



National Payments Corporation of India and the Remaking of Payments in India

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EXECUTIVE SUMMARY

“India Stack” is closely associated with the payment systems of the future. Along with innovations in data sharing and customer due diligence, India Stack enables payment systems that are real time, biometric capable, and connected beyond what most financial systems around the world have achieved. India’s journey also has been a relatively short one. Less than two decades ago, India’s payment systems were characterized by an overworked network of clearinghouses, deferred transaction settlement, and a lack of regulatory structure for payments. In short, India was far from leading the world when it came to payments.

How did India make such substantial progress so quickly? Should other countries follow the same path? And crucially, what impact are these developments having on financial inclusion?

The answer is in large part intertwined with the story of the National Payments Corporation of India (NPCI), a not-for-profit organization founded in 2009 to manage India’s retail payment systems. Although it is less than a decade old, NPCI has rolled out new products at a rate of more than one a year. From a domestic Automated Clearing House (ACH) solution and the RuPay card scheme,¹ to the much-discussed Unified Payments Interface (UPI) and Aadhaar-enabled payments, NPCI has relentlessly driven innovation.

NPCI was also central to India’s ambitious financial inclusion scheme, the Prime Minister’s Jan Dhan Yojana (PMJDY). Launched in 2014 by Prime Minister Narendra Modi, the program resulted in more than 300 million bank accounts being opened in just over three years. NPCI has provided for a RuPay debit card linked to each of these new accounts. By October 2018, NPCI was processing 48 percent of all electronic payment transactions in India (RBI 2018a).

Based on research and interviews, this working paper shares the story of NPCI, from the motivations

for its creation through its operations today. The paper examines the role NPCI played in transforming the way India manages financial transactions, as well as what lessons can be learned from India’s experience. It concludes that several factors underlie NPCI’s success, and these may be instructive for policy makers in other markets. Success factors include:

- An industry-led approach to ownership and governance, with strong regulator backing
- Competitive economics through a utility model, mixed with smart growth and a start-up culture
- A strategy of incremental, open-source product development
- A government/regulator that uses carrots and not only sticks
- A government/regulator that balances caution with progress

This paper is not a history of the Aadhaar program, a study of India’s national payment systems, nor an analysis of Indian politics and related policy topics such as demonetization. Similarly, this paper is not a technical document or a blueprint for the creation of an India Stack. India Stack includes a variety of elements (such as the Digilocker—India’s civic version of Dropbox) that are not part of NPCI and is, therefore, not covered.

The first section of this paper tells the story of NPCI based on research and stakeholder interviews. It addresses why NPCI was created and how it went about reforming retail payments systems in India. The second section provides a deeper look at the NPCI model, including scheme governance, economic rules, and technology decisions that helped NPCI achieve its goals. The final section draws these threads together and highlights lessons for other markets.

1. See “RuPay Product Overview,” NPCI, <https://www.npci.org.in/product-overview/ruPAY-product-overview>.

THE NPCI STORY

PAYMENTS IN INDIA BEFORE NPCI (1986–2007)

In the mid-1980s India was a nation of contrasts. It had just won its first Cricket World Cup, Sridevi was lighting up screens as the dancing queen of a cinema-crazed nation, and Rajiv Gandhi had assumed office as prime minister on a platform promising leaps forward in science and technology. Yet the country's economy was largely closed (Locke 2011). A broad program of nationalization had moved much of India's economy, including its banking sector, under government control only a few years before. Twin fiscal and trade deficits persisted and would soon lead to depleted exchange reserves, a devalued rupee, and by 1991, economic crisis.

Similar contrasts were seen in India's approach to payments infrastructure. In 1986, the Uniform Regulations and Rules (URR) for Bankers' Clearing Houses introduced a new structure to bring consistency to how clearing operations were to be managed across the country. However, these rules were contractual in nature, and there were still no formal government oversight and regulation of payments.

The same year, India's central bank, the Reserve Bank of India (RBI), took the first steps toward computerizing the financial systems. Magnetic Ink Character Recognition (MICR) was introduced for more efficient check processing. However, MICR depended on a large decentralized network of clearing houses and was slow to migrate out of India's largest cities. MICR did not become stable in India's four largest cities (Mumbai, Calcutta, Chennai, and New Delhi) until three years later in 1989. By that time, the transaction volumes managed by MICR were already on the verge of becoming unmanageable.²

Following India's 1991 economic crisis, the deregulation measures that had started in the late 1980s became "systematic and systemic" (Leigh-Pemberton 1990 and Panagariya 2004). As reforms took hold, India's economy opened further to allow private-sector as well as international investments. India's gross domestic product (GDP) growth rate, which had hovered around 3.5 percent from independence through the mid-1980s, reached closer to 5.5 percent by the

mid-1990s. As the economy grew, more pressure was applied to payments systems.

MICR expanded outside India's major cities during the 1990s, and the creation of the Electronic Clearing System (ECS) introduced electronic debit and credit transactions to help reduce pressure on the systems. By 1996, RBI launched the Institute for Development and Research in Banking Technology (IDRBT) to define new technology solutions such as the Indian Financial Network (INFINET) communications system for enabling electronic financial transactions, which would be live by 2000.

Industry also made advances in the 1990s. In February 1997, the India Bankers Association (IBA) launched the Swadhan card switch to improve interoperability of credit and debit cards. Unfortunately, the pace of change remained slow by today's standards. Swadhan would be launched without connectivity to the Visa/Mastercard networks and without any support for point of sale (POS) systems. By the following year, the switch would connect only 69 ATMs from 19 of the country's banking institutions (RBI 1998).

Economic growth and pressure on payment systems accelerated in the years that followed. By the early 2000s, GDP growth reached 7.3 percent, driven by a surge in skilled labor in the technology sector (Anand 2014). At the same time, RBI was aggressively driving financial access. The regulator helped improve core banking in smaller institutions, issued guidelines for correspondent (agent) banking as well as "no-frills" accounts, and enacted regulations geared toward improving access to bank accounts (World Bank 2012). The population was becoming wealthier and more financially included, and payment systems threatened to fall behind.

Much had changed in India's economy by this time, but payments were still being cleared through a decentralized network of over a thousand local clearinghouses, with transactions settled by RBI on a net basis a day or more later. By the time India acquired a Real Time Gross Settlement (RTGS) system in 2004, it was the 69th country to do so, behind countries including Cuba, Kazakhstan, Ghana, and Malawi.³

The Swadhan network, which was capable of handling 250,000 card transactions per day, was still man-

2. For context, check clearing volumes in all of India totaled 746 million in 1990 when no electronic channels existed. In 2018, annual clearing of paper instruments hovered around 1 billion transactions, but this is only 5 percent of all retail transactions (RBI 2018b).

3. See Allsopp, Summers, and Veale (2009) and Bech and Hobijn (2007).

aging only around 2 percent of that potential volume. By the end of 2003, IBA terminated the service after failing to find a vendor willing to continue the contract. The following year, IDRBT would collaborate with switch vendor Euronet to launch the National Financial Switch (NFS). NFS once again provided ATM connectivity in the country and offered an e-commerce gateway, but the move largely represented a reboot for domestic card connectivity in India—with operations now managed by the regulator.

At the same time, RBI's role in the financial system was the subject of open debate. Through IDRBT, RBI was becoming responsible for more and more of the country's retail payments systems, with governance still managed under contract law through URR. In RBI speeches from the time, Yaga Venugopal Reddy (deputy governor and later governor of RBI) acknowledged the need for a "wholesale review" of the government's role in payments, ultimately asking, "How far are we from global standards?" (Reddy 1996 and 1997).

RBI's Advisory Group on Payment and Settlement Systems, formed in 2000, found that "the rights and obligations of banks and the dispute resolution mechanism [were] not legally codified," that the RBI Act of 1934 did not give appropriate powers for the regulation and supervision of payments systems, and that RBI's operation of retail clearing functions was not best practice. The report concluded: "RBI should transfer the management of clearing house operations as well as that of the RTGS system entirely to a separate body/bodies to be constituted by the association of bankers for the purpose" (RBI 2000).

By the time RBI's Vision Document for 2005–2008 was published, clear positions were being taken with respect to both the oversight of markets and RBI's role in clearing payments. A scan of 14 leading markets found that "it is only in very few countries that central banks operate [the] retail payment system" (RBI 2005). The document went on to say: "A point of view which is being increasingly recognized is that the regulator should not be the service provider unless the payment system is systemically important."

The time for structural change in the way India managed payment systems seemed to have arrived, and it was perhaps overdue.

A NEW PAYMENTS LAW USHERS IN NPCI (2007–2009)

The 2007 Payment and Settlement System Act was meant to fill several gaps in payment systems and regulation (RBI 2007). The Act clearly outlined the rights

and duties of various actors in the payments ecosystem, provided clearer legal context on topics such as dispute resolution, and provided for a separate nongovernmental institution to operate retail payment systems.

The Act gave RBI the powers to authorize such an entity, provided that a majority shareholding was retained by public sector banks (government majority held).⁴ RBI tasked IBA with engaging an initial group of bank participants, though membership in the new organization would be voluntary from the start.

Ten of India's leading banks were ultimately recruited by IBA. These included the country's six largest public banks, two private domestic banks, and two foreign banks.⁵ The mix was designed to help ensure a cross-cutting base of Indian consumers and a variety of institutional perspectives on payment systems.

Each of the 10 initial participants would invest approximately US\$14 million and take a 10 percent share in NPCI—giving industry a direct stake in the venture. However, NPCI was formed as a Section 25 company for "charitable objectives," which under Indian law requires that profits be reinvested to serve the mission of the organization.⁶ The decision to file as a not-for-profit underscored NPCI's utility nature from the outset.

While the government did not invest in NPCI directly, it held indirect control through majority shares in public banks. NPCI would be responsible to RBI as the regulator, but officially, it would be independent. The organization's 15-member board included representatives from each of the 10 shareholder banks and five independent representatives, which included one RBI-nominee, but there was no direct regulator representation.

RBI also made important contributions to the economic sustainability of the venture. IDRBT's NFS/Euronet switch, which was processing a majority of the debit/credit card transactions in the country at the time, was transferred to NPCI at book value in November 2009. The sale included the necessary hardware, software, and staff. This transfer, along with check clearing operations, provided a revenue stream from day one. No additional capital injections from RBI or participant banks would be needed in the years that followed.

EARLY CONVENTIONAL PRODUCTS BRING IMMEDIATE REVENUE STREAMS (2010)

NPCI officially began operation in January 2010. Each of the 10 shareholder banks assigned a senior representative to be part of the NPCI team. These assignees

4. Provision in the PSS Act that facilitates NPCI: Chapter III 4(2): "The Reserve Bank may, under sub-section (1) of this section, authorise a company or corporation to operate or regulate the existing clearing houses or new clearing houses of banks to have a common retail clearing house system for the banks throughout the country: Provided, however, that not less than fifty-one per cent of the equity of such company or corporation shall be held by public sector banks" (RBI 2007).

