standards, and low transaction costs. Were these simply characteristics of the adoption, or did they enable those markets to overcome impediments that otherwise would have hamstrung adoption?
- Most importantly, if these same driving factors do not exist today in the U.S. market, is it reasonable to presume that the United States can achieve comprehensive adoption of faster payments? This question arises, given large differences between the United States and other countries in their approach to faster payments, as well as known impediments including a large, established, complex and expensive POS infrastructure that historically has been unreceptive to digital payment innovations.
- And if so, what changes would the United States need to implement? Would this involve convergence to a single standard format for QR code, open POS access by acquirers, or both? How would interoperability be established among more bank and non-bank instant payment networks? And how would those changes come about?
- Once the necessary changes have been agreed upon, and the driving factors for faster payments adoption in the United States have been identified, what is the role the FPC work groups play to champion those changes?

This report presents the QRCIWG's collective knowledge, drawn from both research and expert insights. It sets the stage for the reports that follow with an initial discussion about the QRCIWG's five proposed market-driving factors for faster payments QR code implementations.

1.1 Approach

The QRCIWG reviewed international and U.S. payment solutions using QR codes. The research explored how payment QR codes are used in international and U.S. solutions to understand key characteristics of their deployment with faster payments. The following key market drivers for implementation were identified:

- Oversight: Coalescence within a market by a monetary or regulatory authority that promotes usability and participation across the payment's ecosystem.
- Payment Schemes Supported: Participation of and interoperability among both banks and non-banks, across payment types that address a country's needs and preferences.
- Functionality: Common QR code formats and presentment modes for simplified integration with POS infrastructures, for support of multiple, common use cases, and for integration across faster payment systems.
- Usability: Physical, digital, and cultural preferences should be observed for effectiveness, efficiency, and satisfaction in the use of QR codes. Examples include physical design, technical specifications, scanning process, authenticity mechanisms, marketing links, information embedded that may have impact in security, compatibility, accessibility, and inclusivity.
- Security: Ensuring safety in the use of account credentials, transaction, and marketing data is important, as it enhances user experience with digital payments compared to physical payment alternatives.

The QRCIWG's international research focused on reviewing a diverse set of solutions supporting various types of payment networks including Citcon (Alipay, WeChat Pay) from China, PayNow from Singapore, Pix from Brazil, PromptPay from Thailand, New Payments Platform (NPP) from Australia, and Hong Kong Common QR Code (HKQR) from Hong Kong. In the United States, PayPal®, Cash App, Venmo, Walmart Pay, and Zelle® were reviewed. From these global QR code implementations, commonalities and de facto standards were identified and informed by diverse stakeholder perspectives, along with exploring an initial set of best practices in the development and use of secure QR Codes originated in the United States.

The QRCIWG also explored whether the market drivers were the most salient for driving increased usage of faster payments via QR codes. To complement the internal research, a canvassing for secondary sources included the detailed report by the Global System for Mobile Communications Association (GSMA)³ that specifically addressed this question. With validation of the QRCIWG's opinions, the focus shifted to the implications for the United States and its POS infrastructure. This included considering whether other factors, such as the legacy payment system's preference to leave it 'to the marketplace,' may inhibit or necessitate action. To gain more insight, the QRCIWG sought broader input and expertise from both inside and outside the FPC for what could be supported in the adoption of enabling technology.

The following summary is the QRCIWG's initial discussions on the five proposed market-driving factors for faster payments QR codes implementation, along with some key questions and considerations.

2.1 Oversight

QR code payment adoption varies widely, in part, due to varying degrees of oversight. Oversight encompasses elements such as the establishment and enforcement of technical specifications. The specifications detail the technical requirements for the data fields and API (application programming interface) calls that market participants must use when generating or processing QR code payments. Oversight may involve a central authority (e.g., government agency or monetary authority) that mandates and enforces common specifications, or an ecosystem (e.g., consortium of banks or payment systems) that self-regulates.

The countries with the fastest adoption of QR code payments have a single specification format convention. The EMVCo (Europay, MasterCard®, and Visa®) EMV®4 specification is used in many countries for card payments, but each country has specific adaptations. Countries that support proprietary or non-standard QR codes face a more difficult task in achieving the same adoption rates, owing to the complexities of interoperability such as:

- The Brazilian QR Code specification is based on the EMV specification. It was created just before the launch of Pix in March 2020 and is mandatory for all payment arrangements within the Brazilian Payment System. As part of this instant payments scheme, Brazil created and mandated a QR code based on EMV specifications which immediately allowed for interoperability between different participants. For instance, a customer from Itaú, the largest private bank in Brazil, can process payments using QR codes generated by Bradesco, the country's second largest private bank. This interoperability is possible because all participants use uniform data fields and processes when creating, scanning, and paying with QR codes.
- Similarly, Singapore (PayNow), Thailand (PromptPay), Australia (NPP QR) and Hong Kong (HKQR) all have a QR code based on EMV specifications for card payments, but support bank account transfers to foster greater consumer inclusion and support acceptance by merchants that otherwise do not take cards for payments. Given heavy cross-border travel and commerce in Asian countries, using a common format for card payments supports the rapid interoperability being achieved among countries, while locally or nationally important payment alternatives can still be accommodated.
- In Japan, five faster payment companies - Alibaba, WeChatPay, Mercari, LINE, and NTT Docomo - agreed on a QR code specification for payments. This helped accelerate widespread adoption of the use of all these services in these countries where the use of QR codes is a leading means of payment initiation.

Many faster payments systems have implemented proprietary QR codes designed exclusively for use in their individual payment services. This trend raises a potentially important issue in the United States. In countries where a single QR code specification was adopted through agreement or government mandate, broader adoption has been achieved. Navigating among different faster payments services without a common specification can be perplexing for users who want to discover and use the capabilities. In contrast, markets with a common specification can provide the ability for the consumer to initiate payments from their mobile phones independent of any merchant infrastructure (which has been a key enabler to market adoption in China and India). Such differences are noted by the GSMA study⁵ and highlighted in the following table.

