QR Codes for Faster Payments

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1. Introduction

In recent years, several payment implementations had made innovative use of Quick Response Codes™ (QR Codes[1]). A QR code is a more versatile type of bar code and can contain more information. They have been around for a long time and have many different use cases. This paper summarizes the output of an initial work group inquiry that explored the use of QR codes to aid in the adoption of faster payments in the United States and focuses on the use of QR codes to facilitate consumer purchases using bank accounts.

Faster payment processing supports a variety of transaction types on behalf of consumers, banks, businesses, and governments. QR code technology provides a transport mechanism that offers payment processing advantages including the potential for enabling real-time, secure payments that seem particularly fitting for use at the point of sale (POS). The technology offers the ability to process a transaction from bank account to bank account via cloud-based or local merchant systems.

Payments may be triggered by either a merchant or a consumer. Today, in several dozen countries, merchant payment acceptance is supported by displaying a QR code 'sticker' that the consumer can capture with a mobile phone and send to the cloud for processing. This simple approach will undoubtedly speed adoption of faster payments in the physical space. However, given the dramatic increase in online and mobile transactions, industry stakeholders have moved quickly to support QR code technology for payment transactions performed remotely too. This has precipitated the need for better security requirements to protect against fraudulent transactions in both the physical and online environments.

Making this possible requires payment stakeholders to ensure proper security at large scale, interoperability ultimately on a global basis, and standards for minimizing the payment processing infrastructure that might have to be added to legacy systems beyond simplifying the merchant acceptance at the POS. The conclusions at the end of this paper identify the advantages and challenges that need to be considered and addressed for QR codes to be a driver for the adoption of faster payments.

1.1   What are QR codes?

QR codes are two-dimensional bar codes. They can store more information than a traditional bar code and can be read faster by a scanning device. QR codes were invented in Japan[2] nearly three decades ago to track motor vehicle components throughout the manufacturing process. Then, in the early 2010s, they were applied to mobile marketing applications (e.g., for capture by mobile devices from advertisements in magazines and posters). In 2017, Apple enabled iOS 11 with QR codes (followed by Android) for quick and convenient scans using the camera app on their phones.

By mid-decade, China moved concertedly to deploy QR codes for a multitude of applications, such as collecting wedding gifts at a gift registry, identifying pets, replying to job ads, and—especially—signing in and posting in WeChat messaging network and the Alipay payment system. The COVID-19 outbreak heightened use of QR codes, with expanded applications that ranged from track-and-trace systems to online food and grocery ordering, prepayment, and delivery/pickup.

1.2   How are QR codes used?

QR codes can either be use case-specific or agnostic. QR codes can dynamically include use case-specific data, such as a POS terminal ID, transaction reference, and loyalty ID when presented at a point-of-sale location. For bill payment, QR codes could provide other types of transaction specific information. The use case-specific data can be optional in addition to the payment route information which is use case agnostic by itself. Following is a more comprehensive list of QR code use cases for a deeper sense of the different ways QR codes can be leveraged in payments.

- **QR codes for payment at POS**: Merchants leverage QR code scanners to accept payment from a customer's mobile app or vice versa.

- **Mobile-initiated transfers:** Mobile wallets and money movement apps include QR code to facilitate person-to-person funds transfers. They leverage embedded phone cameras to scan a QR code provided by a recipient to transfer funds to the recipient's account.

- **QR codes on paper bills**: Billers/merchants include QR codes on paper bills, pdfs, and website presented bills which a scanning app can use to initiate payment or launch payers into an e-commerce payment experience.

- **QR codes on receipts at restaurants**: In addition to leveraging QR codes for paperless menus, restaurants are leveraging the 'check' to include QR codes and enable contactless payment and checkout-at-the-table experiences.

- **Merchant loyalty at checkout**: Grocery store chains, for example, allow customers logged into an app to present a QR code generated by the app that ties loyalty/rewards to a payment method on file for payment at the POS (or via unattended checkout) or online.

