ITIF
The Information Technology & Innovation Foundation


EXPLAINING INTERNATIONAL IT APPLICATION LEADERSHIP:

# Contactless Mobile Payments

Stephen Ezell | November 2009

Explaining International IT Application Leaderhip:

# Contactless Mobile Payments

Stephen Ezell


November 2009

# Executive Summary: Contactless Mobile Payments

*Mobile payments will benefit the economy and society by increasing productivity through enhancing operational efficiencies, enabling a range of innovative new business models, and pushing distributed computing intelligence into the physical world.*

Mobile payments systems (e.g., using a cell phone as an electronic "wallet") promise significantly increased economic productivity and personal convenience. But unlike many new applications that require only an enterprising firm to develop it, the widespread deployment and adoption of mobile payments systems requires action from a complex ecosystem of organizations (e.g., mobile phone service providers, banks, retailers and others) to create a mobile payments system. Because of this, only a few nations, notably Japan and South Korea, have been able to coordinate the complex ecosystem required to extensively deploy a widely used mobile payments system. In contrast, most other nations, including the United States, lag far behind. For lagging nations to take full advantage of the opportunities of mobile payments, they will need to develop and adopt national mobile payments strategies.

This study examines which countries lead in deploying and adopting contactless mobile payments, finding Japan and South Korea the world leaders; surveys the development of contactless mobile payments in the United States; analyzes the non-policy and policy factors that explain how leading countries attained their leadership position; and offers a set of recommendations to policymakers, targeted to those in the United States but applicable globally, who wish to promote contactless mobile payments.

Contactless payments leverage near field communication (NFC) technology, a specific standard of radio-frequency identification (RFID) technology, which enables secure wireless data transmission over short ranges between electronic devices. In combination with an embedded electronic wallet on a mobile phone or smart card, NFC makes possible a wide range of transformative monetary and non-monetary transactions. An electronic wallet is a multifunctional device possessing cash, information storage and transaction, identification and authentication, and communication functions. Electronic wallets empower mobile phones and smart cards to fully replicate physical wallets, with the ability to make contactless payments; to capture and trans-

ITIF

mit data like transit, movie, or parking tickets; to check in to offices, schools, or airport gates; and to store and present identification credentials. Whereas a decade ago this technology was not quite ready—the contactless microchips and mobile phones were not adequate, lacking sufficient memory and processing power—the technology has matured substantially over the past decade in accordance with Moore's Law to the point where electronic wallets, NFC-capable phones, and NFC-enabled point-of-sale (POS) terminals are now ready for full-scale implementation and use.

Mobile payments are about much more than mere credit card substitution; rather, they represent a transformative digital application that will benefit consumers, merchants, and the economy and society at large. Mobile wallets will enhance consumer convenience through the potential to replace a litany of artifacts of analog life designed to convey money or information—credit cards, loyalty cards, transit cards, ID cards, keys, key fobs, tickets, passes, etc.—with a single, more powerful digital device. Moreover, mobile payments will benefit the economy by driving a range of productivity improvements through: 1) bringing operational efficiencies to merchants, retailers, transit authorities and others engaged in routinized monetary or information transactions; 2) enabling a range of innovative new business models and service offerings; and 3) pushing distributed computing intelligence into the physical world.

To ensure digital prosperity, nations need to support the development of key digital platforms such as broadband, health IT, and a smart grid. Just like these digital platforms, a national mobile payments infrastructure is a key platform from which a proliferation of creative applications and uses will likely develop, many of which are difficult to even imagine today, but which will continue to create new business opportunities, increase productivity, and drive economic growth.

Notwithstanding the enormous potential, countries can't just snap their fingers and put a mobile payments infrastructure in place or expect that because the technology is now ready the private sector will simply deploy it. The reason is that mobile payments are not like other industries where a company need only acquire requisite inputs, manufacture a product or design a service, and sell it on the market. Mobile payments entail a complex, system-interdependent ecosystem with many players—including mobile network operators (MNOs), handset manufacturers, financial institutions including major banks and credit card issuers, merchants, public transit authorities, government agencies, third party application providers, and consumers—whose success is dependent on joint action by all the players together at the same time. Everyone must act collaboratively in the ecosystem simultaneously, but this is not something at which markets tend to be very good. As such, there are two central challenges: a chicken-or-egg terminal/handset adoption challenge and a business model challenge.

First, for consumers to demand electronic wallet-enabled mobile phones—and thus, critically, for the MNOs to require this feature from handset manufacturers (and pay for it, since MNOs subsidize consumer handsets)—consumers must know that a sufficiently deployed infrastructure exists at merchant point-of-sale (POS) terminals; at fare readers in metro subways and buses; at airports, parking garages, and movie theatres; in automated devices such as vending machines; and in a host of other places where the feature can be used. However, merchants, transit operators and others having to incur the costs of deploying the NFC-enabled reader terminals are not likely to do so until a critical mass of users gives them confidence that their investments will be repaid. This "chicken-or-egg" paradox exacerbates a related challenge: Each party in the ecosystem wants a clearly articulated business model for how it can monetize mobile payments investments before moving forward, meaning players will not act unless the financial incentives and value propositions are clearly understood beforehand. These system interdependency challenges must be solved in each country wishing to realize contactless mobile payments, and government can play a key role in helping to resolve them.

Japan and South Korea have had the most success solving these challenges; they clearly lead the world in terms of per-capita number of contactless-enabled mobile phones and POS terminals deployed, the total number of contactless transactions, and market value of contactless payments. In Japan, 17 million citizens make contactless mobile payments from their cell phones, with 65 million regularly using contactless smart cards, and 73 percent of mobile phones having electronic wallet capability. In South Korea, close to 4 million citizens use their mobile phones to make contactless payments,

with 12 million phones having the capability to do so. Thirty-three million contactless transactions are made daily using either smart cards or mobile phones in South Korea. While the United States has made some progress in fielding NFC-enabled credit cards and POS machines, virtually no mobile phones are equipped with NFC-enabled electronic wallets.

What explains why Japan and South Korea are so far ahead of the United States (and other countries)? Certainly some non-policy factors play a role. Both South Korea and Japan are countries with gadget-loving mobile cultures that enjoy being first movers in innovative mobile technologies. Certainly, their densely packed urban populations, heavily reliant on mass transit, provided a critical mass of captive users across which the research and development cost of contactless electronic wallet technology could be amortized and a market brought to scale. In both countries, the dominant mobile operator stepped forward to lead a vertically integrated mobile payments ecosystem—NTT DOCOMO in Japan and SK Telecom in South Korea—although unlike DOCOMO's successful introduction of the osaifu-keitai (mobile wallet) in 2004, SK Telecom's Moneta service met with middling success, and seems to have been supplanted by T-Money, launched by the public-private partnership Korea Smart Card Company.

But while non-policy factors are important, policy factors, including a conscious role for government to guide mobile payments ecosystems and a corporate business climate oriented towards longer-term investment strategy and receptive to collaborative public private partnerships, appear to play an indispensable role in explaining countries' mobile payments leadership.

Perhaps the single most important reason why Japan and South Korea lead the world in mobile payments is that transit authorities, card issuers, and mobile operators in those countries came together to collaboratively create a common electronic wallet capability for smart cards and NFC-enabled smart phones. But private sector actors did not just decide to do this on their own (and, by definition, the involvement of transit authorities signals the participation of government agencies that either oversee or directly operate transit administration.) Rather, governments in Japan, South Korea, and up-and-comer Singapore played important roles in facilitating the collaborative development of their countries' mobile payments ecosystems.

Japan's government played a vital, if behind-the-scenes, role in furnishing overall direction and motivating the activity of key actors in Japan's mobile payments marketplace, particularly in subtly pressuring DOCOMO to lead a collaborative ecosystem in which it "would not abuse its market power." The government's conscientious strategy to facilitate development of a collaborative mobile payments ecosystem was made easier by the fact that it owns or had owned two crucial players in that ecosystem, DOCOMO and JR East. In South Korea, the government organized and hosted formal meetings between carriers and banks to facilitate standards setting and itself became an early adopter of mobile payments systems because it recognized that, "positive government commitment to support mobile payments is required because many technical issues are closely related to government policy and strategy." Singapore's Infocomm Development Authority (the government's information-technology promotion agency) formed a roundtable group of banks, mobile network operators, and transit companies with the intent of developing a national plan for the introduction of NFC-enabled commerce. Recognizing that developing a fully interoperable NFC environment would generate a market size eight times larger than a non-interoperable environment, Singapore has elected to create a national trusted third party to ensure full interoperability between the NFC services of all mobile operators and service providers. Even the United Kingdom has recognized that government must become explicitly involved in advocating for and helping to foster mobile payments capability. The UK Department of Transport's 2009 Smart and Integrated Ticketing Strategy envisions universal coverage of a smart ticketing infrastructure for all UK public transport, finding that the use of contactless ticketing technologies such as NFC could save the country up to £2 billion annually.

Each of these countries has clearly demonstrated that governments can play critical roles in facilitating development of their mobile payments ecosystems. Governments can play the following roles: addressing the system interdependency challenge by facilitating development of a national mobile payments infrastructure, particularly by ensuring that transit agencies, airports, and other institutions with a public or quasi-public

mission are adopting open, interoperable contactless payment platforms; spurring demand for mobile payments, both by driving transit agencies to adopt contactless payments and by making government facilities and employees early adopters of contactless technologies; by establishing appropriate consumer protections; and by promoting the importance of this technology system to economic growth and quality of life.

While Japan deserves credit for leading the world in innovating and adopting contactless mobile payments, in truth it did not implement them in the most optimal fashion. As with its broader mobile phone industry, Japan has to some degree fielded a proprietary, closed standard mobile payments model. While Sony's FeliCa contactless integrated circuit (IC) chip technology underpins the buyer and seller devices, the different electronic money (digital cash) systems such as Suica, Edy, and Nanaco are not interoperable, requiring merchants to deploy proprietary POS reader terminals to accept the different electronic money systems; some convenience stores and retail merchants have as many as four reader terminals at check-out stations to support the various types of electronic money customers may use. This is akin to the state of email before Web-based email, when services like CompuServe, Prodigy, and MCI Mail dominated, when it was only possible to exchange email if both the sender and receiver both used the same email service provider. In other words, Japan does not have a fully open, interoperable system where any electronic money service (whether pre-paid stored value or post-paid credit) operating on a smart card or mobile phone can interact with any reader terminal. In this regard, a better model is Singapore's, which seeks to deploy a completely open, interoperable mobile payments system. The United States is making some progress in this area because the NFC standard is interoperable. But it will be important for the United States to ensure that the mobile wallet standard be interoperable with the NFC reader standard, so that individuals can use their mobile phones and all the applications stored in them just like they can use their credit cards at any NFC-enabled reader in the United States.

As noted, the United States has made some progress in deploying contactless mobile payments. As of October 2009, more than 100 million branded contactless credit cards have been issued by U.S. card issuers and 140,000 merchant locations have deployed more than 500,000 NFC-capable POS readers (although that number represents a fraction of all POS readers in the United States). However, only a handful of NFC-capable mobile phones have been deployed (mostly in trials), and a full-fledged, phone-based mobile payments ecosystem in the United States continues to be stymied by the chicken-or-egg problem and the inability of mobile network operators, financial institutions, and merchants to mutually craft viable business models palatable to all players. Fully replacing the current POS terminal infrastructure in the United States with NFC-capable devices (credit cards or mobile wallets) could cost upwards of $10 billion, and a key challenge is determining which parties should bear the cost of deploying this infrastructure. Moreover, there is a real risk that the United States will evolve into an NFC cul-de-sac whereby the system is optimized for payments only, but not for the much more functional and economically important mobile wallet (e.g., a device that can store information other than money and process transactions other than financial).

The challenge the United States and many other nations face is that all actors in the mobile payments ecosystem are each pursuing their own interests and concentrating on maximizing their own return, thus making it more difficult for a true infrastructure platform to emerge. For example, merchants and transit operators focus only on assessing their potential return on investment from deploying contactless infrastructure, but each merchant or transit agency that installs an NFC-enabled POS terminal benefits not only themselves but every other participant in the ecosystem. In other words investments in any part of the mobile payments ecosystem can create what economists call a network externality, whereby the benefits of the investment do not accrue fully to the party making the investment.

Transit operators can play a key role in ensuring the evolution of an open, interoperable, multi-function system. In Japan and South Korea, transit authorities, card issuers, and mobile operators came together to collaboratively create a common electronic wallet capability for smart cards and NFC-capable smart phones. And by creating a large number of places where consumers can use their mobile wallets early on, transit agencies in those countries helped build a market for NFC-enabled phones.

Unfortunately, in many nations, including the United States, transit agencies tend to think like private sector merchants trying to maximize their own return and ignoring positive network externalities. But because they have a public function to them, they should also focus on the externalities generated by deploying contactless fare readers, for doing so dramatically expands the range of venues where consumers can use their NFC-enabled phones, spurring consumer demand for the technology. But each of the metropolitan transit agencies in the United States has been confronting decisions about whether to implement contactless fare payment systems on their own. The risk is that in the absence of federal leadership, transit agencies will either choose not to deploy contactless fare payment systems or will choose to deploy closed-loop, proprietary fare payment systems that are not interoperable with those of other transit agencies (as with Boston's Charlie Card) or with NFC reader standards in general, and the opportunity to realize network externalities from contactless mobile payments in U.S. mass transit will be lost or delayed.

Moreover, there has been a standoff between banks, which are migrating credit cards with customer information stored on a magnetic stripe to the new microprocessor-based contactless NFC standard where customer information is encrypted, and the mass transit operators, who would like access to the memory resources on NFC smart cards but who installed an earlier, proprietary version of contactless technology. Thus far, banks have resisted opening up smart card microprocessor resources to meet transit operators' requirements for scratch pad memory access on which they can calculate passenger fare and manage customers' outstanding transit subscription balances. Even successful implementations of an open-loop outside network system, such as the Utah Transit Authority's, which allows passengers to use their regular credit cards for contactless fare payment on UTA's buses and light rail, required the system to be custom-engineered between the credit card-issuing banks and the transit authority.

This points to a central challenge for mobile payments in the United States: no party, neither the banks nor the transit agencies, has an interest in creating a fully open, interoperable multi-function smart card or mobile wallet device that possesses a cash, information storage and transaction, identification, and communication function. But having single purpose cards would be equivalent to broadband service providers building broadband pipes that only allowed their content to flow on them. The risk of going down the contactless credit card route (where most of the progress in contactless mobile payments in the United States has been made to date) is that it is a single purpose device, whereas what is needed is a multipurpose device that can do more than just process e-cash transactions.

To maximize the benefits to the American economy and to American consumers, mobile payments needs to evolve in an open, interoperable, multi-purpose fashion. The risk in the United States is that mobile payments will evolve in the direction of closed- and or single-purpose platforms. Thus, the government holds a key role to ensure the marketplace evolves in this direction, because if a country goes down the path of a limited and non-interoperable systems, it is very difficult to change course.

In summary, mobile payments represent a critical information technology system for the U.S. economy to realize. It is not at all clear that market forces alone will get the United States there, or produce the completely open, multifunctional system that we need, certainly not anytime soon. Therefore, applying lessons from the leading countries, there appears to be a strategic role for the federal government to play in facilitating and accelerating the arrival of mobile payments in the United States. Accordingly, this report makes the following recommendations:

- **Create an inter-government mobile payments working group and private-sector advisory council that would collaborate to introduce, by mid-2010, a strategy for spurring the deployment of an open, interoperable mobile wallet.** In the United States, this means that the Chief Technology Officer should create: 1) a mobile payments working group, whose members would include the Federal Communications Commission, Federal Trade Commission, Treasury Department, Department of Transportation, National Telecommunications and Information Administration, National Institute of Standards and Technology, the General Services Administration, and other agencies as appropriate, along with 2) an advisory

council from the private sector, which together would develop, by mid-2010, a U.S. strategy for spurring the deployment of an open, interoperable mobile wallet platform.

The government's role should not be to take the lead in specifying NFC standards—private markets and collaborative standards-setting consortium such as the NFC Forum are driving this and should continue to do so. Rather, much as the Federal Communications Commission's National Broadband Taskforce is developing a comprehensive strategy for how the United States can achieve ubiquitous broadband deployment, a national mobile wallet/mobile payments strategy would craft a roadmap considering issues such as: how federal, state, and local governments will go contactless; how contactless payments can be enabled in all metropolitan transit authorities; how such payments can be implemented in public and quasi-public venues such as airports, street parking meters, parking garages, toll booths, and other locations throughout the country; and how mobile payments can be used for functions such as food stamps, funds through the Women, Infants and Children program and other federal benefit programs.

- **Governments should assume a leadership role in promoting and adopting mobile payments.** Federal, state, and local governments should be creative in using systems and funding to spur deployment of contactless mobile payments. The government should:

  1. **Require that mass transit agencies receiving federal funding deploy open-loop outside network payment systems.** In the current reauthorization of the Surface Transportation Act, Congress should require that any transit authority receiving federal public transportation funding that has a contactless fare payment system move to an open-loop outside payments network. That is, Congress should require transit agencies receiving federal funding to deploy NFC-enabled contactless fare payment systems interoperable with those of other transit agencies throughout the country.

  2. **Provide funding for pilot programs deploying NFC infrastructure in public venues.** The mobile wallet strategy roadmap should include funding for pilot programs to implement NFC infrastructure in the aforementioned publicly or semi-publicly operated or managed environments.

  3. **Ensure senior government leaders highlight the benefits of contactless mobile payments.** Senior leaders at the FCC, Departments of Commerce and Transportation, and other agencies should provide vision and leadership and speak openly about the transformative potential of contactless mobile payments in the United States.

  4. **Deploy contactless payments infrastructure, including NFC-enabled electronic wallet phones and NFC-enabled POS readers throughout government agencies:**

     - The General Services Administration should commit to installing contactless POS terminals in all cafeterias, parking garages, and other cash facilities it directly operates in federal agencies and facilities, including Department of Defense facilities.
     - Government identification programs such as the Department of Defense's Common Access Card and the Transportation Worker Identification Credential (TWIC) should allow electronic wallet applications to be housed on the card.
     - State and local governments using POS terminals to process payments for services—such as for obtaining marriage licenses, parking permits, drivers licenses, etc.—should deploy NFC-enabled POS terminals, enabling citizens to make contactless payments.

- **Articulate clear consumer protections for mobile payments.** For mobile payments to succeed, consumers must be assured they maintain the same level of recourse in case of disputes with merchants

or digital theft. Consumer protections should be extended to all providers of mobile payment services. The United States should actively engage in ongoing OECD discussions to harmonize consumer payment protections amongst its OECD member countries.

- **Address legitimate security and privacy concerns, but recognize mobile wallets are likely to be more secure than physical wallets.** Policymakers should not be swayed by the claims of some privacy advocates who are likely both to question the privacy and security of mobile payments and to actively denounce proactive government efforts to develop a national payments strategy. NFC-enabled phones offer defenses not generally available to cards, including enabling consumers to keep applications locked with a PIN or other passcode or with a fingerprint or other biometric tools. Moreover mobile operators can remotely shut down all applications on an NFC phone should subscribers report their device lost or stolen.

  Policymakers should also recognize that contactless mobile transactions effected between a mobile phone with a secure integrated circuit smart chip and an NFC-enabled payment terminal are likely to be much more secure than either swiping the credit card through a magnetic card reader, or simply handing the credit card to a third party. This is because in a contactless transaction (whether originated by a smart card or mobile phone) both the IC chip and the payment terminal authenticate one another and, critically, a unique identifier is generated to validate each transaction. If that unique identifier is somehow stolen, it cannot be used to execute a subsequent or future transaction. Moreover, no publicized real-world attacks on contactless bankcards have emerged in the United States or elsewhere since the payments industry has introduced the technology.

- **Resist the urge to regulate RFID technologies, including near field communication.** Given the importance of NFC technology and its inherent security, it is important that policymakers not give in to pressure to regulate NFC, in particular under the broader guise of regulating RFID technologies, which should not be regulated either.

- **Encourage competition and do not favor entrenched interests.** The rapid evolution of mobile devices and applications as well as network and information technologies has engendered an incredibly fertile period of mobile payments innovation and activity. Many new firms with innovative business models and service propositions have emerged to provide novel platforms for remote mobile payments, such as domestic money transfers, international remittances, and even targeted microlending. Regulators should not give in to incumbent business interests that oppose the emergence of innovative new services.

  Likewise, policymakers should not give in to entrenched interests who would resist new automated or self service technologies that NFC makes possible, even if it means certain service jobs may be automated, for these technologies introduce efficiencies that redound to the benefit of consumers and the economy as a whole.

- **Actively work with international NFC standards setting bodies.** Federal bodies involved in trade policy, including the National Institute of Standards and Technology and the United States Trade Representative should support the development of interoperable international standards for mobile payments, which will inure to the benefit of both domestic device manufacturers looking to export to global markets and consumers seeking convenient payment experiences alike.

# Explaining International IT Leadership: Contactless Mobile Payments

*Mobile payments will benefit the economy and society by increasing productivity through enhancing operational efficiencies, enabling a range of innovative new business models, and pushing distributed computing intelligence into the physical world.*

The ever-expanding capabilities of mobile phones have made them increasingly powerful platforms for an impressively wide range of commercial and financial transactions. Mobile phones have evolved from simple personal communication devices to become both platforms for commerce and indispensable "lifestyle infrastructure" that enhances productivity, facilitates financial transactions, and makes life more convenient and efficient. In the most advanced countries, consumers use their phones as multifunctional electronic wallets to pay public transit or taxi fares; to make purchases from merchants, restaurants, convenience stores, and automated devices; and to check in at airports, hotels, and schools; and for a host of other functions.

This report examines which countries lead the world in deploying and adopting contactless mobile payments surveys, finding Japan and South Korea in the lead; surveys the development of contactless mobile payments in the United States; and analyzes the non-policy and policy factors that explain how the leading countries attained their leadership position in contactless payments. It concludes with a set of recommendations to policymakers, targeted to those in the United States but applicable globally, wishing to promote contactless mobile payments in their country.

## UNDERSTANDING MOBILE PAYMENTS

### What are Mobile Payments?

Mobile payments are perhaps the most important form of mobile commerce, a term defined broadly as "commercial or financial transactions mediated through mobile phones or other handheld electronic devices."[1] Mobile commerce is exploding worldwide, with research firm Juniper predicting that, by 2011, the global value of all commercial or financial transactions effected through mobile phones will exceed $587 billion.[2] By 2013, Juniper predicts that more than 2 billion mobile sub-

scribers worldwide will have used their mobile phones for contactless mobile payments, mobile banking, or over-the-air person-to-person payments.[3]

The following taxonomy describes the broad universe of commercial and financial transactions that mobile phones enable:[4]

I. **Mobile financial services**, including: **contactless mobile payments, peer-to-peer mobile payments,** and **mobile banking**.[5]

   1. **Contactless mobile payments**—also called "touchless" or "proximity" payments—leverage radio frequency identification technology (RFID) technology, particularly through a technology standard called near field communication (NFC), to enable mobile subscribers to make contactless payments simply by waving their mobile phone (or a smart card) directly in front of NFC-enabled terminals, such as merchant's point-of-sale (POS) terminals, subway turnstiles, or automated devices such as vending machines (Figure 1).