Proprietary QR Codes

QR Code Standard

Example Schemes	MPM	CPM
Alipay	Supported	Supported
WeChat Pay	Supported	Supported
MTN	Supported	Not Supported
M-Pesa	Supported	Not Supported
Kakao Pay	Supported	Supported

Example Schemes	MPM	CPM
HKQR (Hong Kong) - EMV	Supported	Supported
SGQR (Singapore) - EMV	Supported	Not Supported
JPQR (Japan) - EMV	Supported	Supported
Pix (Brazil) - EMV	Supported	2024 Roadmap
QRIS (Indonesia) - not EMV	Supported	Supported

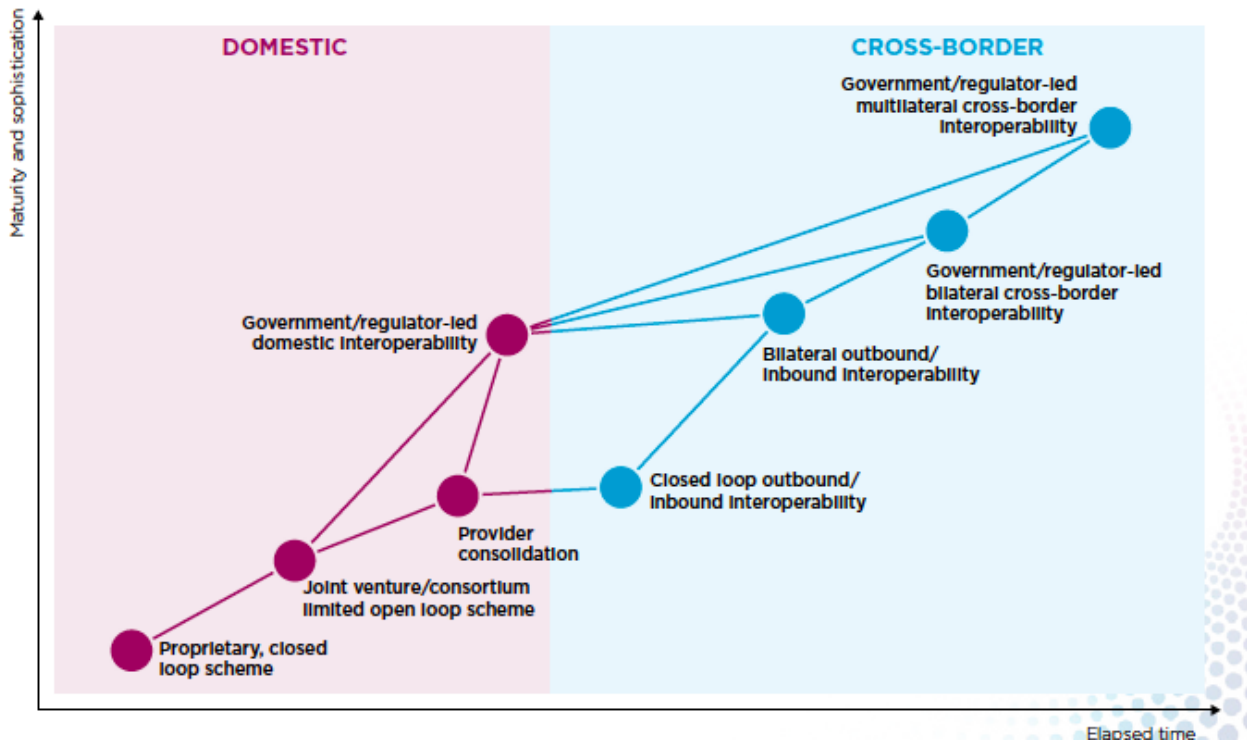
*MPM = merchant presented mode, CPM = consumer presented mode

In countries with a primary or single open-loop interoperable payment ecosystem, the use of a single QR code specification was much easier and enabled interoperability across all the participants, namely non-banks as well as banks. In the open-loop ecosystems that use a single QR code specification it enables payees and payers with accounts at different payment services in that country to transact with each other. Interoperability among frequently visited countries is also viewed as very important. A common QR code specification can be used to support interoperability with other systems and countries. Faster payment systems of Singapore, Thailand, India, and Indonesia are specific examples of bilateral interlinking arrangements that are part of a broader regional economic integration strategy.

Without a common specification, a merchant or biller whose payment service generates a QR code for payment transactions can only be paid by consumers who also use the same payment service that generated the QR code. This closed-loop scenario limits the adoption of QR codes and the associated payment type. Open-loop ecosystems, as well as closed-loop platforms that agree to use a common QR code specification, facilitate innovation and organic market adoption.

A single, common QR code specification also increases the likelihood of interoperability with other systems and countries. As mentioned earlier, Singapore’s PayNow is interoperable with Thailand, India, and Indonesia. The GSMA report portrays a continuum of the progression from closed-to-open-loop configurations (below) that demonstrates the key to cross-border interoperability is a single, common specification.