1.3   Countries where QR codes are used?

QR codes have quickly become a leading method of payment acceptance in Asia, India, and some other parts of the world. Leading services like WeChat and Alipay have dominated payment acceptance adoption due to the low cost and ease of use of QR codes. Following is a list of examples where QR codes are being employed to benefit payment experience and efficiency:

- **India**: India has seen strong QR code payment adoption, where the Unified Payments Interface (UPI) network is compatible with QR code payments. In India, mobile banking apps are commonly leveraged for making payments; Bharat QR codes facilitate payments over the UPI rails, or payments can also be made via EMVCo specs over card network rails.[3]

- **Singapore:** Singapore has accelerated adoption and usage of QR code payments via the development and deployment of the Singapore Quick Response Code (SGQR) as a local standard. The SGQR combines multiple payment QR codes into a single label to make it easier for consumers and merchants. The SGQR is based on EMVCo's QR code spec and connects to their Fast and Secure Transfers (FAST) real-time payments system, which was launched in 2014.[4]

- **Australia:** QR code payments have been standardized and implemented more recently in Australia. The New Payments Platform (NPP), Australia's real-time payments network, was launched in 2017, and the NPP released a standardized QR code spec in 2019. The spec is based on EMVCo's QR code spec and enables real-time payments via QR codes and the NPP rails.[5]

- **United States:** While still maturing domestically, the popular P2P money movement app, Venmo, reflects an example of increasing customer familiarity and comfort with QR codes payments. Venmo has QR code payment functionality, supporting P2P transfers for Venmo users, and is also offered by select merchants across the United States. Other P2P services such Zelle and CashApp are also using QR code technology to make payments.

1.4   What are the benefits to the payments ecosystem?

QR codes are a low-cost technology which provides a simple user experience to both the presenter and scanner of the QR code. This is an attractive combination that is helping drive adoption for an increasing array of A2A, P2P, and other digital payment offerings.

Two benefits in particular offer the opportunity to extend faster payments to the broad physical point of sale:

- Low Costs
  - There is no cost to present or scan a QR code as a user. The devices and apps that present and scan QR codes come with their own costs for usage, security, validation, and the actual payment transactions for which they are used.
  - When the QR code is scanned from a static copy, this can be a lower cost since it does not require any specific device. However, there is a tradeoff for potential security issues unless the scanning app validates the QR code.

- Simplicity and User Experience
  - Implementation of QR codes can be very simple, though it can get a bit more complex once you look to address security and validation plus involve transaction details as part of the scanned QR code data.
  - The user experience for both ends of the transaction can be simple and intuitive especially as the use of QR codes continues to gain traction as it has in other parts of the world where it has gained mass adoption.
  - QR codes enable contactless transactions as an additional benefit to the user experience. This is a key benefit as the demand for contactless payments has exploded since COVID-19.

1.5   Aspects of a QR code payment solution

There are various components involved in a QR code solution for use with faster payments including:

- Static versus dynamic QR codes
- QR code presentment party
- Single versus multiple payment schemes
- Verifying the party presenting the QR code
- Security and privacy
- Scanned data requirements
- Data requirements

1.5.1 Static versus dynamic QR codes

The first aspect of using QR codes for payments is their method of presentment. There are two methods of presentment for QR codes: Static and Dynamic.

Static QR codes can be printed and displayed at convenient locations, such at the point of sale, on a menu, on a bill, on a website checkout page, etc. Static codes include point-of-time information. They can include transaction information, such as the bill they are printed on.

