Contactless Payment and the Retail Point of Sale: Applications, Technologies and Transaction Models

A Smart Card Alliance Report

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About the Smart Card Alliance

The Smart Card Alliance is the leading not-for-profit, multi-industry association of member firms working to accelerate the widespread acceptance of multiple applications for smart card technology. The Alliance membership includes leading companies in banking, financial services, computer, telecommunications, technology, health care, retail and entertainment industries, as well as a number of government agencies. Through specific projects such as education programs, market research, advocacy, industry relations and open forums, the Alliance keeps its members connected to industry leaders and innovative thought. The Alliance is the single industry voice for smart cards, leading industry discussion on the impact and value of smart cards in the U.S. For more information, visit **www.smartcardalliance.org**.

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Executive Summary

Contactless Payment Represents a Growing Market

The latest trend in retail payment applications is contactless payment. Contactless payment systems are used successfully in Asia, Europe and North America and offer a number of advantages to issuers, retailers, and consumers. Contactless payment allows issuers to penetrate the cash payment market, enjoy increased customer transaction volume, and improve customer retention and loyalty. Retailers realize benefits due to faster transaction times, increased revenue, improved operational efficiency, and lower operating costs. Consumers enjoy the convenience of hands-free payment, the ability to pay for multiple services using one device, and the security of not having to display a card for payment.

Contactless payment applications are particularly attractive to retail segments where speed and convenience of payment are essential (for example, quick service restaurants, gas stations, convenience stores, parking facilities, transit services, entertainment venues and unstaffed vending locations).

Multiple Technologies Support Contactless Payment

Multiple technologies may be used to implement a contactless payment system. Candidate technologies include radio frequency, infrared, carrier-based mobile and Bluetooth technologies. Three types of radio frequency technologies are currently used, including: high-frequency 13.56 MHz contactless smart cards, low-frequency (100 to 300 KHz) devices and ultra-high-frequency (900+ MHz) transponders.

The choice of an appropriate technology is driven by issues such as what types of payment mechanisms the technology supports, whether the technology is commercially available and governed by international standards, what regulatory issues apply, how much investment is required, and how well the technology protects customer data and guards against erroneous transactions.

Various Transaction Models Support Contactless Payment

A contactless payment system can follow a variety of transaction models. Candidates include account-based payment, traditional credit or debit card payment, and stored-value payment. Each transaction model requires a different infrastructure investment and different participation by the consumer, retailer, acquiring processor, and issuing bank. Which transaction model is appropriate depends on the approach chosen to implement the system.

Contactless Smart Cards Offer an Excellent Choice for Retailers

Smart cards are being used for payment throughout the world, with Visa, MasterCard and JCB leading initiatives to extend the use of smart cards for contactless payment. The combination of standards-based technology, enhanced security features, availability of products and services from multiple vendors, potential to use the existing payments infrastructure, and support from major financial industry players offer compelling benefits for payment implementations based on contactless smart cards.

About This Report

This report was developed by the Smart Card Alliance to describe contactless payment applications, technology options and transaction model alternatives. This report provides answers to commonly asked questions about contactless payment systems, such as

- What retail sectors can benefit most from contactless payment?
- What are example implementations of contactless payment and how successful have they been?
- What are the technologies that can support contactless payment?
- What are the business drivers for adopting contactless payment?
- Are there advantages to using contactless smart cards in contactless payment systems?

Introduction

The financial, retail, and transportation industries are all abuzz over the latest payment trend — contactless payment devices. These devices come in a variety of shapes and sizes, ranging from traditional plastic cards to key fobs, watches, and cellular phones. Major cities around the world already use contactless smart cards for transit payment, with many major cities in the United States also implementing or planning to implement contactless smart card-based automatic fare collection (AFC) systems.[1] In 2002, MasterCard, VISA and JCB also announced the availability of contactless payment options for traditional cash-only environments where speed is essential, such as quick serve and casual restaurants, gas stations, convenience stores, and movie theaters.

Because contactless payment is a new market using and promoting a range of technologies and transaction models, the terminology describing it can be confusing. This report defines "contactless payment" as the ability to perform a non-cash payment transaction without a physical connection between the consumer payment device and the physical point of sale (POS) terminal. Contactless payment may be implemented using different contactless technologies, including radio frequency (RF), infrared (IR), Bluetooth, and carrier-based mobile technologies. Three types of RF technologies are described in this report, including high-frequency 13.56 MHz contactless smart cards, low-frequency (100 to 300 KHz) devices and ultra-high-frequency (900+ MHz) transponders.[2]

This report provides information on current contactless payment applications and on the benefits and value proposition for retailers and issuers considering such a payment scheme. It examines the various available contactless technologies, transaction models and implementation approaches. Finally, it describes the advantages of contact and contactless smart cards as compared to other current payment mechanisms.

[1] See Appendix A for a summary of North American transit agencies implementing or planning to implement smart card-based systems.
[2] RF bands are defined as: low-frequency - 30 KHz to 300 KHz; high-frequency – 3 MHz to 30 MHz; ultra-high-frequency – 300 MHz to 3 GHz.

Existing Contactless Payment Applications

Contactless payment applications have existed for more than a decade. Since the 1980s, millions of toll-road users have used "long distance" contactless technology for prepaid accounts or customer billing. ExxonMobil's Speedpass™ was introduced in the mid-1990s, and over 6 million customers now use a key fob, vehicle tag or watch to pay for gas and convenience store items at more than 7,500 Exxon and Mobil stations in the United States, Canada, and Singapore.

A number of mass transit agencies are also in the process of moving from magnetic stripe cards to contactless smart cards for fare payment or are testing smart card-based systems. According to Datamonitor, the market for transit-related contactless smart cards will grow from $55 million in 2002 to $200 million by 2006.[3] Contactless smart cards are currently being used in many cities worldwide (including Hong Kong, Tokyo, Seoul, Pusan, Washington, DC, and Shanghai), with the majority of new transit fare payment systems planning to use contactless smart cards as the primary ticket media. In many of these cities, these contactless smart cards are expanding beyond transit-only payments to include contactless payment with local retailers.

This section describes several current contactless payment applications that are being used at the retail point of sale.

Hong Kong Octopus Card

The Hong Kong Octopus card, launched in 1997 as an electronic purse for public transportation, is the most successful and mature implementation of contactless smart cards used for mass transit payment. The card's acceptance and popularity have since extended its use to nearby retailers. Its success highlights two critical components of any payment strategy: strong self-service habits and the ability to leverage these habits to launch payment technologies for the general retail environment.[4] The Octopus card is a good example of a contactless transit payment application that is evolving into a general retail payment mechanism.

Octopus cards were developed as an automatic fare collection (AFC) scheme for Hong Kong's transit system. Over 9 million Octopus cards and 150,000 smart watches have been issued, and over 7 million transactions are recorded on a daily basis, for a daily transaction value of over HK$50 million (about US$6.5 million).[5] This contactless smart card ticketing system currently includes over 100 service providers, including all of the major transport operators (bus, taxi, subway, train, tram, and ferry services). Because Hong Kong's main transport operators are all partners in the Octopus card, kiosks are widely available, making it easy for customers to check the balance on a card and recharge it with cash or electronic payments. The use of the card has shortened queues at ticket barriers,

[3] "Access Will Overtake Transit as Contactless Card Application," *Card Technol*ogy, October 2002, p. 25.
[4] Contactless Smart Card Schemes in the Asia Pacific Region," Asia Pacific Smart Card Association report, August 2002.
[5] Donald Davis, "The Contactless Wave," *Card Technology*, January 2003.

because the card doesn't have to be taken out of a bag or wallet — customers can just wave it past a scanner at a distance of several centimeters.

The first non-transit applications for the Octopus card allowed the card to be used for payment at photo booths located in the Mass Transit Railway (MTR) stations and pay phones operated by New World Telephone. After only 5 years, 25 percent of Octopus card transactions are unrelated to transit.[6] The card lets consumers make payments quickly and conveniently and is accepted by more than 160 merchants:[7]

- Park 'N Shop (Hong Kong's leading supermarket), Watson's, 7-Eleven, and Starbucks accept the Octopus card. Many fast food outlets already accept the card, and McDonald's is expected to accept it in the near future. Octopus charges a 1% commission on retail purchases.
- More than 3,000 soft drink vending machines in offices, schools, and shopping malls now have Octopus scanners. Sales have increased, as consumers make more impulse buys when they don't need to use cash.
- Pay phones, photo booths, and many car parks accept the card, avoiding the need for consumers to carry change. The card can also be used for admission to public swimming pools and other recreational centers.
- Nokia has launched a cover for one of their mobile phones that includes an embedded Octopus chip and antenna, enabling commuters to use their phone to make Octopus payments.

While Octopus cards are anonymous by default, over 500,000 personalized cards have been issued and are used for the Octopus Automatic Add-Value Service. Twelve Hong Kong banks and one credit card company support the automatic add-value service. Because each personalized card has a unique identification number, up to 40,000 cards are also being used as security passes at housing estates, for staff identification cards, and as loyalty cards.

The contactless Octopus card is based on Sony’s FeliCa™ technology, a proprietary 13.56 MHz technology similar to but not compliant with the ISO/IEC 14443 standard technology. This technology has widespread acceptance in the Asia Pacific region, with over 25 million cards issued worldwide.[8] Terminals read the cards instantly, processing transactions in less than one-third of a second. On the MTR, a scanner at the ticket barrier loads data on the card that is then used by scanners at the exit gates to deduct the correct fare and show the remaining credit.