The interoperability journey



Insights

Observations	Ramifications	Questions for U.S. Market
<p>A single QR code format and operational standard with strong oversight is essential for interoperability and consumer confidence.</p>	<p>Harmonization of QR code format and operational requirements would encourage the POS infrastructure to coalesce around compatible configurations (e.g., scanners, Wi-Fi, merchant reconciliation, etc.) by minimizing the burden for users sorting out which system they have and can use.</p>	<p>The United States appears to favor a variety of payment network and account funding options, with varying transaction formats and processing regimens. Can the POS accommodate a family of QR codes at POS that work interchangeably to sufficiently support a consistent consumer (and merchant) experience without excessive training requirements, delays in checkout lines, and confusion over transaction exigencies, rights, and protections?</p>

Observations	Ramifications	Questions for U.S. Market
QR code payment acceptance may remove barrier to entry for some types of merchants.	The relative ease for merchants to deploy a single transactional environment with minimal training and customer education requirements appears to promote rapid adoption, including smaller and rural merchants who currently depend on non-electronic forms of payment.	How might the U.S. market adopt QR code in small business, gig economy, or niche vertical integrations first, before mainstream adoption by the larger retail segment? Initial QR code-accepting payment venues such as restaurants/bars and quick service restaurants (QSRs) appear viable, but what issues arise for acceptance in other retail verticals?
A common specification is best achieved by strong, centralized oversight. Typically, in many high-adoption countries, this is done by the Central Bank, a Monetary Authority, or some other regulatory body.	The convenience of a harmonized set of operations and deployment configurations creates a gratified experience for consumers and therefore promotes trial and usage.	With many different providers and the lack of central authority mandates, how might the U.S. market provide strong, centralized oversight?

2.2 Payment Schemes Supported

Another factor driving market adoption is the degree to which a QR code supports participation and interoperability for both banks and non-banks across payment types and addresses a country's needs and preferences.

Most proprietary QR codes are specific to the payment network for which they were created. This requires the scanning device or app to support scanning QR codes from multiple payment schemes unless the device has separate apps specific to using each of the proprietary QR code payment schemes. This may be simple for the payment network but can become a friction point for some end users that may have to use multiple apps.

If the QR code is scanned by a smart phone using the generic camera app and a URL link to a specific online app or API which then uses payment scheme information captured within the URL, then this can effectively support multiple payment schemes from the same device. However, this presents a potential issue of the URL directing the user to a nefarious website. The more secure preference is the QR code scanned through the payment service provider's specific app, which cannot be redirected but must conform to the payment scheme specific formats of the QR codes it can scan.

It is common internationally to have a QR code format that supports multiple payment schemes and methods that the payee accepts in their market. The ideal standard would be one that can be scanned from any device payment service app that supports one or more of the payment schemes presented and accepted, which it then filters down to those that the payer can choose from or would have pre-selected based on preferences setup through the app and its payment service.

The observations from the QR code international research found that all but one of the countries supported multiple payment schemes through a single QR code standard, most of which were based on the EMV QR Code Specification. All the international countries researched have a single standard QR Code implementation that can be read by more than one service provider's app.

The United States has multiple implementations that can only scan QR codes for participants in their closed-loop platforms. Open-loop ecosystems facilitate interbank and corresponding payment services that interoperate through these rails. These rails and services would likely all use the same QR code standard format such that the end user's use of QR codes is interoperable as are the payment transactions through the rails. Closed-loop network rails may or may not be using a standard QR code format in their market as they primarily only process payments within their closed-loop networks. However, these closed-loop rails also offer on and off ramp transfers with other open and closed-loop rail service providers, so the use of an interoperable QR code standard is still advisable for these closed-loop rail services to implement.

The following table from Deloitte⁶ compares several criteria for six faster payment systems operational in the United States. While these systems have much in common, there are some key differences that would make interoperability challenging.* This illustrates the complexity and need to have the various and diverse U.S. faster payment systems to agree on a common QR code standard or at least to participate in a multi-payment QR code scheme for use in the last mile of QR code adoption.


	TCH RTP [®]	Visa Direct	Mastercard Send	Venmo	Zelle [®]	FedNow SM
Funds posting	Real-time	Real-time	Real-time	Real-time	Real-time	Real-time
Settlement timing	Immediate	Same or next business day	Same or next business day	30 minutes	End of current or next business day; based on ACH schedule	Immediate
Launch state	Active	Active	Active	Active	Active	Active 2023
Clearing mechanism	RTP [®]	Card network	Debit card network	RTP [®]	ACH network, debit card network	Enhanced FedLine network
Availability	24*7*365	24*7*365	24*7*365	24*7*365	24*7*365	24*7*365
Refutability	No	Yes Chargebacks permitted	Yes Chargebacks permitted	No	No	Unknown
Payment type	Push	Push	Push	Push	Push	Push
Transaction limits	\$100,000	P2P: \$10,000 Disbursements: \$50,000	P2P: \$10,000 A2A: \$25,000 B2C: \$50,000	P2P: \$3,000/txn \$20,000/week	Depends on PSPs	\$25,000
Accessibility	Individual or business with a bank account	Individual or business with a Visa-branded card	Individual or business with a Mastercard-branded card	Individual or business with a bank account or Visa/Mastercard debit-cards	Individual or business with a bank account	Individual or business with a bank account
Messaging standards	ISO 20022	ISO 8583	ISO 8583	ISO 20022	Proprietary, NACHA, debit card	ISO 20022
Cross-border transactions	No	Yes	Yes	No	No	No
Primary governance	RTP operating rules, RTP participation rules	Card agreements, service level agreements	Card agreements, service level agreements	Card agreements, service level agreements	Zelle [®] operating rules	Unknown
Use cases	G2C, B2B, B2C, P2P, C2M, M2C	G2C, B2C, P2P, C2M, M2C	G2C, B2C, P2P, C2M, M2C	P2P, C2M	B2C, P2P, C2M	G2C, B2C, P2P, C2M, M2C

* Note that some key comparisons have changed since this table was published in 2020, e.g., FedNow today is a "No" on 'Refutability' and its transaction limit is \$500K. The clearing mechanism for Visa Direct is a 'debit card network'. Entries can and will change as systems dynamically evolve.

Most of the international use of QR codes were in conjunction with the open-loop faster payment rails in that country. By contrast, all the United States QR code implementations (e.g., PayPal, Cash App, Walmart Pay) studied in the QRCIWG’s initial research were closed-loop, rail-specific QR codes that also supported use of the open-loop debit/credit card, ACH and/or RTP rail on and off ramp interfaces.