Dynamic QR codes are ones which can be formatted using the latest up-to-date information plus optional transaction-specific information. Dynamic QR code presentment requires a smart phone, POS QR enhanced device, or dynamic version of the QR code using website checkout-specific information.
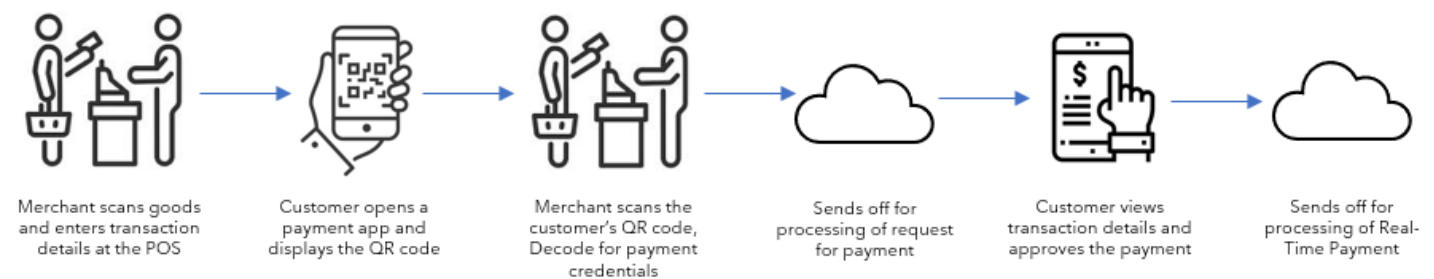
A static or dynamic QR code can also be presented by an individual that is using it to present to another individual that they want to have them credit push funds to them.

1.5.2 QR code presentation mode

QR codes can also be used to initiate a request for payment when the party that is being requested presents their QR code which contains information necessary to send them a faster payments rail request for payment.

1.5.2.1 Consumer presented QR code

A consumer presented QR code can also be presented to a merchant or any party that enables that party to send them a request for payment.

Merchant scans goods and enters transaction details at the POS → Customer opens a payment app and displays the QR code → Merchant scans the customer's QR code, Decode for payment credentials → Sends off for processing of request for payment → Customer views transaction details and approves the payment → Sends off for processing of Real-Time Payment

1.5.2.2   Merchant presented QR codes

QR codes can be used by a merchant or biller, and any receiver of funds, to present the method(s) of payment they accept and the information necessary to make that payment when the scanning app already has the information it needs to create a faster credit push payment.

Merchant scans goods and enters transaction details at the POS → Merchant displays QR code for the customer to scan → Customer opens a payment app on a mobile phone to scan the QR code → Customer views transaction details and approves the payment → Sends off for processing of Real-Time Payment

Another option for the merchant or biller is to present a QR code that can link to their own app or website with the information the consumer can use to input or already has registered with that merchant or biller to make the payment.

1.5.3   Single versus multiple payment schemes

A QR code may contain payment account information for use with one or more payment schemes. The consumer or merchant presenting the QR code may choose which payment schemes are included in an instance of a QR code. A consumer may do this, for example, to select a particular account to use for payment. A merchant may present multiple options to receive payment through a variety of accounts and payment rails to provide broad acceptance. Otherwise, the only way for the merchant to convey all its payment options is to display multiple instances of QR code, one for each payment scheme. This could cause congestion at the point of interaction and confusion for users.

1.5.4   QR code validation

Before sending a payment, the sender should validate the authenticity of the QR code. At a minimum, it should verify that the QR code was created by a valid member of its payment scheme and that the information in the QR code was not altered. This is more of a concern when a static QR code is displayed.

The sender should also ensure that the receiving account information in the QR code belongs to the party it intends to pay. The account information may include signed verification data that can be used to prove it belongs to the recipient. A directory service may help with the process. The recipient bank may pre-validate account information and associate it with recipient alias or other identification in a directory. The sender may then use the directory's pre-validated and up-to-date information to route the payment.

1.5.5   Security and privacy

To protect payment account numbers, QR codes can use tokenized versions of account numbers that are supported by the faster payment rails. The QR codes should also avoid providing any Personally Identifiable Information (PII) that the presenter is not willing to share with the party doing the scan. Other security concerns and best practices are currently being examined by the Accredited Standards Committee X9[6] regarding the encryption of the information passed through a QR code.