      Contactless mobile payments are exploding globally, growing in value from $3 billion in 2007 to approximately $10 billion in 2009, and expected to surpass $52 billion by 2012.[6]

   2. **Peer-to-peer payments** including funds transfer or domestic and international money remittances.

   3. **Mobile banking**, including both informational—alerts and account balance inquiries—and transactional—mobile bill payment or equity trading—components.

II. **Mobile shopping and mobile-facilitated purchases of digital content, data, or services,** where purchases are made via mobile phones either through traditional Internet website channels (e.g. buying a product off the Amazon or eBay Web site using one's mobile phone instead of computer) or via direct downloads of digital content, such as music or ringtones. Purchases can also be mobile-facilitated such as making a purchase from a computer at an online retailer or using the mobile phone for authentication and the mobile operator's bill for invoicing and collection.

**Figure 1: Contactless Mobile Payment**


Mobile purchases through cell phones—particularly of digital content including music, games, e-books, digital avatars, and virtual worlds—has become widespread across all developed countries, and especially prevalent in Asian countries. Mobile sales of digital goods in Japan alone constitute a $4.84 billion market, and well over $1 billion in South Korea. Research firm Ovum estimates the global value of "online shopping" via mobile phones will come to approximately $20 billion in 2009.[7] Notwithstanding the impressive volume of digital content mobile subscribers are downloading to their phones, this report focuses on the transformative capability of mobile phones to act as platforms for enabling remote contactless financial, commercial, and information-based transactions.

## Types of Mobile Payments Applications

Near-field communication technology enables a range of monetary and non-monetary transactions. Embedding electronic wallets on mobile phones (or smart cards) transforms them into multifunctional devices that can execute contactless payment transactions, serve as a store of information and value, house authentication or identification credentials, and exchange data with similarly enabled devices.

This report identifies three primary types of contactless transactions that electronic wallets enable: 1) transactions involving only the exchange of payment information; 2) transactions involving both the exchange of payment details and information/data pertinent to the transaction; and 3) storing and transmitting identification and authentication credentials. (See Table 1.)

The first category includes transactions where the mobile phone (or smart card) is simply used to transmit payment details for purchases of stand-alone goods or services, such as buying a soda from a vending machine, or purchasing items from merchants such as retailers, convenience stores, or fast-food restaurants. There is not an information component to these transactions required beyond the payment instructions. These types of contactless transactions will increasingly replace cash for low-value micropayments (transactions worth less than $25.)

Where electronic wallets (whether on mobile phones or smart cards) become far more powerful is their ability to store, process, and exchange transaction-related information, enabling the mobile phone to replace a litany of tickets, passes, keys, and cards. For example, theater-goers in South Korea purchase movie tickets via their mobile phones, receive the "tickets" electronically, and swipe their phone across a reader at the theatre entrance, eliminating the need to hand a paper ticket stub to a greeter. At parking garages in Japan, drivers swipe their phones across readers as they enter and exit the garage and an application in the electronic wallet records duration of stay and transmits payment information at the exit gate, eliminating the need for both paper tickets and attendants to process the transaction. Likewise, airline passengers in Japan receive their reservation "tickets" electronically to the mobile phone and check in by tapping their phone to readers at the flight gate (and at security check in). Taxi passengers can pay the fare and receive an electronic receipt they can submit to their company's accounting department for reimbursement. Critically, this information storage and processing aspect of electronic wallets also allows transit agencies to issue contactless smart cards (or mobile phone applications) capable of both calculating passenger fare based on journey taken and storing subscription account balances.

As an authentication application, electronic wallets can store identification information, replacing the current generation of key fobs and smart cards to allow individuals to check in/sign in to schools, hotels, health clubs, offices, and apartment buildings with one device, often a cell phone. For example, in South Korean, Japanese, and Swedish schools and universities, students effortlessly swipe their phones across readers outside classroom doors to register their attendance. In New Zealand, hotels are using NFC technology to manage room access: the hotel sends an electronic code to the guest's cell phone that permits access to a specific hotel room for the duration of the reservation, and the guest need simply touch his/her cell phone to the door's reader, obviating the need for physical keys or keys cards. Using electronic wallets for identification purposes will further accelerate as biometric verification is added to existing password authentication features of mobile phones.

*Mobile payments represent a digital platform technology that enables the creation of new and innovative applications limited only by the creativity of organizations seeking to use them.*

And the important thing about this "platform" technology is that new and creative applications are only limited by the creativity of the organizations that seek to use them. For example, the Korean Salvation Army saw this technology platform and realized it could digitally transform the way it collected money at Christmas. Now, next to the traditional red kettle and bell-ringing Santa-costumed volunteers, the Korean Salvation Army has introduced digital donation screens, at which donors simply wave their mobile phone across the screen and the specified amount is deducted from one's T-money account (a digital cash service popular in South Korea) and paid to the Salvation Army—leaving donors with no excuse for not having change in their pockets, reducing the risk of money being siphoned off by the volunteer, and reducing the cost of handling the cash.[8] Another such application would be for the government to deliver food stamps via mobile phones; likely to be more convenient as many individuals who lack bank accounts actually have mobile phones. It's likely that as this platform technology becomes more widely available around the world, the number of innovative applications will blossom.

Though not directly a mobile payments application, it should be noted that NFC technology allows electronic devices to interconnect and exchange information with one another over short distances, just as infrared or Bluetooth technology before it. For example, Apple is currently prototyping a next generation iPhone allowing customers to wirelessly sync their iPods and iPhones to their iMac using RFID technology.[9]

**Table 1: Classifying Contactless Mobile Payments Applications**

| Payment Transactions | Payment and Information-Based Transactions | Authentication/ID |
|---|---|---|
| ■ Mobile payments replace cash/credit cards<br>■ No information component required beyond exchanging payment details<br>■ Includes contactless payments for goods and services purchased from:<br>▪ Big Box Retailers<br>▪ Quick Service Restaurants<br>▪ Convenience Stores<br>▪ Taxis<br>▪ Digital Donations<br>▪ Automated Devices<br>▪ Vending Machines<br>▪ Parking Meters<br>▪ Laundry Machines<br>▪ Toll Booths | ■ Transactions involving exchange of both payment details and information pertaining to the transaction. Data component is stored on mobile phone's electronic wallet.<br>■ Enables mobile phones to replace cards, tickets, passes, etc.<br>■ Enables personalized merchandising and advertising<br>■ Uses mobile phone's electronic wallet to manage, update, pay for, or check into:<br>▪ Public Transit (Tickets)<br>▪ Airport Check-in (Tickets)<br>▪ Parking Garages (Tickets)<br>▪ Movie Theatres (Tickets)<br>▪ Sporting Events (Tickets)<br>▪ Concerts/Museums/Parks (Tickets)<br>▪ Personalized Advertising or Merchandising<br>▪ Loyalty cards<br>▪ Gift cards<br>▪ Coupons | ■ Authentication/identification credentials are stored in the mobile phone's electronice wallet<br>■ Electronic wallet can be used as ID to check into:<br>▪ Schools<br>▪ Hotels<br>▪ Health Clubs<br>▪ Office Complexes<br>▪ Apartment Buildings |

## Benefits of Contactless Mobile Payments

Contactless mobile payments represent a transformative application that will bring a wide range of benefits to consumers, businesses, and the economy and society at large. Consumers will benefit from enhanced convenience and the ability to opt-in to personalized advertising or merchandising campaigns. At a broader level, contactless payments will drive increases in productivity, the central source of economic growth, through three channels: 1) bringing operational efficiencies to merchants, retailers, and transit authorities; 2) enabling a range of innovative new business models and service offerings; and 3) pushing distributed computing intelligence into the physical world.

Using mobile phones as electronic wallets will allow consumers to replace the multitude of keys, key fobs, loyalty cards, various types of ID cards (such as for schools or libraries), credit cards, and cash with a single device capable of checking in to office complexes, apartment buildings, or health clubs; boarding planes and trains; and paying for everything from mass transit and taxis to parking meters and vending machines. Indeed, much of daily life is consumed with the exchange of mundane information—key codes, dollars, time stamps, tickets, passes, ID credentials, etc.—all of which could be automated, streamlined, or even obviated by leveraging mobile phones as a repository for both information and money. Consumers will also enjoy faster transaction processing speeds in retail and transit environments. Organizations will be able to automate these kinds of transactions, saving significant amounts of money, which can be passed on to consumers. Finally, contactless transactions reduce the burden—and security risk—of carrying cash and having to fumble for loose change or bills to make small purchases.

For businesses, contactless payments enable increased operational efficiency in retail and transit environments, whether by accelerating transaction speeds, reducing the costs inherent in handling cash-based transactions, or decreasing the need for ticketing or checkout agents at the point-of-sale (POS). Transactions using contactless technology are as much as 40 percent faster than those made with credit or debit cards and 55 percent faster than those made with cash.[10] In mass transit environments, Japan's JR East Railway reports that moving from swiped magnetic stripe cards to contactless smart cards or mobile phones reduces transaction processing time from 700 to 200 milliseconds. Japan's All Nippon Airways found that using mobile phones at check-in cuts transaction time per passenger from 50 to 8 seconds.[11] South Korea's banks have found that mobile transactions cost one-fifth of face-to-face transaction costs.[12] And Washington, D.C.'s transit authority found that migration to electronic fare payments reduced staff by approximately 15 percent over a 5-year period.[13]

Contactless transactions open up entirely new channels for retailers to introduce opt-in personalized advertising or merchandising campaigns. For example, customers entering a mall could swipe their mobile phones across a NFC-enabled poster that would inform them about sales or promotions at their favorite stores and even provide them with targeted coupons or discounts. In Japan and South Korea, advertising posters (whether in subways or on the street) have embedded chips allowing mobile subscribers to wave their phones across the poster to learn more about—or directly purchase—the advertised good or service. In those countries, one need simply walk up to a poster pitching the latest Cirque de Soleil show, Harry Potter movie, or Bruce Springsteen concert, wave the mobile phone across the poster, and purchase tickets immediately. In essence, NFC technology enables a world of secure end-to-end commerce and connectivity in which consumers can access and pay for physical and digital services anywhere, at any time, using any device.[14] An NFC-based mobile transaction infrastructure will also spur the creation of more self-service opportunities and business models as transactions can increasingly be completed through automated devices.

The productivity story then is not simply about replacing credit cards with mobile phones; rather electronic wallets make possible automated transactions that either eliminate the need for personnel to manually process tickets and cash or that empower employees to use their time more productively by automating routinized activities. In fact, information technology (IT) is moving from a phase where many of the benefits of IT have come from "big boxes," like servers or computers, to a phase where the benefits come more from pushing distributed computing intelligence into the field. Previously, most of the productivity gains from IT came from large IT implementations, such as enterprise resource planning or automated order entry systems, which automated routinized activities employees had performed in desktop or office environments.

*Electronic wallets have the potential to replace a litany of artifacts of analog life that consumers carry in their wallet to exchange money or information—credit cards, loyalty cards, transit cards, ID cards, keys, key fobs, tickets, passes, etc.—with a single device.*

But the next wave of IT will be about pushing mobile computing, sensing, and intelligence out into the physical world. Before, transactions in the field required people because there was little connectivity to technology platforms on the back-end (e.g., no "big box" in the field). But mobile phones bring computing into the field, acting as sensors that can connect physical infrastructure to the virtual world. By enabling fully electronic transactions, contactless payments eliminate the need for cash or physical information exchange (e.g., tickets or passes) at the point-of-sale, removing the need for attendants to staff gates at parking garages, movie theaters, tool booths, sporting venues, airports, etc. For example, if parking meters in the United States were NFC-enabled, not only could drivers pay electronically via their mobile phones, but because the meters would no longer be collecting coins, the need for someone to physically go from parking meter to parking meter to collect them would be eliminated. If teachers didn't have to spend two to three minutes of class time taking attendance because students instead signed in using their NFC-enabled phones, they could save 30 hours or more a year on roll call, freeing them to focus on teaching and improving educational outcomes.[15]

## BOX 1: KEY UNDERLYING MOBILE PAYMENTS TECHNOLOGIES AND ACTORS

**Near Field Communication (NFC) Technology.** Near field communication (NFC) is a short-range wireless connectivity technology that provides intuitive, simple, and safe communication between electronic devices. NFC is a type of radio frequency identification (RFID) technology, and the NFC standard is an extension of the ISO 14443 RFID proximity-card standard. NFC operates at 13.56 MHz and transfers data at up to 424 Kbits/second. Communication occurs when two NFC-compatible devices are brought within four centimeters of one another. NFC communicates via magnetic field induction, where two loop antennas are located within each other's near field, effectively forming an air-core transformer. NFC can operate in one of two modes: passive or active.[16]

Mobile phones, contactless smart cards, and contactless credit (or debit) cards can communicate data via near field communication technology to NFC-enabled payment terminals—including merchant's point-of-sale terminals, vending machines, parking meters, rail or subway turnstiles, airline check-in gates, etc.—to process contactless transactions. Importantly, NFC-based contactless transactions clear (that is, they are settled financially) over existing credit card or bank payment networks, not over the wireless network on which the phone operates.

Contactless payment technologies in Japan and South Korea also use RFID technology, but in the main, use RFID standards that are not currently interoperable with NFC standards. Japan uses FeliCa, a proprietary standard. South Korea uses a passive, as opposed to active, version of RFID that operates in card emulation mode only (no reader mode or peer-to-peer mode), and is not interoperable with NFC.

**FeliCa.** Sony developed the FeliCa integrated circuit chip for contactless payments made via smart cards in 1988. In 2004, Sony teamed with NTT DOCOMO ("DOCOMO") to embed FeliCa chips into the electronic wallets of mobile phones, enabling contactless payments in Japan.

**The NFC Forum.** The NFC Forum, a standards-setting consortium founded in 2004 that includes 140 members from all areas of the NFC ecosystem, drives the development of globally-interoperable NFC standards. As of Q4 2009, the NFC Forum has finalized 11 specifications enabling a basic level of device interoperability.[17]

**Smart Cards.** Smart cards—whether public transit fare cards, credit cards, or stored value (i.e., debit) cards—use embedded microchips, also known as integrated circuits (IC) chips, to electronically store data. Smart card technology can be contact-based or contactless. In contact-based scenarios, customers insert or swipe cards through a card reader. Contactless smart cards have an embedded antenna and short-range radio frequency identification (RFID) computer chip, which transfers data via radio waves, enabling contactless, or "touchless" remote transactions.

**Electronic (or "Digital") Wallets.** An electronic wallet is a mobile phone feature that can centrally and simultaneously store multiple applications managing customer account/transaction information with financial providers, public transit agencies, or third party entities such as health clubs, schools, and office or apartment buildings. For example, the electronic wallets of mobile phones in South Korea can simultaneously manage up to 100 different applications, ranging from electronic money to personal IDs.

**Electronic Money (or "Digital Cash").** Electronic money systems, such as Japan's Edy or South Korea's T-money, appear in the form of either pre-paid, or "stored value," smart cards or as an application in the electronic wallet of a mobile phone. For example, with Edy, customers prepay (via a credit card or by debiting a bank account) to purchase Edy digital cash that is loaded onto their smart card or mobile phone. When customers make purchases, in lieu of using cash, funds are deducted from the stored digital cash value on the smart card or the mobile phone.

**Trusted Service Manager (TSM).** A trusted service manager is a third party intermediary that manages downloads of applications to a phone's electronic wallet. The TSM helps service providers securely distribute and manage contactless services for their customers using the networks of mobile operators. However, the TSM does not participate in actual contactless transactions using NFC devices.[18] The key functions of the TSMs include interconnecting with mobile network operators (MNOs) and application service providers, enrolling new users, updating user interfaces, managing customer databases, managing application lifecycles, managing value-added services such as ticket reloading and branding, and guaranteeing end-to-end security. Examples of TSMs include FeliCa Networks in Japan and VivoTech in the United States. In Singapore, the government's Information Development Authority has taken on the role of setting up a national trusted service manager (there called a trusted third party.)

**Peer-to-peer (or "person-to-person") payment**s. Mobile peer-to-peer payments use the SMS (simplified messaging service) feature of mobile phones to send text messages with payment instructions to third parties, such as the bank accounts of customers, suppliers, or family members. Peer-to-peer payments have become incredibly popular in developing countries through service providers such as M-Pesa in Kenya and Smart Communications in the Philippines.

This all has the benefit of allowing organizations to deploy resources more productively, increasing customer convenience and generating cost savings for consumers and taxpayers, while eliminating routinized, monotonous tasks or jobs, freeing the individuals who once staffed them to pursue more-rewarding, higher-skilled, and higher-paying jobs. If the United States is to continue enhancing its productivity, thus generating increases in growth, wages, and standards of living, it must deploy technologies like mobile payments that enhance productivity throughout the economy.

A national contactless payments infrastructure supports other social objectives, including more efficient governance and helping the environment by eliminating paper waste. A United Kingdom study found that going contactless in mass transit ticketing could save the country £2 billion annually.[19] Japan has found that the amount of paper cash in circulation in the economy has appreciably decreased since 2004, when mobile phones with electronic wallets were introduced.[20] Finally, eliminating the need for paper, whether of rail, movie, or airline tickets (or even paper currency itself) saves money and benefits the environment.

In summary, a system whereby mobile payments and transactions leverage NFC technology is a critical emerging digital infrastructure technology platform that all countries will need to have. Once a country has an open, interoperable mobile payments infrastructure in place, it is akin to having broadband, cellular networks, or a smart grid installed. And like these digital infrastructure platforms, mobile payments exhibit similar network effects: as additional NFC-enabled mobile phones and devices come on the market, they increase the value of other similarly enabled devices. Over time, a proliferation of creative applications are likely to develop from the mobile payments technology platform, many of which are difficult to even imagine today, all of which will continue to create new business opportunities, increase productivity, and drive economic growth.

## The Mobile Payments Challenge

Mobile payments are considerably different from the classic "widget" industry in which a company need only acquire the requisite inputs, manufacture its products, and sell them on the open market. For a country to successfully deploy mobile payments it must engage a wide range of actors, including: mobile network operators, handset manufacturers, financial institutions including major banks and credit card issuers, commercial retailers and merchant stores, public transit authorities, government agencies, and, of course, the customer. Mobile payments thus represent a complex ecosystem with many players whose success depends on joint action at the same time by all the players together. All parties have to figure out a way to act collaboratively at the same time, and this is something markets are not very good at, especially U.S. markets.

*Mobile payments are characterized by a chicken-or-egg problem: consumers won't demand NFC-enabled phones until they know a sufficient number of POS terminals exist where they can use them; merchants won't deploy the infrastructure until a critical mass of users justifies the cost of doing so.*

Mobile payments are marked by a system interdependency (the classic "chicken-or-egg") conundrum, which each country must solve: For consumers to demand cell phones with embedded electronic wallets—and thus, critically, for the mobile network operators to require this feature from the handset manufacturers—consumers must know that a sufficiently deployed mobile payments infrastructure exists at merchants' POS terminals, at fare readers in metro subways and buses, in toll booths along highways, at airports, in parking garages, in automated devices like vending machines and parking meters, and in other places where the feature can be used. Merchants and transit operators, for their part, are not likely to deploy NFC-enabled payment terminals until a critical mass of users gives them confidence that their investments in such technology will be repaid. And indeed, determining who should pay to finance the widespread deployment of the NFC mobile payments infrastructure (particularly reader terminals at merchants and mass transit facilities) is one of the greatest challenges to mobile payments. One industry observer estimated it could cost upwards of $10 billion to fully replace the current POS terminal infrastructure in the United States (alone) with NFC-capable devices.[21]

The system interdependency challenge makes it extremely difficult for all parties in a multi-sided market to craft profitable business models. Each party needs to know that incoming revenues (or value, from the

consumer perspective) will justify the costs of their investments. Therefore, each party must have clarity as to its role in the mobile payments value chain and how it intends to monetize it. A key sticking point is the issue of, "Who owns the customer in mobile transactions?" Wireless network operators believe they own the mobile subscriber relationship, credit card issuing banks insist they own the financial relationship with customers, and retailers contend that they own the customer relationship at the point of purchase. Each entity desires to have the leading place in the mobile payments ecosystem and dominant role in the value chain, and as a result the market has remained stillborn. As Pragnesh Shah, former CEO of mobile payments firm Mobilians, states, "The barriers to mobile payments, in the United States or elsewhere, are not technological nor regulatory; rather they pertain to the business model."[22] Of course, all countries looking to deploy mobile payments must solve these complex system interdependency and business model ecosystem challenges in their own way.

And in analyzing the countries leading the world in mobile payments, it becomes apparent that some forcing function—such as government facilitating the development of the mobile payments ecosystemt or ensuring that transit agencies deploy interoperable contactless fare payment systems—has intervened to either circumvent or resolve the system interdependency paradox, catalyzing the country's mobile payments ecosystem and causing contactless payments to arrive sooner that the marketplace alone would have otherwise delivered it.

## Methodology

This report focuses on which countries are best leveraging mobile phones (and, to a lesser degree, smart cards) as platforms for contactless payments and transactions. The analysis examines quantitative data for each country, principally the number of electronic-wallet capable mobile phones and point of sale terminal readers underpinning the country's mobile payments infrastructure, along with the number and overall market value of contactless payments in each country.

Mobile payments statistics come from a variety of sources, principally market research firms and government agencies, that may use different classification methodologies for defining mobile payments transactions. Year-end 2008 (or most recently available) data are cited wherever possible. Historical data are cited in most cases, though the report also makes use of forward-looking, anticipatory estimates of future market sizes for countries' mobile payments markets. The study relies extensively on facts and figures provided by representatives or publications of foreign governments and thus on the implied accuracy and validity of these resources.

The assessment of country leaders was also informed by consultations with over two dozen experts in the mobile commerce and payments field, who were asked to rank the world leaders in mobile payments and provide both context for and a historiography of the evolution of mobile payments ecosystems in leading countries.

*Mobile payments exhibit classic network externalities; adding an additional NFC-enabled phone or POS terminal device to the network amplifies the value of previously deployed devices and makes the case more compelling for further deployment.*

Mobile payment technologies—and countries' deployments of them—are dynamic and rapidly evolving. As of November 2009, more than 100 trials or tests of RF-based contactless payment systems are occurring in cities and countries worldwide. This report has identified world leaders as of Fall 2009; countries' leadership positions may subsequently shift.