In 2002, the Asia Pacific Smart Card Association reported that 95% of the “economically active population” was using the Octopus card.[9] Travelers have found that the card provides increased convenience, allowing them to pass through fare collection points 15 to 20% faster, according to Octopus card statistics. The scheme has succeeded because it offers real convenience to cardholders.

The Kansai Thru Pass, a similar transit application using the FeliCa technology, is being rolled out over the next 5 years in the Japanese cities of

[6] Asia Pacific Smart Card Association, op. cit.
[7] Ibid.
[8] JCB Contactless Presentation, January 2003.
[9] Asia Pacific Smart Card Association, op. cit.

Kyoto, Osaka, and Kobe. JCB will issue more than 5 million Thru Pass cards to be used in a merchant base that includes 10,000 POS terminals.[10]

In the United States, the Washington Metropolitan Area Transit Authority (WMATA) has 325,000 SmarTrip contactless smart cards in circulation, used for payment throughout the Metrorail system and at all WMATA-operated parking facilities. WMATA has also entered into pilots that expand the use of the card to other applications. In a pilot agreement with First Union National Bank, 1,000 co-branded cards were issued in 2000 that could be used in WMATA's transit system (as a contactless smart card) and used as a debit card (with a magnetic stripe) for banking transactions or re-loading the card for transit use. The cards were re-issued to participants in 2002. Based on survey data gathered from the cardholders, consolidation of functions on a multi-application card was an attractive feature and would lead to increased use of the card. WMATA also entered into a pilot with the U.S. General Services Administration and U.S. Department of Education for a co-branded, multi-function transit-building access card. These pilots were initiated in 2000 and 2002, respectively, include approximately 2,000 cardholders between the two agencies, and continue to operate today.[11]

ExxonMobil Speedpass

Speedpass, introduced by ExxonMobil in 1997, was the first automated payment system to adopt radio frequency-based technology to help consumers make retail purchases. Today, over 6 million Speedpass customers frequent 7,500 Exxon- and Mobil-branded locations around the world. Over 92% of the Speedpass users report a high level of satisfaction.[12]

The ExxonMobil Speedpass project resulted from a 1993 Mobil study that concluded that convenience, friendly service, and recognition of loyal customers create consumer loyalty and additional spending. The benefits to the consumer are straightforward: no foraging for change or bills, no handling of credit cards, no paper receipt to sign or keep track of, and no personal identification number (PIN) to enter or remember. In general, the entire transaction is handled more quickly and the customer is in control at all times.[13]

Motorists enrolled in Speedpass use a key fob, watch, or transponder affixed to their vehicle's rear window to communicate securely with a gas pump or POS terminal. A reader integrated into the pump or terminal sends a signal to the customer's device, which replies with a unique identification code that is linked to a customer account. The customer is then authorized for payment, and the pump is activated, or a purchase can be made at the convenience store. Consumers do not pay for the Speedpass device, and there is no consumer service charge for using this technology to make payments.

Speedpass is recruiting key retailers in other sectors, such as grocery stores and fast-food restaurants, to use the payment technology. Selected Stop &

[10] *ContactlessNews,* Volume 1, Number 2, January 2003.
[11] Source: WMATA
[12] *Texas Instruments RFID eNews*, Issue No. 14, November/December 2002.
[13] Amy Cortese, "Toolbooth Technology Meets the Checkout Lane," *New York Times*, July 7, 2002.

Shop supermarkets began using Speedpass in 2002 for payment, coupons, and a loyalty program. During the past 2 years, over 430 McDonald's locations in the Chicago area have begun accepting Speedpass.

In December 2002, ExxonMobil Speedpass and Timex® released 4,000 timepieces featuring a miniature Speedpass transponder. The watch looks and functions like a regular watch, but enables customers to pay instantly and even more conveniently at Exxon and Mobil service stations.[14]

The RFID transponders used in the Speedpass devices (key fobs, watches, and window transponders) were designed by Texas Instruments and feature a digital signature encryption protocol with challenge/response authentication to ensure consumer protection. This technique makes it extremely difficult, if not impossible, to duplicate the transponder (tag) or the secret encryption key. According to Texas Instruments, even if the key were duplicated, it would only be valid for a single tank of gas.[15] The Speedpass system was also designed to ensure customer privacy and security. The customer's credit or check card number is not used by the Speedpass device or merchant POS terminal, maintaining the confidentiality of that information.

Customers at Exxon- and Mobil-branded service stations increased their purchases of gasoline by 15% after they became Speedpass users, resulting in a sales lift of 4%.[16] (Sales lift is measured as total gallons sold for the 12 months prior to implementing Speedpass compared with the 12 months after Speedpass was implemented at each location). This represents one additional gas purchase per month per customer.

Several other pilots are also in progress using payment systems similar to Speedpass. Shell Canada has launched its 'EasyPay' solution based on ISO/IEC 15693 technology from TI to over 400 service stations. McDonald's is conducting two pilots using RF-based contactless payment systems from other service providers. One involves using RFID technology by FreedomPay® at 32 outlets in Boise, Idaho and the other allows E-ZPass℠ customers on Long Island to use their E-ZPass toll transponders to pay at the drive-through window.[17] Similar trials are being conducted by Taco Bell® and KFC® using a product from a company called 2Scoot®. According to Ed Kountz, a senior analyst for emerging technology with TowerGroup, "Trials in so-called quick-service restaurants (aka fast-food joints) have resulted in a 15 to 30 percent 'bag lift'—the industry jargon for an increase in average order cost."[18]

Bank of America recently announced the QuickWave contactless payment pilot.[19] Launched in 2002 in Charlotte, North Carolina, the pilot includes 10,000 Bank of America employees and 15 downtown restaurants and shops. Participants pay for their purchases and accumulate loyalty points by using the card. The scheme is similar to Speedpass in that the contactless card references the user's bank account. QuickWave uses technology from FreedomPay and Inside Technologies that supports both the ISO/IEC 15693

[14] See Speedpass web site, http://www.speedpass.com.
[15] "Mobil Speedpass Goes Global as Mobil Singapore Rolls Out Asia's First RFID-Based Pay-At-The-Pump System," Texas Instruments press release, April 5, 1999.
[16] Matthew Miller, op. cit.
[17] Ibid.
[18] Matthew Miller, "Received Wisdom," *CommVerge*, November 1, 2002.
[19] *ContactlessNews*, Volume 1, Number 2, January 2003.

and ISO/IEC 14443 Type B contactless smart card standards.[20] The pilot will continue through March 2003.

Visa Contactless Payment in South Korea

Since 1998, approximately 6 to 7 million Visa-branded contactless cards have been issued by several large Visa members in South Korea. These cards contain a chip, which is used for contactless payment in the Seoul transit system, and a magnetic stripe, which is used for regular credit card payments. The popularity of transit applications on credit cards means that contactless chips have become a standard feature for the majority of new credit cards issued to residents of Seoul. Several other major cities in South Korea (Busan, Jeonju, Inchon, and Ulsan) have also deployed Visa credit cards coupled with a contactless transit application. However, unlike the cards used in Seoul, these cards are issued as "dual-interface" cards in which a contact-based electronic purse (on a chip) is offered along with a contactless transit application (also on a chip).

In 2002 Visa introduced the dual-interface GlobalPlatform (GP) card, based on Philips technology. Unlike previous dual-interface cards, the new GP cards allow applications to be downloaded, modified, and deleted after the card has been issued. The cards also support VSDC and Visa multi-functionality. Three major districts in South Korea, (City of Daejon, City of Gwangju, and Chungnam Province) have adopted these dual-interface GP cards. Issuance begins in 2003, with a target of up to 2 million cards. In addition to the ISO/IEC 14443 and MIFARE-based transit application, the card will also carry VSDC (EMV credit and debit), digital ID, Visa Cash e-purse, and loyalty applications. Other cities that have been issuing proprietary transit cards are planning to migrate to Visa's dual-interface Global Platform cards.

Visa continues to work very closely with S-1/Samsung Electronics in several areas to provide VSDC payment and multi-function capabilities through the dual-interface smart card chip. Current programs include contactless access control to corporate buildings for Samsung employees and their families and contactless access for residents of apartment buildings in several major South Korean cities.

SK Telecom, the largest mobile telecommunications service provider in South Korea, launched the second phase of their Moneta card program in December 2002. The Moneta card now supports Visa payment at the point of sale using an IR beam or signal sent from mobile telephone handsets to upgraded merchant terminals. Plans are in place to expand this program and include contactless Visa payment in 2003. By the end of 2003, it is anticipated that approximately 400,000 terminals will be upgraded to support IR and contactless smart card technology and approximately 2 to 3 million handsets will be deployed.

Two other South Korean telecommunications providers, KTF and LGT, have indicated that they will also provide Visa payment at the retail POS using infrared and contactless smart card technology in 2003.

[20] *BiometricTech News*, January 16, 2003.

MasterCard PayPass™

MasterCard's PayPass, announced in December 2002, eliminates the need for users to swipe their cards through a reader. Consumers tap their payment cards on a specially equipped merchant terminal (or wave them at the terminal) that then transmits the payment details wirelessly, The new solution is targeted for traditional cash-only environments where speed is essential, such as quick service restaurants, gas stations, convenience stores, and movie theaters.

Chase, Citibank, and MBNA are working with MasterCard in a MasterCard PayPass trial in Orlando, Florida. Consumers can use the PayPass card at a variety of participating Orlando merchants, including Boater's World, Chevron, City of Orlando Parking, Eckerd, Friendly's, Loews Universal Cineplex, McDonald's, Ritz Camera, and Wolf Camera. Additional retailers are expected to begin participating in early 2003. The MasterCard PayPass card also includes a magnetic stripe, allowing consumers to use it at any location that accepts MasterCard.