Much of the impetus behind QR code payments outside of the U.K., Europe, and the United States (where credit and debit card account usage are much higher than the rest of the world) has been with integration of digital/mobile wallets, which support the use of bank accounts for instant payments on multiple payment schemes.


The following extract from the GSMA report⁷ below depicts the widespread adoption of digital wallets and associated QR code applications that accommodate payments from credit and debit card account networks, bank accounts, and merchant and stored value accounts.





Originally a tool for tracking automobile machine parts, the rise of QR codes in payments was enabled by the widespread adoption of digital wallets


Types of QR codes


Model 2



Micro QR


IQR code


SQRC


FrameQR

Invented by Denso Wave in Japan in 1994, the use of Quick Response (QR) code has grown in popularity from its origins in the automotive manufacturing industry through to today’s merchant payments ecosystems.



Origins and history of QR codes

A QR code is similar to a bar code except it can store a larger amount of information per unit area. It is a two-dimensional code that is capable of 360-degree (omni-directional) high-speed reading.


Initially used in the automotive industry for production, tracking and shipping, QR codes expanded beyond the automotive industry into identification and marketing use cases and finally payments.


China has played a crucial role in the rapid growth of QR code mobile payment services, enabling businesses to accept digital payments without investing in any hardware, such as point of sale (POS) terminals.


The evolution of QR code payments


One of the core enablers of QR code payments has been the mobile wallet. Principally, mobile wallets can operate as:


- **A link to a primary value store**, such as a customer card/bank account. Transactions debit the value from the primary account via the wallet. No preloading of the wallet is required.
- **A virtual store of value**, such as digital/virtual/mobile money that is preloaded into the wallet. Transactions debit the value from the wallet balance.




















Note: some wallets offer both models

As such, fast-adopting countries currently enable multiple payment schemes and options in the quest to offer ubiquitous use, as seen in merchant acceptance displays below from Japan, Singapore, and the Philippines.



Insights

Observations	Ramifications	Questions for U.S. Market
<p>More choice and flexibility for users (both consumers and merchants) translates to greater usage.</p>	<p>Open-loop options expand accessibility for cards and bank accounts. Options for closed-loop multi-payment schemes offer accessibility to any number of networks and third-party providers, including authorization and processing in the cloud independent of the merchants' POS system capabilities.</p>	<p>Would the relative dominance of open-loop payments, especially cards, preclude merchant implementation of QR codes for closed-loop alternatives? Would the payments ecosystem support or otherwise counter the effort?</p>
<p>Merchant acceptance is fostered by the ability for consumers to initiate payments at POS from their mobile phones, while merchants can easily implement QR code scanning for all payment types without disrupting the existing POS processing paradigm.</p>	<p>Presenting a multi-payment scheme QR code, merchants enable consumers to seamlessly switch between bank accounts, e-wallets, and other payment methods, expanding marketability and adoption.</p>	<p>Do POS infrastructure limitations hinder the adoption of new or closed-loop payment options by consumers, even though those same features such as authentication, consumer recourse, and proof-of-purchase are expected with today's open-loop options?</p> <p>Do limitations in POS infrastructure pose challenges for merchants integrating new payment options, when it comes to functionalities like business reconciliation, exception handling, loyalty program compatibility and reach?</p>

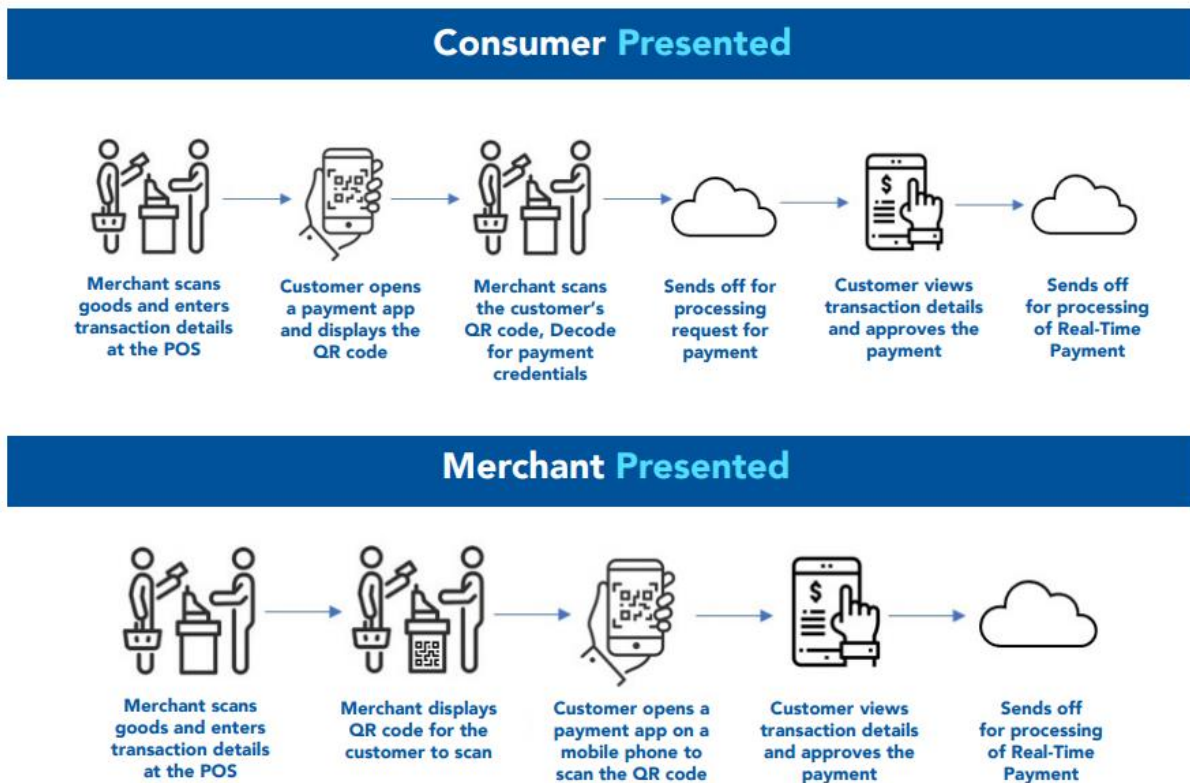
Observations	Ramifications	Questions for U.S. Market
Support by multiple payment schemes encourages participation and interoperability between banks and non-banks, across payment types tailored to a country's needs and preferences.	Through QR codes, consumers could use a variety of payment schemes and leverage open and closed-loops for greater participation.	Given the heavy investment in card-dominated infrastructure at merchant physical POS, will the alternative payment types have sufficient business case and appeal? To what degree do U.S. payment scheme stakeholders value this type of interoperability?