5. Initial participating banks included public banks State Bank of India, Bank of Baroda, Punjab National Bank, Canara Bank, Bank of India, and Union Bank of India; private banks ICICI Bank, HDFC Bank; and foreign banks Citibank and HSBC.

6. Still known informally as a "Section 25" company, the provision exists within the 2013 Companies Act under Section 8. NPCI is now a Section 8 company (MCA 2013).

remained employed by their respective organizations with salaries reimbursed to the banks by NPCI. The model was structured to reinforce the notion that these were temporary postings. The same model initially would be adopted for NPCI's first chief executive officer (CEO), Abhaya Prasad Hota. Hota was assigned by RBI for the first two years of NPCI's operation with the option to return to a job at the central bank at term.

In its early days, visitors to NPCI's offices might easily have mistaken the operation for a small technology start-up rather than a government-supported payments clearing facility. The small team worked out of two small rooms in IBA's offices. NPCI would remain there for almost two years before taking a rent-subsidized floor in an RBI building.

The work came at a start-up's pace as well—fast and furious. The migration of the NFS infrastructure began immediately. At the same time, NPCI began developing the Immediate Payment System (IMPS), a real-time payment platform, and NPCINET, which would eventually replace the INFINET network. Operational meetings were held in the mornings, afternoons were spent recruiting full-time staff and institutional clients, and the evenings were spent on reporting and preparing schedules for the next day. Salaries often did not match private sector rates, and those joining NPCI frequently took a pay cut for the opportunity to help improve payment services in the country.

Taking on NFS as a first order of business would prove a critical success factor. By the time of service migration in December 2009, IDRBT was serving over 40,000 ATMs for 37 of the largest banks in India (RBI 2009). The transaction volumes from NFS made NPCI self-sustaining from the start. Combined with the organization's light operating cost model, cash flow was not a significant concern (RBI 2009).

However, NPCI faced several challenges. The shift to newer technologies was a large lift, and a host of operational challenges had to be sorted out. NPCI was not simply starting fresh outside of RBI; it was also working to improve the stability of retail payments systems that had operated over the previous decades.

At the same time, it had a mandate to grow aggressively. NPCI pursued smaller banks that were not already connected to NFS for card services. It also sought integration with other card switches, such as Financial Software and Systems (FSS), which served smaller institutions. NPCI's debit card—RuPay—was yet to launch and only Visa and Mastercard cards were being issued in the market. NPCI offered domestic switching for cards, often at better rates than were available from the international issuers (around Rs 2 with Visa/Mastercard, compared to 50 paise with NPCI).

A new dispute resolution system was also introduced during this time. It was a single online platform that allowed participants to view and track disputes in real time. Unlike its Visa and Mastercard competitors, NPCI imposed no additional charges for dispute resolution, no card scheme fees, and no card scheme

membership charges. The only costs imposed were for hardware (a flat fee payable over the first five years of operation) and a per transaction charge for processing.

NPCI's comparatively low cost of operation was critical. Government backing was important in enabling NPCI's success, but even more important was the company's not-for-profit status. From the beginning, NPCI was not motivated by shareholder returns, and unlike its private-sector competitors, it did not have to pay taxes on earnings.

A DEBIT CARD FOR ALL (2011–2012)

Over the next few years, NPCI continued to take on more of the retail payment services that had been run by RBI. In 2011, RBI transferred India's Check Truncation System (CTS) to NPCI, and in 2012, NPCI launched a National ACH (NACH) to replace RBI's legacy ECS services. Today, CTS and NACH are the only two NPCI services that are mandatory for all banks to use.

From the time of NPCI's launch, there was a growing opinion among regulators and industry that a country the size of India should be able to accommodate a domestic card scheme—comparable to China Union Pay. Regulators were concerned that cards were not scaling sufficiently with lower-income customers or doing enough to improve financial inclusion. Industry continued to have concerns that the economics of international card schemes meant that issuing cards to these same segments would not be profitable.

RuPay was launched in March 2012 with a domestic debit card product targeted at the mass market. From the start, personal insurance was a part of the pitch from NPCI. Any customer who performed at least one transaction in a three-month period with the card was covered for up to Rs 1 lac (around US\$1,500) in accident, life, and permanent disability insurance. The offering made sense for NPCI because, while the first transaction went to cover the insurance premium, market research had found that consumers' transaction volume increased when they were offered the insurance.

RBI and the Government of India also helped to drive the uptake of RuPay. Over 300 million bank accounts would be opened as part of the PMJDY scheme to provide bank accounts to India's unbanked. Each of these accounts would be issued a RuPay card (Tripathy 2014). The government also drove adoption of RuPay by promoting the card among bank and government employees—walking a fine line between support for NPCI's nonprofit mission on one hand and the perception of market distortion on the other.

Over this time, NPCI drew challenges from international card schemes who claimed NPCI was receiving preferential and anti-competitive treatment from the regulator. Soon, NPCI had exited RBI's offices to obtain a separate commercial office space, and A. P. Hota was hired by NPCI as the organization's CEO, severing his employment at RBI.

Nevertheless, RBI and other parts of the Indian Government continued to exercise strong oversight. Meetings were held, and are still held, to track NPCI performance. On exceptional occasions, these meetings are attended by officials up to the level of the prime minister's office.

In the years that followed, the RuPay product family would grow to include a credit card, chip/PIN and contactless options, and cards enabling e-commerce and international transactions through Discover card rails. Rumors persist that NPCI's card business will or should be spun off into a separate entity to create a more level playing field.

RuPay's success in driving financial inclusion or card adoption among the masses remains an issue of some debate. Today, activity rates for RuPay cards remain low—perhaps because of the directive nature in which many of these cards were issued. RuPay cards also make up a comparatively small fraction of total card transactions in the market. Over 500 million RuPay cards have been issued as of mid-2018—nearly 60 percent of all those in the market—yet RuPay represents about 25 percent of all card transactions (RBI 2018b).

As the focus of India's financial services industry continues to shift toward newer biometric and mobile solutions, it is possible that these new solutions will leapfrog cards as the primary noncash payment channel for large swaths of the country entering the formal financial sector through programs like PMJDY.

BRINGING BIOMETRIC TO PAYMENTS (2012–2013)

During the late 2000s, Nandan Nilekani led the creation of the Unique Identification Authority of India (UIDAI) in what is now a well-known effort by the Government of India to create a biometric identification scheme for all residents. Early on, the UIDAI team considered government-to-person (G2P) payments to be a key use case to generate enrollment demand and bolster support from the government. The idea was inspired in part by similar programs in Latin America—for example, Brazil's Bolsa Familia, which uses electronic channels to reduce fraud in cash transfer programs (albeit through cards and not biometrics) (Aiyar 2017).⁷

Since early 2010, UIDAI and NPCI had been in discussions over how NPCI might help enable the disbursement of government payments keyed on Aadhaar IDs, but these discussions moved from the theoretical to the practical only in 2012 (Aiyar 2017). A task force on Aadhaar Enabled Unified Payment Infrastructure led by Nilekani submitted its report to the finance minister in February 2012. The report recommended the development of a "government e-payments gateway." By September 2012, the prime minister announced a ministerial committee to define the system's architecture.

While the momentum behind the government payments use case was strong, it was not the only reason NPCI was interested in biometrics. Around this time, RuPay cards still used magnetic stripes, and RBI had started to advise the card schemes that better security functionality (e.g., chip/PIN) would soon be required.

Visa and Mastercard had already started to adopt chip/PIN functionality, but for a mass-market card like RuPay, the prospect of moving all cards to chip/PIN technology was daunting. Further, given a largely informal physical addressing system, low literacy rates, and low incomes, the need to ship cards and PINs separately for security purposes and to teach users not to forget or disclose their PINs promised to be a logistical nightmare. As NPCI leadership considered their options, biometrics seemed to be an attractive alternative to meeting RBI's security requirements.

Today only RuPay Platinum cards feature chip/PIN technology, given their higher account limits and larger risk profile. Ironically, since the rollout of biometric support for NPCI payments, NPCI is now planning to pursue chip/PIN technology for all cards, in line with international standards and regulator priorities.

By late 2012, NPCI introduced the Aadhaar Based Remittance Service (ABRS) using Aadhaar numbers to route payments. A precursor to the Aadhaar Enabled Payment System (AePS), ABRS did not enable government (bulk) payments or transactions using biometric authentication. It simply provided an easier way to identify individual recipients as compared to using bank account numbers. ABRS never ultimately scaled, but it provided an important testing ground for later services.

In a story that repeats throughout the history of NPCI, ABRS represents an incremental approach to product development that can prioritize stability and long-term success. The ABRS project allowed NPCI to work with a smaller, simpler piece of the puzzle. NPCI was able to focus on basic system requirements and stabilize existing features before advancing to more complex scenarios. The experience with ABRS helped NPCI to figure out how it could map individual Aadhaar numbers (on Aadhaar-enabled bank accounts) to corresponding banks.

Initially, NPCI sought to hold information such as customer bank account numbers to enable better monitoring and other payments use cases. However, after debate among NPCI, the banks, and the regulator, NPCI was ultimately restricted to holding only the relevant Aadhaar number and a bank identifier. While this may not have been NPCI's ideal scenario, the approach means that only the information necessary for routing is shared and customers can feel more comfortable with the level of data protection offered.

The Aadhaar Payments Bridge System (APBS) was designed to provide functionality for bulk payments. By February 2013, most banks were sending NPCI the daily reports necessary to build out the mapping table

7. See also, Kapur, Mukhopadhyay, and Subramanian (2008).

of Aadhaar numbers to bank identifiers, with encouragement of the bankers' association and the regulator. APBS enabled bulk payments to be directed into Aadhaar-linked accounts, which allows government-led social welfare programs to leverage Aadhaar in making payments.

AePS brought biometrics to individual transactions by enabling micro-ATM and POS use with biometrics. Using AePS, payment recipients can perform any of five core transactions from branch, agent, and merchant locations using only their Aadhaar number and a biometric verification. The transactions include cash deposit, cash withdrawal, balance inquiry, issuance of a mini-statement, and the ability to send a remittance payment.

Products like APBS and AePS offer cheaper and more convenient services for customers, especially those with low literacy. The products also offer savings to providers; savings from leakage in G2P payments is one example. However, the success or failure of these products is also inherently intertwined with the fate of the Aadhaar program itself. Aadhaar has drawn criticism from several corners of India, since even before it was launched—with some challenges more valid than others.