Recent MasterCard consumer research reveals the following reactions to PayPass:[21]

- 63% of the consumers surveyed said that they would "definitely" or "probably" use MasterCard PayPass if their bank offered it to them.
- Consumers who said that they would definitely use the card indicated that it will replace cash in more than half (53%) of their transactions.
- PayPass is perceived to be "innovative" and "fun to use," as well as an enhancement that "would make shopping less of a hassle."

The MasterCard PayPass card uses ISO/IEC 14443 standard technology (Types A and B) to securely transmit Track 1 and Track 2 payment information from the card to the merchant terminal using RF. This eliminates the need for a cardholder to present the card to the merchant to swipe through a reader, allowing the cardholder to remain in control of the card. The payment transaction is then processed through the existing MasterCard acceptance network. The simplified approach of using Track 1 and Track 2 data allows merchants to cost-effectively retrofit their current magnetic stripe POS terminal to start accepting PayPass cards.[22] This is accomplished using an RF adapter that involves no POS software change. MasterCard plans to introduce MasterCard PayPass to additional markets when the Orlando trial is completed.

Summary

Figure 1 summarizes the technology and device formats used by each of the applications discussed in this section.

[21] "New MasterCard PayPass Utilizes Contactless Payment Technology," MasterCard press release, December 12, 2002.
[22] "U.S. Smart Card Breakthrough," The Nilson Report, January 2003.

Figure 1: Featured Applications and Corresponding Technology

Featured Application	# of Cards Issued	Technology	Form Factor
Hong Kong Octopus Card	9+ million	Non-standard 13.56 MHz (FeliCa)	Plastic card
ExxonMobil Speedpass	6+ million	Low-frequency RF (TI)	Key fob, wrist watch, window transponder
Visa Contactless Payment	7+ million	ISO/IEC 14443 13.56 MHz, Infrared	Plastic card, mobile phone
MasterCard PayPass	Pilot phase	ISO/IEC 14443 13.56 MHz	Plastic card

Contactless Payment Benefits and Costs

In the United States, contactless payment is an emerging market. A number of contactless technologies are being implemented, various payment processes are supported, and both pilot and commercial services are available. While the market is new, there is already evidence that retailers can see significant benefits from implementing contactless payment and that consumers value its increased convenience and speed.

This section describes the general business benefits and costs of implementing contactless payment for retailers and issuers. It does not attempt to quantify the business case, since actual benefits and costs vary by retail segment and by the technology used.

Retailer Benefits

Retail segments in which speed and convenience of payment are essential can realize significant benefits from contactless payment. These segments include: quick service restaurants, especially those with drive-through service; gas stations; convenience stores; parking facilities; transit services; entertainment venues; amusement parks; and unstaffed vending locations (for example, vending machines or ticket kiosks).

While the business drivers differ for each retail segment, early contactless payment implementations have demonstrated the following benefits:

- Faster transaction times
- Increased revenue
- Improved operational efficiency and lower operating costs
- Better customer information
- Payment device branding or co-branding
- Competitive differentiation

Faster transaction times are achieved by moving customers more quickly through the transaction process. Contactless payment is faster than both cash and traditional magnetic stripe credit card transactions. By eliminating the need for consumers to extract cash or cards and for retailers to make change or swipe a card, TowerGroup estimates that contactless payment using RFID fobs can save 10 to 15 seconds per transaction.[23] Sue Gordon-Lathrop, vice president for emerging consumer environments at Visa International, has stated that contactless payment can decrease drive-through transaction time by 90 seconds..[24] In some retail segments, faster customer service may translate directly into increased revenue.

Increased revenue results from increased spending per transaction, increased frequency of purchase, and increased loyalty (when the merchant becomes the customer's preferred retailer). Customers also potentially have access to more funds when they pay using a contactless payment device instead of cash. ExxonMobil has stated that a 4% increase in sales resulted from using Speedpass.[25] Other vendors and retailers implementing

[23] Edward Kountz, "RFID Payment Fobs at Point of Sale: The Early Face of M-Payments in North America," Tower Group,, March 2002.

[24] "Visa, MasterCard diverge on proximity payments," *European Card Review*, August 2002.

[25]"Matthew Miller, op. cit.

contactless payment have reported 15 to 30% increases in sales after implementing contactless payment.[26 27 28 29]

Improved operational efficiency and lower operating costs result from reducing overhead and resource requirements at merchant locations, reducing cash handling and pilferage costs, and improving reliability of payment terminals.

Better customer information enables the retailer to better understand customer behavior by collecting data that could not be collected with cash purchases.

Payment device branding or co-branding means major retailers can benefit from relationships with issuers, adding the retailer brand to the payment device and achieving increased visibility with consumers.

Competitive differentiation attracts new customers by providing more convenient payment methods.

Retailer Costs

As with any new payment method, retailers will need to invest in new infrastructure and processes to implement contactless payment. Costs to be considered include both installation and ongoing costs:

- **Cost to upgrade POS hardware and software** to accept contactless payment. This cost depends on the technology chosen (currently ranging from tens to hundreds of dollars) and will change over time as terminal vendors integrate contactless payment capability directly into new terminals.
- **Cost to upgrade retailer host systems** to support new transaction data and to route transactions to the appropriate payment processors. Whether there is a requirement to upgrade depends on which contactless payment transaction model is used. Some contactless payment solutions use existing credit and debit networks and standards, while others require new payment processors or gateways.
- **Cost to train customer service staff**. Customer service staff will need to be trained to use the contactless payment terminal and process and to help customers use the contactless devices.
- **Marketing and promotion costs**, to encourage customers to use new contactless payment options.
- **Transaction fees** for processing contactless payments. Fees will depend on the transaction model and service providers offering contactless payment processing
- **Maintenance and management costs** associated with the new payment solution.

[26] Amy Cortese, op. cit.
[27] Jon Karlen, "Contactless Micropayments," *Wireless Future Magazine*, September/October 2002.
[28] "Gilbarco Wants to Help Gas Stations Pump Up Profits," *RFID Journal*, June 2002.
[29] John Elliott, "Losing contact: the transactions of the future are disappearing into thin air," *Cards Worldwide*, March 15, 2002.

Issuer Benefits

There are a number of different potential issuers for contactless payment devices, including: transit agencies (e.g., Washington, DC, Hong Kong); transit outsourcing providers (e.g., Transys London); new companies focused on providing contactless payment devices and services (e.g., Speedpass); traditional credit/debit card issuers (e.g., MasterCard and Visa members); and retailers who may offer their own branded payment card or device. Each of these issuers will have different drivers for issuing contactless payment devices. Key drivers are the following:

- **Penetration of the cash payment market**. In the United States in 2001, cash was used for approximately 20% of total consumer payments.[30] Issuers can add transaction volume to existing payment cards or reduce cash handling requirements by replacing cash payments with a contactless payment method that is connected with another form of electronic payment mechanism (i.e., credit or debit card or bank account).
- **Increased customer transaction volume**. By making it more convenient for customers to pay, issuers can realize increased transaction volume as consumers use the contactless payment device more often. WMATA has also found that the contactless AFC payment card reduces the consumer's perceived cost of a transit trip.
- **Improved customer retention and loyalty**. The consumer reaction to initial implementations of contactless payment has been very favorable. By offering a payment device that increases the convenience and speed of the transaction process, issuers may experience better customer retention and loyalty, becoming the payment device issuer of choice.
- **Co-branding opportunities.** Issuers entering the contactless payment market have the opportunity to strengthen relationships with major retailers by offering co-branded payment devices.
- **New service opportunities.** Contactless payment issuers can provide new services to retailers that include payment processing and other value-added capabilities, generating new or incremental revenue streams.

Issuer Costs

Issuers must also consider the cost of implementing new contactless payment devices and services. Issuer costs include the following:

- **Cost of the contactless payment device.**
- **Personalization and life cycle management costs** for the payment device.
- **Operations costs** to accommodate the expected risk profile of contactless payment transactions.
- **Transaction processing infrastructure costs** if changes or investments are required to process new contactless payment transactions.
- **Cost of training customer service staff** to answer consumer questions and address any issues created by using the new contactless payment devices.

[30] "Consumer Payment Systems," *The Nilson Report*, Issue #777, December 2002.

Summary

While the benefits of contactless payment to the issuer and retailer are clear, the business case needs to evaluate the actual benefits and costs of a specific contactless payment technology, transaction model, and service. The business case must also compare the results to the cost of the payment methods already in use. For example, the cost/benefit comparison for a retailer who is converting customers from cash to contactless payment will be different than the comparison for a retailer who is converting customers from credit or debit cards (using magnetic stripe or contact smart cards). Contactless payment implementations may also benefit from linking with large-scale transit payment programs that are already underway and that could underwrite card issuance and point of sale terminal deployment (though the harmonization of application requirements and impact on business cases need to be thoroughly considered). As both retailers and issuers gain more experience with early contactless payment implementations, the business case will be proven for different technologies and transaction models.

Contactless Payment Technology Options

Contactless payment requires a wireless information exchange between the consumer's payment token and a payment terminal or infrastructure device. Contactless payment can be enabled using a variety of technologies and payment tokens in many different forms. Each technology has tradeoffs that affect the feasibility and effectiveness of using it in the North American retail environment.

The available technologies support both radio and optical information exchange. Current RF-based alternatives include contactless smart cards, RFID tokens, RF transponders, Bluetooth-enabled devices, and carrier-based mobile solutions (such as mobile phones). Optical alternatives include IR-enabled devices such as PDAs and mobile phones that execute payment transactions over an IR link between the device and POS terminal.