2.3 Functionality

Functionality encompasses the use cases, QR code presentment mode and payment flows (credit push or debit pull).

All the implementations reviewed by the QRCIWG support some form of a retail purchase use case. Some support additional use cases, such as bill payment and person-to-person transfers. Bill payment appears more commonly in the implementations that are integrated with national payment schemes e.g., Pix in Brazil, or NPP in Australia.

Without regard to the type of use case, transactions can be initiated using either a consumer or merchant presented QR code, as discussed in the QRCIWG's previous white paper⁸ and depicted in the following diagram.

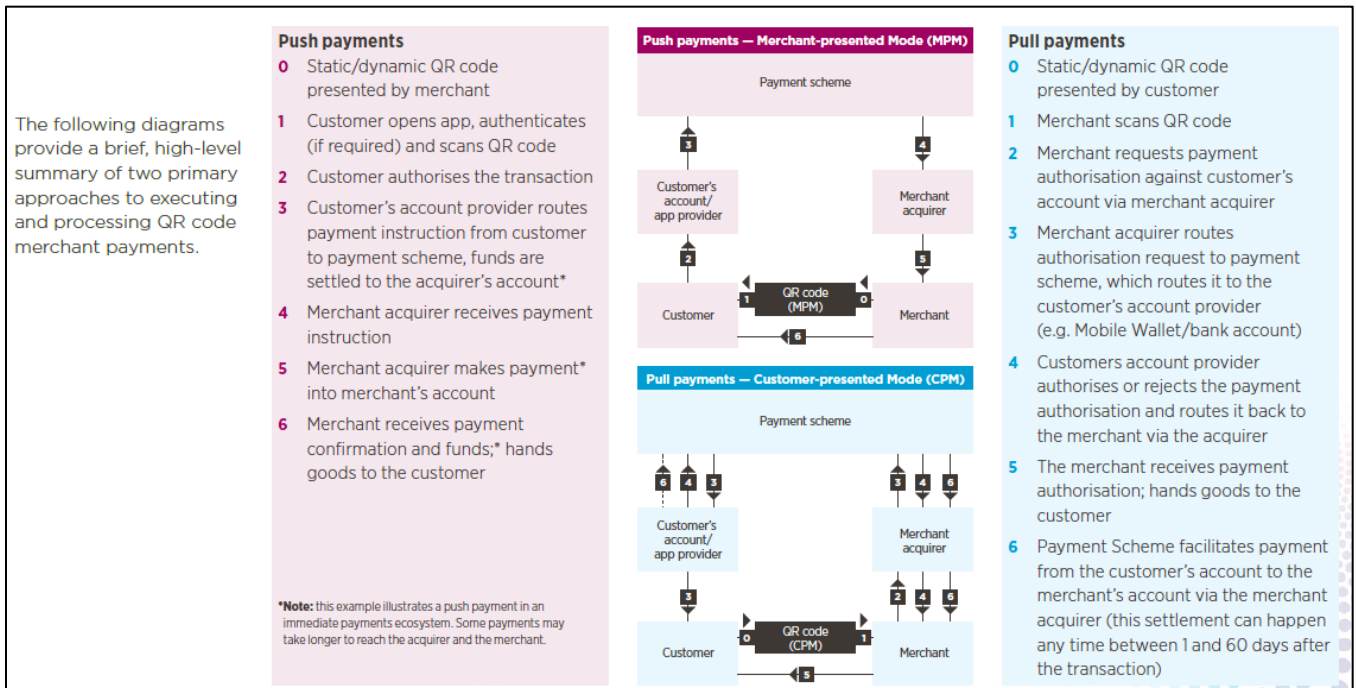


From a users' point of view, payment transactions initiated by either the consumer or the merchants work logically and conveniently. They have been demonstrated to operate at scale (e.g., China, India, and Brazil).

In most cases, when the transactions are initiated, they are sent as a credit push from the sender to the recipient. However, some also support a debit pull where the funds are debited from the consumer's account. These configuration choices are determined by payment network constraints or options. Consequently, some implementations using payment networks that only process credit push payments allow for a request for payment as an analog for a debit pull. Such a move was pioneered by the U.K. faster payments system for bill payment applications in 2008. Request for Payment (RfP) has been initiated by both the Clearing House (in its Real-Time Payments systems introduced in 2017) and the Federal Reserve (when FedNow opened in July 2023).

To initiate an RfP, a biller submits a request to its bank including remittance details such as an invoice description, customer bank routing number, customer account number, and the amount requested. The biller's bank routes the request to the customer's bank to be presented for approval. After the customer approves the request for payment, his bank initiates the push payment transaction.

The following excerpt from the GSMA study⁹ describes how these two different configuration options (QR code presentment mode and push or pull payment) can be used together.



There are a variety of factors that influence an implementation's choices in functionality. For example, recurring payments may not easily be automated using push payment without first allowing for some type of request to initiate it or a pre-authorized recurring credit push in response to a single or recurring request for payment that can be setup.