## Which Countries Lead in Contactless Mobile Payments?

In its 2007 report, *Mobile Commerce*, the OECD noted that, "The level of development of the mobile commerce industry varies widely across OECD member countries. But individuals, particularly in Japan and South Korea, have started to own the Internet-connectable mobile phones that enable the development of mobile commerce."[23] As Shri Kumar, a senior official with India's Ministry of Communications and Information Technology (MCIT), observed in a presentation to the Mobile Forum of India in February 2009, "The Asia-Pacific region is the most advanced m-commerce market in the world, and the test-bed for the majority of m-commerce and m-payment trials."[24] Indeed,

**Table 2: Contactless Mobile Payments Activity in Selected Countries**

| Metric/Statistic | Japan | South Korea | United States |
|---|---|---|---|
| *Mobile phone penetration* | 87% (2008)[30] | 93% (2008) | 88% (2008)[31] |
| *Number of mobile wallet-capable phones deployed* | 78 million | 12 million | Only in trials |
| *Number of citizens using mobile wallets* | 17 million phones; 68 million smart cards | 3.6 million phones; 18 million T-money smart cards | Only in trials |
| *Number of merchants deploying RF-capable POS readers/total number POS readers deployed* | 608,000 merchants deploying/total number POS readers deployed much larger[32] | +500,000 total POS readers deployed[33] | 140,000 merchants deploying/+500,000 POS readers deployed[34] |

almost 500 million mobile transactions will occur in Asia in 2009, versus only 34 million in North America, according to research firm Gartner.[25] By 2012, Gartner expects that mobile transactions will grow to 2.4 billion in Asia and 221 million in North America. Research firm Juniper concurs, finding that, "The Far East and Western Europe will be the top two regions for mobile commerce by 2013, accounting for 60 percent of the [anticipated] $300 billion global transaction value." Not surprisingly then, the two countries clearly leading the world in mobile payments emerge from the Asia-Pacific region.

Japan and South Korea lead the word in mobile payments based upon the aforementioned criteria. (See Table 2.) As Kumar argues, "Japan is two years ahead of the rest of the world in contactless adoption."[26] Industry executive Pragnesh Shah, formerly with Sprint and recently CEO of the U.S. division of South Korean mobile payments firm Mobilians, concurs that, "Japan and South Korea clearly lead the world in the deployment and adoption of phone-initiated contactless mobile payments."[27]

In Japan, 78 million mobile subscribers (73 percent) own FeliCa-capable mobile phones, 17 million subscribers use these phones for contactless transactions in railways or stores on a regular basis, and over 600,000 affiliated merchant stores (and a greater number of terminals) accept contactless payments. The market value of contactless transactions alone in Japan was $8.4 billion in 2008, and the total value of mobile commerce activity in the country, including mobile content downloads, fees for text messaging and Web data plans, etc., was $32.4 billion. Japan's Ministry of Internal Affairs and Communications (MIAC) estimated that the overall value of "all business carried out through" cell phones in Japan was worth as much as $106 billion in 2007, up 23 percent from 2006.[28] In South Korea, 63 percent of citizens have made payments through their mobile phones, at least 12 million subscribers have RF-capable mobile phones (about one-quarter of mobile phones), more than 3.5 million citizens use their mobile phones for contactless payments, and 9.15 million mobile subscribers use mobile banking. South Koreans purchased $1.4 billion worth of digital content in 2008, and the value of South Korea's overall mobile commerce market is expected to grow to 6.84 billion won ($5.9 billion) in 2010.[29]

There are currently over 100 NFC projects, trials, or commercial deployments occurring worldwide, 47 in Asia alone.[35] Although there are many NFC trials ongoing, most of them are still in the nascent phase, and none have reached the level of critical mass of deployment and use that has been achieved in Japan and South Korea. While Hong Kong, Singapore, Taiwan, and Malaysia each make extensive use of contactless payments—there are more than 10 million contactless transactions each day in Hong Kong, for example—almost all these are initiated through smart cards. As consulting firm KPMG noted in a survey of mobile payments in the Asia-Pacific region, "Somewhat surprisingly, the most mobile-penetrated territories on the planet—Hong Kong, Singapore, and Taipei—have shown little comparable adoption of m-payments, except in the use of contactless cards for transportation and some limited retail usage."[36] Malaysia has recently completed NFC trials and is beginning to deploy its mobile payments infrastructure, but the country has

nowhere near the level of deployment as Japan and South Korea.[37] In June 2009, Singapore launched a national "Digital Concierge" initiative, "to promote e-payment adoption, particularly interoperable payments enabled by near field communication," but this has just launched. In China, China Mobile, the world's largest mobile operator, has announced plans for a large scale commercial rollout of mobile contactless payments, but the rollout is not slated to start until 2010.[38] A number of European countries—notably Austria, France, Britain, Finland, and Germany—are conducting trials of mobile-phone based NFC payment systems in major cities, but most are still in the test phase. Even Russia is looking to launch a contactless mobile payments system by 2011 or 2012.[39] But no European country has yet fielded a nationally deployed, ubiquitous mobile payments infrastructure rivaling those found in Japan or South Korea. But even compared to these countries, the United States lags those with multiple ongoing trials or those putting together national strategies to ubiquitously deploy mobile payments. Meanwhile, contactless payments are evolving at a dynamic pace worldwide; countries not planning to deploy such systems risk falling behind globally.

## MOBILE PAYMENTS IN JAPAN

Japan leads the world in mobile payments consumer adoption, technology infrastructure, and market value. As *Card Technology* magazine writes, "Japan has the most advanced mobile payment and ticketing market in the world."[40] Japanese consumers use their mobile devices as osaifu-keitai (mobile wallets) in lieu of cash or credit cards to pay rail or subway fares (Figure 2); to pay for taxi rides, movie tickets, and parking meters; to make purchases from kiosks and vending machines; to auction used items; to manage loyalty cards and programs; and even to check in at airports with their mobile phones acting as a boarding pass. Japanese consumers purchase hundreds of thousands of items—from tickets to groceries—with mobile phones every day in Japan. Because they spend an estimated ¥60 trillion ($514 billion) each year on low-value purchases, the market is primed for cash to be replaced with electronic money.

Japanese consumers also use the electronic wallets on their mobile phones to store identification information used to check into offices, apartment buildings, and health clubs, and register their attendance at school.

**Figure 2: Mobile NFC Payment at a Japan Railway Station[42]**


Japanese citizens view mobile phones as indispensible "lifestyle infrastructure" that serves "as the remote control for all the transactions in our daily lives."[41] This section describes the current state of the mobile payments market in Japan; a subsequent section explores the sources of the country's mobile payments leadership.

Eighty-seven percent of Japanese own mobile phones, 90 percent of which operate on 3G networks. As of September 2008, 78 million mobile phones in Japan had FeliCa-enabled electronic wallet capability, with 17 million mobile phone subscribers using their mobile phones to make contactless transactions.[43] Eighteen percent of Japan's mobile phone subscribers report that they have at least tried out the electronic wallet feature of their mobile phones for contactless transactions.[44] As of August 2009, 82.8 percent of residents in the Tokyo metropolitan area used electronic money, up from 78.9 percent in August 2008. Average transaction amounts per month increased from ¥5,600 to ¥6,000 ($61 to $65) over that time period, with users averaging a total of seven transactions per month.[45]

The value of mobile contactless transactions (whether initiated from a smart card or mobile phone), reached ¥1.7 trillion ($17 billion) in 2008, and is expected to grow to ¥2 trillion ($20 billion) by 2012, according to *Nikkei BP*, a major Japanese business publication.[46] The following categories accounted for proximity payments volume in 2008: actual payments at a physical retail location, 35 percent; online shopping, 34.5 percent; transportation (trains, taxis, buses, etc.), 14.3 percent; auctions, 8.3 percent; mobile music purchases, 4 percent; mobile game purchases, 1.6 percent; mobile

e-book purchases, 1.2 percent; mobile video purchases, 1.1 percent.[47] Considering only the value of transactions executed when Japanese mobile subscribers actually waved their FeliCa-enabled phones or smart cards in front of a FeliCa-enabled terminal reader, this amounted to $8.4 billion in 2008. (The remainder, $8.6 billion, is accounted for by transactions billed to electronic money accounts but that were not actually made in a contactless fashion. For example, one made a purchase on the Internet, but billed the charge to one's electronic money account.)

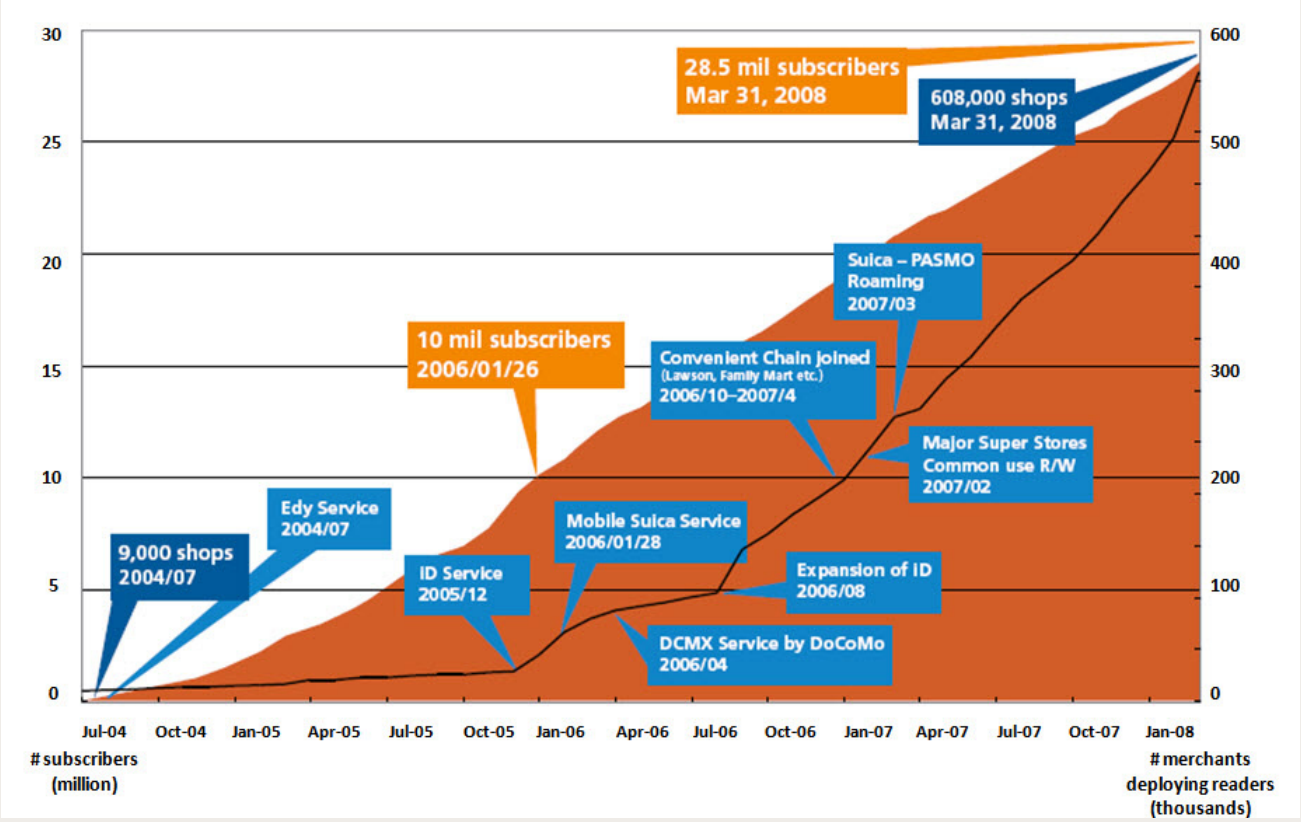
## The Contactless Mobile Payments Market in Japan

Contactless mobile payments in Japan began with the FeliCa smart card platform and subsequently migrated into cell phones. FeliCa is an RFID-based contactless payments standard developed by Sony; it is akin to but not yet interoperable with NFC. There are three major types of mobile FeliCa transactions—whether initiated via a smart card or mobile phone—in Japan today: 1) contactless payments for rail/mass transit using a prepaid, stored value card, such Japan Railway (JR) East's Suica card; 2) mobile payments debited from a prepaid digital cash (electronic money) account operated by service providers such as Edy, Nanaco, or Waon; and 3) contactless transactions that use credit on a postpaid basis, such as the DCMX credit service provided by DOCOMO.

The four largest electronic money services in Japan are Suica, iD (DOCOMO), Edy, and Nanaco. Suica, operated by JR East Railways, serves as electronic cash (available either via smart card or mobile phone) that can be used to pay railway fare or to make purchases from affiliated kiosks and merchants. Over 27 million Japanese use Suica in lieu of cash to pay railway fare. Suica users alone make more than 200 million contactless transactions per month in Japan.[48] Nanaco is a contactless smart card and e-money service provided by Seven & I Holdings (7-Eleven stores), and Waon is a contactless smart card and e-money service from the AEON group (one of Japan's largest retail chains).

As of August 2008, Japanese citizens held 84.56 million mobile FeliCa accounts in Japan, including 67.7 million FeliCa-enabled smart cards, and 16.9 million FeliCa-enabled mobile phones. By service provider, JR East had 25.9 million customers using the Suica smart card and an additional 1.22 million mobile customers; Edy had 34.4 million smart card customers and an ad-

**Figure 3: Growth of Mobile Payments Acceptance in Japan[51]**



ditional 8.3 million more mobile customers; Nanaco had 6.13 million customers of its prepaid service, with 900,000 using the mobile phone service; and DOCOMO had 6.44 million customers using their mobile phones to make mobile purchases on a credit basis.[49] (By August 2009, subscribers of DOCOMO's DCMX credit service had surpassed 10 million.)[50] Over 600,000 shops now accept mobile payments in Japan, as Figure 3 shows.

### History and Development of Contactless Mobile Payments in Japan

Japan's expertise in contactless smart card technology dates back to 1988, when Sony began work on contactless integrated circuit (IC) chips, culminating by 1995 in the development of the FeliCa contactless IC card technology.[52] That same year, Hong Kong authorities adopted FeliCa IC chip technology for the Octopus contactless card used in their public transportation system (akin to today's SmarTrip cards in Washington, D.C.), and in 1999 Sony began trial use of the FeliCa card as an employee ID and "e-wallet" in a Tokyo office and shopping complex. But by the end of the 1990s, FeliCa was struggling to find uptake and penetration in the Japanese market,[53] in large part due to the system interdependency problem described previously.

For its part, Japan Rail (renamed JR East after its 1987 privatization), the country's largest railway line, had begun research and development into automated fare collection technology as early as 1987 and had introduced magnetic stripe cards in 1992.[54] JR East and Sony worked collaboratively throughout the 1990s on contactless payment systems, experimenting with microwaves and battery-operated cards in trials from 1994 to 1997, finding that the advantages of moving from magnetic stripe cards to contactless cards are accelerated transaction processing time—700 milliseconds for magnet stripe cards versus 200 milliseconds for contactless cards—and enhanced reliability.[55] (Payment terminals commonly found in mass transit, which take in and return a magnetic stripe card, contain moving parts that convey the card through the reader and are far more prone to mechanical failure than contactless fare systems.) JR East also recognized that, by deploying contactless ticketing, it could substantially reduce the number of employees it deployed in railway stations to handle paper-based ticketing.[56]

In November 2001, this collaboration led JR East to launch the Suica (Super Urban Intelligent Card) contactless smart card, based on Sony's FeliCa technology, concurrently deploying FeliCa-enabled readers at the turnstiles of the 424 stations in its commuter railroad network in the Tokyo area. Critically, Suica operated as an open-loop, transit-branded card, meaning that passengers could use value stored on the Suica card not just for transit fare, but also to make purchases at affiliated merchants and kiosks in railway stations (and elsewhere) that accepted the Suica card. By introducing an interoperable smart card system, Suica launched the market for electronic money in Japan.

Sony, looking to spur demand for its Mobile FeliCa technology, spearheaded in 2002 the creation of the joint venture BitWallet, Inc. which launched Edy, a contactless smart card-based, prepaid electronic money service using the FeliCa chip. (Ownership of the BitWallet joint venture is shared 33 percent by Sony, 15 percent by DOCOMO, 5 percent by All Nippon Airways, with the remainder accounted for by more than 50 other companies.) Customers can use Edy as digital cash to make purchases at am/pm, Circle K, and Sunkus convenience stores, taxis, bookstores, and other venues. By 2007, Edy had attracted 23 million smart card subscribers and 4.5 million phone subscribers who generated 15 million transactions per month at over 50,000 participating stores. However, Edy is not interoperable with Suica.[57] Nanaco, Waon, and others also emerged as competing digital card services.

Encouraged by the success of Suica and Edy, Sony, JR East, and DOCOMO discussed the possibility of embedding FeliCa technology in DOCOMO's phones, and by March 2003 the trio ascertained that it was technologically feasible to do so.[58] The greater challenge, of course, lay in identifying a sustainable business model for all parties. Sony would profit directly from sales of the FeliCa chip, but because DOCOMO earned revenues primarily through voice and data services traffic, and because contactless transactions settle over the back-end of the financial payment network, contactless mobile payments would not significantly increase telecommunications traffic, and thus would not generate a revenue stream DOCOMO could tap into.[59] Takeshi Natsuno, father of DOCOMO's popular wireless Internet service i-Mode and head of the DOCOMO team negotiating with Sony, advanced a plan to split

profits from mobile FeliCa through a Sony-DOCOMO joint venture that would generate revenues by licensing and managing use of the mobile FeliCa technology.[60] In May 2003, the companies established the joint venture FeliCa Networks, with ¥5.8 billion ($65 million) in capital and a 60/40 percent equity ownership and 80/20 employee split between Sony and DOCOMO, with Sony providing the bulk of the intellectual capital.[61] (JR East would subsequently acquire a 5 percent stake of the company in June 2004.)

FeliCa Networks would act as the trusted service manager and generate revenue through three channels, each a form of transaction fee: 1) collecting license fees from mobile operators (other than DOCOMO) that purchased mobile FeliCa chips; 2) providing platform management services (since applications were not pre-installed on mobile FeliCa chips, the joint venture would receive a fee every time a user downloaded and paid for an electronic wallet application); and 3) providing a range of hosted services, such as managing the servers used to download applications or to authenticate users.[62]

With the technology infrastructure and business model in place, in 2004 DOCOMO began selling mobile phones with pre-installed electronic wallets (the osaifu-keitai), initially allowing customers to download ¥10,000 ($95) per month in credits to a phone via the company's i-mode data service. BitWallet launched a mobile version of Edy digital cash in 2004, which received rapid adoption because it came pre-installed as an application on all DOCOMO FeliCa-capable handsets.[63] In the three years after DOCOMO debuted mobile wallets using Sony's FeliCa contactless system, it sold more than 13.8 million mobile wallet–capable handsets, achieving a 27 percent market penetration rate. By 2007, FeliCa became DOCOMO's fastest growing business, with over 700,000 transactions per month.[64]

Competing mobile operators quickly launched their own mobile wallet–enabled phones. Although DOCOMO's original osaifu-keitai service was limited to ¥10,000 ($95) in pre-purchased credits per month, wireless carriers innovated by adding credit as a feature of their mobile wallets. When KDDI (DOCOMO's chief rival), launched EZ FeliCa as its mobile wallet service, it partnered with JCB (Japan's largest credit card company) to preload JCB's QuickPay service onto its mobile phones. JCB reported that its registered users of credit services jumped threefold in the months following its partnership with KDDI.

Responding to competition, NTT DOCOMO launched iD/DCMX, its platform for mobile credit card transactions, in April 2006. By August 2009, over 420,000 installed reader/writer terminals at merchant locations accepted iD. More than 60 credit-card issuing banks have issued credit cards and/or mobile applications capable of processing credit payments on the iD platform. DOCOMO's own credit service comes in three types: DCMX mini offers the standard ¥10,000 ($95) per month credit line, which settles through the customer's mobile phone bill, requires no authentication, and is available through the mobile phone only. DCMX offers a ¥200,000 ($2,200) permonth credit line, requires authentication at the point of sale, and settles through the customer's credit card bill. A DCMX Gold service with an even higher credit line is available as well.

*Check-in through mobile phones in Japan can occur using one of two mechanisms: using mobile FelICa in a contactless transaction, or using the QR code via optical character recognition.*

JR East launched an electronic wallet version of Suica for mobile phones in 2006, but take-up of the mobile service got off to a very slow start because, at the time, JR East forced customers to also sign up for a JR View credit card.[65] This largely explains why Suica had only 1.22 mobile users, compared with about 26 million card users as of August 2008.[66] In addition to JR East ticketing gates, lockers, and vending machines, about 40,000 participating retail outlets accept Suica payments.

Take-up among mobile subscribers for FeliCa services has been steadily growing. Eighteen percent of mobile FeliCa users report they make contactless transactions daily, 12 percent say they use mobile FeliCa at least four to five times per week, and 17 percent report using contactless transactions two to three times per week.[67] (In 2007, only 12 percent reported using mobile FeliCa daily and 9 percent reported using the service 2 to 3 times per week.) One Sony official noted satisfaction with the

**Figure 4: A QR Code**

steady increase in uptake, commenting, "We are trying to change people's behavior for something that really hasn't changed in 3,000 years."[68]

### Other Forms of Contactless Transactions in Japan

Quick Response (QR) codes, two-dimensional bar codes invented by the Japanese firm Denso Wave that can be read by mobile phone cameras (as shown in Figure 4) have also been instrumental in driving m-commerce and m-payments in Japan.[69] Magazine and newspaper advertisements, movie posters, and even business cards use QR codes.

When a user scans the QR code with the mobile phone's camera, barcode-reading software embedded in the phone processes the barcode and the cell phone performs the task instructed by the code, such as displaying an URL or text. QR codes are extremely popular amongst Japanese businesses as a response channel for advertising media, including print media and packaging, as well as for mobile couponing. Even political parties are putting QR codes on posters and billboards (Figure 5), allowing passersby to simply "click on the poster and access the candidate's Web site for more details."[70]

Major airports and airlines in Japan allow passengers to both pass through security and to board at the flight gate using their mobile phone instead of a paper ticket.

**Figure 5: QR Code in Political Campaign[71]**


**Figure 6: Mobile Check in for Airline Flight in Japan**


Check-in through the mobile phone in Japan can occur using one of two mechanisms: using mobile FeliCa in a contactless transaction, or using the QR code format via optical character recognition. (Mobile phone check-in at U.S. airports uses barcode optical character recognition instead of contactless technology.)[72] In late 2006, All Nippon Airways (ANA) made the readers at their check-in gates FeliCa-compliant, so that passengers could download an ANA Edy application to the electronic wallet of their mobile phone and simply touch their FeliCa-capable handset to the reader/writer at both security and gate check-ins. In the alternate format, ANA can send a QR code to the passenger's mobile phone, which is optically scanned by the reader/writer at the gate. Japan Airlines (JAL) launched a similar "Touch and Go" service (Figure 6) in February 2008, which also allows passengers to pass security and flight gates via contactless transactions.[73] (ANA and JAL applications are not interoperable. That is, one must carry separate ANA and JAL applications in the mobile phone's osaifu-keitai to check in for trips with the different airlines.)

Even laptops now ship with built-in FeliCa readers or FeliCa dongles connected via USB, so users can purchase items online and pay for them simply by placing their mobile phone or smart card near a computer.[74] (The mobile phone can also automatically transmit address and other order entry information.) Thus, even when shopping from an actual computer online, Japanese users can make payments through their mobile phone. FeliCa Network's Kazapon service lets users transmit information such as mobile URLs, transportation timetables, etc., by touching their mobile hand-

set to a computer with a USB-enabled FeliCa reader/writer. This allows data such as address books to be contactlessly communicated between the computer and cell phone.