The following two sections summarize the primary current contactless technologies and alternative solutions.[31]

Primary Contactless Payment Technologies

The three primary contactless payment technologies include: high-frequency 13.56 MHz solutions; low-frequency proprietary solutions like Speedpass; and ultra-high-frequency RF solutions like those used for toll applications.

ISO/IEC 14443-Compliant High-Frequency 13.56 MHz Contactless Smart Cards

ISO/IEC 14443 is a contactless technology standard for "proximity" smart cards operating at 13.56 MHz. This standard specifies the characteristics of cards with an operational range of up to 4 inches (10 centimeters). The technology was originally designed for electronic ticketing and electronic cash applications. For these applications, short operational ranges and fast transaction speeds are critical. These same market requirements led ISO/IEC 14443 to be adopted for transit, off-line purchase, vending, and physical access control applications.

Advantages and Disadvantages

ISO/IEC 14443 was initiated in 1994 to standardize contactless proximity cards and finalized in 2001. To date, approximately 250 to 300 million contactless smart cards have been shipped based on the ISO/IEC 14443 standard.[32] The majority of these cards are used in transportation applications for automatic fare collection, with the largest installations in Asia. ISO/IEC 14443 cards are supplied by the largest base of semiconductor suppliers and card manufacturers.

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[31] Note: The Smart Card Alliance has used best efforts to ensure, but cannot guarantee, that the information described in this section concerning contactless technologies and the status of their deployment is accurate as of the date of this paper.

[32] "Contactless Smart Card Technology for Physical Access Control," Avisian, Inc., April 1, 2002 and Philips Semiconductors.

A number of different ISO/IEC 14443-compliant card products are available, offering a range of characteristics at a number of price points. These characteristics include compliance to different levels of the standards, differing encryption and authentication schemes, and differences in processing power and card resources. Readers are available that can interoperate with the range of available card products, allowing an issuer to provide a choice of solutions and a migration path to more powerful devices if required.

ISO/IEC 14443 does not specify a standard for contactless link encryption or card-to-reader authentication. However, virtually every semiconductor vendor provides options to provide these security services. A common encryption/authentication protocol used with ISO/IEC 14443 Type A is the MIFARE protocol. An independent certification institute offers MIFARE compliance testing, ensuring that certified products from multiple vendors will work together.[33]

The 10 centimeter operational range of ISO/IEC 14443 may be an advantage since the act of payment is more intentional and close proximity of the card to the reader helps limit unintended communication.

The 106 Kbps data rate of ISO/IEC 14443 cards is also considered an advantage in that more bandwidth is available for stronger security, larger amount of application data and reduced time in field.

Contactless microcontroller (MCU) cards that comply with ISO/IEC 14443 offer an excellent combination of interoperability and security. New dual-interface or contactless MCU cards fully comply with ISO/IEC 14443 (through part 4 of the standard). As a result, contactless and dual-interface smart cards have the same level of interoperability as contact smart cards. For example, dual-interface cards made available by Visa can execute the same financial applications in either ISO/IEC 7816 contact or ISO/IEC 14443 contactless mode. ISO/IEC 14443 MCU-based smart cards offer security features equivalent to those offered by contact smart cards. Features such as memory firewalls that separate applications on the card, encryption, sensors, tamper-resistance, and crypto coprocessors provide robust security for transactions.

Contactless wired logic technologies are also available in the market and can comply through Part 3 of the ISO/IEC 14443 specification. While these products cannot support the ISO/IEC 7816-like Part 4 protocol layer, they do offer a lower price point and faster performance. Depending upon the needs of the issuer and the products or applications to be supported, these could be a cost-effective choice.

ISO/IEC 14443-compliant readers are available from multiple vendors. In addition, several readers are capable of reading both ISO/IEC 14443- and ISO/IEC 15693-compliant cards, with a few supporting an even broader range of technologies.

The financial industry is supporting contactless payment solutions based on ISO/IEC 14443. Visa International has endorsed a global payment specification for contactless cards based on ISO/IEC 14443, and a number of

[33] Ibid.

trials in Asia are already underway or planned.[34] MasterCard International has also implemented contactless technology based on ISO/IEC 14443 for use by its members and in the PayPass pilot in Orlando, Florida.[35]

Summary

The adoption of ISO/IEC 14443-based contactless solutions by payment associations, the security features of the technology, and its widespread use in payment applications make ISO/IEC 14443-compliant contactless smart cards well suited for any open or closed payment application.

ISO/IEC 15693-Compliant High-Frequency 13.56 MHz Contactless Smart Cards

ISO/IEC 15693 is a contactless technology standard for "vicinity" smart cards operating at 13.56 MHz. This standard specifies the characteristics of cards with an operational range of up to 1 meter, although practically speaking the range is limited to 70 centimeters or less. Traditionally, ISO/IEC 15693-compliant tokens have been used for tagging, ticketing, and access control applications. As these tokens become more capable and are deployed more widely, however, new applications are being considered, especially for closed-system enterprise payment (for example, as part of multi-application employee badging systems and for some retail solutions).

Advantages and Disadvantages

ISO/IEC 15693 was initiated in 1996 to standardize contactless vicinity cards and finalized in 2001. The most common application identified for these cards, to date, is multi-application enterprise access control cards. ISO/IEC 15693 cards are supplied by a growing number of semiconductor suppliers and card manufacturers.

Since ISO/IEC 15693, like ISO/IEC 14443, does not define any security protocols or requirements, vendors have implemented a number of security features, including encryption of stored data, authenticated access to card memory and card-to-reader mutual authentication.

The longer range afforded by ISO/IEC 15693-compliant systems is viewed as very beneficial by drive-through restaurants and retail, two of the fastest growing contactless payment sectors. The longer range is also considered beneficial by enterprises that support parking or vending applications. On the other hand, any technology with a longer range may be perceived to have a potential security risk for two reasons: the lack of payment "intentionality" on the part of the token holder, and the potential that someone with a compatible reader could stand a few feet away and access data on the card (though this risk exists in differing degrees with all contactless technologies). Appropriate selection of security services or adjustment of operational ranges can mitigate this risk.

The ISO/IEC 15693 standard supports a maximum data transfer rate of 26 Kbps (a function of operational range). Due to the longer operational range, the card may be in the RF field for a longer period of time, allowing enough

[34] John Frank, "Visa selects ISO 14443 as its standard for global contactless payments," *ContactlessNews*, December 2002.
[35] MasterCard, op. cit.

time for communication between the reader and card even with this lower data rate. Requirements for transaction time, amount of data in each transaction and security services must be considered to determine whether this data rate is sufficient to meet payment application requirements.

ISO/IEC 15693- compliant readers are available from multiple vendors. In addition, several readers are capable of reading both ISO/IEC 14443- and ISO/IEC 15693-compliant cards, with a few supporting an even broader range of technologies.

Summary

ISO/IEC 15693-compliant contactless smart cards are currently well suited for closed-system payment applications. This technology is especially attractive where a longer read range is beneficial or mandatory; shorter ranges are also achievable. The perceived security risks for payment and lack of endorsement by any payment association or major financial institution have resulted in this technology being used for payment primarily in closed systems today. As demand for payment requiring longer operational ranges increases, ISO/IEC 15693-based solutions may emerge.

Proprietary High-Frequency 13.56 MHz Technology

Non-standard 13.56 MHz cards and readers are currently available that are used extensively for transit applications in Asia Pacific markets (such as Hong Kong and Japan) and, to a more limited extent, in the United States. The most prominent examples of this technology are the FeliCa card, developed and promoted by Sony, and the GO CARD®, developed by Cubic Transportation Systems, Inc.

FeliCa Card

The FeliCa card is used by the Hong Kong Octopus card transit system, the New Delhi Metro, the Singapore Land Transit Authority, and by the majority of Japanese transit agencies. The FeliCa card uses the same frequency and form factor as ISO/IEC 14443-compliant cards but differs in some technical specifications. In Hong Kong, the FeliCa card is also increasingly being used for non-transit payment applications (for example, quick service retail and vending applications). Sony is promoting FeliCa with an electronic purse in Japan and other countries.

Several vendors are licensed to produce FeliCa-compliant cards and readers. The joint Philips and Sony Near Field Communication development could help drive the use of this technology beyond the Asia Pacific region.

Cubic GO CARD

The Cubic GO CARD is used by a number of large transit operators and has been used in several North American pilot transit projects. GO CARD technology uses the same frequency, modulation scheme, bit coding and form factor as ISO/IEC 14443 Type B-compliant cards but differs in other technical specifications. The technology's functional capabilities are tailored for high-speed, tear-proof transit applications and large storage requirements. Cards are available from a variety of card manufacturers licensed by Cubic and Cubic's Tri-Reader® supports communication with ISO 14443 Type A and B cards and the GO CARD.

Advantages and Disadvantages

The primary advantage of proprietary 13.56 MHz technology is the installed card base and reader infrastructure that exist within specific geographic regions. Retailers in cities that are implementing contactless smart cards for transit payment could consider teaming with their local transit authority to offer contactless payment and take advantage of the broad issuance of cards to local consumers (though the harmonization of application requirements and impact on business cases need to be thoroughly considered).

The installation of readers that handle multiple card types provides issuers with additional flexibility, allowing multiple card types to be used with a common infrastructure.

The primary disadvantage is the lack of standards, which leads to interoperability issues among implementations. This may not be a disadvantage to a local transit agency, but should be taken into consideration by issuers and retailers when evaluating contactless technology.

Summary

Proprietary 13.56 MHz technologies tend to be suitable for use in specific geographic locations where interoperability with existing infrastructure is important. Proprietary technologies can also be used successfully in areas where global contactless payment is not a requirement (e.g., within countries or among cardholders where travel beyond a single city, region or country is infrequent).