In September 2018, India's supreme court ruled on the constitutionality of the country's ambitious biometric identity program. Much of the Aadhaar framework was upheld, but some uses were struck down. As it stands, Aadhaar-based payment products such as APBS and AePS, as well as other financial services, including electronic know your customer (eKYC), are still allowed for government benefit transfers (Jain 2018). In January 2019, the Indian government passed an amendment allowing voluntary use of Aadhaar IDs, including by the private sector. For many, Aadhaar remains the only official proof of identification they have (The Economic Times 2019). The legal landscape will no doubt continue to be refined as further interpretations of the court's ruling and India's upcoming Data Protection Bill become available.

CHALLENGES IN CREATING A SINGLE USSD CHANNEL (2014)

A few years into NPCI's operations, IMPS had been largely successful in making real-time push payments accessible through online channels, including mobile. The transactions could be initiated using bank account information, mobile numbers, and in certain cases, Aadhaar numbers for products that have Aadhaar-enabled accounts.

However, there were still concerns that digital was not moving fast enough to reach the poorest people and that financially excluded people remained digitally excluded. Barriers included poor financial literacy and low smartphone penetration. NPCI looked to other

markets for ideas. It studied the success of M-PESA in Kenya, which had introduced formal financial services to nearly 50 percent of the country's population in less than a decade.

M-PESA relied primarily on SMS to reach the country's unbanked, few of whom had smartphones at the time of the product's 2007 launch. India's mobile network operators (MNOs) had already made a few attempts at offering similar products. For example, India's largest MNO formed a joint venture with the country's largest bank in 2010, but the venture soon ended because of issues around branding and product control. By 2012, some MNOs were partnering with banks, and most became prepaid payment issuers (wallet providers without the authority to cash out at an agent location) when the license became available.

In late 2014, NPCI introduced a single USSD channel for India to promote interoperability. It had determined that USSD needed to be an open system of rails for feature phone owners to transact through the NPCI infrastructure. A single short code (*99#) would open a session with NPCI regardless of the telecommunications provider, and messages would be sent over NPCI rails to the relevant bank.

Initially MNOs resisted being a "dumb pipe" for financial transactions. They wanted to share revenue with the banks. Ultimately, the MNOs were required by the telecommunications regulator to not only connect, but to do so without a revenue-sharing model. Customers would pay the MNO directly for each session, but the MNO would have no say as to the type of transactions, fees thereof or profit share in the transaction. Their revenue would be the USSD session fees charged by the MNO to the customer, which started at around US\$0.03 and later dropped closer to US\$0.01 in response to regulatory pressure.

For its part, NPCI applied the same economic model to USSD as it did to other transaction types: charging only the provider for transaction switching. Messages for balance inquiry and on-net transactions were routed through NPCI at no charge.

The relationship between the banks and MNOs was rocky from the start. The MNOs were not satisfied with the deal that had been struck, and many still had ambitions to launch proprietary models. For *99#, most MNOs capped the session time at 45 seconds, meaning that customers would frequently face timeout errors before completing their transactions.⁸

The challenges with *99# outweighed whatever momentum might have been gained early on. Almost five years after launch, USSD is not used heavily in India, and even the MNOs are moving away from the channel as they focus on their own app-based solutions. The failure of *99# to scale may be because of the lack of incentives and the power dynamics between institutions with competing priorities, but it may also be because of low English literacy rates among feature phone users or because the solution simply came too

8. See NPCI, "99# Product Overview," <https://www.npci.org.in/product-overview/99-product-overview>.

late in a world that is increasingly moving away from feature phones.

Today, NPCI has largely moved past feature phones as a target channel. Rather than focus on reforming or replacing *99#, resources are being directed into furthering other channels such as biometrics and app-based solutions.

UPI AND INDIA'S SIMPLIFIED PAYMENTS (2015–2016)

If there is a single most popular, most recognized, most widely reported and often misreported product from NPCI, it is UPI. Simply put, UPI is a solution that allows many of the other products discussed throughout this paper to come together to offer interoperable, real-time mobile payments.

The biggest difference between UPI and other products, such as IMPS, that focus on real-time mobile payments is its focus on interoperability. Financial transactions require a variety of messages to be passed back and forth. They require authentication messages to verify a customer's identity, authorization messages to verify available funds, and payments clearing messages to provide debit and credit instructions. UPI standardizes these messages to allow for seamless payments among institutions, including banks and nonbanks; channels, including web, smartphone apps, and USSD; and financial addresses, including mobile numbers, bank account numbers, and email-like virtual payment addresses.

By standardizing messaging, UPI has allowed for an unbundling of accounts from customer experience and the rapid adoption of payment apps like Google Pay. It has already massively changed the way digital payments are made in India, and use of the service is still growing rapidly. But how did this happen?

In 2013, Raghuram Rajan became India's first central bank governor with extensive experience outside the country. He came into RBI pushing the types of faster payments solutions he had seen in markets like the United Kingdom. At the same time, NPCI was searching for ways to make its growing list of products fit together better. There was a realization that the acronym-soup of mostly siloed products was limiting the potential of each. NPCI also needed to address technical limitations in its systems (e.g., moving from messaging standard ISO 8583 to ISO 20020).

With strong buy-in from the regulator, NPCI began looking for a solution to these challenges. It looked globally to understand best practices but developed a customized solution to meet local needs.

The NPCI team traveled to developed markets, such as Australia and the United Kingdom, that had already started to introduce faster payments schemes. Next, NPCI worked with iSPIRT, an open source developer community, to define and develop UPI. Throughout this iterative and collaborative process, NPCI committed significant amounts of its own developers'

time in its work with iSPIRT, and regulators provided feedback at several junctures.

As with the development of Aadhaar itself, the use of open source standards and practices helped to avoid issues around proprietary rights vesting with particular technology vendors and many of the other common pitfalls of large-scale technology projects. Nilekani would later write of UPI: "Its high volume, low cost and highly scalable architecture built on an open source platform is key to India's transformation to a digital payment economy" (Bhushan 2018).

The BHIM app and driving UPI adoption

Initially, not all banks in India were on board with the plan for UPI. A model in which users could transact through nonbanks independent of their banking relationship was a potential threat to existing products and services from India's banking sector. Banks worried that they might be relegated to a role as the "dumb pipe" for financial transactions—not dissimilar from the way MNOs viewed the threat of a unified USSD channel through *99#.

The banks also were concerned, partially justified, that connecting nonbanks would add systemic risk to the payments system. Nonbanks were not liable for fraud to the same extent as banks, and some nonbanks were using incentives, such as cash-back offers, that violated the terms of a banking license.

Like most NPCI products, UPI is a voluntary service. NPCI needed to convince banks to sign on if the service was to be a success. The dominos began to fall in UPI's direction when the country's largest financial institution, State Bank of India (SBI), agreed to join the scheme. SBI joined after being lobbied by NPCI and some convincing presentations from others, including Nilekani. SBI's enrollment drew a handful of the other large institutions—SBI's key competitors—but a large swath of middle-tier banks continued to sit out.

At the same time, every bank on UPI wanted to create its own app and control the customer experience, yet some were not effectively supporting their own technologies, which threatened to degrade the user experience. Smaller banks often did not have the resources to compete. The offices of the prime minister and minister of finance determined that a common app was needed. The concept was simple: create a single app that can be branded by any financial institution and used as its own.

NPCI proceeded to develop the app with the support of the iSPIRT open source developer community and under the watchful eye of the government. At Prime Minister Modi's request, the app was called BHIM in honor of Dr. Bhim Rao Ambedkar, the revered champion of India's oppressed and a key architect of India's constitution.

Naming the application BHIM proved a shrewd political move for Modi and boosted UPI because banks could not use BHIM unless they were on UPI. The government aggressively marketed BHIM as India's national app, fanning patriotism. This in turn

drove a groundswell of customer demand. As growing numbers of customers visited banks asking for their BHIM app, many otherwise resistant banks were incentivized to join UPI.⁹

Today, over 1,400 banks are members of NPCI. Around 160 of these are on UPI. Although this is a small percentage, these banks serve 95 percent of the country's banking customers. Many of the country's small banks that are not yet on UPI have not joined because of their limited technical capacity, but more banks are steadily coming online.

In addition to driving UPI adoption, the BHIM app provided a better, more standardized user experience. Banks can brand the app as their own—an attractive option for smaller banks that do not have the technical expertise to develop state-of-the-art solutions in-house.

Regulators strongly recommend that all banks on UPI use BHIM. Banks are welcome to promote a proprietary app in addition to BHIM, but regulators watch carefully to ensure banks are putting sufficient weight behind the use and promotion of BHIM. NPCI continues to upgrade the app on behalf of banks. For their part, banks continue to shoulder some responsibility for driving its use, and in certain cases, they attend meetings with regulators to discuss whether targets have been met in promoting the service.

Serious criticism of the product or its mandate have been largely mitigated because BHIM is a well-designed app that works for most users. In an independent design review of six financial services apps, BHIM emerged with top honors (Raman and White 2017). Yet as with RuPay, BHIM has triggered concern in some corners that NPCI is acting simultaneously as scheme owner, standard setter, and solution developer—an arrangement with potentially negative effects on market competition.

UPI 2.0 was released in August 2018. The new version included overdraft and the ability to pay later, among other features (Gupta 2018). Originally, UPI 2.0 was to use biometrics; however, this feature ultimately was not approved by RBI. UPI 2.0 omitted an earlier feature whereby an Aadhaar number could be used as a payment address. UPI is now wholly separate from the Aadhaar infrastructure and related payment schemes that NPCI operates under AePS and APBS. The separation represents continued caution by regulators as the debate around Aadhaar and biometrics continues.

In any event, there is little doubt that UPI will continue to evolve as it gains traction. The number of transactions running over UPI increased by over 50-fold from 2017 to 2018. Reports place the value running over UPI at half of all debit and credit card swipes in the country (Bloomberg 2018). Nearly 60 NPCI developers sit in Bangalore working with iSPIRT to iterate, reach, and innovate beyond existing solutions.

ACCELERATING GROWTH (2017–TODAY)

Several other products have been developed since the launch of UPI. Some of these, such as National Electronic Toll Collection for open road tolling, use new consumer technologies to change the way India's population pays. Others, such as BharatQR, are making it easier for providers and customers to use existing services.

BHIM Aadhaar

The BHIM Aadhaar app is a merchant POS solution for Aadhaar payments, unlike the biometric-enabled payments supported by APBS and AePS, which do not include merchant payments. The BHIM Aadhaar app enables merchants to accept a payment authenticated by biometrics. The maximum transaction size is capped to 10,000 rupees.

QR Standards

Under an initiative driven by RBI in late 2016, NPCI and the international card schemes (Visa, Mastercard, and American Express) worked together to create common messaging standards for QR codes in India. These standards support QR-based transactions riding over the AePS rails for biometric authentication or over the UPI rails for nonbiometric authentication.