1.5.6   Data requirements

The QR code will need to contain enough information to originate a payment. The data requirements can vary by use case. Generally, the QR code will contain user account information and transaction-specific details such as the date, location, and amount. The app scanning the QR code may also be able to supplement data that is not presented through the QR code, such as a tip amount or a transaction reference. There is a practical limit on the amount of information that can be conveyed in a QR code. The limit is a function of the quality of the QR code image and the capability of the device scanning it. If there is too much information, then the quality declines and the accuracy of the scanned information may not sum to a checksum total that the QR code uses to confirm that it was scanned properly.
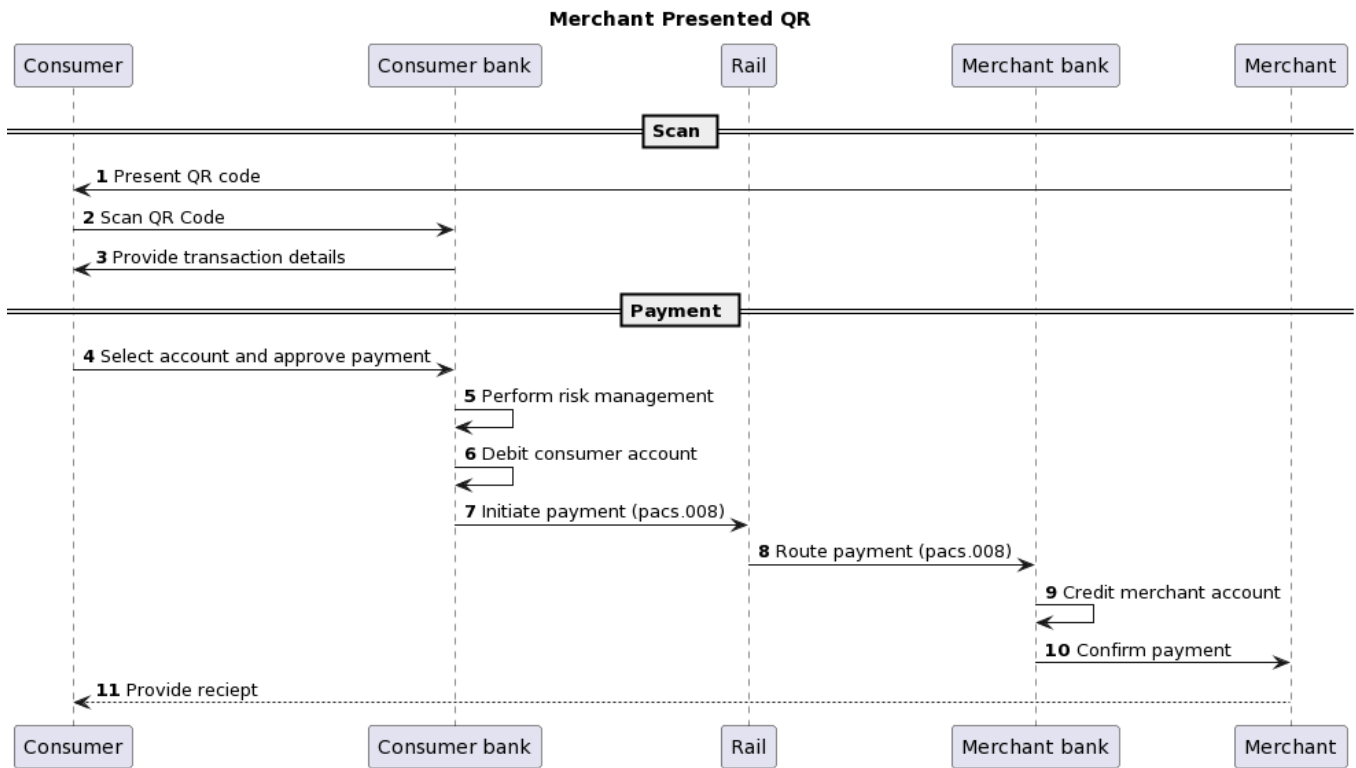
2. Using QR Codes for Faster Payments

Adoption of QR codes flourished with non-payment applications such as inventory tracking and billboard/ magazine marketing, but more recently they have become associated with payments as discussed earlier. Due to the popularity and relative ease of deployment it has become important to consider the potential role of QR codes in faster payments–particularly for the 'last mile' of smaller merchant locations.