However, the lack of standards compliance and transit operator-specific implementations suggests that adoption for use in more open systems or global payment environments may be limited.

Proprietary Low-Frequency 125 to 134 KHz RF Technology

Low-frequency RF technologies operate at less than 300 KHz. These generally use a unique ID within the application, so are most often referred to as RFID technology. Such technologies have been used extensively for security applications such as automobile immobilizers and for access control.

Speedpass is an example of the use of low-frequency RFID technology for payment in North America. The Speedpass technology operates at 134 KHz and can achieve ranges up to 10 cm, but with relatively low data transfer rates.

Advantages and Disadvantages

Low-frequency RFID technologies have no established communications standards at present and very limited processing power on the RF tag. They can also have potentially longer read ranges, though this is often addressed through the design of the antenna (to limit range). For these reasons, this technology may be perceived to have a potential security risk, unless addressed for a given application.[36] The most predominant form factor used for low-frequency RFID payment is the key fob, but both automobile-mounted tags and tags embedded in watches are also available commercially. The auto tags are active tags, requiring a battery that must be replaced every 3 to 4 years.

There are no global standards for the technology; however ISO/IEC 18000-2 is currently in the process of being defined. Solutions are typically available only from limited sources.

Summary

The use of low-frequency RFID technology for contactless payments appears to be best suited for closed-system applications. A retailer selecting this technology could implement its own solution or partner with a contactless payment service provider (such as Speedpass or FreedomPay). Electing to join an existing network has the advantage of acquiring an installed base of users and an infrastructure and fulfillment system. Implementing a retailer-specific solution has advantages in terms of brand differentiation, promotion and overall control, and disadvantages in terms of interoperability and added costs of implementation and promotion. Given the lack of standards, lack of endorsement by payment associations, and perceived security risks, this technology does not appear to be appropriate for high-value payment or more general retail applications.

Proprietary Ultra-High-Frequency RF Technology

Systems based on ultra-high-frequency RF typically operate in the ISM band (902 to 928 MHz in the United States) and have an operational range of anywhere from 3 meters to more than 10 meters. These generally use a unique ID within the application, so are also referred to as RFID technology. The best example of the use of ultra-high-frequency RF technology that is applicable to payment applications is the use of RF transponders to pay highway tolls, such as the E-ZPass℠ system (used in the northeastern United States), TollTag™ (used in the Dallas metropolitan area), and FasTrak™ (used in California).

This technology could also be used for some forms of retail payment in conjunction with its use for paying highway tolls. For example, one McDonald's franchisee is participating in a trial using TollTag technology at five drive-through McDonald's restaurants in the Dallas area and a Long Island McDonald's is using E-ZPass. The consumer benefits from being able to access additional hands-free services without having to acquire an additional token. The toll operators will presumably increase revenue from the services provided to the retailers.

Automobile-mounted transponders can also be used in conjunction with smart cards (a payment card could be inserted into a transponder slot). This type of combined technology is used quite extensively in Singapore but is not currently deployed in North America.

[36] Note: Proprietary vendor-specific low-frequency RF security features are available.

Advantages and Disadvantages

Security for high-frequency RFID systems is limited or nonexistent. The transponders for these systems used in tolling applications are typically active devices, though passive transponders could be used for consumer payment applications requiring limited read range. The ultra-high-frequency and low power requirements translate into very small, efficient devices with high bandwidth between transponder and reader. Some devices may be capable of limited channel encryption or device authentication, but in general, security is an issue since most of these devices have not been developed for consumer payment applications. The long read ranges and limited security also contribute to the perception that a consumer could be charged inadvertently for fuel or services or maliciously defrauded.

The transponder devices can be very inexpensive, but the readers are typically more expensive than the readers required by other RF technology. The lack of a suitable ISM band at these frequencies also limits the use of this technology for global applications. Because there are no global standards for this technology, solutions are typically available from a single source only. Progress is being made on an open 5.9 GHz standard for tolling and other vehicle-oriented payment applications; this standard is targeted as an ISO/IEC sub-standard for global use.

Summary

The use of ultra-high-frequency RF tags for contactless payments appears best suited for closed-system payment applications like tolling and, potentially, for retail or payment operations linked to the toll system. The ability of the technology to operate at long ranges supports a positive user experience in executing drive-through transactions. However, given the lack of standards, lack of ISM band for global use, lack of endorsement by the financial industry, and potential security issues, this technology does not appear to be appropriate for high-value payment or more general retail applications. The required form factor and requirement to (typically) mount the tag semi-permanently also limit the general usefulness of this technology for payment.

Alternative Contactless Technologies

Alternative contactless technologies include IR solutions, Bluetooth, carrier-based solutions, and the joint development work by Philips and Sony called Near Field Communication.

Infrared Solutions

IR solutions offer an opportunity to use the more than 330 million IR-enabled mobile devices worldwide for payment purposes. Consumers are not only carrying these devices more frequently, they are also comfortable using IR, especially given the nearly omnipresent electronic remote control. IR-enabled devices can support operational ranges up to 2 meters, but devices that support ranges of 20 to 30 centimeters consume 10 times less power than the longer range devices. IR data transmission rates range from 9.6 Kbps with primary speed/cost steps of 115 Kbps up to a maximum speed of 4 Mbps.

Consumers are expected to be able to use their IR-enabled mobile phones and PDAs to make payment at the physical retailers. Many of the mobile phones being released today are programmable and could allow consumers to maintain a mobile wallet with various credit, debit, pre-paid, and loyalty cards securely stored in memory. Consumers would then choose a payment type using a simple menu at the time of payment

Trials of payment applications using IR are being carried out at a number of different locations, including South Korea and the University of Southern California (USC), with additional pilot projects planned for Japan. In South Korea, all three telecommunications providers (SKT, LG, and KTF) are participating in Visa contactless IR payment trials. In these implementations, Visa payment information resides in the handset of the telephone, and the consumer beams the Visa payment information to a POS terminal. The purpose of these pilot implementations is to test consumer and merchant acceptance of the new technology. In the planned USC pilot, a mobile phone-capable PDA can be linked to a USC Credit Union account to make payments at IR-enabled POS sites on campus. This is a hybrid payment approach involving carrier-based mobile and IR for the actual payment link.

Advantages and Disadvantages

The use of IR presents significant challenges. Different devices do not interoperate. In many devices, the IR port is currently disabled, requiring manual customer activation. There is also no easy way to download software to control the ports.

In addition, IR provides no link level security. Low-level transaction security is provided by the consumer's intention to conduct a payment transaction and the fact that it is difficult to intercept data being transmitted by a line-of-sight, narrow-angle beam. Application-layer security must be provided for stronger encryption or authentication service.

Summary

The Infrared Data Association® (IrDA®) is actively promoting interoperability of IR devices, and its Financial Messaging (IrFM) working group has developed Point and Pay Profiles[37] for payment applications. Visa is backing a variation of this profile, called the Visa Financial Messaging Profile for Proximity Payment.[38] When new IR-enabled mobile devices that support these standards are introduced, infrared-based contactless payment may become more widely deployed. However, the current interoperability issues and absence of widely adopted standards suggest that IR will not be practical for retail payment transactions in the near term.

Microwave Technology – Bluetooth

Bluetooth™ is a wireless RF technology designed as a small form factor, low-cost solution to connect mobile computers, mobile phones, and other portable handheld devices to the Internet. Bluetooth operates in the 2.45 GHz ISM band and has an operational range of 10 to 80 meters with a data

[37] See http://www.irda.org/news/fmupdate.asp
[38] See http://international.visa.com/fb/vendors/standspecs/downloads/proximity/main.jsp

transmission rate of up to 1 Mbps. After many years of development, there is finally strong growth in Bluetooth-enabled devices for different applications.

Advantages and Disadvantages

Bluetooth offers the advantage of longer-range transmission but has the disadvantage that the technology was developed for networking, not point-to-point localization. This means than any Bluetooth tag could be linked to multiple POS recipients. Localization processes can be implemented to address this issue, but at the expense of time and user experience.

Payment has not been a focus of the Bluetooth community to date. There were some earlier trials of payment applications based on Bluetooth in northern Europe, but there has not been any recent activity.

Summary

The lack of focus on payment, the lack of endorsement by the financial industry, and the lack of any available technical solutions suggest that using Bluetooth for retail payment transactions is not practical in the near term.

Carrier-Based Mobile

The use of carrier-based mobile devices (such as mobile phones) for payment applications seems a natural step, given the increasing use of the technology. Many telecommunication operators, suppliers, and infrastructure vendors have participated in a myriad of payment pilot projects. These pilots have tested wireless Internet payment, payment for vending and ticketing, and payment at brick and mortar establishments. The technologies used have involved a variety of approaches, including using a phone's IR port, using GSM SMS messages for payment authorization, using dual-slot phones for a payment smart card, and embedding RFID technology in the phone.

Current Status

None of the payment pilot projects has been particularly successful for a number of reasons, including lack of interoperability, difficulty of use, and high total cost of ownership. The situation in North America has an even greater potential for interoperability issues: numerous different technologies are in use by mobile operators (including GSM, PCS, TDMA, and CDMA), and the telecommunications environment is changing rapidly as newer broadband technology is deployed. The use of carrier-based mobile payment also raises a host of consumer experience and business issues, including how the consumer initiates the transaction, who "owns" the customer and how the costs of fielding solutions are covered. However, the major stakeholders continue to take an active interest in mobile payment, as is evidenced by the work of the Mobile Payment Forum.[39]

Summary

Given the lack of standards for mobile payment, the continuing technical and business challenges, and the lack of critical mass in any one particular

[39] See http://www.mobilepaymentforum.org.

payment approach, mobile payment can be eliminated as a practical alternative in the near term.