## SOUTH KOREA

After Japan, South Korea ranks as the second most advanced country in the world in adoption and deployment of contactless mobile payments. South Korea boasts some of the world's most sophisticated mobile handsets, mobile broadband networks, and mobile users, and has a 93 percent mobile penetration rate.[75] Over 80 percent of phones in South Korea operate on 3G networks.[76] South Korea actually introduced mobile payments earlier than Japan did, in 2002, although consumer uptake has come slower than in Japan.[77] Nevertheless, by year-end 2008, 63 percent of South Koreans had made mobile payments using their cellular phones.[78] At least 12 million mobile phones in South Korea (about one-quarter of the country's mobile phones) have the ability to make contactless mobile payments.[79] More than 1 million cell phone subscribers use T-money, electronic cash stored and refilled on SIM cards, to pay for public transit or make other contactless purchases in South Korea.[80]

As with Japanese consumers, South Koreans view their cell phones as the "ultimate enabler," using them for a wide range of commercial, communications, and entertainment purposes, including: contactless payment of railway, subway, bus, taxi or limousine fare; contactless payment for purchases in convenience, fast food stores, and kiosks; and as personal ID to check into workplaces or apartment buildings. South Koreans also use their mobile phones as an Internet payment gateway; to buy movie tickets and enter theatres; to power on and off home appliances such as air conditioners; to monitor diabetes and other diseases remotely; and for entertainment purposes as a karaoke machine, camera, MP3 player, game device, or HD video recorder. Students even touch their mobile phones to reader terminals outside classroom doors to mark their attendance at school, with the school's server logging attendance and tardiness. As SK Telecom's Shim Gi-tae explains, the intent is to, "Make the cell phone the center of life, bringing complex bits of daily life—cash, credit cards, membership and student ID cards, everything—into the mobile phone."[81] His colleague, Ju Hae-Sang, Manager for Mobile Cash Payments at SK Telecom concurs, noting that the goal is to bring cash and credit to mobile phones, "thus making South Korea a walletless, cashless society."[82]

Monitoring the progress of mobile payments in South Korea is especially important, because, as one analyst notes, "What happens in South Korea matters to mobile network operators and banks considering launching m-payment schemes throughout the rest of the world because new mobile technologies often get their first large-scale tryouts in South Korea, before being slowly adopted elsewhere."[83]

### The evolution of contactless mobile payments in South Korea

The mobile payments ecosystem in South Korea developed quite differently from that in Japan.[84] Moreover, the mobile payments ecosystem in South Korea is still rapidly evolving, with the market picture today looking quite different from even just several years ago.[85] The evolution of mobile payments in South Korean can be said to have evolved through three phases: 1) early initiatives by mobile network operators to drive the marketplace from 2002 to 2007 that have had difficulty sustaining traction; 2) the rise of the Internet payment gateway mobile payment providers from 2004 to the present; and 3) the introduction of T-money as a smart card platform for contactless transportation and e-money payments since 2004 (and on mobile phones since 2007).

### Mobile Network Operator-Led Initiatives

As with NTT DOCOMO in Japan, South Korea's largest telecommunications company, SK Telecom, moved early to advance a vertically integrated mobile payments ecosystem in South Korea, including a comprehensive framework for mobile cash (Moneta Cash), mobile payments (Moneta), and mobile banking (Mbank).[86] SK Telecom launched Moneta in November 2002 as a mobile wallet application allowing customers to make proximity (in-store) contactless payments through several mechanisms. Moneta initially supported a mobile cash payment product (Moneta Cash) and subsequently evolved toward a platform to support credit card payments through mobile phones.[87]

SK Telecom sought to pioneer mobile payments in South Korea with a mobile cash product called NeMo (Network + Money), which was launched alongside

nine major Korean banks in 2001.[88] (NeMo was subsequently rebranded as Moneta Cash.) Moneta Cash represented a fundamentally new payment instrument, which SK Telecom hoped might eventually replace credit cards.[89] This vision led to tensions with participating banks, who increasingly saw SK Telecom's m-cash accounts as an invasion of an outsider into their business domain. For example, the head of Kookmin Bank reacted to Moneta Cash by "issuing a warning to his fellow bankers that the likes of SK Telecom were out to steal their business."[90] While Moneta Cash garnered 3 million customers, continued in-fighting with bank partners contributed to the service being discontinued in 2004.[91]

Unlike Moneta Cash, which gave customers a new type of financial account, Moneta itself was not a payment instrument but rather a mobile wallet application that allowed customers to pay using their existing credit or debit account over mobile terminals. Moneta worked with a new type of chip-embedded Moneta Card (a credit card in a smart card format). Moneta cards were launched in September 2001; they were initially co-branded by Visa and issued by five major domestic credit card companies and banks. Over time, SK Telecom expanded its Moneta payment services from the merchant proximity payment service (Moneta Card) to online payment services and mass transit payments (Moneta Pass) in Seoul. In addition, it has used the payment platform to offer mobile shopping, mobile banking (Moneta Bank or MBank), and mobile stock trading (Moneta Stock Trading) services.[92] The Moneta service allows a mobile device to be used as an e-money account, credit card, transit ticket, membership loyalty card, and mobile platform for equity trading. SK Telecom acts as the m-wallet owner, meaning that customers are able to hold multiple accounts from different issuers under one mobile device serviced by SK Telecom.[93]

Though SK Telecom clearly took the lead to create and launch the Moneta service, Moneta represents a collaborative operator/financial services mobile payments ecosystem model, with both parties making important contributions and concessions.[94] Credit/account issuance is performed by the partnering banks and payments are processed through existing Visa and Mastercard networks. SK Telecom took responsibility for developing new payment applications and investing in rolling out new POS readers with merchants.[95] For those investments, SK Telecom received a share of the revenue generated by transactions initiated by mobile phones, directly insinuating itself into the revenue stream generated by contactless payments. SK Telecom received 1.3 percent of the merchant processing fee, payment networks 0.1 percent, and issuing banks 1.2 percent, which represented a concession from their usual 2.5 percent merchant processing fee.[96]

As of February 2007, SK Telecom's Moneta service had over 2.6 million subscribers and had deployed 500,000 POS readers.[97] But as one 2007 report noted, "actual Moneta usage is very low, and the future of Moneta is uncertain"[98]; indeed over the past two years Moneta has continued to struggle. As Professor Suk-Gwon Chang of Hanyang University's School of Business and a leading expert on South Korea's ICT industry, explains, "Moneta is an older mobile payments business model from SK Telecom that appears to be losing traction in the marketplace."[99] Moneta's difficulty in gaining traction in the marketplace illustrates the difficulties many countries have confronted in developing mobile payments ecosystems. Moneta's challenges stemmed chiefly from ecosystem players fearing the risk of technology lock-in and continuing distrust from financial institutions.[100]

With regard to the threat of technology lock-in, in the mid 2000s many players were positioning themselves with their own technologies to enable credit card payments over mobile phones: SK Telecom and KTF were each promoting their own standards, a start-up called Harex Info Tech was offering its own infrared based m-payment service called ZOOP in parts of Seoul, and some established credit card companies wanted to develop their own card-based m-payment solutions.[101] Moreover, the competing solutions required installing proprietary merchant POS readers, which were not interoperable among rival systems. Retailers faced the need to deploy multiple card-accepting devices (which would only add to the cost and complexity of operations), and therefore retailers resisted investing in the new equipment necessary to process Moneta transactions before demand for the service was well proven.[102] South Korean handset vendors were also slow to respond in developing the special-purpose Moneta capabilities until they felt the market had fully developed.[103]

Meanwhile, public bickering between banks, telecoms, and the consortia they formed hampered development of m-payments in South Korea. Despite trying, the players established little alignment in their business models. The banking and credit card industries were not very supportive because the mobile carriers were demanding such a large share of the transaction revenue.[104] Customer ownership issues also flared up. With the single Moneta chip housing both SK Telecom subscriber data and the customer's credit card (or even bank account) information, banks were concerned that SK Telecom's control over the Moneta chip would allow it to control which services were proposed to their customers.

With the mobile payment services put forward by the mobile network operators failing floundering throughout the mid-2000s, a series of innovative startups, including Mobilians, Danal, Infohub, and Incis, began offering Internet payment gateway services through mobile phones. The service found enthusiastic uptake in the marketplace. Customers purchasing cheap digital goods (ranging from a few cents to $150, such as music, avatars, or video game enhancements) online from their personal computers at checkout can enter their cell phone number into the seller's Web site. The merchant's Web server then sends a code to the customer's phone as a text message. The customer keys in the code on the checkout page of the Web site, receives the digital purchase, and the purchase is added to the subscriber's cell phone bill. In 2006, 23 million South Korean cell phone subscribers used this service, and 70 percent of all digital content—valued at more than $1 billion—sold in South Korea was charged directly to cell phone bills instead of traditional credit cards. Although the service was initially targeted to a younger generation of South Koreans who generally lacked credit cards and thus a means to pay for digital goods online, it has become so popular that 67 percent of South Korean online users prefer paying via their mobile phone when purchasing PC-based online digital content. By 2007, the Internet payment gateway services were processing hundreds of millions of transactions annually, and the mobile operators were generating high profit margins, explaining why the service, which started out with small ticket items (less than $10 digital goods), quickly grew to include purchases of physical items costing $150 or more.

### T-money

In 2004, a new player burst on the scene to take center stage in South Korea's mobile payments marketplace.[105] T-money is a pre-paid radio frequency (RF)-based smart card developed by the Korea Smart Card Company (KSCC) that is embedded with a central processing unit (CPU) that enables calculation on the card. One's T-money card serves as both a transportation card and electronic money card, meaning the same T-money card is accepted for payment in public transit and by affiliated merchants. T-money can be used on all public, and most private, transportation modes in Seoul, including bus, subway, and taxis, and in other venues like parking garages and toll booths. As an e-money card, T-money can be used in lieu of cash or credit cards to make payments at convenience stores, movie theatres, theme parks, vending machines, museums, kiosks, bookstores, and some merchants. Citizens can also use T-money to pay taxes and fines or to pay for other civic services. T-money can only be used on a pre-paid, debit basis, not on a post-paid credit basis. The "T" in T-money stands for travel, touch, traffic and technology.

Customers purchase a T-money smart card from dispensing terminals ("value loading machines") in metro or railway stations and add value to it ("top it up") by linking it to a credit or debit account, or adding value over the Internet. T-money can be seen as a cousin of near field communication-based systems. Just like NFC and FeliCa, T-money uses radio frequency identification technology. However, since T-money uses a passive, as opposed to active, version of RFID that operates in card emulation mode only (no reader mode or peer-to-peer mode), T-money is a proprietary system not interoperable with NFC.[106] That is, a South Korean mobile subscriber could not (at this moment) use the same mobile phone to effect contactless payments in Japan, South Korea, or European locations.

The development of T-money resulted from the Seoul Public Transportation Reform launched in the early 2000s by the Seoul Metropolitan Government. With over 22 million residents, the Seoul metropolitan area depends on mass transportation, with 765 bus routes, nine metro (subway) lines, and 391 subway stations. Due to a wide spectrum of origination-destination trip demands, the majority of trips in Seoul require

intermodal transit. But because metro and bus services were not adequately integrated, passengers had to contend with hassles, such as making multiple payments for a single journey or dealing with circuitous bus routes or inadequate extension facilities.[107] As a consequence, transit ridership declined in the early part of the decade, raising the subsidy needs of the bus industry to a point of grave concern.[108] The Seoul Metropolitan Government recognized that it needed a unified public transit fare system that would charge customers consistently by distance travelled regardless of modal use or operator providing the service.

*The Korea Smart Card Company is a public private partnership spearheaded by the government to launch a combined transportation and electronic money contactless card.*

To oversee creation of the New Transportation System, the government spearheaded the creation of the Korea Smart Card Company. KSCC represented a joint venture through which the government could raise capital from the private sector.[109] KSCC formed in 2003 with the investment of several shareholders including the Seoul Metropolitan Government (the majority shareholder), LG Group (an electronics company), credit card companies, smaller telecommunication companies, and the Korean Teacher's Mutual Fund.[110] On July 1, 2004, KSCC launched Seoul's New Transportation System, with T-money as the electronic system for unified fare collection and settlement for Seoul's public transport network. Under the fare structure, fare is charged for a "transaction unit," defined as a set of sequential rides from an origin to an end destination. Different operators (such as private bus service providers) collect fares not for themselves, but for the entire system. Since its launch in 2004, the New Transportation System has delivered impressive results: within two years of launch, average daily mass transit ridership in Seoul increased by 5.2 percent while average bus fare cost fell by 5 percent.[111] Moreover, as Seoul's subway system has moved from paper tickets to smart cards, it has eliminated the need for 450 million paper magnetic stripe tickets at a savings of 3 billion won ($2.4 million) per year.[112] As of March 2009, customers use T-money for 30 million public transit transactions per day (15.4 million bus and 14.6 million subway).

While those achievements are impressive, the beauty of T-money is that the government and KSCC designed T-money from the beginning to be extensible for applications beyond mass transit and to be adopted in commercial environments. Thus, T-money can be used for commercial transactions in convenience and fast food stores, universities, and theatres; with automatic devices such as vending machines, copy machines, and automatic civil document issuers; and at public facilities, including public parking garages, toll booths, and amusement or theme parks. Beyond mass transit, South Korean consumers make over 3 million e-money transactions per day using T-money, including 1.4 million T-money transactions at vending machines, over 1 million transactions in convenience stores, and some 400,000 transactions in public facilities.[113] Within the Seoul metropolitan area, 18 million T-money smart cards have been issued, with T-money accepted at the reader terminals of 19,750 buses; over 8,000 subway terminals; 73,000 taxi cabs; 21,000 vending machines; and 8,300 convenience stores, fast food stores, and parking garages.[114] Seoul government's launch of the New Transportation System substantially catalyzed momentum for mobile payments in South Korea.[115] As Gye Hun Park, President and CEO of KSCC commented, "Our integration of the New Transportation System served as momentum for applying smart cards throughout Korea."[116]

From its start with smart card based T-money in Seoul in July 2004, KSCC has moved to expand the range of devices—and geographies—through and in which T-money can be used. In February 2007, SK Telecom launched a "Mobile T-Money" service, which enabled users to have their T-money transportation cards preinstalled onto the USIM (Universal Subscriber Identity Module) of their 3G cellular phone handsets (Figure 7).[117] Rivals LG Telecom and KT quickly followed suit. In addition to mobile phones, KSCC has also introduced T-money on innovative new media such as watches and USB keys.[118] KSCC is working to implement T-money nationally throughout South Korea, and now deploys T-money in 14 South Korean cities beyond Seoul, including Incheon, Gyeonggi, and Je-Ju. Convenience stores, Internet cafes, discount stores, and online shopping malls regularly accept either mobile T-money or Moneta, but because banks and wireless companies continue to squabble over who should pay for the cost of installing reader terminals in those

**Figure 7: Mobile Payments in South Korean Mass Transit[121]**

venues, many restaurants and merchant shops cannot yet accept these forms of payment.[119] Most of the POS terminals initially deployed by merchants to work with the Moneta services have or are being updated to work with the T-Money service.[120]

Two applications of T-money that have become incredibly popular are for personal remittances and gift giving. Instead of giving children a cash allowance, parents often transfer money directly into their children's T-money account. SK Telecom launched a popular service, Gifticon, which combines barcode technology with mobile payments to allow users to send gift vouchers for over 130 items. For example, one can go to a mobile carrier's online shop, buy an icon depicting coffee and send it to, say, a girlfriend's phone, who can then go to the Starbucks, flash the icon from the phone, and get the drink. The Gifticon service has attracted 2.5 million users and delivers 70,000 gifts daily. SK Telecom expects the service to generate $10 million in revenues in 2008.[122]

## MOBILE PAYMENTS IN THE UNITED STATES

The state of NFC-based mobile payments in the United States can best be described as in the pre-market, trial phase, with ecosystem relationships between mobile network operators, financial institutions, and merchants just beginning to be established and the technology and customer value propositions undergoing initial tests in pilot markets. Over the past five years, a number of limited field trials of NFC-based mobile payments have taken place across the United States—in San Francisco, New York, Dallas, Atlanta, and elsewhere—but no effort has moved beyond the trial phase. Only a small number of mobile phones equipped with NFC-mobile wallet capability exist in the United States. However, the United States has made considerably more progress in beginning to deploy NFC-capable contactless smart cards and credit/debit cards and getting initial merchant deployment of NFC-capable point of sale readers. This section examines: 1) the overall U.S. mobile payments market; 2) efforts to get contactless payment functionality on U.S. mobile phones; and 3) the use of mobile payments in U.S. public transportation.

The United States clearly trails its East Asian (and even European) peers in mobile commerce generally, and mobile payments specifically. A recent Nielsen survey found that only 9 million Americans had made at least one mobile commerce purchase, although 125 million Americans said they were willing to make a mobile commerce purchase in the near future, a sign of the market's immense potential.[123] In-Stat's David Chamberlain estimates that the number of wireless customers in the United States using their phones for mobile commerce transactions will reach 20 million by 2011.[124] The total size of the U.S. mobile commerce market is expected to reach $2.6 billion by year-end 2009.[125] The Tower Group has estimated that the total value of contactless micropayments (though made almost entirely from contactless credit cards) in the United States will reach $11.5 billion by 2009, and that 10 percent of U.S. payments will be contactless in 2010.[126]

## BOX 2: MOBILE PAYMENTS IN THE DEVELOPING WORLD

Some of the most innovative deployments of mobile payments are actually happening in the developing world. There are two primary reasons for this: 1) mobile devices are the primary means of connectivity in the developing world; and 2) the financial and banking infrastructure in many developing countries is severely underdeveloped. In the context of the developing world, "mobile payments" refers to domestic funds transfer or international money remittances using primarily the SMS features of mobile phones to communicate money transfer instructions; it does not refer to contactless, NFC-based mobile payments.

Mobile commerce has grown very rapidly in the developing world, in part because many developing countries skipped a technological generation in fixed-line phone networks and went directly to mobile communications. Thus, in many low-income countries, mobile phones represent substitutes for fixed-line phones, whereas in industrialized Western countries mobile phones began as a supplement to fixed-line phones.[127] Three times as many individuals in developing countries connect to the Internet through mobile phones than through computers, with 32.4 percent of citizens in developing countries in 2006 having mobile connectivity and only 10.2 percent having Internet connectivity.[128]

Whereas mobile commerce in the developed world has complemented generally well-established banking and financial infrastructure, in many developing countries, the mobile phone is stepping in to substitute for underdeveloped or nonexistent financial infrastructure. Services such as Kenya's M-Pesa allow mobile subscribers to send text messages to make or transfer payments from phone to phone. Mobile technology thus extends financial services to people who otherwise might not have access to them. In some parts of the developing world, unused mobile phone minutes are actually treated as a form of currency that is bartered in exchange for goods or services. For many consumers in emerging markets, their first banking transactions will likely be made through cell phones.[129] As *The Economist* notes, mobile phones have "the potential to give the 'unbanked masses' access to financial services, and bring them into the formal economy."[130] Cost-effectively equipping millions more people with a mobile communications/computing device has the potential to lift the economic status of a significant number of people across the world.[131]

Kenya and the Philippines lead the developing world in adopting mobile payments (m-payments). As of June 2009, there were 7.2 million m-payment subscribers in the Philippines and over 6 million in Kenya. In the Philippines, the companies Smart Communications and Globe Telecom pioneered mobile payments through their SmartMoney and GCash services, respectively. Smart Money has just over 6 million users while GCash has 1.2 million.[132] Since its launch by Kenya's Safaricom in February 2007, M-Pesa has grown massively to reach 6.2 million registered users, accounting for 46 percent of Safaricom's 13.4 million users by the end of March 2009, with the service enrolling 11,000 new subscribers per day.[133] A total of Ksh 17.3 billion ($220 million) was transferred in March 2009 to a cumulative total of Ksh 135.4 billion ($1.73 billion) since the service's launch. M-Pesa's success in Kenya, and Smart Money's in the Philippines, has prompted many emerging market service providers and banks to enter the marketplace. GSMA (a global association of mobile carriers using GSM technology) reports that over 100 mobile payment services have launched in emerging markets to date.[134]

M-payments benefit mobile subscribers in developing countries in a variety of ways. They have played a significant role in expanding the availability of micro-finance to rural and underdeveloped communities.[135] In the Philippines, millions actually receive their salaries paid directly into their phones' mobile wallet, and then pay others through text messages, sending the funds directly from their phones. Filipinos find it faster and cheaper to get money from families overseas via text message than by using a bank transfer. As another example, many Filipino farmers have to commute for hours to their banks to pay interest on their loans, and their commuting cost alone often exceeds the interest they owe; sending m-payments provides them tremendous savings in both time and money.[136] In Kenya, using mobile phones to transfer money is much cheaper than using traditional money transfer channels, with informal channels, such as bus or taxi drivers, costing up to 15 to 25 percent of the transferred amount, and formal money transfer channels (such as banks or Western Union Money Transfer) slightly cheaper at 10 to 15 percent, but requiring a trip to town to give instructions to an agent. With M-Pesa however, moving $5 costs only 7 percent of the funds transferred, $20 costs 3 percent, and $100 costs 1 percent.

The arrival of mobile payments has also transformed how rural communities consume essential utilities and services. Previously, these communities had to spend considerable funds upfront in order to get a modern well capable of providing clean drinking water. Now companies have emerged that will install wells for free, complete with an integrated cell phone payment system, so that when someone needs water, they can simply pay with their M-Pesa account. By integrating a payment system on the mobile platform with a utility, customers can not only pay as they go, but they are also empowered to manage their consumption of the utility or service according to cash available, a substantial benefit to individuals in emerging countries living on irregular or unpredictable income streams, and for whom standard billing cycles can be burdensome.[137]

Indeed, the opportunity to use electronic wallets in mobile phones for micropayments in the United States is vast, for micropayments (transactions valued at less than $25) represent at least a $2 trillion market opportunity, the largest components of which include: $153 billion at fast food restaurants, $14 billion at vending machines, $7 billion in street-metered parking, $14 billion at movie theaters, $7 billion at car washes, $7 billion at tolls and bridges, $10 billion in metropolitan subway and bus traffic, $4 billion in laundry, and $3 billion in taxis and limos (using 2007 data).[142] Thus, the United States presents a ready-made market to leverage the mobile phone as an electronic wallet for convenient micropayments. As Doug Brown, Head of Mobile Product Development for Bank of America, puts it, "The endgame here is that we can replace the physical wallet and all of the cash needs and the plastic that you're using today."[143] And as experienced in South Korea and Japan, the use of mobile wallets extends far beyond payments.

But notwithstanding the enormous potential, the U.S. mobile payments have been stymied by the system interdependency, business model, and chicken-or-egg challenges introduced in the earlier "The Mobile Payments Challenge" section of the paper.