The most prominent use case for QR codes in faster payments is the ability to do purchase transactions at the POS with lighter lift in deployment at the merchant checkout counter and the ability for merchants to accept this mode of payment by simply displaying a static sticker with the QR code that enables the merchant to be paid for the purchase. The display of the QR code can also be dynamically generated along with some transaction information and presented for the consumer to scan. The code to scan can be presented on a POS device for the consumer to scan. E-commerce checkout can display an option to pay by QR code as well. As discussed in our introduction, QR code presentment and scanning can be used in another context where the consumer presents the QR code for the merchant to scan. This section provides example flows and corresponding best practices for each of these two QR code presentment modes.

In either presentment mode, the merchant receives payment via a faster payment method. For illustrative purposes, the payment rail in the examples uses ISO 20022 for bank-account-to-bank-account real-time payment. It can also be done via push-to-card transactions or same day ACH in some implementations. The consumer can be provided payment receipts in a variety of ways.

In these examples, it is assumed the consumer has a mobile application that is provided by their financial institution (bank/credit union/other financial service) and that their financial institution participates in a payment rail that supports faster payments. Similarly, it is assumed that the merchant has an account with a financial institution that participates in the same payment rail. A payment rail may define implementation- specific rules and act as the intermediary between the consumer and merchant financial institutions. Financial institutions may also involve third-party service providers that help fulfill these roles. For simplification, no third-party service providers are displayed in the examples.
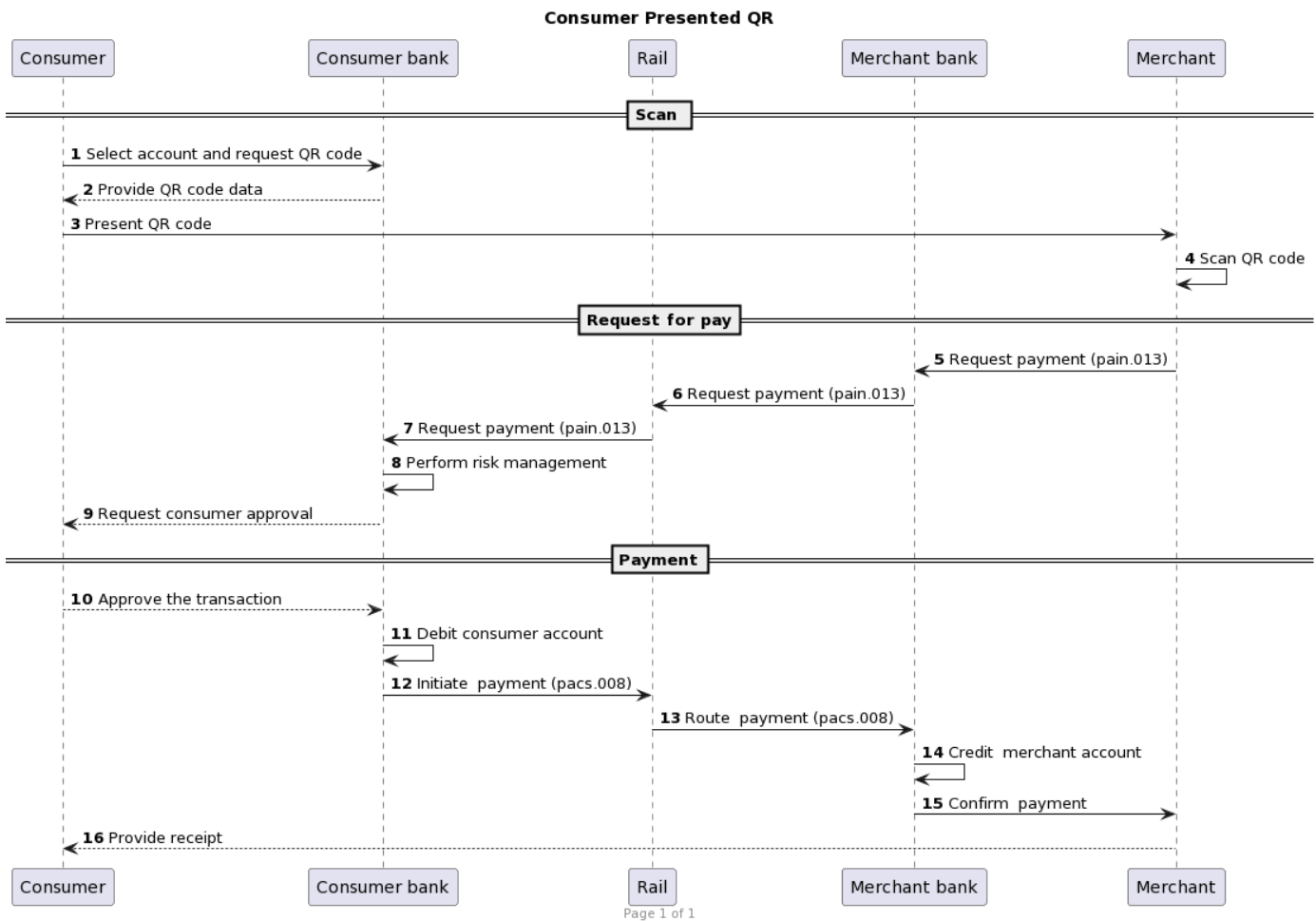
2.1 Purchase using a merchant presented QR code