The flow for payment initiation may also be dictated by the environment or processing expectations. For example, a merchant may want to receive the user credentials and do its own payment initiation. In this case, a consumer presented QR code would be a preferable implementation.

Ultimately, successful implementations meet market needs by delivering the right use cases in the proper contexts to help payor and payee conveniently complete their transaction.

Insights

Observations	Ramifications	Questions for U.S. Market
The purchase use case is universal and is the catalyst for adoption.	Widespread adoption of QR code for purchase payments paves the way for extensions to bill payments, P2P, and other faster payment use cases.	Network and bank support for POS use cases appear very limited versus bill payment and corporate/B2B use cases. What could make them more comfortable with the POS use case? Does this need to be solved so POS can lead the U.S. market, or may the U.S. need to drive adoption with some other use case?
Successful implementations provide a context based QR presentment mode and transaction processing flow.	Purchase payments traditionally use a debit pull transaction flow, so a credit push transaction processing flow typical of faster payment rails may require changes in processing for several stakeholders in the ecosystem.	What changes do the various stakeholders need to make to accommodate the new processing flows and requirements? How is this done in a manner that encourages interoperability?

2.4 Usability

In simple terms, usability refers to the extent to which a product, system, or interface can be used to achieve specific goals effectively, efficiently, and with satisfaction. Due to their potential to serve as a bridge between the physical and digital realms, the usability of QR codes must be addressed within these two dimensions. Therefore, to optimize usability regarding the last mile of adoption of QR codes, it is necessary to analyze factors related to:

- The physical design, encompassing aspects such as size, placement, visibility, and distance to ensure the creation of a QR code image that can be efficiently read.
- The technical specifications, involving considerations of data accuracy, density, complexity, integration, and error correction, especially in a strategic field such as payments.
- QR code scanning process, which encompasses scanning through smartphone cameras or built-in QR code scanners in banking and payment apps.

- QR codes are a convenient means for the consumer to choose the payment type.
- QR code authenticity mechanisms, methods to initiate transactions of account credential initiation or URL-based initiation, offline usability, and user feedback mechanisms.
- The best practices for integrating the marketing links and information embedded in the symbol payload, which is a unique capability among payment types that has great appeal to marketers (whether banks, merchants or third parties), and helps augment security preferences, such as use of dynamic symbols and conveyance of augmenting security data.
- Compatibility and accessibility, encompassing inclusivity, particularly for individuals with disabilities, QR codes containing multilingual information combined with needed adaptability of resultant interfaces upon scanning, operating system compatibility (iOS, Android, etc.) and feature phone solutions.
- Usability with accounts and services that support financial inclusion payment type.

Internationally, QR codes have become integral for quick payments and accessing information, with their usage and adoption varying due to factors like technological understanding, smartphone usage, cultural practices, and people's familiarity with the codes:

- Asia, led by China, quickly adopted QR code payments through services such as WeChat Pay and Alipay, creating efficient and user-friendly interfaces. Their early adoption provides insights into effective implementation and shows their advancement in this field.
- Africa, particularly countries like Kenya, has utilized QR codes to foster financial inclusion, integrating them with mobile money services and ensuring compatibility with basic phones.
- In contrast, Europe, with its established banking systems, uses QR codes as supplementary payment methods, emphasizing smooth integration with existing bank apps and prioritizing security.
- In India, dynamic QR codes, changeable for every transaction, have enhanced security in high transaction regions using the UPI system.
- Another trend is the inclusion of loyalty programs, especially in Southeast Asia, which encourages QR code usage through rewards.
- Customizing QR codes for certain demographics, like larger fonts for Japan's elderly population or designs that resonate with local cultural aesthetics, boosts adoption.
- For countries rich in linguistic diversity, such as India or Canada, QR codes support multiple languages to ensure broad usability.
- Brazil's Central Bank introduced the BR Code, a QR code standard for payments, promoting financial inclusion and interoperability across platforms. This system, linked to the Pix instant payment system, leverages QR code scanning for easy transactions even on basic phones.

Adobe Systems' 2014 research showed that in developed nations, like the United States, Germany, France, and the U.K., between 25-30 percent of the population engaged with QR codes.¹⁰ The growth in digital payments in 2020 has further propelled businesses to choose between customer-presented or merchant-presented codes. These QR codes now offer a wealth of customer data for businesses, facilitating targeted marketing strategies.

Regarding financial inclusion, the Brazilian case is a practical example regarding the importance of QR code compatibility with feature phones.¹¹ In Brazil, feature phones contribute to approximately 30 percent of the market share in 2023. From an economic standpoint, the feature phone market in Brazil is noteworthy. However, the market is anticipated to experience a contraction at a compound annual growth rate (CAGR) of -4.62 percent from 2023 to 2028. This declining trend is not unique to Brazil; globally, the dominance of feature phones is waning, as seen in countries like India. It is noteworthy that even though smartphones have an approximate penetration rate of 90 percent in the United States, there is a global focus on supporting feature phones. The rationale behind this is to foster access and financial inclusion, especially for individuals who do not possess smartphones.

All the international experience gathered through the research can be inspiring for the enhancement of QR code usability in the U.S. payments system.

Insights

Observations	Ramifications	Questions for U.S. Market
Use of a standard QR code for faster payments clearly promotes ease of use and convenience for consumers, as well as ease of acceptance for merchants.	Today's scanners can often be adapted to QR codes, and limiting the variation in the formats ensures minimized incorporation requirements at POS. By all appearances, user education and training hurdles for use have been small, and quickly overcome with conventional and social media support.	The United States has a complex array of card processing terminals, and some retail verticals (e.g., convenience stores) require multiple terminals due a lack of overall integration; adding a QR code scanner on crowded checkout shelves can be an obstacle. Can promoted use of consumer initiated QR code transactions for difficult POS environments (including smaller, mobile, or rural merchant venues) obviate this issue?
Usage and adoption of QR codes vary due to factors like technological understanding, smartphone usage, cultural practices, and people's familiarity with it.	Provision of alternative payment types that cater to consumers appear to support promises of ease of use.	Given historic experience in the United States on resisting new payment modes, what are the obstacles, and incentives, to educate and train consumers to move from cards and cash?