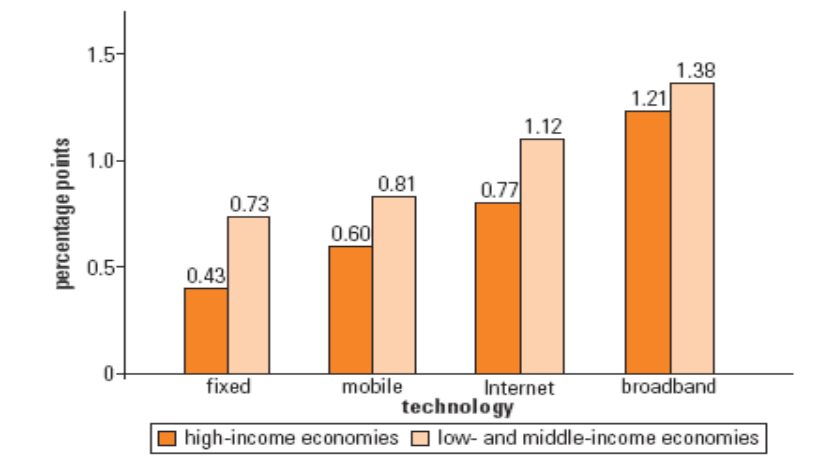
Industry players themselves lament the challenges. Thad Langford, Sprint VP of Innovation, notes, "A key consideration of moving NFC capabilities forward will

**BOX 2 (*Continued*)**

In addition to bringing financial services to individuals, the use of mobile phones has transformed small and individual businesses in developing countries by providing access to the real-time information that helps markets operate more efficiently. For example, farmers in remote areas of the Ivory Coast share mobile phones so they can follow hourly fluctuations in coffee and cocoa prices on world markets, allowing them to sell their crops at the most favorable prices.[138] Fishermen in India use mobile phones to obtain information about the price of fish at various accessible ports before deciding where to land their catch.[139] Similarly, Indian cereal farmers have traditionally received only 53 percent of the final sale price of their product, with middlemen taking as much as 31 percent, but those who check price quotes from their mobile phones and receive payment from cooperatives to the mobile phone realize substantially higher earnings. Research on such commodities markets in India has shown that using mobile phones can eliminate up to six middlemen per transaction.

A growing body of economic research finds a direct linkage between rising mobile phone penetration and increased economic growth. One 2005 study found that a developing country with an average of ten more mobile phones per 100 inhabitants between 1996 and 2003 would have enjoyed per capita GDP growth that was 0.59 percent higher than an otherwise identical country.[140] Updating this research in 2008, the World Bank found that a 10 percent increase in mobile phone penetration in low- and middle-income economies adds 0.81 percent to annual per-capita GDP growth (Figure 8).[141]

**Figure 8: Effect of a 10 percent increase in technology penetration on per-capita GDP growth**



be timing and participation of the carriers, infrastructure providers, and the retailers and banks that would make this possible. Significant investment will be required by each of these groups and must be predicated on the belief that customers will use and value the technology. It will take some time as all parties build out their business models." Simon Pugh, Vice Chairman of the NFC Forum and Head of Mobile Payments at MasterCard, observes, "There's no firm plan about who would pay for the technology to be added to phones and put into stores."[144] Spencer White, Director Mobile Financial Services, AT&T, states, "The current paradigm for payments does not hold a place for entities like the wireless operator. For AT&T to get into the business, make and receive a return on our investments, we have to find a revenue stream. The challenge is that in the current ecosystem, the merchants have little to no tolerance for a more expensive solution, and the existing financial industry is reluctant to either lower prices for merchants or share revenue with carriers."[145]

Where the United States has made some progress in mobile payments is in the deployment of NFC-capable contactless credit cards and with early-adopting retail merchants that have deployed them. Each of the major U.S. credit card issuers offer contactless credit cards: American Express with ExpressPay, MasterCard with PayPass, Visa with Visa payWave, and Discover Network Zip. Thus, unlike in Japan and South Korea, where new forms of electronic money, such as Edy and Nanaco in Japan or T-Money in South Korea, were created to enable mobile electronic payments, the strategy in the United States has been to add contactless payment capability to customers' existing financial (primarily credit card) accounts. As of October 2009, more than 100 million branded contactless credit cards have been issued by U.S. card issuers.[146] Despite the fact that 100 million NFC-enabled contactless credit cards have been issued in the United States, consumer awareness remains a problem. Customers often have to contact their card issuer directly to request a contactless credit card. Many cardholders remain unaware that they possess a contactless credit card, unaware that merchants they frequent accept contactless payments, or unfamiliar with how to use them.[147] Merchant POS terminals and credit cards displaying the symbol below (Figure 9) are enabled for NFC contactless transactions.

**Figure 9: NFC-Capable Symbol**

To accept customers' contactless credit cards, 140,000 merchant locations have deployed more than 500,000 NFC-capable POS readers in the United States (although that number represents a fraction of all POS terminals).[148] The NFC-capable readers being deployed in the United States are equally capable of processing NFC-based transactions initiated either by NFC-enabled contactless credit cards or NFC-enabled mobile phones.

Merchants are currently evaluating whether the operational efficiencies and potential lift in spending justify investments in NFC-capable POS readers. Chase found that using contactless payments reduces time at the point of sale by 30 to 40 percent.[149] Another study reported that contactless transactions were 40 percent faster than those made with credit or debit cards and 55 percent faster than those made with cash. Market research firm Tower Group estimates that contactless payment can reduce individual transaction times by 10 to 15 seconds. Some research has found that consumers spend more per transaction when they are not using cash; Chase reported that the value of contactless transactions was 20 to 30 percent greater than cash purchases (for transactions under $25).[150] In a survey asking merchants who had done so why they deployed NFC-enabled POS readers, 51 percent cited faster checkout and increased throughput at the point of sale and 46 percent cited the ability to support customer preference for the contactless payment option.

A critical question is whether the increasing penetration of contactless credit cards that serve only as payment devices will act as a substitute, or gateway, for electronic wallets (defined as multipurpose devices including not just payment, but also information storage, authentication, and communication features). The United States already has a well-developed credit infrastructure; moving to a "tap and go" environment that makes credit cards that much easier to use raises the bar even higher on the value electronic wallets on mobile phones will have to deliver to get customers to shift to them.

On the other hand, contactless credit cards in the United States may serve as an invaluable gateway, an interim step, towards the widespread realization of phone-initiated mobile payments, for two reasons: 1) they acclimate consumers to the concept of making contactless payments in the first place (whether by phones or cards); and 2) they can prove to merchants the value of, and business case for, contactless payments. Certainly this was the case in Japan, as one observer notes, "Using the physical form of the contactless smart card in Japan's rail stations made it much easier for customers to accept that it [digital cash] could exist virtually on the phone."[151] Moreover, once Edy was introduced on DOCOMO's FeliCa-enabled mobile phones, use of the Edy card increased 40 percent.[152]

Indeed, in initial U.S. trials, Citibank found that contactless users are twice as likely to use mobile wallet services as non-users, with 43 percent of contactless users likely to use a mobile device to make payments compared with 19 percent of non-users. MasterCard found that more than 25 percent of participants who used their PayPass card two to three times per month prior to the trial program increased their frequency of usage to more than three times per month after experiencing MasterCard Mobile with PayPass. A Smart Card Alliance study found that close to half of contactless payment users would switch mobile operators to gain access to mobile payment services. This evidence suggests that American consumers are likely to follow a similar path as Japanese and South Korean consumers of progressing from contactless credit cards to phone-initiated mobile payments.

While there is merit to both perspectives that contactless credit cards may deter or abet the introduction of phone-based mobile payments in the United States, what the propagation of contactless credit cards truly represents is a statement from the card issuers that they will not be left out of the mobile payments game—they are going to ensure that their brand remains "top of wallet," whether the wallet is in one's pocket or on one's phone. In other words, credit card issuers are firmly ensconcing themselves in the U.S. mobile payments value chain, suggesting that U.S. mobile network operators will either have to collaborate with the card issuers or develop new approaches to monetize contactless mobile payments, perhaps by supporting retailers personalized merchandising or advertising campaigns.

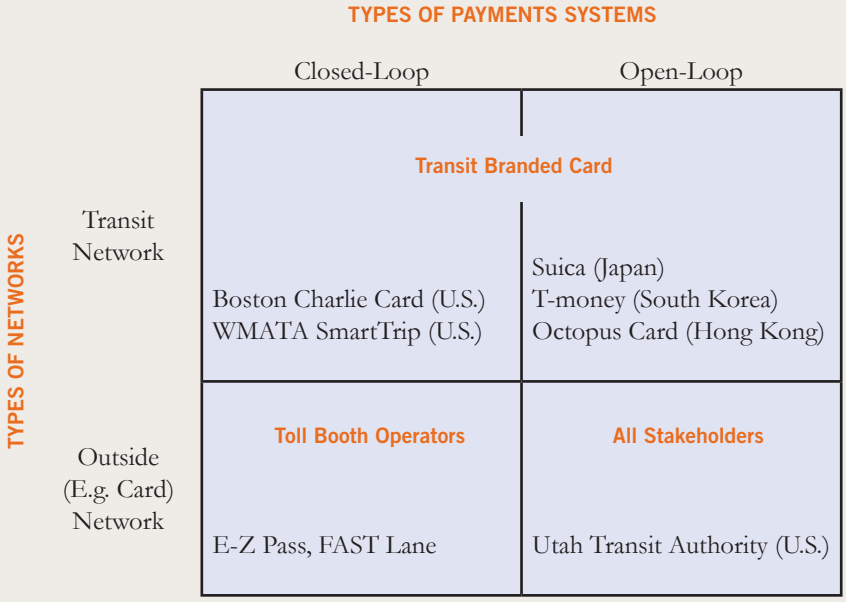
### Mobile Payments in U.S. Mass Transit (and Parking Meters)

Whereas consumers in Japan and South Korea (and Austria) can use their mobile phones to pay directly at parking garages or meters, the lack of an NFC-imbued mobile payments ecosystem means that making "mobile payments" at parking meters in the United States requires using workarounds or less-elegantly integrated solutions than in other countries. For example, several U.S. jurisdictions, including San Francisco, California, Coral Gables, Florida, and Montgomery County,

**Table 3: Deployment of Contactless Fare Payment in U.S. Mass Transit[158]**

| City | Terminals | Projected Users | Status |
|---|---|---|---|
| *Atlanta* | 1,500 | 824,000 | Fully Operational |
| *Boston* | 4,000 | 1,800,000 | Fully Operational |
| *Chicago* | 5,000 | 3,500,000 | Transitional |
| *Houston* | 1,500 | 750,000 | Fully Operational |
| *Los Angeles* | 6,600 | 3,600,000 | Mid-Launch |
| *Miami* | 2,000 | 900,000 | Initial Launch |
| *Minneapolis* | 1,200 | 425,000 | Fully Operational |
| *New York (PATH)* | 350 | 400,000 | Fully Operational |
| *Phildelphia (PATCO)* | 200 | 35,000 | Fully Operational |
| *San Diego* | 1,200 | 370,000 | Initial Launch |
| *San Francisco* | 4,500 | 2,800,000 | Mid-Launch |
| *Seattle* | 3,000 | 947,000 | Mid-Launch |
| *Washington/Baltimore* | 4,500 | 2,700,000 | Fully Operational |

**Figure 10: Transportation Contactless Payments Matrix[160]**




Maryland, offer the option to pay for time at parking meters via cell phone. However, the user experience entails identifying a telephone number on the parking meter, dialing the number, manually keying in the meter number and amount it costs to park, and then entering one's credit card number.[153] While this represents progress, parking meters in the world's leading mobile payments countries feature embedded RFID chips, enabling the customer to simply wave their cell phone across the face of the meter to effect payment instead of having to call a phone number and key in information.

Japan and South Korea are also ahead of the United States when it comes to empowering their citizens to pay rail, subway, and bus transit fares with a seamless touch of their mobile phone to the turnstile payment reader. As Nasreen Quibria, a leading mobile payments industry analyst with Aberdeen Research, notes, the mass transit industry in many countries has been at the vanguard of pioneering contactless payment systems.[154] As Quibria explains, "Given a captive clientele that must use a public transit agency's preferred payment method to utilize its services, the mass transit industry is better positioned than many industries to drive mass adoption of a new payment system."[155]

Historically, the United States has lagged behind leading countries in implementing electronic payment methods for the mass transit market.[156] But with nearly 33 million trips made daily on public transportation in the United States, public transit represents an ideal venue to generate a critical mass of initial demand for mobile payments and acclimate customers to paying for everyday retail purchases on a contactless basis. And indeed, over the past several years, the United States has started to make much more progress in deploying smart card–based (though not phone-based) contactless payment systems in mass transit, with at least 15 major U.S. metropolitan areas now in the process of or having completed deployment of contactless smart cards.[157] Washington, D.C.'s Washington Metropolitan Area Transit Authority (WMATA) was the first major American city's transit agency to deploy a system-wide contactless smart card for mass transit (SmarTrip). Table 3 displays progress in deploying smart card–based contactless payment systems in U.S. mass transit. Unfortunately, most of these contactless systems are proprietary to the issuing transit agency, meaning that one cannot use Boston's CharlieCard on the Washington Metro, or vice versa.

With regard to contactless payments in transportation, there are two primary types of contactless payment systems, closed-loop and open-loop, which utilize one of two types of payment networks, a transit network or an outside network (as shown in Figure 10).[159] Closed-loop systems use a proprietary stored-value contactless card that is limited to payment for transportation services provided by the issuing mass transit agency only.

Open-loop systems use a payment method that is also accepted by businesses outside the transit agency that issued the card. Public transit systems utilize one of two types of payment networks. The first is a "transit network," in which the transit operator independently sets up and operates its own payment network. Alternatively, transit authorities may use outside networks, such as existing credit card networks, leveraging contactless or magnetic swipe cards from major issuers, such as American Express, MasterCard, Visa, JCB, or other credit card issuers.

Four potential payment mechanisms or business models emerge from this matrix—closed-loop transit networks, closed-loop outside networks, open-loop transit networks, and open-loop outside networks.[161] In Washington, D.C., both WMATA's magnetic stripe cards and its newer contactless SmarTrip cards have been deployed within the context of a closed-loop transit model; WMATA set up its own payment system and the WMATA card cannot be used for purchases at other merchant locations. (In essence, in a closed-loop transit network environment, one must use cash or a credit card to buy a new paper magnetic stripe ticket or contactless smart card for travel.) Most of the contactless card deployments in the United States listed in Table 3 use the closed-loop transit network approach. In contrast, an open-loop card network approach would allow transit riders in the United States to simply use their existing contactless credit cards to pay at subway turnstiles or buses, with the cost of the trip charged directly to one's credit card.

In Hong Kong, the popular Octopus Card, which uses the FeliCa IC chip and originally launched in September 1997, is an example of an open-loop transit network card, meaning the card can be used on both the city's mass transit system and with participating merchants, who accept payments via the Octopus card. Based on acceptance, the Octopus card is one of the world's most successful electronic cash systems, with over 95 percent of Hong Kong residents between the ages of 16 and 65 owning an Octopus smart card.[162] (However, because Octopus has lagged in transitioning from the smart card to the mobile phone platform for contactless payments, and because Octopus is not emblematic of China's capabilities in mobile payments at a national level, this report has not cited Hong Kong as one of the world leaders in contactless mobile payments.) Suica and T-Money are also examples of open-loop transit network cards.

In January 2009, the Utah Transit Authority (UTA) became the first transit authority in the United States to launch a full-system rollout of an electronic fare collection (EFC) system based on the open-loop, outside network model. UTA's system allows customers to make contactless payments using contactless credit and debit cards such as Visa payWave, MasterCard PayPass, and American Express ExpressPay on more than 600 buses and a fleet of light rail and commuter rail trains.[163] Washington, D.C., is currently weighing adding an open-loop element to its system that would allow riders to pay for rail, bus, and street parking using their regular credit or debit cards.[164]

*The mass transit industry in many countries has been at the vanguard of pioneering contactless payment systems and driving early adoption of mobile payments through a critical mass of users.*

In determining which type of payment system to deploy, U.S. transit authorities face two major decision points: 1) Should they continue to operate proprietary, closed-loop transit networks, or should they move to an open-loop system that leverages external payment infrastructure? and 2) Should they move from using traditional magnetic stripe cards (paper fare cards) to using contactless smart cards (and ultimately payment applications embedded in the wallets of NFC-enabled mobile phones)? Both of these questions tend to get answered in the context of transit agencies' primary objectives: minimizing capital expenditures and reducing operational costs. Indeed, decisions by mass transit authorities to implement smart card systems have often been based on perceived operational benefits and cost-savings opportunities, rather than consumer demand.[165] Moreover, each of the transit agencies in the United States has been confronting these questions, making decisions, and implementing systems independently, in the absence of federal leadership from the Department of Transportation. As discussed below, these questions should be answered in a way that redounds to the national interest, rather than as one-off decisions made by regional transit authorities.

An open-loop, outside network model can eliminate the need for the transit operator to incur the expense of owning and managing the entire card lifecycle. The

disadvantages to transit agencies of accepting credit card payments—and the reasons this has been so scarce in the United States to date—include: 1) by accepting credit card transactions, transit agencies, in effect, become merchants that have to perform authorization for each transaction, be exposed to fraud, and meet compliance standards; and 2) transit agencies incur an interchange (merchant account fee) on each transaction, losing 2 to 3 percent of each transaction they are otherwise able to retain for themselves by managing their own transit card network.

*In Japan and South Korea, transit authorities, card issuers, and mobile operators came together to create a common electronic wallet capability for smart cards and new NFC smart phones.*

Thus, for transit agencies to accept credit or debit cards, they must perform external payment authorization on each transaction. Further, they are exposed to payment risks such as fraud and data breach, which requires the agency to invest in risk (loss) mitigation assets, and because they would be considered card merchants, they must comply with PCI (Payment Card Industry) Data Security Standards.[166] Pragnesh Shah raises another challenge, "When U.S. mobile operators went to pilot mobile payments at transit terminals or other public venues, they found the stations and stadiums didn't have adequate telephone line infrastructure at the turnstiles to process payments over the ACH network, so new phone lines and equipment had to be funded, ordered and installed. That's solvable, of course, but the process of just getting expense authorization for the infrastructure and doing the work added several months to the timeline of getting to mobile payments in the U.S." [167]

The second decision point for U.S. transit agencies is whether to migrate from paper magnetic stripe fare cards to contactless smart cards. The primary advantages of contactless systems are lower maintenance and operating costs, speed and flexibility provided by the smart card application, better security over payments, and increased ability to collect system usage statistics. For consumers who have registered their smart transit cards online, lost cards can be frozen and new ones issued that retain the value already purchased, as opposed to lost paper cards, which are gone forever. One transit agency's 2005 study found that eliminating or substantially reducing the need to handle cash could (by moving from cash- to electronic-based collections) deliver up to a sixfold reduction in aggregate incremental operating costs.[168]

On an ongoing basis, contactless payments are less costly than other fare media because of their lower operating and maintenance costs. In Washington, D.C., migration to electronic payments reduced staff by approximately 15 percent over a five-year period.[169] Another benefit comes from reducing the risk of loss due to fraud or fare evasion, which can represent from 5 to 15 percent of a transit operator's annual fare revenue.[170] Another advantage of electronic payment systems for transit authorities is the valuable information that smart card ticketing systems can generate; this data helps transit operators better understand consumer behavior and service customers more effectively.[171] The information can also be used for traffic management and logistics, leading to better allocation of resources, efficient timetables, reduced delays, and improved safety. Mobile electronic payments further enable transit agencies to better control, monitor, and influence ridership patterns through measures such as congestion pricing techniques.[172]

Despite these potentially substantial benefits, the adoption of contactless mobile payments—through contactless smart cards (let alone mobile phones)—has come slowly in the U.S. mass transit market. While transit agencies cite the cost of deploying contactless systems as the biggest obstacle, a close second is that key stakeholders—transit agencies, municipalities, card issuers, and technology vendors—have not agreed on a standardized, interoperable platform, as both Japan and South Korea did.[173] Standards are critical for the success of contactless ticketing applications in mass transit systems. They set communication requirements and protocols between the card and the reader and provide a degree of interoperability to support multiple applications, including transit, banking, retail, security, and building access. Moreover, standards enable operators to buy products from competitive vendors that will work at multiple venues. Thus, there is a role for governments to play in facilitating development of nationally interoperable contactless smart card standards.

Perhaps the central impediment for contactless payments in U.S. mass transit has been a standoff between banks, which are migrating credit cards with customer information stored on a magnetic stripe to the new microprocessor-based contactless NFC passive RFID ISO 14443 standard where customer information is encrypted, and the mass transit operators, who would like access to the memory resources on NFC smart cards but who installed earlier proprietary versions of NXP/Philips MIFARE contactless technology.[174]

The crux of the smart card interoperability issue is that transit operators want access to memory space on the IC chip of the smart card where they can store information, such as the traveler's origination and destination points and times of travel, so that the passenger's fare can be calculated based upon the distance and time of day travelled. (Recall how South Korea's T-money smart card had "an embedded CPU that enables calculation.") Thus far, banks have resisted opening up smart card microprocessor resources to meet transit operators' requirements for "scratch pad" memory access on which to carry transit details (and outstanding transit subscription balances).[175] Even successful implementations of an open-loop outside (e.g., card) network system, such as the Utah Transit Authority's, required the system to be custom-engineered between the credit card-issuing banks and the transit authority.[176] As Stephen Miles, a Research Scientist at the Auto ID Labs at the Massachusetts Institute of Technology and a leading authority on contactless identification and access systems, noted, "Japan and South Korea worked all this out up front, building on the precedent of the Hong Kong transit authorities' 1997 launch of the Octopus card (Hong Kong's contactless stored-value smart card based on Sony's FeliCa chip) with transit operators, issuers, and mobile operators coming together to create a common electronic wallet capability for smart cards and the new NFC smart phones."[177]

Clearly, the United States needs more collaboration and incentives, both at metropolitan, regional, and national levels to achieve deployment of interoperable contactless smart card systems for mass public transit in the United States. The recommendations section offers suggestions for policies federal and state governments can adopt to accelerate the deployment of NFC-based contactless payments in U.S. mass transit.

### What's Next for Contactless Mobile Payments in the United States?

There appears to be latent consumer demand for mobile payments in the United States, and several players are trying to develop stop-gap solutions until true electronic wallet-enabled mobile phones appear on the U.S. market. Twitter founder Jack Dorsey recently secured venture capital funding for the Square iPhone Payment System, a plug-in attachment that would NFC-enable iPhones.[178] Apple itself is rumored to be currently developing prototypes of its next-generation iPhone that will have a built-in RFID reader.[179] (That does not mean the phone will be fully NFC-capable, but that it could have the ability to, for example, touch an iPhone or iPod to an iMac and wirelessly sync iTunes songs.)

Another interim step would be stickers or memory cards with embedded NFC-capable IC chips that can be affixed to the back of mobile phones to mimic contactless payment functionality.[180] One such example is First Data's new GO-Tag. The GO-Tag is a pea-sized chip with an embedded radio transmitter that can be placed inside a mobile device or ID badge to complete purchases within one second—much faster than using a traditional credit card or cash.[181] Supporters argue that affixing NFC capability onto the phone before putting it inside the phone will prove out the NFC value proposition to merchants and make customers more comfortable using the technology.