Near Field Communication

In September 2002, Philips and Sony announced joint development of a new near-field radio frequency communication technology called Near Field Communication (NFC).[40] The technology is designed to enable short-range communication networks between consumer devices with an NFC interface. The goal is to greatly improve wireless access to data and services. Ultimately, Philips and Sony intend to build an open infrastructure of NFC-compliant devices that incorporate smart key and smart card reader functions, providing a convenient method of implementing services such as payment (including credit card payment), ticketing, and accessing online entertainment content (such as gaming).

The wireless NFC technology will operate at 13.56 MHz across a distance of up to 20 centimeters. The technology will allow any kind of data to be transferred between NFC-enabled devices, such as mobile phones, digital cameras, PDAs, PCs, laptops, game consoles, or PC peripherals, at speeds fast enough to transfer high-quality images. With communication speeds of up to 212 Kbps, the NFC technology is expected be compliant with Philips' MIFARE and Sony's FeliCa contactless smart card technologies. Philips and Sony have stated that they will promote the NFC technology as an open standard in order to integrate it into consumer devices, including those built by other manufacturers in the electronics, PC, automotive, and other industries.

Once this technology is more completely specified and standards are proposed, it may be practical to consider it for retail payment applications. Understanding the potential of NFC may play a part in longer-term interoperability and application planning when implementing a contactless payment system in the near term.

[40] "Philips and Sony Announce Strategic Cooperation to Define Next Generation Near Field Radio-Frequency Communications," Philips press release, September 5, 2002.

Key Technology Considerations

Selecting a technology to implement a contactless payment system requires consideration of multiple key issues:

- Does the technology support the required payment mechanisms?
- What technical characteristics and features are important and how do they affect the customer experience?
- Is the technology commercially available today?
- What investment is required for implementation?
- What types of risks does the technology introduce or protect against and how do the risks affect the business model?

Supported Payment Mechanisms

In theory, contactless technology can support virtually any payment mechanism, including traditional credit and debit payments, pre-authorized account-based payment, and stored value payment.

Credit and debit transactions require the participation of one or more financial institutions and the participation or approval of a payment association. Contact smart card credit and debit payment based on the EMV standard is gaining rapid acceptance in Europe and Asia. In North America, the three major cards associations (American Express, MasterCard and Visa) have established contact smart card programs with significant issuer participation. The stronger security inherent in EMV could help drive increased offline sales (e.g., vending and kiosk-type payments). The Smart Card Alliance white paper “Smart Cards and the Retail Payments Infrastructure: Status, Drivers and Directions” has more information on key considerations for implementing EMV.

A pre-authorized system requires some level of certification and oversight by a participating financial institution or payment association. There are two types of pre-authorized accounts, each typically linked to a financial payment card or account. In one case, transactions are processed immediately by the financial institution. In the other case, pre-defined transaction limits are established and the account is replenished when its value reaches the lower limit.

Stored value systems are the predominant payment mechanism used by transit systems. Currently, all stored value systems are proprietary, although there is a major drive in Europe to promote the Common Electronic Purse Standard (CEPS). Stored value systems should not be discounted because they are proprietary. They have several favorable characteristics, including support for anonymous payment, fast transaction speeds with offline capability and, depending on the transaction processing model, the potential for limiting or avoiding transaction fees.

The key considerations for determining an appropriate payment mechanism include:

- Understanding maximum transaction value.
- The availability of proven technology for implementation.
- Knowing where fraud liability lies.
- Knowing what transaction fees will apply.

- Understanding what type of online processing and networking will be required.

It is also important to clearly understand what strategies are appropriate for risk mitigation and what type of financial oversight will be mandated.

Technical Characteristics

Selecting a contactless technology with the appropriate technical characteristics depends in part on what type of retail operation is to be supported. For example, transactions in traditional retail operations are typically more leisurely, and there is potentially more physical space available for a consumer to complete the transaction comfortably (for example, by presenting a card to a terminal). Transactions in quick service restaurants, at kiosks or vending machines and at transit locations are expected to be very fast, with a card simply being waved at the terminal. A card that will be used in multiple environments must be appropriate for the worst-case scenario.

Key technical characteristics include operational range, operational orientation, time in field, anti-tear and anti-collision capabilities and supported form factors.

Operational range is determined by system design and limited by standards, regulations, or technology characteristics. It may be important for the card to be placed close enough to the reader to signal an intentional payment act by the consumer. At longer operational ranges, there is a perceived risk (and potentially a real threat) that a fraudulent or inadvertent transaction could be executed. For certain applications, like parking and drive-through restaurants, this risk may be acceptable, given that short ranges may not provide an acceptable user experience. RF-based systems typically offer a very good user experience because they are quite forgiving in terms of how close the card must be to the reader.

Flexibility in **operational orientation** can be critical to ease of use. Magnetic stripe cards and contact smart cards must be oriented and inserted or swiped in a particular way. Other payment technologies, like IR, require that the card be pointed in a particular direction. Contactless smart cards do not have to be oriented or moved in a particular way during a transaction (depending on the operational range). This flexibility has significant advantages for throughput, reduction of repetitive actions, and increased customer satisfaction.

Time in field depends on system design and technology characteristics such as range, amount of data required to complete a transaction, data rates, and operational conditions (e.g., error rate due to interference). Higher frequencies and data rates may be essential to ensure adequate bandwidth for effective security. Real transactions must be tested thoroughly to ensure that the time in field meets consumer expectations and operational goals. Transaction types incorporating significant data exchanges must balance performance, security, and processing overhead. Contactless transactions are as much about ergonomics and environment as they are about transaction integrity. Typical "high flow" transit applications, for example, may require transactions to be completed in less than 150 to 300 milliseconds.

Anti-tear provisions are extremely important in "high flow" environments (e.g., transit) where data is being processed and then updated on the card. The card and application must be able to prevent incomplete transactions and corruption of card files by early removal of the card from the communications field.

Anti-collision is unique to contactless technologies since more than one card can be placed in the communications field at the same time. Product features must be in place to "sort out" the prioritization of devices in the communications field. The ISO/IEC 14443 and ISO/IEC 15693 standards specify how anti-collision is handled.

Device **form factor** (e.g., card, key fob, watch) is an important consideration for both the user and the service provider. Users want form factors with which they are comfortable or which are convenient and complete transactions quickly. The service provider needs form factors that will meet operational goals (for example, throughput requirements), boost customer loyalty and acceptance, and be secure and reliable.

Commercial Availability

Appropriate technology should be selected based on commercial availability and on whether the technology has a demonstrated capability to support payment applications similar to those being considered. Standards-compliant systems are generally a better choice: there are typically more sources for components, the technology has undergone more independent scrutiny and, over time, economies of scale drive costs down.

It is important to understand the complete cost of ownership for any technology. For example, using a card form factor allows for very cost-effective and automated branding, personalization, fulfillment, and integration into existing customer relationship management (CRM) systems.

Required Investment

Two major factors affect the amount of investment required to implement a payment system using a particular technology: the system architecture and the selected payment type. The amount of required investment depends first on whether the retailer buys into an existing network, builds a system based on an open architecture, or builds a proprietary solution. The chosen payment type may dictate additional investment in at least three major areas: POS upgrades, transaction processing infrastructure, and supporting systems (e.g., customer support). The next section, "Contactless Payment Transaction Models," summarizes the requirements for each payment type.

In general, the amount of investment required depends on what type of systems the retailer currently has in place, whether there are multiple vendors for the selected devices and POS terminals, and what the costs are for connecting to a particular network. Depending on the issuer model (for example, retailers may elect to issue their own cards), significant additional costs could be associated with acquiring new customers or supplying existing customers with payment devices.

Merchant transaction processing requirements will also affect infrastructure costs. For example, using EMV in North America will be more costly than using other approaches. Card-based contactless payment systems have an edge over other form factor and technology choices. Their rapid adoption for transit applications has resulted in increased availability of standards-compliant off-the-shelf components and systems from a growing number of vendors. Publicly funded transit infrastructure also provides a nucleus from which non-transit initiatives can build in key geographic areas.

Risks and Security

To evaluate the risks introduced by contactless payment, it is necessary to understand the differences between current and proposed payment systems. For example, it is generally known that magnetic stripe cards are susceptible to fraud and that smart cards with appropriate security technology can significantly mitigate this risk.

Contactless technology does not typically introduce additional points at which a system is potentially vulnerable, with the exception of the air interface between the consumer payment device and the POS terminal. Appropriate token-to-reader authentication and data security services significantly reduce this vulnerability. Contactless smart card solutions are available today that have stronger security than magnetic stripe cards and also reduce the losses and costs inherent in paying with cash or by check. If lower cost and less powerful contactless devices are selected, it is important to understand any inherent potential threats and ensure that appropriate safeguards are adopted.

As is true for any system upgrade, a system security analysis should be conducted, since changes in transaction flow and processing and human interaction can introduce new vulnerabilities. Understanding these risks will also help determine what fees apply to any contactless transactions.

Figures 2 and 3 summarize the key technical specification and business factors that may be considered in selecting the contactless technology to deploy for a payment system.