Merchant Presented QR

Step	Considerations
1. The merchant presents the QR code	The QR code may contain transaction information and one or more sets of merchant account information that may be used to send payment to the merchant. The QR code should contain an alias or token instead of the merchant's real account information. It could also just include a lookup into a directory which contains the information.
2. The consumer scans the QR code	This can be done through the consumer's payment app.
3. The consumer's financial institution (FI) provides transaction details for payment approval	The FI should take measures to verify the QR code is authentic.
4. The consumer selects their funding account and approves the payment	Account selection is only necessary if there is more than one merchant and/or consumer account to choose from. The consumer needs to view the transaction details including that it is going to reach the proper payee.

5. The consumer's financial institution performs risk management on the transaction	Confirm the consumer's account has sufficient funds, credit, or overdraft to send the funds. Check if there is anything suspicious about the payment or merchant payee, perform applicable anti-money laundering and fraud detection and review for anomalous activity. If applicable, consider communication with the consumer through the app or otherwise prior to payment approval.
6. The consumer's financial institution debits the consumer's funding account	The approved payment is debited (recommend setting it as a pending debit) from the consumer's account in this step. The pending debit would be released once the merchant's FI has confirmed the receipt, credited the merchant's account, and notified the merchant to provide the receipt to the consumer. If the process flow fails after this step, then the pending debit hold can otherwise be released along with applicable notification back to the consumers app.
7. The consumer's financial institution initiates a credit payment to the merchant through the payment rail	In this step the consumer's FI is initiating the payment to process through the real-time ISO 20022 payment rail using a pacs.008 message. If the QR code contains an alias or tokenized account data, then it should be used in the credit payment. This would prevent disclosing the merchant's real bank account information anywhere through the end-to-end flow.
8. The payment rail routes the payment to the merchant financial institution	The real-time payment rail validates the ISO 20022 pacs.008[7] message and proceeds to forward it to the merchant's FI, who then validates it as well. This may also include some form or risk management similar to what was described above for the consumer's FI risk management.
9. The merchant's financial institution posts the credit to its account	It also acknowledges this back to the payment rail which performs the real-time interbank settlement. *Note: The real-time payment rail would also be acknowledging the status back to the consumer's FI who in turn should be notifying such status back to the consumer through the app or other notification methods setup with the consumer. This part of the process flow is NOT depicted in the simplified example flow diagram.* In some real-time implementations, the merchant's bank can acknowledge receipt of the pacs.008 message before it has a maximum number of seconds to post the credit to the merchant's account. The merchant FI needs to still let the merchant know immediately that their account is going to be credited, so that the merchant can provide confirmation to the consumer in the next two steps.
10. The merchant's financial institution confirms receipt of the payment to the merchant	The merchant's FI notifies the merchant in any of the various ways that they can do such immediately so that the merchant can then provide the confirmation receipt back to the consumer.
11. The merchant provides a receipt to the consumer	The merchant can now provide a payment receipt with applicable payment transaction reference information similar to other POS card terminal receipts when the payment has been successfully processed.