This activity shows there is market demand for mobile payments solutions. But while the marketplace is evolving, these are jerry-rigged, one-off solutions. The risk is that such stop-gap solutions are not really in the phone, are not ubiquitous, may not work well, and lack all the desired functionality. Unfortunately, these are patchwork solutions, not platform solutions. These solutions are responding to demand, but through workarounds that do not require the network externality to be solved, because these parties cannot solve it themselves. Without a true platform solution, these approaches will be inherently limited.

## WHY COUNTRIES ARE LEADERS

Given the wide difference between nations in their deployment and use of mobile payment systems, a key question is why? Why are a few nations so far ahead, while other similarly situated nations (at least with regard to per-capita GDP) are lagging behind?

Both non-policy and policy factors explain these differences. In Japan and South Korea, their dense urban populations with heavy mass transit ridership, their highly intense mobile cultures and lifestyles, and the willingness of a dominant player to step forward and catalyze their country's mobile payments ecosystem have played important roles in positioning these countries as mobile payments leaders.

Yet both Japan and South Korea had a dominant player—DOCOMO and SK Telecom, respectively—that stepped forward to lead their country's mobile payments ecosystem; what accounts for why DOCOMO's vertically integrated approach succeeded, whereas SK Telecom's efforts met with middling success until T-money catalyzed South Korea's mobile payments market?

Non-policy factors are important, but it is policy factors, including a conscious role for government to guide mobile payments ecosystems and a corporate business climate oriented towards longer-term investment strategy and receptive to collaborative public private partnerships, which appear to play the pivotal role in explaining countries' mobile payments leadership.

### Non-Policy Factors

The most important non-policy factors explaining countries leadership in mobile payments are: 1) urban population density and heavy mass transit ridership, 2) cultures embracing a mobile lifestyle, and 3) the willingness of a dominant player to step forward and lead a country's mobile payment ecosystems. This section examines another non-policy factor—the role of competition—and finds it to be weak explanatory factor of countries' success in mobile payments.

### Density and Mass Transit Ridership

In both Japan and South Korea, large populations living in very dense urban centers and relying heavily on public mass transit provided a critical mass of early-adopting users that allowed first electronic money providers and then mobile network operators to introduce compelling contactless payment solutions that could be quickly scaled up. 40 percent of the Japanese population lives in the vicinity of Tokyo, and a similar percentage of South Koreans live in the vicinity of Seoul. As Carmen Franks of Sybase noted, contactless payments have "happened first in countries where mass transit is centrally operated."[182] Indeed, JR East's Suica truly launched the smart card/digital cash market in Japan, and as demonstrated, T-money has redefined mobile payments in South Korea. With this big installed base of e-cash readers, consumers in these nations had a compelling reason to want to buy a phone with mobile payments capability. This, in turn, enabled other businesses and organizations to feel confident in the business case for installing readers, knowing that many customers would already have a mobile payments-equipped device.

### Consumer Culture and Lifestyle Factors

Certainly Japan and South Korea have distinctive consumer cultures that have fervently embraced mobile phone technology. Nearly half of Japanese confess to being "obsessed" with their mobile phones, and there is even an acknowledged "keitai culture" ("mobile culture") in Japan.[183] Japanese and South Koreans alike view the style, sophistication, and functional capabilities of their mobile phones as social status symbols, which encourages rapid uptake of innovative mobile services like contactless payments. And as Japan and South Korea boast some of the world's most-demanding customers for mobile services, mobile phone manufacturers and network operators worldwide have long viewed the countries as fertile resources for discovering the latest mobile consumer trends and as a test bed for piloting new mobile technologies.

One way in which Japanese and South Korean lifestyle is particularly conducive to mobile payments is their propensity for low-value purchases in convenience environments. As Christopher Billich, Senior VP of Research and Strategy with Infinita, a leading Japanese mobile telecommunications research and consulting firm, notes: "Mobile payments actually make a lot of sense in the context of the lifestyle of many Japanese, for two reasons: Firstly, people in the big cities make frequent purchases from convenience stores, vending machines or quick service restaurants during the course of their day. The need for frequent, low-value transactions is tied to how Japanese citizens live their lives. And second, the mobile phone as a powerful multi-purpose tool with lifestyle management capabilities far beyond just voice calls and messaging that has been around long enough in this country for people to accept and adopt extensions of functionality faster than in other markets."[184]

There are other non-policy factors that have been cited as drivers. But on closer examination, the case for these is actually quite weak. For example, some have attributed the success of mobile payments in Japan to the fact that credit card usage has historically been very low in the country. However, Japan's government had long placed restrictions prohibiting its banks from offering revolving credit lines, and thus Japanese "credit cards" were, in reality, debit cards where the money was automatically deducted from a client's bank account at the end of the month. That credit card usage was so low in Japan was largely a product of government restrictions, not a unique cultural phenomenon of aversion to credit.[185] In 2006, Japan's government relaxed credit regulations. Taking advantage of that relaxation, DOCOMO started offering DCMX that same year, and within just three years became one of Japan's largest credit issuers.[186] That consumers adopted mobile credit so quickly in Japan demonstrates there is not a cultural aversion to credit. Moreover, Japanese consumers have demonstrated a preference for payment instruments (whether pre-paid or post-paid) on the mobile platform, as evidenced by the fact that usage of Edy digital cash increased by 40 percent when it was introduced on mobile phones. The experience of Japanese consumers suggests American consumers will likewise embrace the shift from using financial instruments on physical cards to mobile phones.

Overall, the mobile culture and lifestyle in Japan and South Korea certainly contributed to those countries' leadership in mobile payments. However, it is unclear that some inherent uniqueness of Japanese or South Korean mobile culture contributes to their adopting mobile technologies whereas U.S. mobile culture does not. Most mobile technologies that emerged in Asia before the United States and which pundits said would never garner uptake in the U.S. market—SMS text messaging, cameras on mobile phones, etc.—were subsequently enthusiastically adopted by American mobile subscribers, just later. This suggests that the U.S. mobile market is not inherently different, but is rather behind Asian mobile technologies, and that American subscribers will ultimately embrace contactless mobile payments when the service is available in the United States.

### Vertically Integrated Mobile Payments Ecosystem Approach

In both Japan and South Korea, the dominant mobile players—DOCOMO and SK Telecom, respectively—stepped forward to lead their country's mobile payments ecosystem, but with dramatically different results. What accounts for DOCOMO's success and SK Telecom's relative lack thereof? This section examines DOCOMO's vertically integrated approach in depth, before turning to explain what accounts for the companies varying success levels.

Japan would not lead the world in contactless mobile payments were it not for DOCOMO's willingness to play the central role in leading a vertically integrated mobile payments ecosystem. While the motivations that led it to do so elicit varying analyses (as explored subsequently), few debate that DOCOMO played the critical role in coalescing Japan's mobile payments ecosystem by forging the partnership with Sony to get FeliCa contactless chip technology into mobile phones, by directing handset manufacturers to introduce FeliCa-capable phones, by enticing merchants to deploy FeliCa-capable POS readers, by providing an attractive platform for third party applications, by becoming in effect a financial institution offering its own credit brand (iD DCMX), by keeping the mobile FeliCa platform open for competition, and by using its marketing muscle and deep pockets to promote FeliCa-based mobile contactless payments with consumers. As Akira Sato, an analyst with E-Research, a Tokyo-based mobile telecommunications consultancy, summarized DOCOMO's instrumental role in catalyzing contactless mobile payments in Japan, "NTT DOCOMO realized the importance and potential of mobile payments. We had a leader to develop this market."[187]

Convincing the handset manufacturers to produce FeliCa-enabled phones was straightforward, as Japan's wireless operators exercise very strong leverage over handset manufacturers, with each wireless operator maintaining a vertically integrated relationship with affiliated handset manufacturers in an arrangement that has made handset manufacturers dependent on, and thus responsive to, the key carriers.[188] Japanese wireless carriers are far more empowered to provide precise specifications to handset manufacturers than their Western counterparts.[189]

Convincing a critical mass of Japanese merchants to deploy FeliCa-capable reader terminals presented a much larger challenge. Knowing it would have to seed the market, DOCOMO set aside ¥20 billion ($22 million) to subsidize small merchants' installation of NFC-enabled readers/writers.[190] In most instances, DOCOMO subsidized 100 percent of the cost small merchants incurred to install FeliCa-capable reader writers.[191] In exchange for the FeliCa-enabled readers, merchants paid a small fee for each FeliCa transaction.[192] DOCOMO also acquired minor stakes in several convenience store chains, investing $90 million each to acquire 2 percent of the Lawson convenience store chain and 3 percent of the Family Mart chain, and deploying FeliCa-enabled POS systems in those stores.[193]

DOCOMO also effectively took on the role of a credit-issuing financial institution in its effort to promote mobile payments. Specifically, it invested close to $1 billion to purchase a 33.4 percent interest in Sumitomo Mitsui Card. The purchase enabled DOCOMO to extend credit to customers for mobile-phone initiated purchases. DOCOMO assumed the traditional responsibilities of a credit issuing institution, including assessing consumers' risk profiles, authorizing financial transactions, and accepting credit risk for defaults and charge backs. As Takeshi Natsuno discussed DOCOMO's move into credit with the DCMX service:

> The credit card business was interesting for DOCOMO. Ninety-nine percent of mobile subscribers in Japan were actually post-paid (people pay their cell phone bill one month later in Japan) so it actually wasn't that much of an expansion for us to move into credit. (In three years, DOCOMO became one of the Japan's top three credit issuers.) While making money on the credit transactions was nice, the key for DOCOMO was that the service dramatically decreased our subscriber churn rates.[194]

Mobile operators' willingness to share revenues with application and content providers also contributed to Japan's mobile payments leadership. In contrast to mobile markets in Europe and North America, where until only the last several years mobile operators took 50 to 70 percent of revenue generated by third-party content or application providers, DOCOMO revolutionized the approach in 2004 by taking only 10 percent of revenue generated by third-party content and application providers affiliated with its 3G i-Mode network, leaving content providers to keep 90 percent of their revenues. This caused a dramatic increase in content and applications available, driving preference for DOCOMO phones (and a corresponding jump in mobile data traffic and thus revenue for DOCOMO). It also established DOCOMO's phones as a more open application platform, setting the stage for the phone as a mobile wallet, and making subscribers comfortable with storing multiple accounts and applications for purposes as varied as managing digital cash, paying rail fare, checking in at airport gates, or as an ID to check-in to buildings.[195]

A critical factor in the development of the mobile payments ecosystem in Japan was DOCOMO's decision not to seek exclusive rights for Mobile FeliCa. This made Sony's FeliCa contactless chip available to all mobile network operators; indeed, each mobile carrier's osaifu-keitai offering is based on FeliCa technology. As then-DOCOMO CEO Masao Nakamura observed in 2004, "We did not inhibit KDDI from participating in FeliCa. Even if Softbank enters the mobile phone business, we will not create any obstacles." As Nakamura elaborated:

> With support expected from JR East and other rail companies and eventually from all the mobile carriers, it is true that FeliCa could become a *de facto* standard. Given the rapid replacement rate for mobile phones in Japan, FeliCa could soon be built into 80 million handsets. Since applications in those handsets must be activated through FeliCa Networks, and since our rivals must license technology from FeliCa Networks, our joint venture may have considerable power, and it might become very profitable. We welcome that success, but to protect DOCOMO's reputation, we must never abuse our position.[196]

That a corporation in an intensely competitive marketplace would articulate a perspective that it "must never abuse its position" clearly illustrates the collaborative approach DOCOMO in specific and Japan in general has taken toward fostering its mobile payments ecosystem. For example, FeliCa Networks is a collaborative joint venture of Sony, DOCOMO, and JR East. BitWallet, the joint venture that convened to launch Edy digital cash, is 55 percent owned by Sony, DOCOMO, and All Nippon Airways, with the remain-

ing ownership interest accounted for by more than 50 other companies, all working to collaborative effect. Such collaborative approaches are rarely seen in Western telecommunications markets and are an important reason Japan has accelerated past the United States in mobile payments. These collaborative approaches allow participants to share the significant risks and upfront capital requirements needed to invest in new technology platforms whose potential for success are unclear when the initial investments are made. They are also indicative of corporate business climates geared towards longer-term investment strategies.

Yet the essential question remains: Clearly DOCOMO was the central player, but what *compelled* DOCOMO to incur the risk to take the central role in driving FeliCa-based mobile phone payments in Japan? In their Harvard Business School case study, "NTT DOCOMO, Inc.: Mobile FeliCa," Bradley et al. offer the conventional view (shared nearly unanimously by academics interviewed for this report) that DOCOMO's promotion of Mobile FeliCa was the straightforward product of a corporation acting on its own initiative in an intensely competitive marketplace. To paraphrase their argument:

> Though NTT DOCOMO was Japan's dominant mobile carrier in the early 2000s—with a 56 percent market share and 49 million customers—it faced several strategic challenges. The mobile market had become increasingly saturated, as two-thirds of Japanese citizens owned a mobile phone by 2004. Rival KDDI, which had introduced a mobile music download service and flat rate pricing for data plans, was significantly cutting into its market share, especially with the younger generation, and for the first time ever, from April 2003 to March 2004, KDDI's net increase in mobile subscribers exceeded DOCOMO's increase. Finally, competition in the mobile phone industry was expected to escalate with two regulatory changes: the licensing of one or two new entrants and the introduction of number portability.[197]
>
> As then-DOCOMO CEO Nakamura commented in 2004, "If we sit back, we're doomed. We must continue to provide innovative services. The mobile commerce market is moving to the next stage of retailing, distribution, and financial services, which will require a new business model." Faced with these challenges, DOCOMO needed new revenue sources and a means to increase subscriber attraction and retention.[198]

In other words, Bradley et al. (echoing what might be called the conventional academic view) argue that competition drove DOCOMO to launch Mobile FeliCa. One other (though closely related) potential explanation for DOCOMO's drive to introduce Mobile FeliCa is that it arose from the vision of a singular corporate executive, Takeshi Natsuno, Senior Vice President of DOCOMO's Multimedia Services and father the company's i-Mode and osaifu-keitai services. In his book *Keitai-no-mirai* (*The Future of Mobile*), Natsuno wrote that it was his personal aspiration to introduce mobile wallets to Japan:

> It has been my dream to put a wallet in the phone. DOCOMO used a three step approach: 1) First, give subscribers an easy to use service, i-Mode, to access the Web and send mobile messages; 2) Then make it easy for subscribers to download applications such as games (hence the favorable revenue share arrangements for i-Mode content providers) and get subscribers comfortable with the concept of downloading applications and installing them on their mobile phones; and 3) Finally, introduce an application that enables subscribers to make purchases from their cell phones. We had a long term plan to move from the i-Mode 3G mobile Internet service to introducing the osaifu-keitai.[199]

But the notion that either market competition or a supremely talented corporate executive with a well-crafted strategic vision is sufficient to explain Japan's mobile payments leadership is inadequate. There are plenty of talented corporate visionaries in telecommunications companies in U.S. and European mobile firms whose visions of introducing mobile payments in their countries have not come to fruition. And there is no less competition in North American or European mobile telecommunications markets than there is in Japan—in fact there is probably more—suggesting that if competition was in fact the key driving factor, America and European countries would already have mobile payments. In fact, it can even be argued that it was the relative lack of competition that enabled DOCOMO to act as a facilitator of the mobile payments ecosystem,

because DOCOMO held such a dominant position in Japan's mobile market (commanding a 56 percent market share in 2004) and possessed deep pockets, that it had the financial wherewithal to be able to invest in developing contactless mobile payment services. Not only does a dominant market player's size confer ample resources, but also because mobile payments represent a platform technology (a technology that other companies in an array of sectors can utilize), if a company commands a larger share of the market it can be ensured there will be more users on that platform.

Competition is thus not a sufficiently explanatory variable to explain either why DOCOMO moved to lead a vertically integrated mobile payments ecosystem in Japan, or why it has proven successful. It also fails to explain why vertically integrated approaches in Japan and South Korea reached differing results. What the conventional, market-based explanation leaves out entirely is any constructive role for government to play in facilitating a country's mobile payments ecosystem, the subject to which the report now turns.

## POLICY FACTORS

Governments can play critical roles in fostering development of their countries' contactless mobile payments platforms. Governments can address the system interdependency challenge by facilitating development of a national mobile payments infrastructure, particularly by ensuring that transit agencies, airports, and other institutions with a public or semi-public mission are adopting open, interoperable contactless payment platforms by spurring demand for mobile payments, especially by making government facilities and employees early adopters of contactless payments technologies, by establishing appropriate consumer protections, and by promoting the importance of this technology system to economic growth and quality of life.

Within these roles, one of the most important governments can play is fostering consumer demand for mobile payments, especially by ensuring mass transit agencies and airports deploy open, interoperable contactless payments infrastructure that will expand the range of mobile payments use cases beyond commercial environments and into the public domain. The more venues in which consumers know they can use mobile payments applications, the more likely they are to demand. But there is what economists call a network externality with regard to the purchase of mobile commerce readers. The installation helps the organization installing it, but because it creates a larger market for mobile payment devices, building a larger market, organizations do not reap all the benefits of their investments, especially if they are early adopters. There is thus a compelling role for government policy to spur demand for mobile payments that drives the market towards a tipping point after which the private sector can take over.

### Government Facilitation of Countries' Mobile Payments Ecosystems

#### IN SOUTH KOREA, SINGAPORE, AND BRITAIN

A number of governments, including those in South Korea and Singapore, both at a regional and national level, have become explicitly engaged in fostering the development of a mobile payments ecosystem in their country. In South Korea, Seoul's government clearly played a leading role in developing T-money and catalyzing the development of both the city's and subsequently the country's mobile payments infrastructure.

*One of the most important roles government can play to support mobile payments is by encouraging demand by ensuring transit agencies deploy interoperable systems and by being an early adopter of the service itself.*

At a national level, South Korea's government "organized and hosted formal meetings with carriers and banks to discuss standards, and it proliferated mobile commerce by developing public m-payment systems for taxes and other public charges."[200] South Korea has also encouraged government personnel to use electronic wallet features on their mobile phones. According to Dholakia et al., "The country recognized that a positive government commitment to support mobile commerce is required because many technical issues are closely related to government policy and strategy."[201] Moreover, the salient point about mobile payments in South Korea is that they did not succeed until the government became actively involved in establishing a public-private partnership approach that introduced an interoperable solution consumers could readily use across commercial and public domains.

Singapore's government is playing an even more pronounced role in fostering the country's mobile payment ecosystem. In January 2008, Singapore's Infocomm Development Authority (IDA), the government's information-technology promotion agency, formed a roundtable group of banks, mobile network operators and transit companies with the intent of developing a national plan for the introduction of NFC-enabled commerce.[202] (Members of the roundtable included Singapore's leading mobile operators, application service providers, credit card issuers including MasterCard and Visa, the Ministry of Finance, the Monetary Authority of Singapore, and the Land Transport Authority.) In February 2009, IDA announced that Singapore's banks, telecoms, and transit operators had given the go-ahead for the creation of a national trusted third party (TTP) to ensure full interoperability between the NFC services of all mobile operators and service providers.[203] The trusted third party will be tasked with the mission of ensuring that subscribers of any mobile network operator will have access to the full range of NFC services offered by any service provider.

As *Near Field Communications World* notes, "One of the key reasons for going ahead with a trusted third party approach was the result of a consultancy study conducted for IDA by Consult Hyperion in 2008 that concluded a fully interoperable NFC environment would generate a market size approximately eight times that of a non-interoperable environment." The IDA noted that, once established, the TTP "will help eliminate the duplication of infrastructure and lay the foundation for the development of innovative services in the near future."[204] IDA CEO Ronnie Tay observes that this effort is part of Singapore's "Digital Concierge" program, whose objective is "the growth of a vibrant mobile ecosystem—by having key organizations such as the IDA collaborate with industry—to develop and deploy mobile commerce applications, location-based services and innovative mobile services." By committing to establish a fully open, interoperable mobile payments infrastructure, these developments have poised Singapore to become perhaps the world leader in mobile payments over the next several years, particularly given that Japan and South Korea, for all their advances, do not have a fully open, interoperable system.

In the United Kingdom, the Department of Transport is preparing a detailed strategy for Smart and Integrated Ticketing (due out by year-end 2009) that paints a bold vision of universal coverage of smart ticketing infrastructure in all public transport, explicitly envisioning that "NFC mobile phones will replace smart cards as the dominant media for carrying ticket products," and preparing transit agencies for this transition.[205] The UK's Transport Department notes that a national ticketing project, which could use NFC for contactless payments, could save £2 billion per year. In essence, the Department of Transport is articulating the benefits of deploying contactless mobile payments and collaboratively building a roadmap for how the United Kingdom can achieve deployment of a contactless mobile payments infrastructure. The UK strategy stops short of directly providing funding for deployment of NFC readers, maintaining that, "Since many of the benefits of smart ticketing will be realized by operators and local authorities, we do not believe it is a reasonable expectation that the Department will wholly and directly fund all smart ticketing infrastructure and this will not be part of the final strategy."[206] However, by funding the early adopters (e.g., the train and transit system), the UK government plans to seed the initial deployment of the ecosystem.

#### IN JAPAN

While some governments have played clearly visible roles, the role of Japan's government in fostering the country's mobile payments ecosystem elicits varying perspectives. The "conventional academic view" insists that the development of contactless mobile payments in Japan—starting with Sony's development of FeliCa and extending to JR East's decisive move to deploy contactless based smart cards and DOCOMO's drive to develop the osaifu-keitai by embedding contactless IC chips inside the mobile phone—were the product of decisions made independently and solely by commercial actors incurring the concomitant risks for strategic reasons in a competitive marketplace.

There is evidence, however, which suggests that Japan's government played a subtle, yet instrumental, role in encouraging key players to collaborate in convening Japan's mobile payments ecosystem. As Chalmers Johnson argued in *MITI and the Japanese Miracle,*

"collaboration between the state and big business has long been acknowledged as the defining characteristic of the Japanese economic system."[207] Japan's administrative guidance (or "capitalist guidance") model stresses the role of government in collaborating with the private sector in defining the strategic direction of the economy. The approach relies on institutional arrangements, defined as "formal and informal, explicit and implicit social structures developed to coordinate activities within large formal organizations such as corporations, government bodies and universities to link those organizations to one another."[208]

*Japan's government played a pivotal, if behind-the-scenes, role in guiding key players to collaboratively develop Japan's mobile payments ecosystem.*

With regard to Japan's information technology industry, the administrative guidance approach appears in a series of strategy documents—e-Japan Strategy I (2001), e-Japan Strategy II (2003), U-Japan Strategy (2004), and The New IT Reform Strategy (2006)—that explicitly lay out the Japanese government's role in promoting information technology and "creating an environment necessary for realizing the advanced information and telecommunications network society [that] determines a nation's world competitive leadership in the 21st century."[209]

E-Japan Strategy II unambiguously articulated the roles of the government and the private sector in these strategies:

> The policies are based on the concept that the private sector has a leading role to play, with government support, in these reforms. The government in turn, defines—and limits—its roles to: 1) *furnish overall direction*; 2) implement regulatory reforms and competition policies (focusing on market competition); 3) *motivate activity of private sector*; 4) implement minimum investments and gap remedies, as well as guarantee security; and 5) promote more efficient government and the efficient distribution of resources.[210] (Emphasis added.)