Everything else remains the same. Banks or their designated third parties are still responsible for merchant acquiring, and the same rules around merchant discount rates (MDRs), interchange, and other economic and governance considerations apply.

Bharat BillPay

Technically, the Bharat BillPay System (BBPS) is a separate program from NPCI, but it is housed within the organization. BBPS uses NPCI infrastructure, but it has its own scheme rules and economics. The primary difference between BBPS and other merchant solutions, such as those supported through UPI, is that BBPS is focused entirely on bill payment. Unlike a merchant economic model based on an MDR, BBPS is based on customer fees for bill payment transactions. It is a regulator program, and entities currently in the business of bill payments who are not authorized on BBPS cannot offer services in the market—though they can become an agent of a scheme participant.

Looking forward

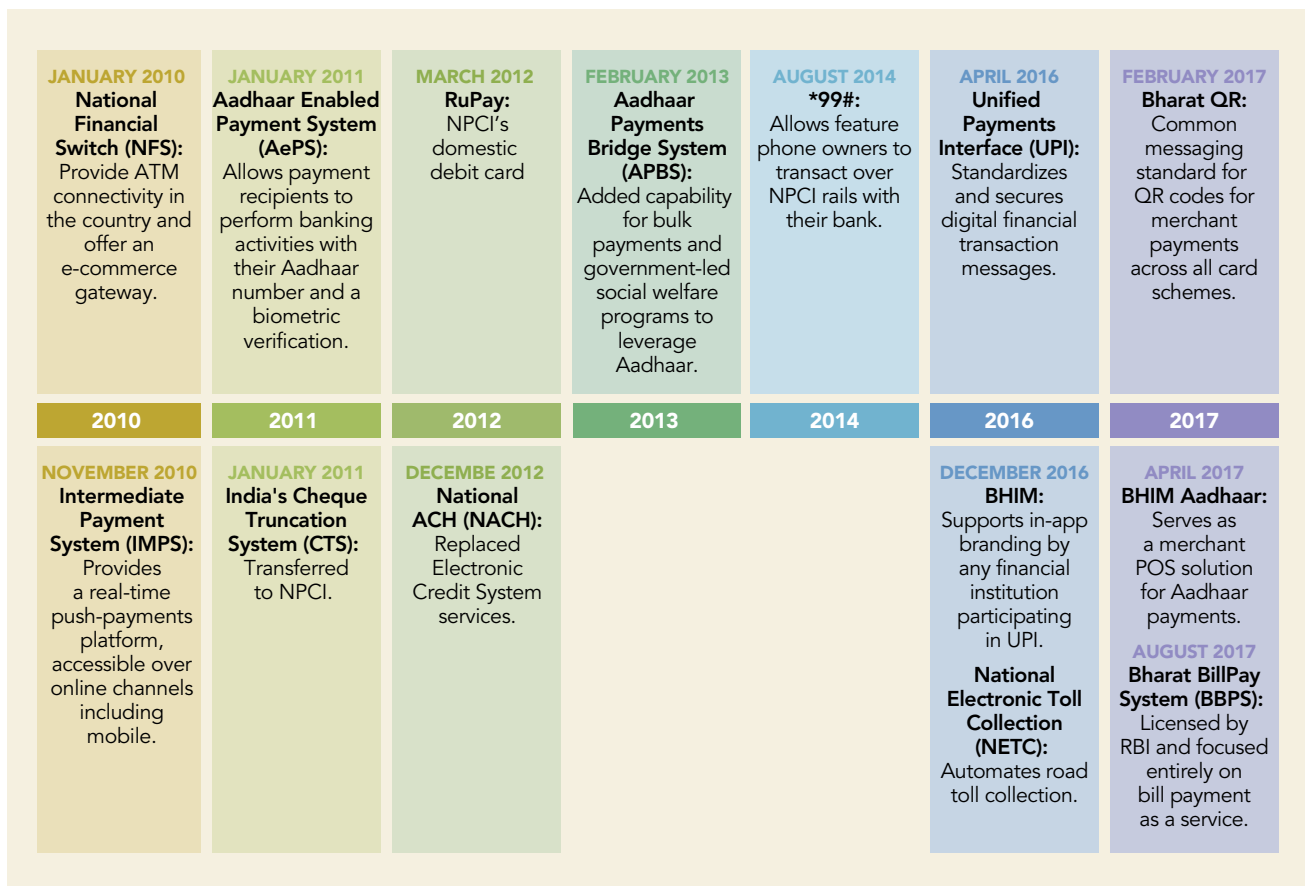
The India market continues to rapidly evolve, so it is difficult to predict the future of NPCI. However, it seems safe to assume that NPCI will continue to grow and become more inclusive over time. The ownership model that began with 10 shareholder banks has expanded to 56 bank shareholders today. Board seats have been similarly updated, with six seats allocated to the original promoter banks and four seats allocated to

new shareholders on a rotational basis. Similarly, PPIs have been granted permission to connect directly to NPCI, a capability previously limited to banks.

Yet these moves toward more open and inclusive services are still set in a dynamic legal and regulatory context. Changing interpretations of the role Aadhaar can play in service delivery, views on RBI's role in over-

sight over payments, and the competitive positioning of NPCI, among other considerations, continue to shape NPCI's journey. The type of retrenchment seen with UPI 2.0 demonstrates a continued balancing act between progress and restraint in India's retail payments systems. See Figure 1 for a timeline of NPCI's journey to date.

FIGURE 1. NPCI's product journey



THE NPCI MODEL

GOVERNANCE

Operators of payment schemes, whether domestic solutions like NPCI or international card schemes like Visa and Mastercard, frequently provide more than a switch or even a brand. They also define the way their members will interact with one another through a set of scheme rules. These rules set the terms needed to safely and efficiently exchange payments, they define the power structure and the way decisions will be made, and ultimately, they guide how competitors will collaborate.

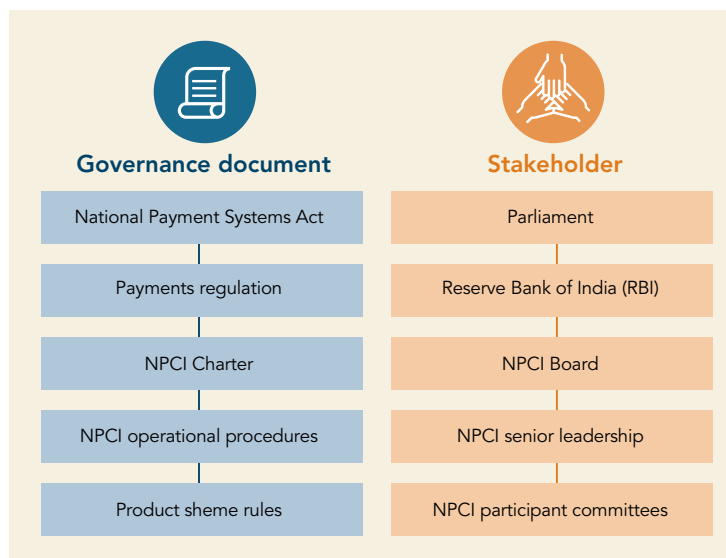
NPCI scheme rules are defined by product-level steering committees composed of participating institutions (see Figure 2). These include representatives of both NPCI shareholders and nonshareholding participants in NPCI services. The institutions passing transactions over NPCI's rails (i.e., participants with a stake in the game) determine what rules are applied and how those rules are enforced.

Committee membership is decided by NPCI management, but the organization has made efforts to assign key participants for relevant products and maintain proportionate representation from the diversity of banking institutions created by regulation over the years, including public, private, foreign, cooperative, regional rural, payment, and small-finance banks. As nonbanks begin to use NPCI rails directly, they, too, will become participants with a voice in decision making.

These committees make decisions on everything from operational processes to interchange rates between participants. In the early days of a product roll-out, committees typically meet twice or more monthly and then settle into a quarterly schedule once the product is live. Decisions are made by consensus. Once participants in a committee reach agreement, rules are documented and sent to the NPCI board for approval. Finally, once approved by the NPCI board, the rules are submitted to RBI for regulator information and comment (See Figure 3).

Like other products, UPI is considered a separate scheme within NPCI. It has its own participant committee and rules. However, because UPI is an aggregation of other products that have their own scheme rules, scenarios can arise where several rules apply. For example, a web transaction initiated within mobile banking and sent to another bank account could leverage the rules of UPI or IMPS. In such cases, the send-

FIGURE 2. NPCI governance structure



ing provider selects the scheme rules that will govern the transaction. The rules are not materially different in these scenarios, and the decisions would not typically have any impact on the customer experience.

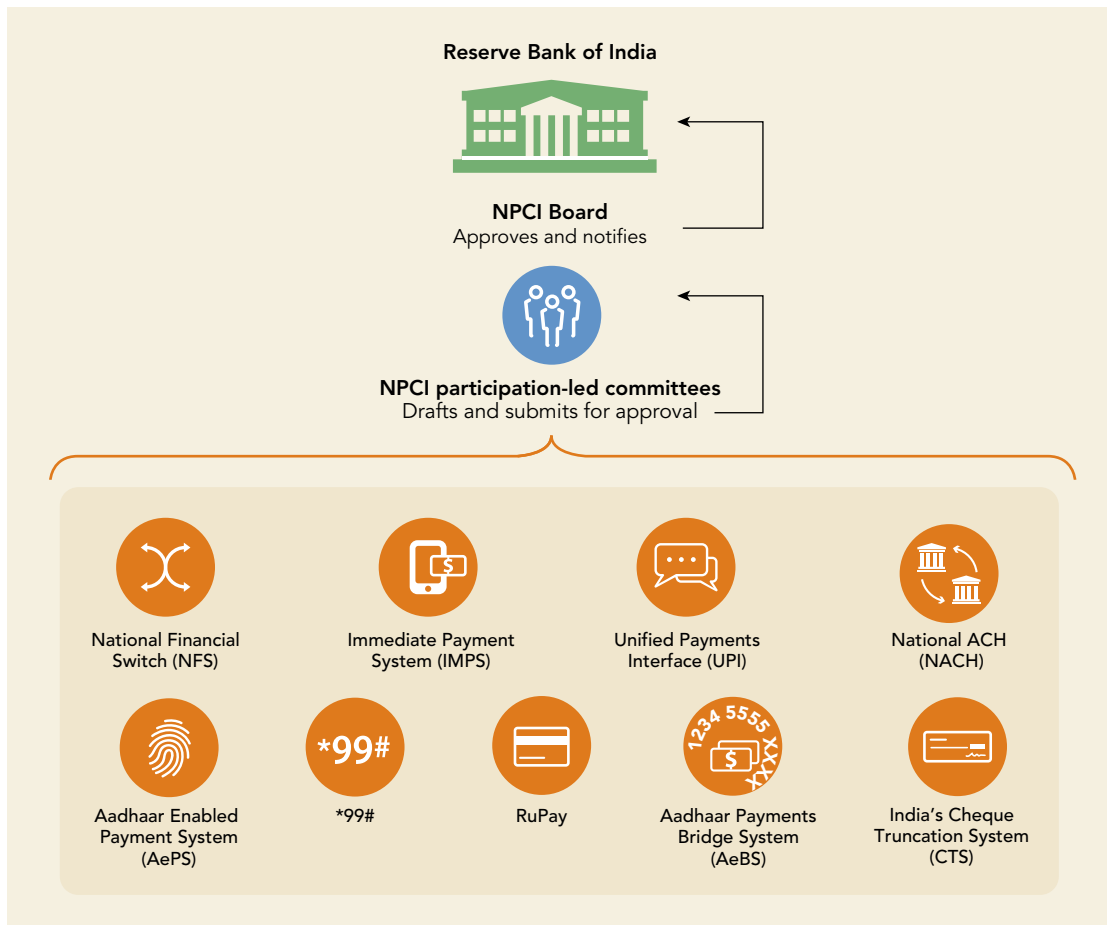
ECONOMICS

Like other scheme rules, interparty economics are set through committee. The interparty rates for RuPay card transactions resemble those of other popular card networks. NPCI applies an issuer-pays interchange for ATM transactions and an acquirer-pays interchange for POS transactions. IMPS uses a small sender-pays interchange like other EFT-type solutions.

