Proximity payments: why QR codes are better than NFC

From humble beginings as a matrix barcode for the Japanese car industry, QR codes are being touted as a major proximity technology for mobile payments, illustrated by the successful rollout of a QR-based mobile payments card by Starbucks. Brian Doyle, Managing Director of Yodo Inc., a Canada-based mobile payments platform provider that has developed a QR-based product called Yodopay, explains the possible role for QR codes in driving mobile payments forward and shares his views on why QR codes are better than NFC.

Quick response (QR) codes are a leading proximity technology for mobile payments (m-payments) in North America. Starbucks' QR mobile version of a coffee card alone represented the bulk of all in-store m-payments in North America in 2012[1]. There are a number of active operators such as Levelup, Kuopay and Yodopay using QR codes to transact m-payments for millions of users[2]. Moreover, it is difficult to discuss the use of QR codes in m-payments without drawing comparisons to the technology's competitor Near Field Contact (NFC), which provides similar benefits in terms of the quick and secure transfer of a payer's credentials.

NFC has proven itself as a robust technology for financial cards, and products like PayPass and PIN-less debit continue to spur the growth of NFC in the card industry. Many therefore assume that this success will be carried over into the m-payments arena. In truth, however, there is little correlation between being a good technology for plastic cards and being a good technology for mobile phones. NFC begins to lose its lustre when compared to QR codes for m-payments on mobile handsets.

Unlike NFC, QR is already present on almost all existing mobile phones. There are hundreds of free mobile apps for generating and reading QR codes. The easy availability of QR codes from mobile phones is one reason QR outshines NFC for m-payments. As little as the incremental cost to include an NFC chip on a mobile handset may be, it is hard to compete with a software-only solution that costs nothing and already exists on billions of phones in service.

QR codes are also faster than NFC and speed is a key driver of adoption of new payments technologies. Mid-level smartphones and even feature phones can generate and display QR codes in a few seconds and QR can be captured and decoded by commercial barcode scanners from mobile displays in under 200 milliseconds[3]. This is considerably faster than the typical 600-800 milliseconds for a NFC transaction on a phone, which is proving unacceptably long for London Transit[4]. It worth noting the typical transactions times on Oyster cards are only about half the time required when NFC is moved to the handset and the secure element is placed on the SIM card, indicating that a good technology for card payments does not imply a good technology for m-payments. Commercial barcode capture software such as Honeywell's SwiftDecoder capture and decode QR codes in under three milliseconds. Quick response codes, as the name implies, are a very quick and convenient way to share information.

The systems to both display and capture QR codes are improving with the release of each new iteration of a smartphone or tablet. This is a positive unintended consequence of smartphone makers being locked in an 'arms race' to deploy better cameras and better displays for a public who are demonstrating an insatiable appetite for high quality images and HD videos. The displays and the cameras on these new phones are dramatically increasing the ability to reliably exchange information with QR codes and are setting the stage for the two dimensional bar code symbologies of the future. Denso Wave, the originator of the QR code, has developed iQR codes that can encode ten times the amount of data as regular QR codes in a smaller dimensional code and still be captured in mere milliseconds.

It should also be noted that NFC is excluded from half the mobile market due to Apple's decision not to deploy NFC on any of its handsets and tablets. Meanwhile, the mobile industry's unrelenting drive towards more powerful digital sensors and more pixel rich high definition displays only solidifies QR as the technology of choice for m-payments. Tablet makers are also building rugged touch tablets with fully integrated 2D barcode scanners which are quickly becoming *de rigueur* new age POS devices for millions of small merchants worldwide.

Consider for example Google's new Nexus 5, which has a 1080p display (445 ppi) and HDR+ 8 megapixel camera and uses the power of the 2.2 GHz Snapdragon 800 processor and a super fast shutter to take multiple, almost instantaneous, images at different exposures before combining them to produce an almost perfect image. It seems that 13-20 mega pixel cameras have become almost standard on even lower priced handsets. Relative unknown Xiaomi's latest Mi-3, which sold

out in China 86 seconds after sales opened, also has a 1080p display and a 13 mega pixel camera. These low cost handsets with high-end cameras serve as more than adequate imagers for scanning QR codes from such pixel rich displays. It's a safe bet to assume with all this hardware and photo enhancing software flooding into the marketplace, newer versions of QR code apps able to generate and capture the newer versions of QR codes such as iQR will soon evolve.

QR codes are arguably also safer than NFC. When it comes to the security of a transaction, a visible technology which can be intuitively protected by as simple an action as placing one's hand over the code so as not to allow others to skim or eavesdrop becomes preferred and trusted by consumers. When combined with precursor biometrics tokens, such as a user's facial template or voice print, accompanied by a time stamp and encrypted with a public key, QR codes become extremely secure. One-time-use codes, which can be transferred in milliseconds, seem well placed to become the preferred method to authenticate mobile users. It is a fact that unidirectional communications, as QR codes are, will always be more secure than inherently flawed bidirectional communications, like NFC. Unidirectional communications cannot be compromised by mere capture. Analogous to the way one's face cannot be compromised for identity purposes by the mere taking of a photograph, the security of a QR code cannot be compromised by its capture. The importance of this secure aspect of QR codes or unidirectional communications cannot be overstressed.