2.1 Purchase using a consumer presented QR code

Consumer Presented QR

Step	Considerations
1. The consumer selects their funding account and requests a QR code to make a payment	Account selection is only necessary if the consumer has more than one account and has not otherwise selected a default funding account for purchases. The QR code will provide the merchant information so it may request payment from the consumer's bank.
2. The consumer's bank provides QR code data that can be used for payment	The QR code should contain an alias or token instead of the consumer's real account information. Alternatively, it could just include a lookup into a directory that contains the information.
3. The consumer presents the QR code to the merchant	The consumer presents the code from their smart phone app.
4. The merchant scans the QR code	This can be done through the merchant's payment app or POS terminal which can perform the scan.

5. The merchant requests payment through their financial institution using information from the QR code	The example shows the use of ISO 20022 pain.013[8] message for the request for payment.
6. The merchant's financial institution sends the payment request to the consumer's bank through the payment rail	The request for payment is sent to the routing number associated with the consumer's account as conveyed by the QR code.
7. The merchant's financial institution sends the payment request to the payment rail	The merchant's financial institution may use the routing number associated with the consumer's account (as conveyed by the QR code) to determine if the consumer's financial institution participates in a payment rail.
8. The payment rail routes the payment request to the consumer's financial institution	The payment rail may use the routing number of the consumer's FI to identify its processing configuration and messaging endpoint.
9. The consumer's financial institution forwards the request for payment to the consumer	Depending upon consumer preferences and controls, the method of this presentment can vary.
10. The consumer approves the request for payment initiating the payment for such	The consumer can reject the request and/or adjust the requested amount of the payment.
11. The consumer's financial institution debits the consumer's funding account	The approved payment is debited (recommend set as a pending debit) from the consumer's account in this step. The pending debit would be released once the merchant's FI has confirmed the receipt, credited the merchant's account, and notified the merchant to provide the receipt to the consumer. If the process flow fails after this step, then the pending debit hold can otherwise be released along with applicable notification back to the consumers app.
12. The consumer's financial institution initiates payment to the merchant's financial institution through the payment rail	In this step, the consumer's FI initiates the payment through a payment rail using a real-time ISO 20022 pacs.008 message. If the QR code contains an alias or tokenized account data, then it should be used in the message. This would prevent the disclosure of the merchant's real bank account information anywhere through the end-to-end flow.
13. The payment rail routes the payment to the merchant's financial institution	The real-time payment rail validates the ISO 20022 pacs.008 message and forwards it to the merchant's FI, who validates it, and may also perform some form of risk management similar to what was described above for the consumer's FI risk management.

14. The merchant's financial institution posts the credit to its account	The merchant bank acknowledges receipt to the payment rail which performs the real-time interbank settlement. *Note: The real-time payment rail would also be acknowledging the status back to the consumer's FI who in turn should be notifying such status back to the consumer through the app or other notification methods setup with the consumer. This part of the process flow is NOT depicted in the simplified example flow diagram.* In some real-time implementations, the merchant's bank can acknowledge receipt of the pacs.008[9] message before it has a maximum number of seconds to post the credit to the merchant's account. The merchant FI needs to still let the merchant know immediately that their account is going to be credited, so that the merchant can provide confirmation to the consumer in the next two steps.
15. The merchant's financial institution confirms receipt of the payment to the merchant	The merchant's FI notifies the merchant in any of various ways that they can do such immediately so that the merchant can then provide the confirmation receipt back to the consumer.
16. The merchant provides a receipt to the consumer	The merchant can now provide a payment receipt with applicable payment transaction reference information similar to other POS card terminal receipts when the payment has been successfully processed.

For the primary stakeholders in faster payments, QR codes clearly offer some interesting potential benefits. This rapidly growing mode of payment also presents some discernible challenges, including the ability to fit within the complementary payment paradigms familiar to both consumer and merchant users. The table below summarizes some of the representative advantages for adopting QR codes as well as the challenges for the four major stakeholder groups, in the context of faster payments.