	ISO/IEC 14443	ISO/IEC 15693	Proprietary 13.56 MHz	Low-frequency RF	Ultra-high-frequency RF	Infrared (Lightwave)	Bluetooth (Microwave)
Operational range	<10 cm	<70 cm	<10 cm	<20-60 cm	3.5 to 10+ m	1-2 m; 20-30 cm with low power	10 - ~80 m
Operational orientation	Within RF range, depending on antenna	Within RF range, depending on antenna	Within RF range, depending on antenna	Within RF range, depending on antenna	Within restricted antenna beam	Line of sight only, with accurate alignment required	Wide range but potential conflict with multiple devices
Data rates	106-424 Kbps	26 Kbps	FeliCa: 211 Kbps GO CARD: 115-460 Kbps	<10 Kbps	20-100 Kbps	9.6 Kbps to 4 Mbps	1 Mbps
Carrier frequency	13.56 MHz	13.56 MHz	13.56 MHz	100-300 KHz	902-928 MHz	Not applicable	2.4 GHz ISM band
Standards-based communi-cations link	ISO/IEC 14443 Types A/B	ISO/IEC 15693	No	No	Most are proprietary; no single global standard	Specified under auspices of the IrDA trade association (IrFM)	Specified under auspices of the Bluetooth trade association
Standards-based payment protocol	Visa: EMV MasterCard: Track 1 and 2 magnetic stripe data JCB	No	FeliCa: JCB GO CARD: None	No	No	Visa: Refers to IrFM 1.0 and adds security and other requirements	No
Availability of POS terminals	Multiple vendors	Multiple vendors	FeliCa: Multiple vendors GO CARD: Cubic	Multiple vendors	Available for trials	Available for trials	Available for trials
Security	Perceived security advantage due to intentionality of payment due to short range; more capable, crypto-enabled proc-essors; wired logic security services	Can operate at either long or short ranges; wired logic security services	Perceived security advantage due to intentionality of payment due to short range; more capable proc-essors or wired logic security services	Typically transactions are short range; less capable proc-essors and low data rates	Perceived security threat due to longer range; much less capable processors	Low-level security via line of sight with 30° cone; application level security required for higher strength (e.g., as specified by Visa)	Strong authentication must be built into application
Available form factors	Plastic card Watch Mobile phone	Plastic card Watch Key fob	Plastic card	Plastic card Key fob Watch Car tag Mobile phone	Car tag	Any IR-capable device	Any Bluetooth-capable device

Figure 2: Contactless Technology Comparison: Technical Features

Figure 3: Contactless Technology Comparison: Business Issues

	ISO/IEC 14443	ISO/IEC 15693	Proprietary 13.56MHz[41]	Low- frequency RF	Ultra-high-frequency RF
Availability in card form factor	Yes	Yes	Yes	Yes	No
Payment association support for payment	MasterCard, Visa, JCB	No	FeliCa: JCB GO CARD: None	No	No
Current market deployment for retail payment applications	Extensive worldwide, with over 200 million cards used in transit AFC; trials in US	Not historically used for payment	FeliCa: Extensive worldwide for AFC; 25 million shipped world-wide GO CARD: Selected in major cities in North America for AFC	Over 6 million Speedpass activated fobs, plus several other trials in the U.S.	Trials in the U.S. for retail payment
Availability of cards/ tokens and readers	Many vendors	Multiple vendors	FeliCa: Multiple vendors for cards and readers GO CARD: Multiple vendors licensed by Cubic for cards; Cubic for readers	Typically single source per proprietary implementation, though multiple vendors provide technology	Few vendors
Integration with payment processing services	MasterCard trial in U.S.; Visa trials in Asia that link to existing credit networks; AFC	Bank of America QuickWave pilot; Shell Canada	JCB in Japan with Kansai Thru Pass; AFC and parking	Typically pre-authorized account-based proprietary infra-structure con-necting to exist-ing financial networks (e.g., Speedpass)	Typically pre-authorized account-based proprietary infrastructure connecting to existing financial networks
Inter-operability	Potentially strong – based on standards, with Visa endorsing contactless pay-ment standard	Potentially strong – based on standards	Non-standard technology; like technologies are interoperable.[42]	Weak since based on proprietary systems	Weak since based on proprietary systems
Ease of use by consumer	Strong. Variety of form factors, but shorter oper-ational range	Strong. Variety of form factors, with longer potential operational range	Strong. Variety of form factors, but shorter oper-ational range	Strong. Variety of form factors, with longer potential oper-ational range	Strong. Variety of form factors, with longer oper-ational range
Ease of integration with mer-chant POS terminals	Easy, with addition of adapter	Easy, with addition of adapter	Easy, with addition of adapter	Easy, with addition of adapter	More difficult due to antenna size

[41] Data shown is for Sony FeliCa technology and Cubic GO CARD technology.
[42] In North America, the American Public Transportation Association (APTA) is working on interoperability specifications for transit applications.

Contactless Payment Transaction Models

The transaction model for contactless payment applications varies depending on the implementation approach. This section describes the end-to-end transaction model for the following contactless payment application implementations:

- Speedpass
- E-ZPass
- Payment using Track 1 and Track 2 data on a contactless smart card
- EMV credit/debit card
- Offline stored value card

The activities of the consumer, retailer, acquiring processor, and issuing bank are summarized for each application, as is the expected retailer investment. The descriptions assume that the retailer currently supports credit card transactions, where the credit cardholder data is received by swiping a magnetic stripe credit card at the POS.

Speedpass

Speedpass as used at a gas pump is implemented as a pre-authorized account-based payment, authorized on a transaction-by-transaction basis. The table below summarizes the process that takes place when consumers use Speedpass at a gas pump. The Speedpass system uses a low-frequency RFID payment device that identifies the consumer and processes the transaction as a traditional credit or debit card transaction.

Step	Consumer	Retailer/ Service	Acquiring Processor	Issuing Bank
1	The consumer waves the Speedpass key tag in front of the sensor (1 - 2 inches away).			
2		The sensor on the pump senses the tag. The contactless reader in the pump reads the information from the tag and the sensor lights up.		
3		The information read from the Speedpass key tag (Speedpass ID/serial number) is sent to the Speedpass central database for authentication.		
4			The bank card information tied to the Speedpass tag is retrieved.	
5			The bank card data and request for authorization are transmitted to the bank issuing the card.	

Step	Consumer	Retailer/ Service	Acquiring Processor	Issuing Bank
6				The issuing bank authorizes or denies the transaction.
7		The issuer's response indicates whether the consumer can pump gas. If the request is denied, the pump is not enabled and the process terminates with the Speedpass light going off.		
8	The consumer selects a grade of gas and pumps the gas.			
9		The cost of the sale is computed at the pump and the amount is transmitted back to the processor.		
10			The transaction amount is forwarded to the issuing bank.	
11				The amount is entered as a charge to the consumer's corresponding bank card account.
12		A receipt is issued at the pump. The sale data are entered in the gas station's electronic ledger. The pump returns to the idle state.		
13	The consumer takes the receipt and the transaction is complete.			

A retailer who wants to accept payment using Speedpass technology requires the following infrastructure:

- POS terminals enabled with devices that can communicate with the Speedpass RFID key tags.
- A POS application that can format the authentication message to be sent to the Speedpass server for authorization and settlement.
- POS systems that can establish a connection with the server hosting the data that translates the Speedpass key tag ID to a credit card number.

E-ZPass

E-ZPass is implemented as pre-authorized account-based payment with set transaction limits. E-ZPass uses an ultra-high-frequency RFID payment device that identifies the consumer to a central system in which the consumer's account and transaction limit information is stored. The consumer funds and replenishes the account using traditional payment methods. The table below summarizes the payment process that takes place when consumers use E-ZPass.

Step	Consumer	Retailer/ Service	Acquiring Processor	Issuing Bank
1	The consumer approaches the toll lane. The E-ZPass tag sends out a radio signal with the consumer's E-ZPass account information.			
2		The E-ZPass information is read by a receiver above the lane.		
3		The E-ZPass information is decoded and sent to the E-ZPass central database.		
4			The E-ZPass information is processed and the appropriate amount is deducted from the consumer's pre-paid account (funded from the consumer's credit or debit account).	
5		If the transaction is successful, the light at the toll lane turns green.		
6	The vehicle passes through the tolls without stopping since the transaction takes only a fraction of a second.			

A retailer who wants to accept payment using E-ZPass technology requires the following infrastructure:

- POS terminals enabled with devices that can communicate with the E-ZPass transponder.
- A POS application that can format the data to be sent to the E-ZPass server for authentication and settlement.
- POS systems that can establish a connection with the servers on which details about the E-ZPass accounts are stored.

Contactless Payment Using Track 1 and Track 2 Magnetic Stripe Credit Card Data

Consumers can use a contactless payment card that transmits Track 1 and Track 2 magnetic stripe credit card data to retailer POS systems. The transaction is then processed as a traditional credit or debit card payment. Data included on Track 1 and Track 2 identify the cardholder by cardholder name, card number, and expiration date; this information is stored in the contactless smart card chip when the card is issued. The MasterCard U.S. pilot uses this transaction model, implemented using ISO/IEC 14443 contactless smart card technology. The table below summarizes the payment process that takes place when consumers use a contactless card with Track 1 and Track 2 data.

Step	Consumer	Retailer/ Service	Acquiring Processor	Issuing Bank
1	The consumer presents the card to the contactless reader.			
2		The contactless reader exchanges data with the card. The POS terminal now "knows" the card-holder magnetic stripe data.		
3		The POS application gathers the data and the dollar amount of the transaction and creates an authorization request for the acquiring processor.		
4			The request for authorization and credit card data are transmitted to the financial institution issuing the credit card.	
5				The issuing bank authorizes or denies the transaction.
6		The issuer's response indicates whether the consumer can complete the purchase.		
7	If the transaction was authorized, the consumer takes the receipt and signs a copy for the merchant. The transaction is complete.[43]			

A retailer who wants to accept payment using data from a contactless version of a traditional credit/debit card requires the following infrastructure:

- POS terminals enabled with devices that can communicate with the contactless credit cards to receive Track 1 and Track 2 data.
- A POS application that can receive credit card data by means of a contactless interface. In the MasterCard PayPass pilot, no application software change is required if using a special retrofit adapter.[44]
- The authorization and the settlement mechanism are the same as when using a magnetic stripe card for payment.