As a bi-directional communication, NFC is susceptible to numerous spoofing

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and eavesdropping attacks. Not only will rogue phones be able to infect POS terminals but ultimately, when left unchecked, all handsets using NFC to transact may become infected. Numerous studies and research papers have exposed breaches in NFC security including the 'Man in the Middle Attack'.[5] The safest way to avoid the possibility of contamination is to never allow payment terminals to communicate to your phone. All bidirectional M2M communication creates a vector for the introduction of viruses, Trojans and malware, so NFC will never be immune to these contagions. Given that based on past efforts to combat computer viruses and malware, such a lucrative target as fully blown NFC payments would attract the best criminal minds. QR codes simply do not carry similar risks, while still serving adequately the limited purpose of passing a payment credential.

Proponents of NFC point to the high value of NFC tags on 'smart posters,' which can be used for advertisements or the upload of digital products. NFC tags are more convenient but are also more costly than printed QR codes and haven't generated sufficiently higher consumer engagement. Smart posters have also been singled out as having the greatest potential for the type of vulnerability disclosed by Mulliner in his research. The company Three, in Sweden, found nearly equivalent engagement when deploying smart posters with both NFC and QR codes on subway cars[6]. Products like Android BEAM only use NFC to establish a link and then deploy zippier Bluetooth to transfer files. Bluetooth is 50 times as fast as NFC and Wi-Fi Direct is more than 500 times as fast. NFC's short range (less than 10 cm) is proving just as detrimental to NFC as the limiting

transfer speeds. Products like Apple's iBeacon and PayPal's Beacon have bypassed NFC to use Bluetooth to affect the payment process because of the extended range of Bluetooth. It's worth noting that the limited range of NFC was designed into the product to help make NFC more secure and thus more ideally suited for payments. It will be ironic if its short range becomes a factor in NFC's inability to cross the chasm to mobile, which is possible should something like secure Bluetooth or secure Wi-Fi Direct displace NFC due to their ability to provide enhanced consumer service by way of greater reach. NFC simply fails to feed off the mobile ecosystem. The NFC payments infrastructure is too costly and too risky to build when it really only serves a single purpose as a payment facilitator.

What we are witnessing is the evolution of mobile devices able to collect an 'alphabet soup' of precursor identity tokens, and quickly generate and display this information for extremely fast reliable transfer to POS devices by way of a single QR code. On the flip side, these same devices are beginning to serve as the POS devices themselves, capturing the same QR-coded information and routing it to cloud-based transaction switches for authentication and payment processing. This is creating downward price pressure on the manufacturers of 2D barcode readers which traditionally commanded roughly double the price of their weaker linear bar code cousins and which are now moving towards price equity. Almost all manufacturers of commercially available barcode readers have developed special algorithms for the capture of QR codes from highly reflective surfaces or mobile displays. Importantly, barcode readers can

multi-task by providing other services such as merchandise scanning and inventory audits rather than simply taking up valuable space on the checkout counter. Most importantly, barcode scanners are common, familiar and accepted by consumers in retail environments worldwide.

A lot of people in NFC circles were disappointed to see Apple once again release a new iPhone without NFC in 2013. The reality is that the guys at Google, ISIS and the banks should all be wondering if Apple doesn't know something they don't. Apple's talent for reading the future and designing products that appeal to consumers rather than attempting to force them to adopt a particular technology is well acknowledged. Don't be surprised if there is a connection between that new fingerprint reader on the iPhone 5 and Apple's own QR-based Passbook product (a biometric precursor and easily captured QR codes are a potent combination).

QR codes can be processed anywhere in the retail industry where 2D bar code scanners are used. American Eagle Outfitters installed NFC terminals in all their stores back in 2011 and two years later less than 0.01 percent of transactions have been with NFC[7]. At approximately the same time, Starbucks began a trial acceptance of QR-based m-payments in 16 stores. In the space of a year, Starbucks expanded its QR payments to a further 7,000 stores. By the end of 2012 Starbucks won the Mobile Marketer of the Year award and reported doing two million m-payments per week[8].

The success or failure of a technology can also be influenced by regulation. This is especially true in the highly regulated financial sphere. Therefore, it was a positive event for QR codes when, last year, the Short Payment

Descriptor (SPAYD format) was accepted by the Czech Banking Association and submitted to all Czech banks as the official standard for QR code payments[9]. The US Fed has recognised major gaps in the payments system and is soliciting support from industry to, among other things, develop methods for '[m]asked account details, eliminating the need for end users to disclose bank account information to each other.'[10] The Fed's current vision 'focuses on the end-to-end payment process, whereas past Federal Reserve Bank payment strategies focused on interbank issues'[11] and governments around the globe are beginning to realise that they must tackle the identity issue to enhance financial inclusion. A payment system should not expose personal information when identity theft is one of the fastest growing crimes, and youth and under-banked consumers often lack the identity requirements for traditional bank payment products. One of the Canadian Task Force for Payment Review's major recommendations in 2012 was to 'Propel the build of a digital identification and authentication (DIA) regime to underpin a modernized payments system and protect Canadians' privacy.'[12] Secure QR codes, because of their adequate data content, instant capturability, enhanced security, great ubiquity and ability to anonymise, or pass strong biometric identity tokens while protecting individual privacy, make for an excellent DIA regime and appear to be poised to become the standard for m-payments.

Of course, it is possible that neither QR codes nor NFC may win the race. It's possible that a different technology, probably from the developing world, may prevail. This is so because NFC appears to be delaying the 'coming of age' of m-payments in the

developed world by extending the plastic card's life. This causes innovation in m-payments in mature economies with ubiquitous credit and debit systems to lag behind the innovation found in the developing economies. 73 percent of Kenyan adults already use m-payments[13]. M-Pesa is the most successful m-payment product on the planet, representing 25% of Kenya's GNP and used daily by more than 25% of the population. It's revealing therefore that M-Pesa is a SMS money transfer system devoid of either NFC or QR codes.

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