2.5 Security

As QR codes evolved from a shipment tracking mechanism in the 1990s, to a mechanism for digital links, to marketing messages and promotions in the 2000s, to high-volume expedited payments systems today, security has steadily been ratcheted up to meet the needs of users. Traditionally QR codes have communicated with providers via an embedded URL, so the principal security challenges have been a compromise of URLs, namely misdirection to an illicit website.

Also, there have been issues with phony or pseudo QR codes and other concerns over the years. The industry has addressed these issues with a shift from static QR codes to dynamic versions that can be monitored and checked for veracity for incoming presentations to providers. Scanning QR codes directly within a payment application, which is designed to only accept QR codes containing valid payment information, eliminates most of the issues associated with scanning malicious URLs.

The inclusion of tokens for the payment account credentials has proved to be highly effective as well. And by all indications, in China, India, Brazil and other high-adoption countries, the end-to-end process security has been optimized over time to produce low rates of fraud on a massive scale.

Security challenges experienced with QR codes and payments are familiar to other payment types, though misdirection of embedded URLs can be a daunting problem for high-value payments when account credentials get exposed. As with other payment types, users need to be educated about and understand the role they play in risk mitigation. The following extract from the GSMA¹² report describes the following vulnerabilities (not to mention downstream risk issues with user fraud compromising funds immediately with little chance of recoverability).

Examples of appropriate risk mitigation responses:

Risk		Appropriate risk mitigation response	
Name	Detail	Approach	Detail
1 Lost or stolen	Unauthorized use can occur if a smartphone with a QR code payment app and the password were stolen.	Reduction	Add biometric authentication, such as facial recognition, fingerprint scanners and voice identification. A two-step verification system can also reduce the risk.
	QR code shoulder hacking If there is no time limit to use a QR code, QR code shoulder hacking may occur.	Reduction	To pay with a QR code, the app must have limits, such as a time limit on the validity of a QR code or trial.
2 Fake QR code	QR code phishing Attacker replaces original QR code and the fake QR code leads the user to malicious internet content.	Avoidance	The QR code payment app should not redirect the user to a website via the phone's browser, which would increase the number of victims of QR code phishing, or the QR code payment application should scan the vulnerability of redirected. It is preferable that merchants not use paper-printed QR codes because these are easy to replace.
3 Hacking/cracking	The information on the QR code payment system contains personal financial information that is targeted by the hacker.	Reduction	A QR code cannot be hacked (apart from fake QR codes), but the QR code payment system could contain vulnerabilities. Therefore, there should be unified security guidelines that all QR code payment system providers must follow. They should also be audited. Example: Japan began unifying QR code merchant payments in 2019, when the Ministry of Economy issued Guidelines for Unified Standard Code-Payment Technologies: CPM (Consumer-Presented Mode) and Guidelines for Unified Standard Code-Payment Technologies: MPM (Merchant-Presented Mode).
4 Falsification	Cashier may conduct fraud if the payer's QR codes are not generated every time they use it.	Avoidance	Time-limited QR codes should be generated every time customers present their QR codes to cashiers.

Faster payment systems across the globe also have varying requirements for authentication. Most countries are moving toward the adoption of multi-factor authentication techniques including passwords, biometrics, and pattern recognition. The following is a chart from GSMA¹³ that describes authentication requirements.

Summary: Authentication and authorisation approaches across the example schemes are as follows:

	Specification	Authentication approach	When*	Detail
Harmonised specifications	EMV	No mandatory requirements	—	EMVCo has not provided any mandatory requirements for authentication.
	JPQR	No mandatory requirements	—	JPQR does not specify any mandatory requirements, so the authentication varies by company. JPQR recommends PIN, fingerprint or facial recognition
	Bharat QR	Username and password	2) The app is launched	When a customer launches the app, they approve it with a username and password. There is no other form of approval and the customer cannot choose.
	HKQR	Password or biometrics	1) The mobile device is unlocked	*If the bill exceeds 1,000 yuan (-\$150), the user will have to enter his password in the complete transaction.
	SGQR	No mandatory requirements	—	SGQR has not provided any mandatory requirements for authentication.
	QRIS	No mandatory requirements x	—	QRIS has not provided any mandatory requirements for authentication.
Proprietary specifications	Allpay	Password and biometrics	3) Before payment	The most common payment authentication methods have been passwords and fingerprints. Some devices support facial recognition that the user can choose.
	WeChat Pay	Password and biometrics	3) Before payment	WeChat Pay requires the user to enter their payment password to confirm the transaction.
	Prompt Pay	Passwords	3) Before payment	Some companies let users use Face ID and fingerprints as an authentication method, but the common authentication method is typing passwords before settlement.
	M-Pesa	Passwords	3) Before payment	The authentication method is typing a PIN before settlements. The user can change the PIN on the M-Pesa app at any time.
	Mercado Pago	No mandatory requirements	—	Mercado Pago does not specify any mandatory requirements before or after settlement.

* Authentication is performed at 1) when the mobile device is unlocked, 2) when the app is launched, or 3) at the time of payment.

In addressing the lack of definitive standards (as opposed to best practices) for security in QR code payment, the U.S. financial services standards organization ASC ANSI X.9 has convened a work group to determine a globally acceptable (and flexible) form of encryption as an emerging international standard for security.