UPI's economic model similarly varies depending on the transaction type. Merchant transactions follow an acquirer-pays interparty model like POS transactions. P2P payments carry a small sender-pays interchange. A switching fee is paid to NPCI in all scenarios, and the terms between a nonbank provider and the bank facilitating its access to UPI are decided by those institutions.

A low switching fee has helped to remove barriers to transacting (Shukla and Rebello 2015). However, MDRs and interparty fees remain comparatively low as well, leaving some to question whether providers have enough of an incentive to drive volumes outside their own networks. This applies to merchant transactions

FIGURE 3. NPCI scheme rules development process



as well as deposit and withdrawal transactions through agent networks.

MDRs have been regulated in India since 2013, and the permitted rate has been progressively lowered. While interparty fees are not directly regulated, the constraint on MDRs gives an acquiring institution little room to work with when determining what to pay the issuer. Concerns remain that the MDR cap has stripped much of the value proposition out of the merchant acquiring business and is preventing merchant networks from growing. Caps apply to debit cards as well as newer digital products, such as UPI and BharatQR, but not to credit cards.

The government announced¹⁰ a decision to refund providers for the MDR on any transaction less than ~US\$27 for 2 years starting January 2018, to kickstart the growth of wider merchant networks. Whether this measure will work remains to be seen. However, as acquiring banks continue to spin off acquiring operations to independent third parties, the merchant payments market may still rely on cash (RBI 2017).

TECHNOLOGY

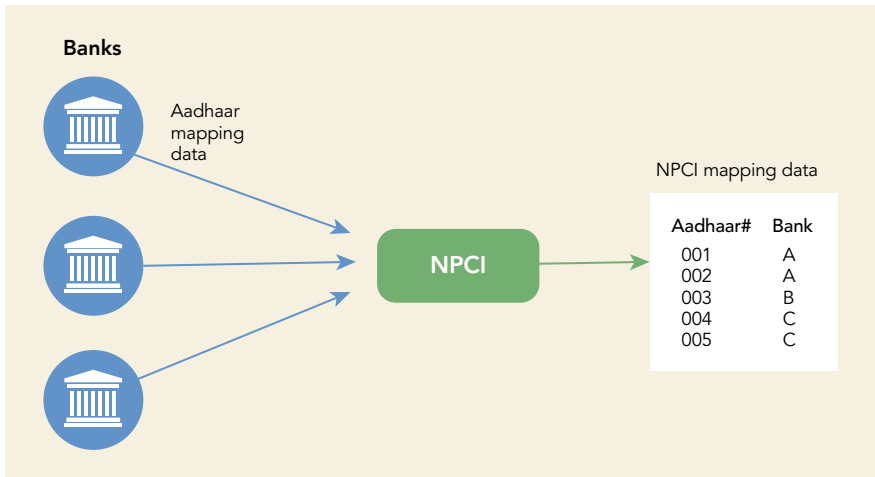
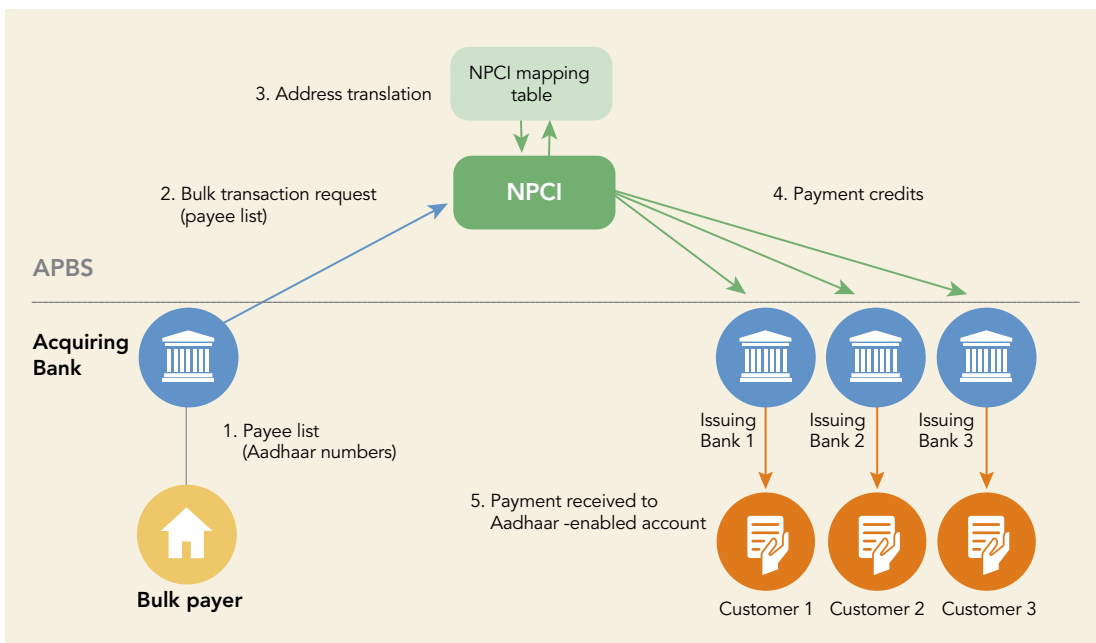
Initially, the National Financial Switch (NFS) obtained from IDRBT was the core technology infrastructure supporting NPCI services. NPCI has since added a second switch called Bharat. Like the NFS developed by Euronet, the Bharat switch is vendor developed. However, NPCI owns the source code for the switch and plans to take it forward as a more adaptable solution for the future. Currently, services still operate across NFS and Bharat.

Each NPCI product has its own processes for clearing and settlement. Some of these are more closely related than others, and some such as IMPS, closely resemble the processes for legacy EFT-type solutions used globally. However, processes supporting Aadhaar payments and UPI warrant further explanation.

Aadhaar-based payments

Banks are responsible for registering customers for Aadhaar-enabled accounts and maintaining the relevant mappings of Aadhaar numbers to bank accounts. Since the 2018 Supreme Court judgement, customers are, in most cases, responsible for linking their Aadhaar numbers to their bank accounts.

10. MDR Refund, <https://www.moneycontrol.com/news/business/no-charges-on-mdr-debit-card-payments-up-to-rs-2000-from-january-1-2018-2462607.html>.

FIGURE 4. Bank account to Aadhaar mapping**FIGURE 5. Bulk payment transaction using Aadhaar (APBS)**

The banks submit the relevant Aadhaar numbers held at their bank to NPCI. This mapping of the Aadhaar number to a bank institution allows NPCI to route transactions based on the Aadhaar number (Figure 4). Customers with accounts in more than one bank must explicitly designate a bank as the customer's default banking relationship for the mapping table to be updated.

A typical bulk payment transaction through APBS, such as a G2P payment, begins when the payor's bank transmits the relevant payment files to NPCI (Figure 5). Address translation is performed against the mapping table to learn which banking institution should receive the payment. Finally, funds are transferred to the relevant Aadhaar-enabled account at the relevant bank.

Transactions between two individuals, or between an individual and a merchant/agent, are slightly more complex. Before an electronic payment can be cleared, a system will generally require that the user be

authenticated (proving they are who they say) and that the transaction be authorized (proving the user has the authority to perform the relevant transaction). AePS helps to address these requirements (Figure 6).

By regulation, electronic payments transactions in India must be authenticated using two factors. For cards, this typically means having the physical card and knowing the PIN. For online transactions, this means knowing a card number and receiving a one-time PIN to one's mobile phone or a static password linked to the card account. For AePS users, the first factor is something one *knows* (Aadhaar number), and the second factor is something one *is* (biometric identity via fingerprint, iris scan, or facial recognition).

The access point must be able to verify biometrics captured against the ID number provided. Access to query the UIDAI identity database is limited to organizations that meet stringent requirements around security and service reliability. UIDAI offers several types of access profiles.