Stakeholder Advantages and Challenges

Stakeholder Group	Potential Advantages	Potential Challenges
End-user (e.g., consumer/business and merchant)	• High degree of potential ubiquity across all accepting merchants • Ability to include loyalty information • Transition from physical to digital • Fully digital experience – touch free experience • Extension of trusted relation with the bank/3rd party	• Define impacts to payment expectations and rights with respect to consumer disputes • Communication to and education of consumers on security challenges and best practices Install and/or retrofit issues at the point of sale
Creditor (e.g., merchant bank or service provider)	• Sender choice to use bank accounts • Ease of technology/hardware for acceptance; low barrier of entry to experiment with alternate payment methods • Personalized experience to consumers • Flexible processing/implementation options	• Mitigate any potential consumer friction that may arise from changes in application and how they interact at the point of sale • Standardize acceptance across deployments • Assessment and communication of incremental and/or specialized security considerations for merchants and acquirer
Debtor (e.g., account holder's bank or service provider)	• Consumer choice • Ability to engage with the consumer during checkout/purchase • Ability to use multiple bank accounts • Sender choice of rails • Security (potential to incorporate encryption, tokenization, and authentication)	• Cannibalization of conventional payments • Adequacy of security proposition and fit with compliance requirements • Consumer education

QR codes can assist with the adoption of faster payments at the point of sale. For this to be possible, the payments industry will need to address a number of challenges, only some of which have been identified in this paper.

The U.S. Faster Payments Council QR Code Interface Work Group calls on industry stakeholders to develop and enhance standards to address this emerging consumer need. The following is a summary of key characteristics of the standards that are needed.

- Support for both merchant-presented and consumer-presented QR code modes.
- Consistent and simple consumer experience across payment methods and rails.
- Ease of implementation by leveraging existing infrastructure to the extent possible.
- Standardized certification program covering all major mobile devices and operating systems.
- Robust security controls to mitigate current and emerging risk and fraud vectors.
- Extensible standards with the ability to offer value-added services such as merchant offers, coupons, tokenization, etc.

The potential of faster payments at the point of sale should motivate the industry to solve these complex business and technical challenges. Doing this for retail point of sale will establish the capabilities and ubiquity that will support expansion more broadly into other use cases and payment types.

About the Faster Payments Council and the QR Code Interface Work Group

The U.S. Faster Payments Council's vision is a world-class payment system where every person or organization can safely and securely pay anyone, anywhere, at any time and with near-immediate funds availability. To further this vision, the Faster Payments Council established the QR Code Interface Work Group promotes the adoption of faster payments by developing QR code guidelines and best practices for use by end-users and financial institutions.

QR Code Interface Work Group Members

Thank you to the members of the U.S. Faster Payments Council QR Code Interface Work Group who contributed to this white paper.

- Scott Green, SHAZAM (Work Group Chair)
- Steve Mott, BetterBuyDesign (Work Group Vice Chair)
- Maria Arminio, Avenue B Consulting (FPC Work Group Facilitator)
- Steve Stevens, Accredited Standards Committee X9
- Jerry Breef, BMO Harris
- Tanmoy Banerjee, Citibank NA
- Avnish Kumar Gupta, BNY Mellon
- Hatim Daginawala, Catalyst Corporate Federal Credit Union
- Mark Keeling, Catalyst Corporate Federal Credit Union
- Glenn Wheeler, Catalyst Corporate Federal Credit Union
- Charles Harkness, Corporate One
- Amy Brandt, DuPage Credit Union
- Sean Loosli, Early Warning Services LLC
- Brian Byrne, EMVCo
- Karen Shunk, EMVCo
- Staff Members of the Federal Reserve System
- Tim Ruhe, Fiserv
- Nick Denning, ICBA Bancard
- Tony Sabetti, JP Morgan Chase
- Abu Carri, Mastercard International
- Stuart Dwyer, Microsoft Corporation
- Adam Rust, National Community Reinvestment Coalition (NCRC)
- Sameer Jain, Opus Consulting Solutions Inc. (C Corp)
- Christienne Genaro, PayGility Advisors LLC
- Steven Wasserman, Vments, Inc.
- Matt Howarter, Walmart, Inc.
- Sabeer Nelliparamban, ZIL Money Corporation

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