ANSI X.9, the U.S. industry group that develops and prescribes security solutions for the financial services industry, has completed an initial work group specification that seeks to harden payment QR codes at scale with digital signing of QR code for QR code authenticity and integrity, and strong encryption of the data objects and elements within the QR code. After industry review, X.9 will submit their specification to the International Standards Organization (ISO) for consideration and potential adoption on a global level. At that point, users will have a choice and motivation to embrace the standard for security purposes, which in turn will congeal into a path for standardized QR code symbol formats to foster global interoperability. That work is expected to be submitted to ISO in 2024.¹⁴

Insights

Observations	Ramifications	Questions for U.S. Market
<p>So far, faster payments systems have promised minimal levels of fraud and have delivered on that promise.</p>	<p>Low rates of fraud and chargebacks translate into lower costs for the users of these systems.</p>	<p>Historically, the United States has been a high-fraud, expensive-recourse country for card and bank account payments, which is reflected in its cost of payments. Can best practices/standardization around a truly workable security framework be possible?</p> <p>Since faster payments in the United States are newer to other international payment schemes, and they have yet to mature, will the prevalence of fraud come along with it or can these newer faster payment schemes in conjunction with QR codes and enhanced security create a new and better norm?</p>
<p>ANSI X.9 has proposed much stronger security protocols (e.g., digital signing of the QR code and encryption of data objects) than what exists today for ANY payment type.</p>	<p>Implementors will need to integrate the payment type and security protocols within their POS systems or support a stand-alone, alternate method.</p>	<p>What are the issues associated with implementation of the proposed ANSI X.9 security improvements within a POS environment?</p> <p>How can it become a differentiator and justification for the adoption of faster payments at the POS?</p>
<p>The EMV QR Code specification facilitates device interoperability.</p>	<p>Implementations benefit from the common format and data conventions helping minimize development cost, time to market, and longer-term cost of ownership.</p>	<p>How might a security framework, such as the one envisioned by ANSI X.9, be implemented for QR codes formatted using the EMV specification?</p>
<p>Uniform faster payments systems operating with good Wi-Fi/Internet access demonstrate high availability and tolerance for high volumes at low costs and good security when properly deployed.</p>	<p>Many countries have pushed for Internet ubiquity and hosting faster payments systems with QR codes can help provide good cost justification for investments in access and security.</p>	<p>Internet access in the United States is finally reaching many of the rural areas where consumers and merchants struggle with electronic payments, but Wi-Fi quality in physical stores can be erratic and represent security threats. What authority exists to regulate and improve quality for deployment and usage of QR code payments?</p>

3 Summary

3.1 Market-driving factors for faster payments adoption

The market-driving factors for faster payments adoption using QR codes have been identified as:

- **Oversight:** A single QR code standard with strong oversight is essential for interoperability and consumer confidence. This would allow QR codes to be used across different payment networks and devices, making it easier for consumers and merchants to adopt them. Strong oversight would also help to ensure that QR code payments are secure and reliable.
- **Payment schemes supported:** Consumers should be able to use QR codes to pay with a variety of payment schemes, including open-loop and closed-loop. This would give consumers more choice and flexibility when using QR codes. Open-loop payment schemes allow consumers to pay with any bank account or card, while closed-loop payment schemes are tied to a specific merchant or payment network.
- **Functionality:** While purchase transactions are fundamental, QR codes should be able to support a variety of additional use cases, such as bill payments and person-to-person transfers. This would make QR codes more versatile and appealing to consumers.
- **Usability:** QR codes should be easy to use for both consumers and merchants. This includes factors such as the size and placement of QR codes, the ease of scanning and the simplicity of the payment process.
- **Security:** QR code payments must be secure from fraud and other risks. This includes using strong encryption and authentication methods.

For each of these factors, the QRCIWG summarized its opinions about key assumptions, their ramifications, and their applicability to adoption of QR code for payments in the U.S. market. This report also identified some of the challenges that the United States faces in achieving widespread adoption of QR code for payments. These include the fragmented payment landscape, the lack of a single QR code standard, and the absence of government oversight. Going forward, the QRCIWG plans to review each of these factors in-depth and answer the key questions that have been posed relative to adoption in the U.S. market.

3.2 Call to Action Invitation

The QRCIWG is inviting readers of this report to render an opinion on what it will take to get to ubiquitous adoption of faster payments and to share their views on the degree to which QR Code acceptance at the POS will help to achieve the last mile of faster payments adoption in the United States. This input will provide the QRCIWG with a greater understanding of the issues and point the way to a prospective resolution. Additional reports, research materials, and other clarifying information will be posted on the FPC website, www.fasterpaymentscouncil.org, as available.

Want to be part of the solution? Join the Faster Payments Council and tackle key adoption hurdles by getting involved www.fasterpaymentscouncil.org. To help shape the future of payments, share your thoughts on QR Codes for faster payments with the QRCIWG at info@fasterpaymentscouncil.org.

QR Code Interface Work Group

Thank you to the members of the FPC QR Code Interface Work Group (QRCIWG) who contributed to this report.

QRCIWG Leadership & WG Contributors

Scott Green (Work Group Chair), SHAZAM

Steve Mott (Work Group Vice Chair), BetterBuyDesign

Maria Arminio (Work Group Facilitator), Avenue B Consulting, Inc.

Valerie Gorsh (Work Group Facilitator), Guidehouse

Mark Tiggas, Accredited Standards Committee X9

Wesley Cruaia Clemente, JJ4Tech

Caroline Cypriano, JJ4Tech

Steve Wasserman, Photon Commerce

Charles Jackson, Sionic Mobile Corporation

Staff, The Federal Reserve System

About the QR Code Interface Work Group

The FPC QR Code Interface Work Group promotes the adoption of faster payments by developing QR code guidelines and best practices for end users and financial institutions.

About the U.S. Faster Payments Council

The U.S. Faster Payments Council (FPC) is an industry-led membership organization whose vision is a world-class payment system where Americans can safely and securely pay anyone, anywhere, at any time and with near-immediate funds availability. By design, the FPC encourages a diverse range of perspectives and is open to all U.S. stakeholders.

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