E-Japan Strategy I discussed how government and the private sector would collaborate to lead in mobile communications technology, including the ability of "terminals" (i.e., NFC) to read data:

> The United States is superior both in market share and technological development in the area of the conventional PC-centered Internet and technologies of content production related to it…but the central technologies for ubiquitous networks will be mobile communications technology for overcoming spatial and geographical restrictions, the terminal technology for overcoming restrictions of the receiving devices and terminals, and optical technologies to enhance communication performance. Here, Japan has been promoting farsighted R&D of these technologies, under the joint cooperation of the public and private sectors, so Japan has the edge in these fields.[211]

E-Japan Strategy II specifically detailed the efforts to support R&D towards developing mobile terminals and digital cash (electronic money):

> R&D on our world-class, cutting-edge technologies, such as for mobile terminals, wireless Internet, optical technology, electronic devices, information appliances, and robot technology that contributes to effective IT utilization will be stepped up. The development of application technology based on the assumption that all electrical appliances and information devices inside and outside the home can be entirely connected will be promoted. As a prerequisite for the development of this network, R&D on security and authentication technology, as well as for the protection of individual information, will be promoted. Taking user privacy into account, R&D on the development of an online payment method (electronic money) which can be utilized by various kinds of electronic terminals, will be promoted.[212]

This report thus argues that Japan's government played a pivotal (if behind-the-scenes role) in guiding key players to collaboratively develop Japan's mobile payments ecosystem. The government's strategy was based (as E-Japan II described) on a conscious decision to furnish overall direction and motivate activity by the private

sector. Moreover, Japan's government was clearly well positioned to influence the development of a collaborative mobile payments ecosystem in Japan due to the fact that it owns or had owned key players. Indeed, Japan retains a 33.3 percent ownership interest in NTT[213] (Japan's incumbent landline telecommunications provider), and NTT in turn owns 66.6 percent of NTT DOCOMO[214] (the wireless service provider) and the government effectively owned JR East (through the government-owned JNR Settlement Corporation) until its full privatization in 2002.

For some practitioners, such as Ursula Österle, VP of Innovation for Swisscom who heads a technology sensing outpost in Singapore closely monitoring and looking for the latest trends and technologies in Asian mobile telecommunications, the role of governments in Japan, South Korea, and Singapore in promoting their countries' mobile payments ecosystem is quite clear. As Österle elaborates:

> Japan, South Korea, and Singapore are very process-oriented countries. Senior government leaders and C-level executives (often consulting international experts) think and come together to create a common vision, which everyone else executes. In Japan, the heads of Sony and DOCOMO agreed to move forward with NFC, creating the joint venture [FeliCa Networks]. Early involvement by the government made it easier to get Japan Railway involved.
>
> The ability to pull through well-conceived long term plans is the upside of a more paternalistic society. In each of these nations, the country has a vision, the top people take ownership of it, and the rest of the country goes and executes on the vision; decisions are made and activity gets going. These countries heavily value economic and political health and stability, and thus are more inclined to collaborate.[215]

As Miles noted earlier, "Japan and South Korea worked all this out up front, with transit operators, issuers, and mobile operators coming together to create a common electronic wallet capability for smart cards and the new NFC smart phones." And as industry analyst Billich notes, "It would be a very 'un-Japanese' way of doing things for all stakeholders not to assemble and create agreement first to ensure smooth execution."[216] It was not just Japan's private sector working this all out; it was the private sector doing so under the guiding direction of government to do so.

One area Japan's Ministry of Internal Affairs and Communications (MIAC) has openly played a direct role is in working to promote FeliCa as a global standard for mobile wallets. In August 2008, the country began "an aggressive push to market abroad its mobile technology, especially the nation's popular wallet phone."[217] The initiative was spearheaded by the government with an industry group of Japanese carriers and manufacturers. In addition to promoting FeliCa as a global mobile wallet standard, the effort sought to promote overseas other kinds of Japanese-developed wireless technology, including 3G mobile phones with GSM, and 4G wireless. The ministry planned international missions and seminars to spread the word about Japan's technology.[218] In 2009, MIAC announced the "Ubiquitous Alliance Project" which aims to introduce Japanese technology into developing countries. The Ministry allocated approximately ¥1 billion ($10 million) for implementing a mobile payments settlement system in Thailand, another part of the effort to help Japanese technologies spread around the world.[219]

Taken together, it is clear that the actions of governments in Japan, South Korea, and Singapore have played a decisive role in fostering and driving needed collaboration between key ecosystem constituents to bring NFC-based contactless mobile payments to their countries.

## POLICY RECOMMENDATIONS

Mobile payments are a critical information technology system for the U.S. economy to achieve. It is not at all clear that market forces acting on their own will get the United States there, or produce the completely open, interoperable system needed; certainly not anytime soon. Therefore, taking lessons from countries leading in mobile payments, there appears to be a strategic role the federal government can play. This report offers the following recommendations to policymakers looking to spur the realization of contactless mobile payments.

- **Create an inter-government mobile payments working group and private-sector advisory council that would collaborate to introduce, by mid-2010, a strategy for spurring the deployment of an open, interoperable mobile wallet.** In the United States, this means that the Chief Technology Officer should create: 1) a mobile payments working group, whose members would include the Federal Communications Commission, Federal Trade Commission, Treasury Department, Department of Transportation, National Institute for Standards and Technology, National Telecommunications and Information Administration, the General Services Administration, and other agencies as appropriate, and 2) an advisory council from the private sector, which together would develop, by mid-2010, a U.S. strategy for spurring the deployment of an open, interoperable mobile wallet.

  The government's role should not be to take the lead in specifying NFC standards; private markets and collaborative standards-setting consortium such as the NFC Forum are driving this and should continue to do so. Rather, much as the Federal Communications Commission's National Broadband Taskforce is developing a comprehensive strategy for how the United States can achieve ubiquitous broadband deployment, a national mobile wallet/mobile payments strategy would craft a roadmap considering issues such as: how federal, state, and local governments will go contactless; how contactless payments can be enabled in all metropolitan transit authorities; how such payments can be implemented in public and quasi-public venues such as airports, street parking meters, parking garages, toll booths, and other locations throughout the country; and how mobile payments can be used for functions such as food stamps, funds through the Women, Infants and Children program and other federal benefit programs.

- **Governments should take a leadership role in promoting and adopting mobile payments.** Federal, state, and local governments should be creative in using systems and funding to spur deployment of contactless mobile payments. The government should:

1. **Require that mass transit agencies receiving federal funding deploy open-loop outside network payment systems.** In the current reauthorization of the Surface Transportation Act, Congress should require that any transit authority receiving federal public transportation funding that has a contactless fare payment system move to an open-loop outside payments network. That is, Congress should require transit agencies receiving federal funding to deploy NFC-enabled contactless fare payment systems interoperable with those of other transit agencies throughout the country.

2. **Provide funding for pilot programs deploying NFC infrastructure in public venues.** The mobile wallet strategy roadmap should include funding for pilot programs to implement NFC infrastructure in the aforementioned publicly or semi-publicly operated or managed environments.

3. **Ensure senior government leaders highlight the benefits of contactless mobile payments.** Senior leaders at the FCC, Departments of Commerce Transportation, and other agencies should provide vision and leadership and speak openly about the transformative potential of contactless mobile payments in the United States.

4. **Deploy contactless payments infrastructure, including NFC-enabled electronic wallet phones and NFC-enabled POS readers throughout government agencies:**

   - The General Services Administration should commit to installing contactless POS terminals in all cafeterias, parking garages, and other cash facilities it directly operates in government agencies and facilities, including in Department of Defense facilities.

   - Contactless smart cards and readers should be deployed across all military bases and installations.

- Government identification programs such as the Department of Defense's Common Access Card and the Transportation Worker Identification Credential (TWIC) should allow electronic wallet applications to be housed on the card.

- State and local governments using POS terminals to process payments for services—such as for obtaining marriage licenses, parking permits, drivers licenses, etc.—should deploy NFC-enabled POS terminals.

- **Articulate clear consumer protections for mobile payments.** For mobile payments to succeed, clearly articulated consumer protections are essential. Consumers must have confidence that the money flowing through their mobile device during transactions will be protected against digital theft. Consumers must also be assured that they maintain the same level of recourse in case of disputes with merchants when making mobile payments as they presently enjoy with credit card payments. Policies must clearly define which parties are responsible should something go awry with, or a consumer contest, a mobile transaction. To address this concern, common consumer protections should be extended to all providers of mobile payment services. This could be achieved as part of a broad scale effort to harmonize different consumer protection standards in the United States. Internationally, the OECD is working to harmonize mobile commerce protections amongst its member countries, and the United States should actively engage in these discussions.[220]

- **Address legitimate security and privacy concerns, but recognize mobile wallets offer far more security than physical wallets.** Policymakers should not be swayed by the claims of some privacy advocates who are likely to be reflexively opposed to mobile payments technology and actively denounce proactive government efforts to develop a roadmap for a national payments strategy. Some anti-technology privacy advocates actively oppose phone-based proximity payment standards on a prima facie basis. For example, Lillie Coney, Associate Director of the Electronic Privacy Information Center, sees mobile phones as a security risk, contending that, "If phones replace wallets, would-be thieves will see every person walking down the street talking on his or her phone as a target for robbery. It would be the ultimate forum of identity theft, that's for sure."[221] Frankly, this stance is preposterous. First, it misses entirely that people walking down streets carrying their wallets or purses today are equally, if not more, at risk of theft, because they are almost certainly already carrying cash, and, if they are carrying identification materials with them they are ready targets for identity theft as well.

  This perspective also ignores that mobile phones can be substantially more secure than purses or wallets. In fact, NFC-enabled phones offer defenses not generally available to cards, including enabling consumers to keep applications locked with a PIN or other passcode or with a fingerprint or other biometric tool. Moreover mobile operators could remotely shut down all applications on an NFC phone should subscribers report their device lost or stolen. For example, DOCOMO developed a remote locking system where the operator can lock the phone, and even remotely wipe its content, if a customer reports it lost or stolen, certainly not a feature a lost or stolen wallet can provide.

  Contactless mobile transactions effected between a mobile phone with a secure integrated circuit smart chip and an NFC-enabled payment terminal are likely to be much more secure than swiping the credit card through a magnetic card reader—or simply handing the credit card to a third party. This is because in a contactless transaction (whether originated by a smart card or mobile phone) both the IC chip and the payment terminal authenticate one another and, critically, a unique identifier is generated to validate each transaction.[222] If that unique identifier is somehow stolen, it cannot be used to execute a subsequent or future transaction. Moreover, no publicized real-world attacks on contactless bankcards have emerged in the United States or elsewhere since the payments industry has introduced the technology.[223]

  Merchants also have the option to implement "Chip and PIN" transactions, which offer the double protections of ensuring the card is in the physical possession of its owner (who manually enters his/her

PIN number at the point of the sale) and securing the transaction electronically via the generation of the unique identifier for each transaction. The salient point is that, far from being less secure, mobile transactions have the potential to be much more secure than existing forms of credit or debit transactions.

Privacy advocates are likely to oppose non-monetary applications of NFC technology as well. Compare the experience of one elementary school in the rural town of Sutter, California, against how effortlessly South Korean students use their cell phones to register class attendance. In late 2004, Sutter Elementary issued badges to seventh- and eighth-graders as part of a wireless attendance program.[224] Students wore the badges around their necks and scanned them to a reader upon entering class. The school hoped the technology would reduce attendance tracking errors and be a timesaver for teachers and administrators. The student badges employed the same technology used in building access badges that companies commonly issue to employees for security purposes.

Some anti-technology privacy advocates reacted violently to the system, with Cedric Laurant of the Electronic Privacy Information Center claiming that, "It treats children like livestock or shipment pallets, thereby breaching their right to dignity and privacy they have as human beings."[225] Others speciously asserted that the radio waves could pose a health risk to students. If privacy advocates object to such a service with student badges, they are likely to also object to using mobile phones for contactless transactions. It is unfortunate that such views make it difficult to implement common-sense solutions that both bring efficiencies to educators (allowing them to save administrative time and focus on education) and leverage a technology platform students readily embrace. Other opponents have objected to a range of RFID-based contactless technologies, such as Exxon Mobil's Speedpass, espousing hypothetical objections about potential privacy harms while ignoring the very real consumer value consumer benefits contactless technologies make possible.[226]

If the United States is going to make progress in deploying mobile payment, policymakers must not give into such Luddite anti-technology sentiments. As a result, policy makers should resist the urge to regulate RFID technologies, including near field communication. Given the importance of NFC technology, and its inherent security, it is important that policymakers not give in to pressure to regulate NFC, in particular under the broader guise of regulating RFID technologies, which should not be regulated either. Industry deployment of NFC technology in the United States has actually been held up by some of the overly restrictive legislation pertaining to RFID technology. Policymakers should leave the technology aspects of NFC specifically, and RFID technologies generally, unregulated.

- **Encourage competition and do not favor entrenched interests.** The rapid evolution of mobile devices and applications as well as network and information technologies has engendered an incredibly fertile period of mobile payments innovation and activity. Many new firms with innovative business models and service propositions have emerged to provide novel platforms for remote mobile payments, such as domestic money transfers, international remittances, and even targeted microlending. Telecommunications, banking, and financial services regulators should assure that the regulatory system allows the creation of innovative business models, even in they disrupt the business models of established industry players. Both new and incumbent players should enjoy a level playing field, and regulators should not give in to incumbent business interests that oppose the emergence of innovative new services.

  For example, when European banks and financial institutions recognized that mobile network operators in Europe were starting to bring forward mobile financial payment services, they launched an effort with the European Union to make mobile operators subject to European banking regulations.[227] This would have had the effect of severely limiting the ability of European carriers to offer post-paid digital cash services on mobile phones. European regulators wisely rejected such efforts by European financial institutions; American regulators should similarly resist any such overtures that may appear.

  Likewise, policymakers should not give in to entrenched interests who would resist new automated or self service technologies that NFC makes pos-

sible, even if that means certain service jobs may be automated (while consumers receive lower prices and increased convenience. For example, legislation was introduced in California Legislation (AB 1060), introduced on behalf of the United Food and Commercial Workers (UFCW) union and its allies that would restrict self-service check out in grocery stores. The root of the union's resistance is that highly efficient self-checkout systems, while they would increase front-end productivity to the benefit of both consumers and companies, could decrease employment of check-out workers.[228] While self-checkout systems in grocery stores are not NFC-based, they are emblematic of the resistance that will likely be encountered as wider deployment of NFC technologies brings increased efficiency to retail and transit environments. Policymakers must resist such calls and focus on how such technologies introduce efficiencies that redound to the benefit of all consumers.

- **Actively work with international NFC standards setting bodies.** Achieving global interoperability of NFC devices—something desired by device manufacturers to sell standard devices on international markets and also by consumers desiring to use their handsets on a global basis for contactless payments—requires close collaboration between standards setting bodies. Federal bodies involved in trade policy, including the National Institute of Standards and Technology and USTR should support the development of interoperable international standards for mobile payments, which will inure to the benefit of both domestic device manufacturers looking to export to global markets and consumers seeking convenient payment experiences alike.

## ENDNOTES


1. Organization for Economic Co-Operation and Development (OECD), "OECD Policy Guidance for Addressing Emerging Consumer Protection and Empowerment Issues in Mobile Commerce," June 2008, 2, http://www.oecd.org/dataoecd/50/15/40879177.pdf.

2. Natasha Lomas, "Mobile banking set to boom," Silicon.com website, June 18, 2008, http://www.silicon.com/financialservices/0,3800010322,39248269,00.htm.

3. Dan Herman, "Mobile banking, innovation and culture," Wikinomics blog, September 26, 2008, http://www.wikinomics.com/blog/index.php/2008/09/26/mobile-banking-innovation-and-culture/.

4. Mary Lou Jay, "The Promise of M-Commerce: Convenience and Security for Consumers, New Opportunities for Carriers," CTIA The Wireless Association, http://www.ctia.org/content/index.cfm/AID/11316.

5. Menekse Gencer, "Is There REALLY a Market for Mobile Payments in the United States," Presentation at Mobile Payment Series Event #2, October 5, 2009, http://www.slideshare.net/mpayconnect/is-there-really-a-market-for-mobile-payments-in-the-us.

6. ICT World Today, "Facing a New Era of Financial Services," Korea Information Society Development Institute, Summer 2009, 40, http://www.kisdi.re.kr/kisdi/fp/kr/board/listSingleBoard.do?cmd=listSingleBoard&sBoardId=ENG_RESEARCH_ICT&listScale=5.

7. ICT World Today, "Facing a New Era of Financial Services," 41.

8. Joohee Cho, "The World's Most High-Tech Nation," ABC News Seoul, December 24, 2008, http://blogs.abcnews.com/worldview/2008/12/the-worlds-most.html.

9. Mike Clark, "Apple testing RFID-enabled phone," *Near Field Communications World*, November 5, 2009, http://www.nearfieldcommunicationsworld.com/2009/11/05/32191/apple-testing-rfid-enabled-iphone/.

10. Marianne Crowe, "Emerging Payments—The Changing Landscape," Presentation to Maine Association of Community Banks, April 15, 2008, http://www.bos.frb.org/economic/eprg/presentations/2008/crowe04151708.pdf.

11. Christopher Billich, "Mobile NFC: Current Market and Developments," January 2009. (PowerPoint presentation given in Vienna, Austria.)

12. "Korea: Mobile Banking Takes Off," *BusinessWeek*, September 27, 2004, http://www.businessweek.com/magazine/content/04_39/b3901068.htm.

13. Nasreen Quibria, "Emerging Payments Industry Briefing: The Contactless Wave: A Case Study in Transit Payments," Federal Reserve Bank of Boston, June 2008, http://www.bos.frb.org/economic/eprg/papers/briefings/transit.pdf.

14. NFC Forum, "Making Money with NFC," Presentation at CTIA Wireless San Diego, October 8, 2009, http://www.nfc-forum.org/resources/presentations/CTIA_slides.pdf.

15. Author's calculation; assumes teacher spends two and a half minutes per class taking attendance, at six classes a day over 150 school days.

16. "Near Field Communication," Wikipedia, June 2008, http://en.wikipedia.org/wiki/Near_Field_Communication. In the passive mode, the initiating device provides a carrier field and the target device answers by modulating existing field. In passive mode, the target device may draw its operating power from the initiator-provided electromagnetic field, thus making the target device a transponder. In the active mode, both initiator and target device communicate by alternately generating their own field. In this mode, both devices typically need to have a power supply.

17. NFC Forum, "Making Money with NFC," 33.

18. Gemalto, "The Role of the Trusted Service Manager (TSM)," http://www.gemalto.com/nfc/tsm.html.

19. Sarah Clark, "National ticketing project could use NFC and contactless to save £2bn a year, says UK's Department for Transport," *Near Field Communications World,* September 3, 2009, http://www.nearfieldcommunicationsworld.com/2009/09/03/31575/national-ticketing-project-could-use-nfc-and-contactless-to-save-2bn-a-year-says-uks-dept-for-transport/.

20. Takeshi Natsuno, Phone interview with Stephen Ezell, October 7, 2009.

21. Mark MacCarthy, Phone interview with Stephen Ezell, May 20, 2009.

22. Pragnesh Shah, interview with Stephen Ezell, June 2, 2009.

23. OECD, "Mobile Commerce," January 16, 2007, 4, http://www.oecd.org/dataoecd/22/52/38077227.pdf.

24. Shri S.A. Kumar, Department of Information Technology, Ministry of Communications and Information Technology, Government of India, "International Practices in Mobile Payments," Presentation at the Sixth Annual Meeting of the Mobile Forum of India, February 27, 2009, http://www.mpf.org.in/ppt/International_Practices.ppt.

25. Laura Isensee, "U.S. subway rides via cell phones still a ways away," Reuters, August 6, 2009, http://www.reuters.com/article/technologyNews/idUSTRE5745MX20090806.

26. Kumar, "International Practices in Mobile Payments."

27. Pragnesh Shah, Phone interview with Stephen Ezell, June 4, 2009. Shah notes that Japan and South Korea also lead the world in mobile-facilitated Internet payments.

28. Serkan Toto, "Japan's super-advanced mobile web: Too unique to serve as a global blueprint?" Tech Crunch.com Web site, August 9, 2008, http://www.techcrunch.com/2008/08/09/japan%E2%80%99s-super-advanced-mobile-web-too-unique-to-serve-as-a-global-blueprint/.

29. OECD, "Mobile Commerce," 14. (Currency exchange rates as of November 11, 2009.)

30. Alexei Poliakov, "Japan finishes 2008 with 110 million mobile phone subscribers," Japan's Cell Phone Edge Blog, January 9, 2009, http://www.analytica1st.com/analytica1st/labels/Wireless%20penetration.html.

31. "Worldwide and US mobile subscriber penetration," About Mobility blog, December 2008, http://weblog.cenriqueortiz.com/mobility/2008/12/29/worldwide-and-us-mobile-subscriber-penetration-dec-2008/.

32. Beth Jenkins, "Developing Mobile Money Ecosystems," International Finance Corporation and the Harvard Business School, 2008, 14, http://www.hks.harvard.edu/m-rcbg/CSRI/publications/report_30_MOBILEMONEY.pdf.

33. Mohammad Khan, Phone interview with Stephen Ezell, November 6, 2009.

34. Ibid.

35. The NFC Forum, Making Money with NFC.

36. Seung Hwan Choi and David Collins, "Mobile payments in Asia Pacific," KPMG, 2007, 11, http://www.kpmginsiders.com/pdf/Mobile_payments.pdf.

37. Ibid.

38. Sarah Clark, "Is China heading towards the adoption of NFC?" *Near Field Communications World*, September 10, 2009, http://www.nearfieldcommunicationsworld.com/2009/09/10/31642/the-nfc-report-is-china-heading-towards-the-adoption-of-nfc/.

39. Sarah Clark, "Russia looks to introduce mobile contactless in two to three years," *Near Field Communications World*, October 16, 2009, http://www.nearfieldcommunicationsworld.com/2009/10/16/32011/russia-looks-to-introduce-mobile-contactless-in-two-to-three-years/.

40. "Japan's Mobile Wallets Fail to Impress—Yet," *Card Technology*, April 13, 2007, http://www.cardtechnology.com/article.html?id=200704131WCTISI9.

41. Stephen Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa," Case Study 9-805-124, Harvard Business School, June 7, 2006.

42. Cellular phone in Japan, 2009. Courtesy Christopher Billich.

43. Billich, "Mobile NFC: Current Market and Developments," citing data from Impress R&D.

44. Christopher Billich, "Future Insight: Mobile Commerce in Japan," Presentation at Mobile Copenhagen 2009, June 16, 2009, http://www.slideshare.net/cbillich/future-insight-mobile-commerce-in-japan.

45. Data provided in an email from Satoshi Baba, Executive Manager, ICT Consulting Department, NTT Communications Corporation, citing research from the Nomura Research Institute.

46. Data provided in an email from Christopher Billich after September 7, 2009 phone interview with Stephen Ezell, citing a July issue of *Nikkei BP magazine* (Japanese language only), http://bizmakoto.jp/makoto/articles/0809/26/news099.html.