FIGURE 6. Transaction authentication using biometrics (AePS)

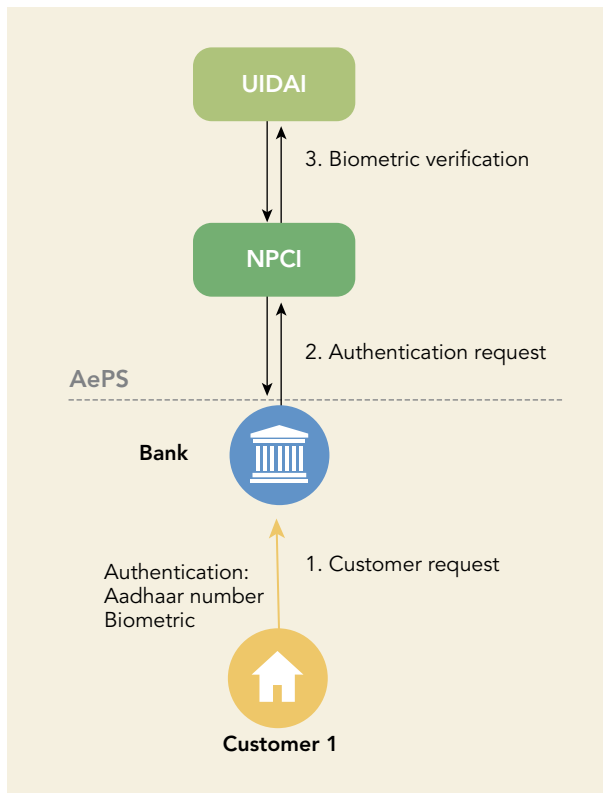
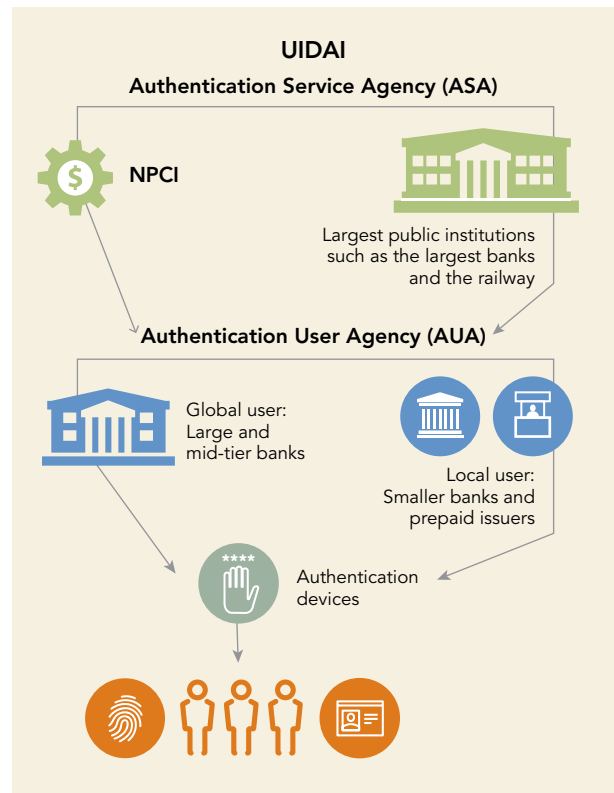


FIGURE 7. Authentication agencies for biometrics



Authentication Service Agency is one of the classifications. These are typically large organizations that are vetted through stringent due diligence requirements with dedicated, leased lines into UIDAI for maximum security. They include NPCI; large public institutions, such as the railway; and a few of India’s largest banks, including SBI.

Another classification is User Agency, which offers access with slightly lower requirements for other private sector organizations. Within the past year, this classification has been divided into more granular categories to address concerns around data protection and information security. Different User Agency requirements are now in place for “global users” (mostly large and mid-tier banks) and “local users” (mostly smaller banks and prepaid wallet issuers). The latter category must use a temporary, virtual ID number when performing transactions such as completing an e-KYC form. They are not allowed to store any data on their system. This tiered architecture is important for security, but it is equally valuable in helping to facilitate access to the system (Figure 7). It prevents UIDAI from becoming a bottleneck in individually servicing many different stakeholders.

For a biometric transaction, NPCI (as the agency) receives only the relevant bank identifiers, the Aadhaar number, and an encrypted packet containing the customer’s biometric data. This packet is forwarded to UIDAI, which then decrypts the message, determines

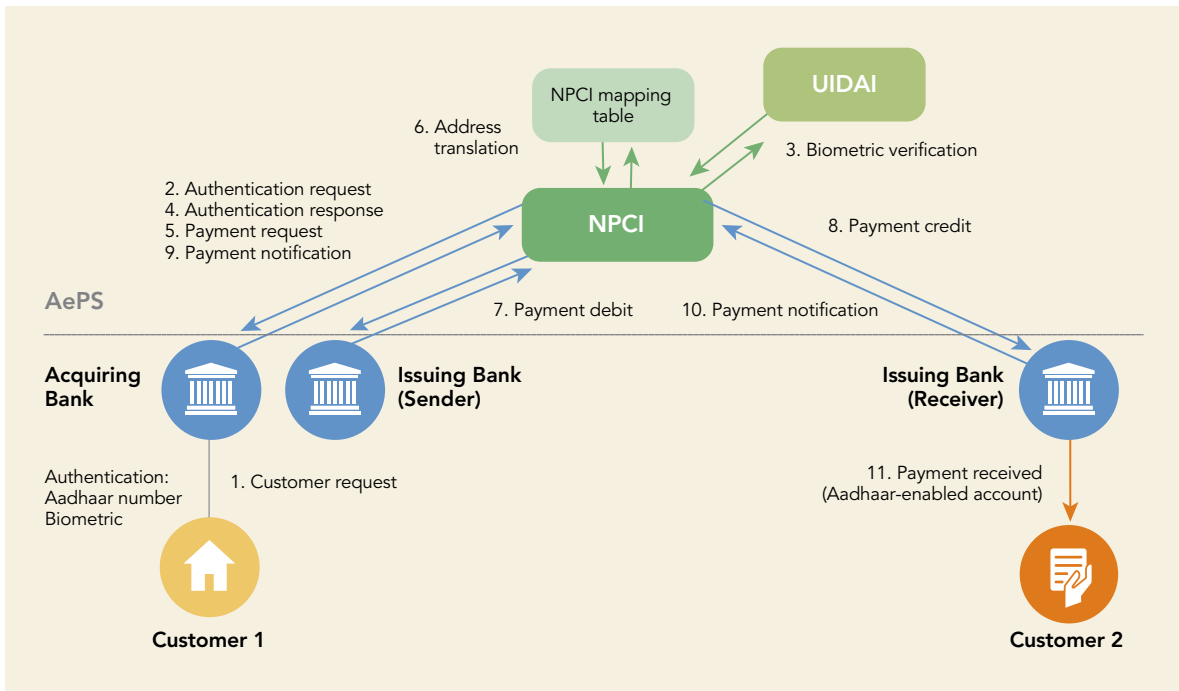
the appropriate response (either a Yes/No for an identity validation, or selected data fields for an e-KYC query), packages the response into an encrypted message, and relays it through NPCI back to the access point. All of this happens in real time as the customer stands at the point of service.

Until recently, UIDAI did not charge a fee for the service (Devika 2019). Under the previous arrangement, agencies linked to UIDAI for verification service were permitted to charge a fee not exceeding around US\$0.0014—just over one-thousandth of a dollar.¹¹ NPCI charged its customers (banks) this fee regardless of the transaction type. It remains to be seen how recent changes in pricing rules for biometric services will impact the market, but the basic process remains the same. NPCI is simply passing encrypted packets between the relevant parties—a process other authentication agencies follow.

Once authenticated, a transaction must be authorized by the issuer of the customer’s bank account (Figure 8). In the card world, the switch operator passes a message from the acquiring bank to the issuing bank and back again. The process is effectively the same with a biometric transaction. Once the customer has been authenticated through UIDAI, NPCI passes the relevant requests to the issuing bank and relays the response back (via the acquiring bank) to the microATM where the customer has initiated the transaction.

11. There are indications that rates may change early in 2019.

FIGURE 8. Person-to-person transaction using biometrics (AePS)



Finally, once authentication and authorization processes are complete, the transaction can be cleared. NPCI sends messages instructing the relevant financial institutions which accounts to debit and credit, and notification messages are exchanged to complete the transaction. Settlement is done between banks over India’s RTGS system, outside of NPCI.

UPI

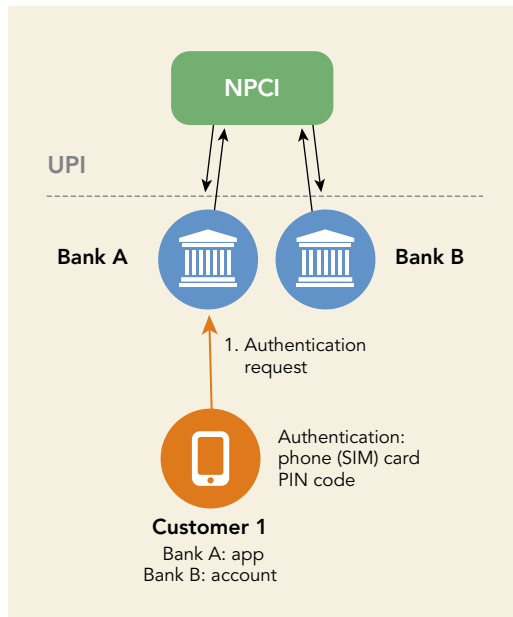
UPI prioritized a modular and interoperable architecture from the start, and several key design decisions were made to reach these goals.

UPI focuses on enabling the unbundling of accounts from the customer experience. To do this, APIs allow financial providers to separate authentication (verifying the identity of the customer) and authorization (verifying the availability of funds for the transaction) messages.

Through a mandate issued in 2013, RBI requires that payment transactions in India use two-factor authentication. UPI transactions use the physical phone as the first factor (the “what you have” of a registered device). This holds true whether using a smart phone or feature phone. However, it means that users must first register their phone number with their financial providers and second use the UPI service only when the SIM linked to that number is inserted in the device. The banks need to be able to validate that a transaction request is coming from the user’s device each time the user transacts.

The second factor is a one-time PIN issued by the customer’s bank. If a customer uses the channel of an institution other than the one that holds their account, the request is relayed through NPCI to the institution that holds the customer’s account (Figure 9).

FIGURE 9. Authentication request (UPI)



Transactions are authorized for payment in the same way. Messages are passed through UPI to the relevant financial service provider for both payor- and payee-initiated transactions.

Another central principle of UPI is that users should be able to send funds across a variety of payments addresses, including bank account numbers, mobile numbers, and virtual payment addresses. The virtual payment address is itself an innovation allowed by UPI. Users can set up an email-style payment address with their bank (e.g., filmfanatic@sbi) or with NPCI (e.g., avocado@UPI), which then become the only identifier needed to receive payments.

If the address is a mobile number, a bank account number, or a virtual address held by a bank, NPCI does not maintain bank account data or any other information beyond the identifier (e.g., the payments address) and the bank identification number. It simply routes the transactions for address translation. However, there are exceptions where the sender is using USSD or where the virtual address is held by NPCI (an @UPI address). In these scenarios, NPCI holds the bank account data for routing (Figure 10).

Once NPCI knows that the payor is authenticated and authorized to make the transaction and it knows where the funds need to go, it facilitates the actual

transaction by sending messages that identify which bank accounts are to be debited and credited. As with the biometric transactions described in the previous section, notification messages are sent to inform all parties that the transaction is complete, and settlement occurs through RTGS, outside of NPCI (Figure 11).

All the financial institutions discussed thus far are licensed account issuers—i.e., banks. These include organizations like PayTM or Airtel Money that have a payments bank license under the current regulatory regime. While there is no direct regulatory category in India for “e-money issuers” as seen in markets like

FIGURE 10. Address translation (UPI)

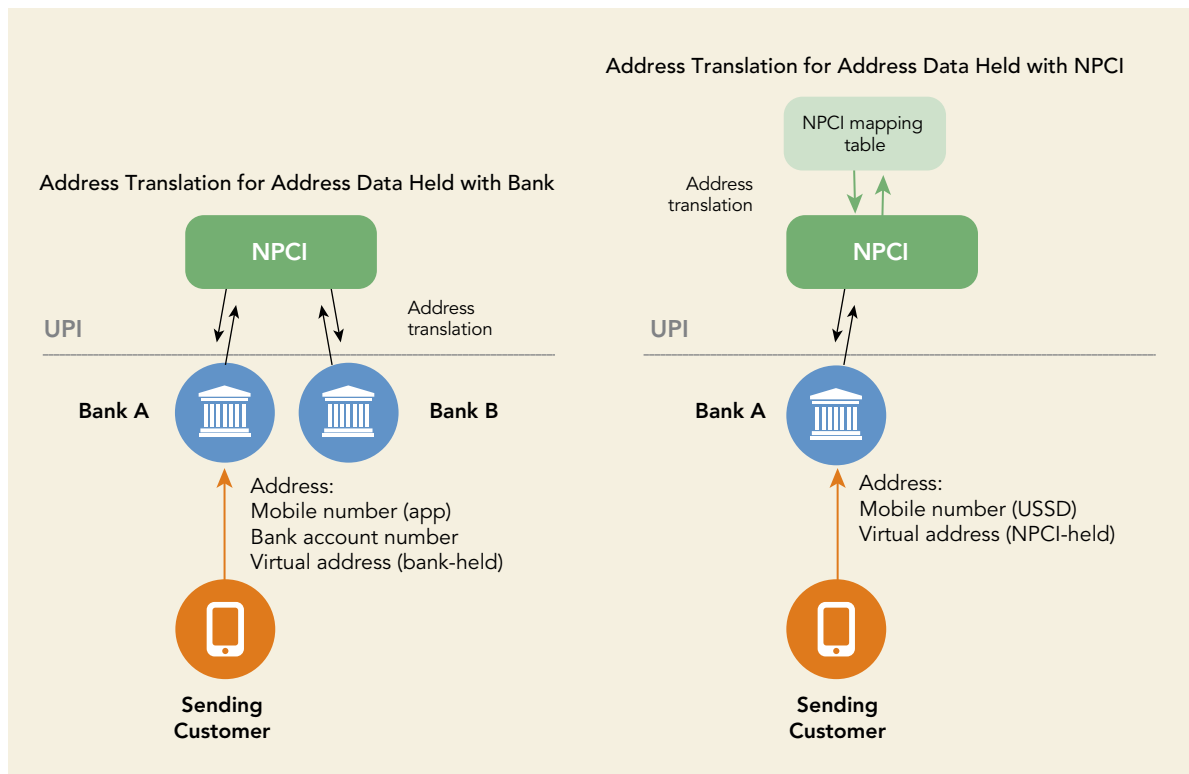
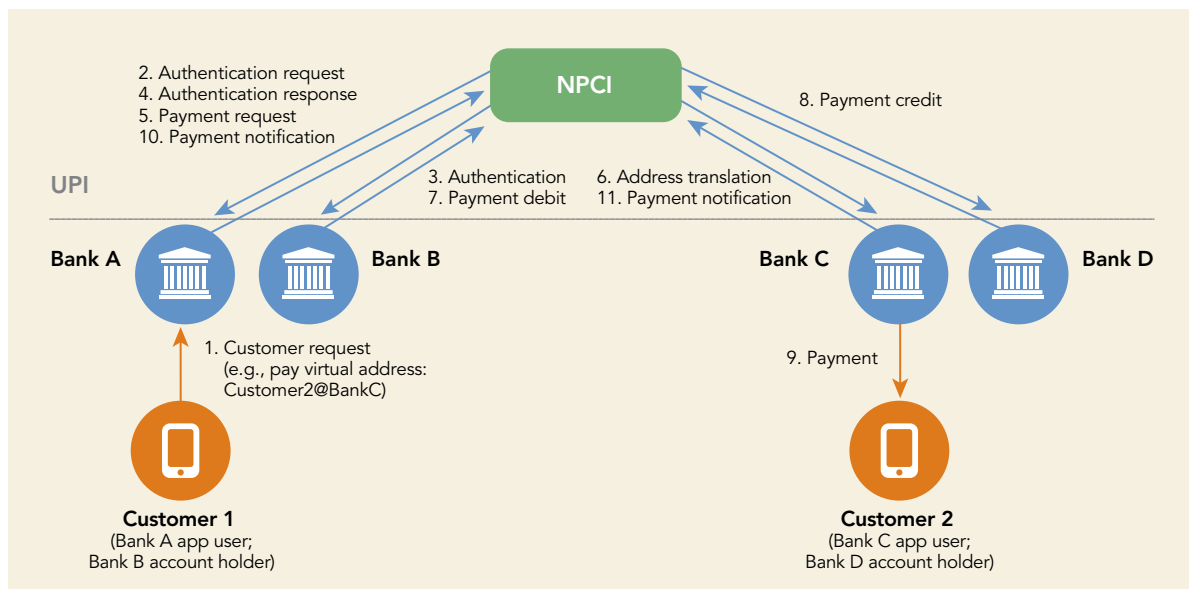


FIGURE 11. Person-to-person transaction using UPI



Kenya with M-PESA, the payments bank is the closest analogy.

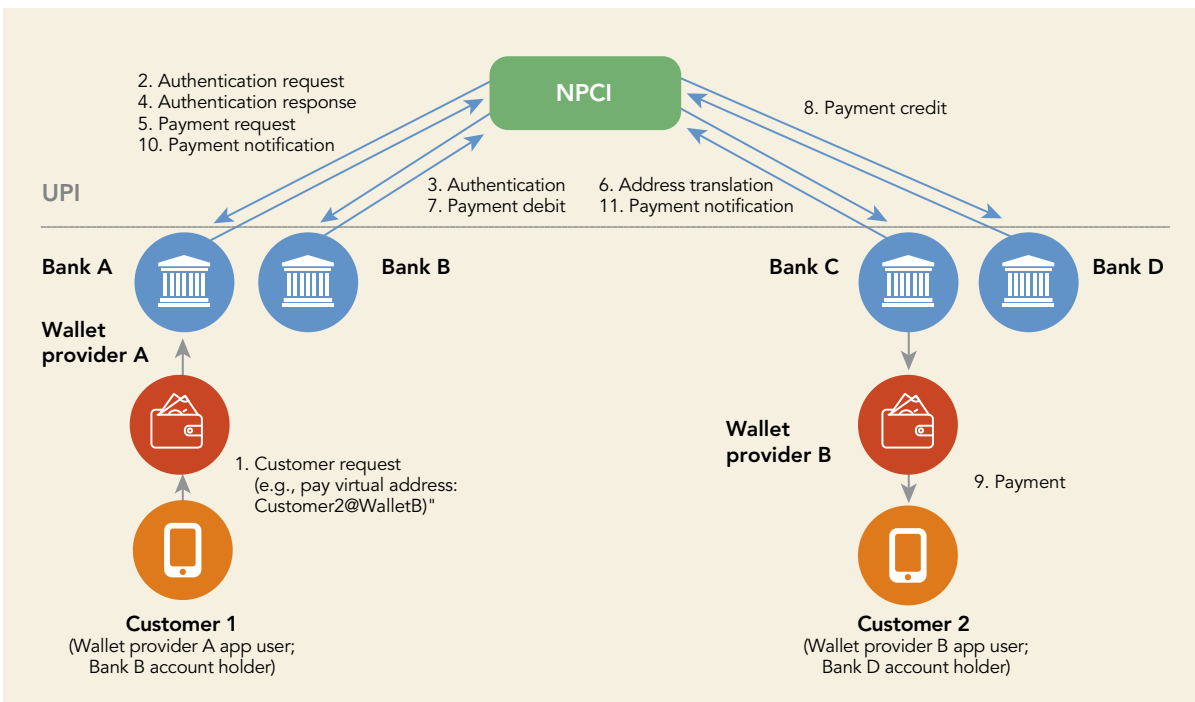
There are also separate classifications of nonbank wallet providers in India. Prepaid issuers (PPIs) can store value and are not subject to two-factor authentication requirements, but they are also not permitted to offer cash withdrawal services. For example, Oxigen and Eko are PPIs. Other wallet providers that do not hold a PPI license do not store value. These include products like Google Pay.

Since the inception of UPI, nonbank wallet providers have not been permitted to interact with the system directly. Instead, they have had to partner

with banks that in turn connect to UPI. As of October 2018, RBI has published guidelines paving the way for PPIs to connect directly to NPCI rails. Other wallet providers must continue to connect through a bank. However, with full interoperability in a market the size of India, there will likely always be a willing bank partner for nonbank wallet providers.

The transaction flow in this scenario looks like the one between banks. In this scenario (e.g., a payment from one Google Pay user to another Google Pay user), messages take the extra step of being routed from the wallet provider to a bank before reaching UPI (Figure 12).

FIGURE 12. Person-to-person transaction between wallet holders using UPI



LESSONS FOR OTHER MARKETS

Numerous lessons can be drawn from the NPCI experience. While context clearly matters, many of the decisions taken by NPCI, local financial regulators, and the Government of India can be instructive for other markets.

The following are critical success factors in the NPCI case:

- An industry-led approach to ownership and governance, with strong regulator backing
- Competitive economics through a utility model, mixed with smart growth and a start-up culture
- A strategy of incremental product development
- A government/regulator that uses carrots and not only sticks
- A government/regulator that balances caution with progress

An industry-led approach to ownership and governance, with strong regulator backing

Perhaps the most critical success factor for NPCI was its ability to gain clear, tangible buy-in from industry at the outset. Bank participants provided 100 percent of the start-up capital (10 percent each from the 10 initial banks), two-thirds of the board members (10 of 15, the remaining five being independent appointees), and NPCI's initial employees (on loan from their employers). Industry had a clear stake in the success of NPCI, and it had a lot to lose if the plan did not work.

It's safe to say that a model led by the regulator would not have met with the same success. Indeed, that was exactly the scenario RBI sought to avoid when, after a scan of global best practices, it opted to transfer operation of retail systems outside the regulator. When RBI managed retail clearing, not only was the innovation we see today absent, but the core systems were at times operationally overwhelmed.

At the same time, NPCI cannot be considered purely an industry initiative. India's Parliament provided the statutory backing for the creation of a retail payments institution in its 2007 Payments Act. RBI also took a series of strong actions to give support and legitimacy to NPCI as a national solution. From the transfer of the NFS card switch, to discounted office space, to heavy promotion of the BHIM app, RBI continually acted as a champion of NPCI. Strong oversight

(up to the level of the prime minister's office in certain cases)—from the deputization of NPCI's first CEO from RBI, to stakeholder meetings—helped to ensure NPCI was held accountable for its performance.

An industry-only initiative, without strong regulator support, likely would not have succeeded. IBA's Swadhan switch in the 1990s is an example of how many of the same industry actors tried and failed to establish the same type of coordination that NPCI achieved.