47. When making purchases on shopping or auction sites—whether on the PC or mobile versions of these services—as well as when buying mobile content via mobile phones, subscribers can use their account number from their electronic cash accounts (such as Mobile Suica, Edy, or Nanaco) to make the payment, and in these cases there is no true contactless transaction happening from device to device.

48. Choi and Collins, "Mobile Payments in Asia Pacific," 10.

49. Billich, "Mobile NFC: Current Market and Developments."

50. "Subscriptions to DOCOMO's Credit Payment Service Top 10 million," NTT DOCOMO, August 25, 2009, http://www.nttdocomo.com/pr/2009/001450.html.

51. Jenkins, "Developing Mobile Money Ecosystems."

52. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa."

53. Ibid.

54. Gerald Madlmayr, "FeliCa, Suica & Osaifu-Keitai—The Japanese Way of NFC," Gerald Madlmayr's Forum on Nokia blog, May 20, 2009, http://blogs.forum.nokia.com/blog/gerald-madlmayrs-forum-nokia-blog/2009/05/20/FeliCa.

55. Ibid.

56. Takeshi Natsuno, Phone interview with Stephen Ezell, October 7, 2009.

57. Choi and Collins, "Mobile Payments in Asia Pacific," 10.

58. Ibid.

59. Ibid.

60. Hiroko Tabuchi, "Why Japan's Cell phones Haven't Gone Global," *New York Times,* July 20, 2009, http://www.nytimes.com/2009/07/20/technology/20cell.html.

61. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa."

62. Ibid.

63. Billich, "Mobile NFC: Current Market and Developments."

64. Kate Norton, "Contactless Payment Comes to Cell Phones," *BusinessWeek,* November 21, 2006, http://www.businessweek.com/globalbiz/content/nov2006/gb20061121_811258.htm.

65. Billich, "Mobile NFC: Current Market and Developments," citing data from Impress R&D.

66. Ibid.

67. Ibid.

68. Christopher Billich, Phone interview with Stephen Ezell, September 7, 2009.

69. Philip Sugai et al., *The Six Immutable Laws of Mobile Business* (Malden, MA: Wiley InterScience, 2009), 100.

70. Ibid.

71. QR Code used in Japan political campaign, 2009. Courtesy Philip Sugai.

72. Mobile check-in is now available at 31 airports across the United States, although not using contactless technology as in Japan. Taylor Buley, "Mobile Check-ins Take Flight," *Forbes,* October 5, 2009, http://www.forbes.com/2009/10/05/mccarran-airport-speedcheck-technology-biz-travel-09-mobile.html.

73. Billich, "Mobile NFC: Current Market and Developments."

74. Tim Cobley, "M-commerce: East Meets West," *European Communication*, June 20, 2006, http://www.eurocomms.com/features/111218/M-commerce:_east_meets_west.html.

75. "South Korea: Almost More Phones than People," Mobile Marketing Watch.com Web site, January 28, 2009, http://www.mobilemarketingwatch.com/south-korea-almost-more-phones-than-people/.

76. Also, new 4G mobile WiMax (or "WiBro") broadband networks currently being rolled out allow South Korean mobile subscribers to reach wireless networks at speeds of 10 to 30 Mbps. These wireless speeds mean that many South Koreans can download a feature-length movie to their mobile phones faster than Americans can to their personal computers; a one-hour television episode takes but ten seconds to download to most mobile phones in South Korea.

77. Terri Bradford and Fumiko Hayashi, "Complex Landscapes: Mobile Payments in Japan, South Korea, and the United States," Federal Reserve Bank of Kansas City, September 2007, http://www.kc.frb.org/Publicat/PSR/Briefings/PSR-BriefingSept07.pdf.

78. Rudy De Waele, "A Day in the Life of a Mobile Phone in Seoul," M-Trends Web site, October 5, 2008, http://www.m-trends.org/2008/10/a-day-in-the-life-of-a-mobile-phone-in-seoul.html.

79. Barry Levine, "Nokia Joins the 'Mobile Wallet' Initiative," News Factor, April 25, 2007, http://www.newsfactor.com/news/Nokia-Joins--Mobile-Wallet--Initiative/story.xhtml?story_id=12300C3F8C26.

80. Considering only the value of digital goods—including music, videos, ringtones, online game subscriptions, archived newspaper articles, and other items (including contactless transactions)—South Koreans made 1.7 trillion won ($1.4 billion) worth of mobile payments in 2008.

81. Chose Sang-Hun, "In South Korea, All of Life is Mobile," *New York Times*, May 25, 2009, http://www.nytimes.com/2009/05/25/technology/25iht-mobile.html.

82. Ibid.

83. Choi and Collins, "Mobile Payments in Asia," 11.

84. Ibid.

85. Suk-Gwok Chang, Phone interview with Stephen Ezell, November 3, 2009.

86. Ignacio Mas and Sarah Rotman, "Going Cashless at the Point of Sale: Hits and Misses in Developed Countries," CGAP, CGAP Focus Note, No. 51, December 2008, http://www.cgap.org/gm/document-1.9.7885/FN_51.pdf.

87. Ibid.

88. Ibid.

89. Suk-Gwok Chang, Phone interview with Stephen Ezell, November 3, 2009.

90. Dan Balaban, "Korean Telcos and Card Companies Clash Over Mobile Commerce," *Card Technology*, October 2, 2003.

91. Mas and Rotman, "Going Cashless at the Point of Sale."

92. Ibid.

93. Hamilton Sekino, "Mobile Payments: Mobile Operator Market Opportunities and Business Models," Diamond Consultants, 2007, 6, http://www.diamondconsultants.com/PublicSite/ideas/perspectives/downloads/INSIGHT%20-%20Mobile%20Payments%20_Diamond.pdf.

94. Ibid.

95. Ibid.

96. Ibid.

97. "Visa, SK Telecom Announce Plans to Launch Mobile Payments in South Korea," PaymentNews.com Web site, February 8, 2007, http://www.paymentsnews.com/2007/02/visa_sk_telecom.html.

98. Mas and Rotman, "Going Cashless at the Point of Sale."

99. Suk-Gwon Chang, Phone interview with Stephen Ezell, November 3, 2009.

100. Ibid.

101. Ibid.

102. Ibid.

103. Steve Wallage, "The Far East Mobile Payment Race," TheFeature.com Web site, November 27, 2003.

104. Bradford and Hayashi, Complex Landscapes.

105. Ibid.

106. Sarah Clark, "The NFC Report: Could NFC be in danger of being too much, too late?" *Near Field Communications World*, September 24, 2009, http://www.nearfieldcommunicationsworld.com/2009/09/24/31729/the-nfc-report-could-nfc-be-in-danger-of-being-too-much-too-late/.

107. Korea Smart Card Company, Ltd., "Public Transportation Management in Seoul," http://eng.t-money.co.kr/images/pub/eng/PRelations/toolkit.pdf.

108. Ibid.

109. Yunho Cheung, Phone interview with Stephen Ezell, June 2, 2009.

110. "Topis and T-money," Public Transit International, February 2006, http://www.t-money.co.kr/images/pub/util/UITP_PTI_news_200602.pdf.

111. Ibid.

112. STMicroelectronics, "Seoul Subway to Save Millions of Dollars with RFID Ticketing Technology from STMicroelectronics," July 8, 2009, http://www.st.com/stonline/stappl/cms/press/news/year2009/t2391.htm.

113. Korea Smart Card Company, Ltd., "T-money service," http://eng.t-money.co.kr/jsp/newpub/oversea/english/t-money/T_service.jsp.

114. Korea Smart Card Company, Ltd., "Success Story: Seoul Case," http://eng.t-money.co.kr/jsp/newpub/oversea/english/solutions/S_success_seoul.jsp.

115. Gye Hyun Park, "About Korea Smart Card Company," http://eng.t-money.co.kr/jsp/newpub/oversea/english/introduce/C_ceo.jsp.

116. Korea Smart Card Company, Ltd., "About Us," http://eng.t-money.co.kr/.

117. "SKT to Provide T-Money Service in 3G Handsets," *Maeil Business Newspaper*, February 26, 2007.

118. Korea Smart Card Company, Ltd., "What's T-money," http://eng.t-money.co.kr/.

119. Sang-Hun, "In South Korea, Life is Mobile."

120. Mohammad Khan, Phone interview with Stephen Ezell, November 6, 2009.

121. Contactless mobile payments in South Korea. Courtesy NFC Forum. Source: NFC Forum, "Making Money with NFC,15."

122. "Mobile Gifts a Hit for Korean Telecom Operator," *BusinessWeek,* July 29, 2008, http://www.businessweek.com/globalbiz/content/jul2008/gb20080729_252965.htm.

123. Jennifer Meacham, "Mobile Commerce: 800 Million Untapped Users," Practical Ecommerce Web site, October 9, 2008, http://www.practicalecommerce.com/articles/839-Mobile-Commerce-800-Million-Untapped-Users.

124. Jay, "The Promise of M-Commerce."

125. "Mobile commerce seen as future for Japan retailers," Textually.org website, September 12, 2006, http://www.textually.org/textually/archives/2006/09/013512.htm.

126. "M-Commerce, the Next Big Investment Idea?" iStock Analyst, April 28, 2008, http://www.istockanalyst.com/article/viewarticle/articleid/1776895.

127. Nikhilesh Dholakia et al., "Global Heterogeneity in the Emerging M-Commerce Landscape," University of Rhode Island, 2004, http://ritim.cba.uri.edu/wp2003/pdf_format/M-Commerce-Global-Landscape-Chapter-v12.pdf.

128. The World Bank, "m-Government: The New Frontier in Public Service Delivery," November 29, 2007, http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/EXTEDEVELOPMENT/0,,contentMDK:21534706~pagePK:210058~piPK:210062~theSitePK:559460,00.html.

129. Tarmo Virki, "Kenya, Turkey, Japan lead mobile money trend," Reuters, February 13, 2009, http:// www.reuters.com/article/technologyNews/idUSTRE51C3R720090213.

130. "A Cash Call," *The Economist*, February 15, 2007.

131. "Bottom-of-pyramid poised to leapfrog with mobile wallet," *The Economic Times*, June 26, 2009, http://economictimes.indiatimes.com/News/News-By-Industry/Banking/-Finance-/Finance/Bottom-of-pyramid-poised-to-leapfrog-with-mobile-wallet/articleshow/4705220.cms.

132. Alexander Villafania, "E-commerce spurs growth in mobile payments," Inquirer.net Web site, August 13, 2009, http://www.newsinfo.inquirer.net/breakingnews/infotech/view/20090813-220125/E-commerce-spurs-growth-in-mobile-payments.

133. Angel Dobardziev, "Pricing mobile payment services," ITMatters.com Web site, June 9, 2009, http://www.itmatters.com.ph/ovum.php?id=060909a.

134. Ibid.

135. Choi and Collins, "Mobile Payments in Asia Pacific," 2.

136. The Economic Times, "Bottom-of-pyramid poised to leapfrog."

137. Niti Bahn, "Inspired by pay as you go fresh water," The Prepaid Economy Blog Web site, March 12, 2009, http://www.emergingfutureslab.com/prepaid_economy/kenya/.

138. Asbel Lopez, "The South Goes Mobile," UNESCO Courier, July/August, 2000, http://www.unesco.org/courier/2000_07/uk/connex.htm.

139. S. Rai, "In Rural India, a Passage to Wirelessness," *New York Times*, August 4, 2000, C1-C3, http://www.nytimes.

com/2001/08/04/business/international-business-rural-india-passage-wirelessness-companies-jump.html?scp=1&sq=In Rural India, a Passage to Wirelessness&st=cse.

140. Catherine L. Mann, *Accelerating the Globalization of America: The Role for Information Technology* (Washington, D.C.: The Institute for International Economics, June 2006), 82-83b.

141. The International Bank for Reconstruction and Development / The World Bank, "2009 Information and Communications for Development: Extending Reach and Increasing Impact," 2009, http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/EXTIC4D/0,,contentMDK:22229759~menuPK:5870649~pagePK:64168445~piPK:64168309~theSitePK:5870636,00.html. See also, Asheeta Bhavnani et. al, "The Role of Mobile Phones is Sustainable Rural Poverty Reduction," The World Bank, ICT Policy Division, July 15, 2008, http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf.

142. Nasreen Quibria, "Understanding Emerging Payments—Moving Towards a Cashless Society," Federal Reserve Bank of Boston, May 8, 2007, http://www.bos.frb.org/economic/eprg/presentations/quibria050807.pdf.

143. John Sutter, "Wallet of the future? Your mobile phone," *CNN,* August 13, 2009, http://www.cnn.com/2009/TECH/08/13/cell.phone.wallet/.

144. Jay, "The Promise of M-Commerce."

145. Ibid.

146. Mohammad Khan, Phone interview with Stephen Ezell, November 6, 2009.

147. Ibid. Khan notes that part of the challenge is that, in the current economic environment, card associations have curtailed advertising budgets that might have been allocated to promoting contactless payment forms.

148. "Contactless transit uptake paves way for mass-market NFC mobile payments - Smart Card Alliance," Finextra.com Web site, March 18, 2008, http://www.finextra.com/fullpr.asp?id=20481.

149. Quibria, "Moving Towards A Cashless Society," 17.

150. Smart Card Alliance, "The What, Who, and Why of Contactless Payments," November 2006, 3, http://www.smartcardalliance.org/resources/pdf/CP_What_Who_Why_Final.pdf.

151. Christopher Billich, Phone Interview with Stephen Ezell, September 7, 2009.

152. "The VivoTech Convenience: Tap Your Way to Pay Your Tab," *CardsNow Asia*, Volume 8, Number 2, (March/April 2007), http://www.vivotech.com/newsroom/coverage/articles/cardsnowasia_coverstory_khan_sm.pdf.

153. Lori Aratani, "Pay-by-Cell phone Meters Considered in Montgomery," *The Washington Post*, May 18, 2009, http:// www.washingtonpost.com/wp-dyn/content/article/2009/05/17/AR2009051702033.html.

154. Nasreen Quibria, "The Contactless Wave: A Case Study in Transit Payments."

155. Ibid., 2.

156. Ibid., 9.

157. NFC Forum, Making Money with NFC.

158. Ibid.

159. Quibria, "The Contactless Wave: A Case Study in Transit Payments," 5.

160. Adapted and reprinted courtesy Nasreen Quibria. Original source: Quibria, "The Contactless Wave: A Case Study in Transit Payments," 6.

161. Quibria, "The Contactless Wave: A Case Study in Transit Payments," 6.

162. Ibid., 7.

163. "Utah Transit Authority Showcases Open Payment System for Transit," GovTech.com Web site, February 23, 2009, http://www.govtech.com/gt/621904.

164. Lena H. Sun, "Bank Card Systems Weighed for Metro," *The Washington Post*, May 10, 2009, http://www.washingtonpost.com/wp-dyn/content/article/2009/05/09/AR2009050902459.html.

165. Nasreen Quibria, Phone interview with Stephen Ezell, May 27, 2009.

166. Quibria, "The Contactless Wave: A Case Study in Transit Payments," 14.

167. Pragnesh Shah, Phone interview with Stephen Ezell, June 4, 2009.

168. Quibria, "The Contactless Wave: A Case Study in Transit Payments," 21.

169. Ibid.

170. Dan Ilett, "Inside China: Oyster and Octopus—A Tale of Two Cities' Contactless Cards," Silicon.com Web site, June 28, 2006, http://www.silicon.com/research/specialreports/china/0,3800011742,39159958,00.htm.

171. Quibria, "The Contactless Wave: A Case Study in Transit Payments," 7.

172. Ibid.

173. Ibid.

174. Stephen Miles, "Contactless payment applications for mass transit," Twine, http://www.twine.com/twine/124drhj0r-1p0/contactless-payment-applications-for-mass-transit.

175. Ibid.

176. Stephen Miles, Research Scientist, Auto ID Labs, Massachusetts Institute of Technology, Phone interview with Stephen Ezell, September 8, 2009.

177. Ibid.

178. Sarah Clark, "Twitter founder adding mobile payments to iPhones via NFC?" *Near Field Communications World,* November 6, 2009, http://www.nearfieldcommunicationsworld.com/2009/11/06/32209/twitter-founder-adding-mobile-payments-to-iphones-via-nfc/.

179. Mike Clark, "Apple testing RFID-enabled phone."

180. NFC Forum, "Making Money with NFC."

181. Steve Hamm, "GO-Tags May Replace Cash and Credit Cards," *BusinessWeek,* August 28, 2008, http://www.businessweek.com/magazine/content/08_36/b4098058931873.htm.

182. Matt Hamblen, "Mobile commerce apps gaining ground in US," *TechWorld,* June 5, 2009, http://www.techworld.com.au/article/302104/mobile_commerce_apps_gaining_ground_us.

183. Lisa Katayama, "In Japan, Cell phones Have Become Too Complex to Use," *WIRED*, June 6, 2008, www.wired.com/print/gadgets/wireless/news/2008/06/japan_phones.

184. Christopher Billich, Phone interview with Stephen Ezell, September 7, 2009.

185. Choi and Collins, "Mobile Payments in Asia," 33.

186. Ibid.

187. Orla Ryan, "Japan's m-commerce boom," *BBC News,* October 11, 2000, http://news.bbc.co.uk/2/hi/business/945051.stm.

188. Jeffrey Funk, Associate Professor at National University of Singapore, Division of Engineering Technology Management, Phone interview with Stephen Ezell, August 24, 2009.

189. Billich, Future Insight: Mobile Commerce in Japan.

190. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa," 7.

191. Billich, "Mobile NFC: Current Market Developments."

192. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa," 7.

193. Billich, "Mobile NFC: Current Market Developments."

194. Takeshi Natsuno, Phone interview with Stephen Ezell, October 7, 2009.

195. Ibid.

196. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa," 8.

197. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa," 1.

198. Bradley et al., "NTT DOCOMO, Inc: Mobile FeliCa," 4.

199. As translated and paraphrased by Christopher Billich in a Phone interview with Stephen Ezell, September 7, 2009.

200. Nikhilesh Dholakia et al., *M-Commerce, Global Experiences and Perspectives* (Idea Group Publishing: London, England, 2006), 215.

201. Ibid.

202. Sarah Clark, "Singapore to get national trusted third party for NFC," *Near Field Communications World*, February 25, 2009, http://www.nearfieldcommunicationsworld.com/2009/02/25/3819/singapore-to-get-national-trusted-third-party-for-nfc/.

203. Ibid.

204. Ibid.

205. Clark, "National ticketing project could use NFC."

206. UK Department for Transport and Detica, "The benefits and costs of a national smart ticketing infrastructure," July 2009, http://www.dft.gov.uk/pgr/regional/policy/nationalsmartticketing/ticketreport.pdf.

207. Chalmers Johnson, *MITI and the Japanese Miracle* (Stanford, CA: Stanford University Press, 1982), vii.

208. Ibid., 238.

209. Japan IT Strategy Headquarters, "e-Japan Priority Policy Program," http://www.kantei.go.jp/foreign/it/network/0122full_e.html.

210. Japan IT Strategy Headquarters, "e-Japan Strategy II," July 2, 2003, http://www.kantei.go.jp/foreign/policy/it/0702senryaku_e.pdf.

211. Ibid.

212. Japan IT Strategy Headquarters, "e-Japan Strategy II," 35.

213. OECD, "Communications Outlook 2007," Paris, 2007, http://www.cesifo-group.de/portal/page/portal/DICE_Content/INFRASTRUCTURE/COMMUNICATION_NETWORKS/Liberalisation%20Process/gov-own-pub-tel-net.pdf. See "Government Ownership of Public Telecommunication Network Operators" table on pages 39-42.

214. "NTT DOCOMO, Inc.," CTIA Smart Brief, http://www.smartbrief.com/news/ctia/companyData.jsp?companyId=9964&c=allaccessspublished&page=1. (Citing data from Hoovers, Inc.)

215. Ursula Österle, Vice President Innovation, Swisscom, Phone interview with Stephen Ezell, May 22, 2009.

216. Christopher Billich, Phone interview with Stephen Ezell, September 7, 2009.

217. Yuri Kageyama, "Japan Aims to Put 'Wallet Phone' in Global Pockets," *USA Today,* August 19, 2008, http://www.cesifo-group.de/portal/page/portal/DICE_Content/INFRASTRUCTURE/COMMUNICATION_NETWORKS/Liberalisation%20Process/gov-own-pub-tel-net.pdf.

218. Ibid.

219. Information provided by Satoshi Baba, Executive Manager, ICT Consulting Department, NTT Communications Corporation, in an email to Stephen Ezell on August 31, 2009.

220. Stephen Ezell, Phone interview with Mark MacCarthy, May 20, 2009.

221. Sutter, "Wallet of the future?"

222. Mark MacCarthy, Phone interview with Stephen Ezell, May 20, 2009.

223. Dan Balaban, "NFC Mobile Payment: A New Front in the Security Battle," PaymentsSource.com Web site, July 21, 2009, http://www.paymentssource.com/asset/article/2690091/nfc-mobile-payment-new-front-security.html.

224. Alorie Gilbert, "Elementary school nixes electronic IDs," *CNET News*, February 17, 2005, http://news.cnet.com/Elementary-school-nixes-electronic-IDs/2100-1029_3-5581275.html.

225. Ibid.

226. Robert Atkinson, "RFID: There's Nothing To Fear Except Fear Itself," Opening Remarks by Robert Atkinson at the 16th Annual Computers, Freedom, and Privacy Conference, Washington, D.C., May 2006, http://www.itif.org/files/rfid.pdf.

227. Mark MacCarthy, Phone interview with Stephen Ezell, May 20, 2009.

228. Rob Atkinson, "Innovation and Its Army of Opponents," *BusinessWeek*, September 23, 2009, http://www.businessweek.com/innovate/content/sep2009/id20090923_521177.htm.

## ABOUT THE AUTHOR

Stephen J. Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on international information technology competitiveness and national innovation policies. Mr. Ezell comes to ITIF from Peer Insight, an innovation research and consulting firm he co-founded in 2003 to study the practice of innovation in service industries.

Prior to co-founding Peer Insight, Mr. Ezell worked in the New Service Development group at the NASDAQ Stock Market, where he spearheaded the creation of the NASDAQ Market Intelligence Desk and the NASDAQ Corporate Services Network, each a service to NASDAQ-listed corporations. Stephen holds a B.S. from the School of Foreign Service at Georgetown University, with an Honors Certificate from Georgetown's Landegger International Business Diplomacy program.

## ABOUT THE INFORMATION TECHNOLOGY AND INNOVATION FOUNDATION

The Information Technology and Innovation Foundation (ITIF) is a nonprofit, non-partisan public policy think tank committed to articulating and advancing a pro-productivity, pro-innovation and pro-technology public policy agenda internationally, in Washington and in the states. Through its research, policy proposals, and commentary, ITIF is working to advance and support public policies that boost innovation, e-transformation and productivity.

For more information contact ITIF at 202-449-1351 or at mail@itif.org, or go online to www.itif.org.
**ITIF | 1101 K St. N.W. | Suite 610 | Washington, DC 20005**