NPCI benefited from having a balance between industry ownership of the scheme and sufficient regulator and government accountability to progress. NPCI's commitment to industry-led decisions is evident even today, where participants and not only shareholders sit on committees to form the scheme rules for the various products.

Competitive economics through a utility model, mixed with smart growth and a start-up culture

NPCI operates as a utility. Earnings are reinvested into operations instead of being returned to shareholders, and NPCI does not pay taxes. These factors, combined with a cost-conscious operating model more fitting for a start-up than a clearinghouse, make it easy to see why NPCI was able to price its switching services at rates significantly lower than that of the international card schemes. Competitors ultimately dropped their prices just to compete.

Support from the regulator in the form of subsidized start-up capital (i.e., NFS) was clearly important in allowing NPCI to compete in the early days. However, NPCI was also cost-conscious from the beginning, sharing resources from participant banks and occupying space with the bankers' association when needed.

NPCI was a learning organization that started modestly and increased the pace of innovation over time. Its first products were not particularly innovative: cheaper switching for cards issued by the international schemes, bank transfers via IMPS, ACH transfers via NACH. These core products offered little of the innovation seen today, but they provided a stable revenue stream while NPCI focused on recruiting more banks to the platform and building a winning team. There was a clear focus on getting the basics right before jumping into the next big thing.

NPCI continually looked outside its own organization and market to inform its decision making. This meant studying a market like Kenya for SMS solutions or markets like Australia and the United Kingdom to inform “faster payment” design for UPI. The solutions, while developed locally, were informed by global experience.

A strategy of incremental, open-source product development

NPCI pursued incremental product development with a focus on stability at each stage. The development of Aadhaar-enabled payments and UPI was iterative, and the NPCI team focused on basic stability before it turned to more complex use cases.

Even the roll-out of products like Aadhaar-enabled payments was done in increments. The now lesser used ABRS, which preceded AePS and APBS for biometrics, had only replaced existing account identifiers with Aadhaar numbers in otherwise traditional account transfers. The step was a simple one, but it paved the way for future products while proving the technical viability of the model.

No discussion of payments technology in India can underplay the importance of an open-source approach and the support provided from civic technologists like those at iSPIRT. iSPIRT offered a ready source of free technology expertise. The open-source approach of iSPIRT’s work meant that it was not tied to one vendor and it could manage the many procurement, contracting, technology, and operational challenges that plague implementations in so many other countries.

Yet it is worth noting that NPCI contributed significant resources to the work as well. Today, NPCI has more than 60 developers in Bangalore working alongside iSPIRT to support existing products and to design the next generation. NPCI benefited from India’s large base of technology expertise and civic technology movement, but it also planned appropriately and committed the resources necessary to get the job done.

A government/regulator who uses carrots and not only sticks

The Indian government and RBI played significant roles in driving the success of NPCI through their strong and clear support for the organization. However, there was also a tension between what was considered support for the organization and the perception of favoritism and anti-competitive behavior.

More broadly, RBI and government mandates were met with mixed success. By most accounts, caps enforced on merchant fees continue to suppress merchant acquiring. Similarly, the mandate for telecommunications providers to offer USSD as a “dumb pipe” for banks ultimately failed to create a viable model at scale.

The biggest successes of government and regulator intervention were their ability to shape market forces by employing carrots rather than sticks. Exam-

ples include RBI offering incentives to bring banks to the table in forming NPCI, promoting BHIM to drive uptake on UPI, and offering free access to the Aadhaar database for biometric authentication.

All of this was bolstered by a strong, sustained effort by the regulator to improve financial access in the country. Over time, RBI had helped support banks with better core banking technology and enabling regulations in areas such as agent banking. It also pushed banks to expand access through regulations designed to hold the sector accountable for reaching the poor (World Bank 2012).

A government/regulator that balances caution with progress

With all the hype around the level of innovation in India, it is easy to forget that RBI is still a cautious regulator. For example, biometrics are not allowed on UPI, and the ability to send to an Aadhaar number as a financial address (present in version 1.0) has been rolled back for UPI 2.0 because of the ongoing data protection debate surrounding Aadhaar. Similarly, the beneficiary bank model where wallet providers initially linked to UPI only through licensed banks was intended to ensure that only appropriately regulated and supervised banks touched the service. There remains a healthy tension between RBI’s priorities and industry’s ideal solution. And this tension has not stymied progress thus far.

Is NPCI the solution for financial inclusion for poor people?

NPCI’s most innovative products like biometric-enabled payments and UPI continue to be lauded as immensely innovative on the one hand and a victory for financial inclusion on the other. However, questions remain around the actual value to the poor. NPCI has opted for a retrenchment away from USSD and feature phone services, activity rates on the mass market RuPay card remain low, and challenges persist in growing agent networks within an interoperable environment.

In sum, one could argue that NPCI’s solutions represent a deepening of the value proposition for the included, rather than a transformative expansion of the access frontier. However, a focus on the payments value proposition is not to be undersold. Improving the value proposition of financial products and services is important in engaging a wider community in the formal sector. And products like biometrics have the potential to remove the historical frictions to serving the very poor (e.g., language and use of USSD).

In any event, NPCI solutions should be viewed through the lens of PMJDY and other efforts focused on expanding financial access. NPCI may not be the silver bullet to financial inclusion, but it helps to answer the question of what 300 million new account holders do with their accounts once they are opened.

Should other markets follow the same path?

One lesson learned from the story of NPCI is that context matters. Local context is paramount in any market.

For example, India's decision to drive BHIM as a centralized app solution works because (i) BHIM is a superior product, (ii) it was developed using open-source tools at low cost with support from iSPIRT, and (iii) the government was able to fan patriotism in a country with high levels of trust in public institutions. It is all too easy to imagine another market taking the same path but failing to find the same success for any one of a hundred reasons: vendor capture, inferior product design, lack of commitment to consumer adoption, loss of provider commitment, and so forth. There are many things to consider to find the right path, and 10 times as many ways to get it wrong.

Yet, the critical success factors from the NPCI experience do not reference anything about the 1 billion residents of India or the country's relative position as a technical hub for the world. Scale and human and technical resources are important, but they are not the only things that matter. Costs of technology and even biometrics (thanks to a large purchase by India) are decreasing globally. The types of tools developed in India are being made open source so that the wheel does not have to be reinvented for every market.

Regional solutions can and are being explored in significantly subscale markets. There is no reason why a physical piece of technology must sit within geographic borders, and collaboration should be pursued where possible. The path for each market will be different. But there is no reason for the types of solutions that NPCI has scaled effectively in India to be considered out of reach for other markets.

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ACRONYM GLOSSARY

Acronym		Description
Aadhaar		The brand name for the unique identification number issued to Indian residents to prove ID biometrically.
ABRS	Aadhaar Based Remittance Service	A service using Aadhaar numbers to route payments. A precursor to the Aadhaar Enabled Payment System (AePS).
AePS	Aadhaar Enabled Payments System	A service that enables financial transactions for individuals (such as cash withdrawal) using their Aadhaar number and biometrics as authorization.
ACH	Automated Clearing House	Electronic network for financial transactions, generally domestic low-value payments.
APBS	Aadhaar Payments Bridge System	A service designed to enable bulk payments such as direct cash transfers using Aadhaar numbers as the destination.
ATM	Automated Teller Machine	A physical machine that automates teller functions such as cash withdrawal and so on.
BBPS	Bharat Bill Payments System	An independently regulated scheme to enable bill payments and collection (mostly for utilities) across geographies, payment points and methods.
BHIM	Bharat Interface for Money	An NPCI created app and service riding on the UPI infrastructure.
CTS	Cheque Truncation System	A system of automatically imaging cheques and electronically transferring them across geographies and banks to eliminate the need to physically move checks for clearing.
ECS	Electronic Clearing System	A mechanism to set up automated debits and credits based on customer authorization.
EFT	Electronic Fund Transfer	A mechanism to electronically transfer funds across bank accounts settled by the country's central bank.
eKYC	Electronic Know Your Customer	A procedure for providers to electronically verify customer identity and demographic information usually mandated by regulation.
G2P	Government to Person	Usually social welfare payments made by the state to citizens.
IBA	Indian Bankers Association	An institution set up by banks to represent them and act in their collective interest.
IDRBT	Institute for Development and Research in Banking Technology	An institution set up by India's central bank to promote advancement and adoption of information and communications technology in banking.
IMPS	Immediate Payments System	A real-time payment platform to facilitate interbank retail payment transactions.
INFINET	Indian Financial Network	An infrastructure to enable cross-bank communication for transactions.
iSPIRT	Indian Software Product Industry Round Table	A volunteer software technical support organization.
MDR	Merchant Discount Rate	The fees that merchants pay banks to facilitate their acceptance and clearing of electronic (mostly card) payments.
MICR	Magnetic Ink Character Recognition	Technology used to automate interbank check clearing.
MNO	Mobile Network Operator	Licensed mobile telecommunications providers in a country.
NFS	National Financial Switch.	Payments infrastructure initially launched by IDRBT for ATM transactions and as an e-commerce gateway, later transferred to NPCI upon its creation.
NPCI	National Payments Corporation of India	Umbrella nonprofit organization for retail payments in India.
P2P	Person to Person (payments)	Electronic means of fund transfers between individuals.
PIN	Personal Identification Number	A code (often four digits) known (only) to users of financial services to authorize transactions usually in conjunction with some other factor such as a debit card or a phone app.

Acronym		Description
PMJDY	Pradhan Mantri Jan Dhan Yojana	A government-led financial inclusion scheme to provide one bank account in every household.
POS	Point of Sale (machine)	A device generally used to accept and process card payments at merchant establishments.
PPI	Prepaid Payments Instrument (issuer)	A regulated scheme for providers to issue wallets that can be loaded to make electronic purchases.
QR (code)	Quick Response (code)	A two-dimensional scrambled image used to encode information that can be scanned and interpreted using smartphone cameras.
RBI	Reserve Bank of India	India's Central Bank
RTGS	Real Time Gross Settlement System	Electronic network for financial transactions, generally domestic high-value payments.
SIM	Subscriber Identification Module	A physical chip with embedded electronics and software used in mobile phones.
SMS	Short Messaging Service	A text messaging service universally available on mobile networks.
UIDAI or UID	Unique Identification Authority of India	An institution set up by the government of India to capture, issue, and manage a biometric identification proof for all Indian residents.
UPI	Unified Payments Interface	An integrated interface and infrastructure that facilitates retail payments.
URR	Uniform Regulations and Rules	Rules for bankers' clearing houses to bring consistency to clearing operations across banks.
USSD	Unstructured Supplementary Service Data	A telecommunications protocol that is used to transmit and interpret messages from feature phones over mobile networks.