[43] In some cases, a consumer signature may not be required.
[44] "Contactless POS Environment," presentation by Mohammad Khan, ViVOtech, Smart Card Alliance Mid-Winter Conference, February 12, 2003.

Contactless Credit/Debit Card Using EMV

The table below summarizes the payment process that takes place when consumers use a contactless smart card for EMV credit and debit transactions.

Step	Consumer	Retailer/ Service	Acquiring Processor	Issuing Bank
1	The cardholder selects goods and presents an EMV credit/debit card.			
2		The EMV card and the EMV terminal perform risk management functions. The card signs the transaction data. The terminal sends the purchase price, card data and signed data for authorization.		
3			The acquirer forwards the transaction data to the issuing bank for authorization.	
4				The issuer verifies the signed data to prove the transaction came from a legitimate card and authorizes or denies the payment. If the payment is authorized, the issuer debits the cardholder's account.
5			Authorization or denial is received from the issuer and is returned to the retailer.	
6		The issuer's response is received and stored. If the transaction is authorized, goods are sold to cardholder.		
7	If the transaction was authorized, the consumer takes the receipt and signs a copy for the merchant. The transaction is complete.[45]			

A retailer who wants to accept payment using contactless EMV technology requires the following infrastructure:

- POS terminals enabled with devices that can communicate with EMV credit/debit cards by means of the contactless interface and receive the EMV data personalized on the card. The POS terminal hardware used must be EMV Level 1 and Level 2 certified.
- A POS application that receives EMV data by means of a contactless interface and supports the authorization and settlement of an EMV

[45] In some cases, a consumer signature may not be required.

transaction. This may require changes to other POS systems and changes to the connection to the retailer's payment processor.

Additional information on the infrastructure required to support EMV payment can be found in the Smart Card Alliance white paper "Smart Cards and the Retail Payments Infrastructure: Status, Drivers and Directions."

Stored Value Card

Contactless offline stored-value cards hold a monetary value for use by a consumer. The table below summarizes an example process that allows consumers to use an offline stored-value card for payment.

Step	Consumer	Retailer/ Service	Acquiring Processor	Issuing Bank
1	The cardholder makes a purchase.			
2		The amount of purchase is encrypted and re-quested from the card.		
3	The card receives and authenticates the re-quest, debits the internal value, and encrypts and sends the purchase value to the retailer.			
4		The retailer receives the value and stores the payment locally.		
5		The retailer sends a batch of all sales (values received) to the proc-essor.		
6			The batch is checked and passed on.	
7				The issuer checks the batch and credits the retailer account.
8			A confirmation message is routed to the originator.	
9		The retailer receives confirmation of payment.		

A retailer who wants to accept payment from a stored value card requires the following infrastructure:

- POS terminals enabled with a device that can communicate with the contactless stored value cards.
- A POS application that supports a stored value transaction according to the scheme selected for stored value payment. The stored value application must also implement the authorization and settlement process for the stored value transaction.

Why Contactless Smart Cards?

As payment mechanisms, credit and debit cards are now ubiquitous. The usual question from most retailers to a customer who wants to make a purchase is "How do you want to pay?" meaning "Do you want to pay using cash or using a credit or debit card?" The payment card technology used by the banking industry is now evolving from the traditional magnetic stripe card technology to smart card technology in many regions of the world, with varying rates of introduction depending on business requirements for added functionality or higher security.

This section summarizes the advantages of contact and contactless smart cards as compared to other current payment mechanisms.

Why Smart Cards?

The use of smart card technology is helping the payments industry and associated markets develop new business opportunities. The smart card's expanded memory and processing capabilities permit multiple payment and non-payment applications on a single card, with features that both ensure security and enhance privacy. Smart card technology is also ideally suited for Internet and e-commerce transactions.

Application Flexibility

With magnetic stripe cards having limited memory, smart card technology provides the flexibility and capacity for new applications that can drive both retailer and issuer business cases. Opportunities are now available to develop partnerships to handle multiple functions with a single card (such as a payment card linked to a retailer loyalty scheme) or to develop true independent applications and combine multiple applications on a single card (using frameworks such as Visa's Global Platform or MasterCard's MultOS™). New applications (for example, a retailer loyalty program) can now be issued during the life of the card, expanding card services. Increasingly, card issuers and retailers are exploring a range of new and innovative business cases that will help to provide competitive differentiation.

The payment solution need not necessarily be credit or debit; it could be (for example) a closed system electronic purse linked to a mass transit scheme, or a solution linked to a Visa, MasterCard, American Express or JCB brand. The more versatile the card, the more likely it is to be accepted by users. American Express has reported that 67% of their cardholders said they would charge less to their Blue card if there were no chip in the card,[46] indicating that smart cards are already finding user acceptance in the United States.

Security

Smart cards were originally developed to address security issues and they continue to provide a highly secure solution for numerous applications (e.g., payment, identity verification for physical and logical access, data storage).

[46] "TowerGroup Offers Rosy Forecast for Chips in U.S., *American Banker*, January 29, 2002.

As an example, in the late 1970s, G.I.E. Cartes Bancaires demanded a bank card offering superior protection and significantly improved security against fraud to counteract an escalating level of fraud in France. The solution, conceived by Bull Information Systems, was to add intelligence to the card by embedding a microprocessor that would react intelligently to information received and protect data stored in memory. Smart card payment that is based on the EMV (Europay MasterCard Visa) specification is now being deployed in Europe, Latin America and Asia to reduce credit card fraud and telecommunications expense.

Smart cards provide strong security capabilities for all applications supported by a card. Security features include:

- Large memory size that can support the addition of software providing enhanced security features or new applications.
- Extreme difficulty of replication. The difficulty of obtaining a source for chips that have been manufactured with specific embedded software, coupled with the difficulty of reading data encrypted in chips, provide significant barriers to counterfeiting cards. The widespread practice of skimming and producing "white cards" is not practical with smart cards.
- Enhanced decision-making process with the card reader. Smart cards support both online and offline card verification and the use of strong encryption algorithms. Smart cards can therefore provide better protection and security for transactions at unattended terminals.
- Strong identity verification features. For example, the use of a PIN rather than a signature with a smart card may significantly reduce the opportunities for fraud. A smart card can also include biometric data (such as a digitized photograph, fingerprint, iris scan, or voice print) to enhance security. Although biometrics are not yet widely used for identification in the payment industry, they are starting to be used by applications such as personal identification confirmation and access control.
- Ability to meet specific market requirements and evolve as requirements change (for example, adding additional risk management features that are needed for transaction processing models in some markets).

While smart cards cannot solve all transaction security issues (for example, "'card not present" transactions), they provide an excellent solution that delivers a high degree of security, along with application flexibility and growth. This is particularly important in the United States where fraud rates are low (since the majority of payment transactions in the United States are authorized online and issuers are using sophisticated fraud detection tools and neural networks to identify fraud). As a result, it is expected that the driving business case for smart cards in the United States will be based on revenue generation, new payment types and value-added applications.

Why Contactless?

The primary advantages to both the consumer and retailer of using any contactless technology for payment applications are convenience and speed. Convenience comes primarily as a result of speed: no fumbling for exact change while getting on a bus with parcels or while standing at the checkout counter, and no delay to put a ticket or card into a mechanical reader with the proper orientation when rushing to catch a train. The option of not needing to remove the card from a wallet or handbag, but merely needing to pass the wallet or bag within a few centimeters of the reader, provides additional convenience.

For the retailer, contactless technology also means more rapid throughput, resulting in fewer queues and smaller numbers of checkout staff. Initial results from MasterCard's PayPass pilot showed that PayPass reduced transaction times by up to 64%. Mass transit authorities show increased throughput of from 15 - 20% (according to Hong Kong's Octopus card statistics).

Contactless technology is an ideal payment method for unattended terminals, such as vending machines, toll booths, gas stations, transit stations and parking meters, especially in potentially dirty or harsh environments (such as exterior parking lots, gas stations, or toll booths). The absence of coins decreases opportunities for using fake coins or vandalizing the machines used to collect payment by damaging or blocking coin or card slots. Contactless technology implementations also have higher reliability (with fewer components to maintain), leading to increased availability and decreased maintenance costs.

In those regions where mass transit is using contactless smart cards for payment, it is also feasible for interested third parties to team with regional transit operators and form commercial alliances aimed at sharing costs and generating value.

Global Standards

The importance of standardization to mass acceptance of a new method of payment cannot be overstated. The presence of international and industry standards helps ensure that systems are reliable, that components can be manufactured correctly, and that there is a choice of vendors. The smart card industry has developed standards for both contact and contactless cards and terminals.

There are four key standards:

- ISO/IEC 7816 for smart cards.
- ISO/IEC 14443 for contactless proximity cards.
- ISO/IEC 15693 for contactless vicinity cards.
- EMV 2000 for payment cards.

For more information on these standards, refer to the Smart Card Alliance reports "Smart Cards and the Retail Payments Infrastructure: Status, Drivers and Directions" and "Contactless Technology for Secure Physical Access: Technology and Standard Choices."

Why Contactless Smart Cards for Payment?

Cards are the dominant form factor used for payment. Consumers are comfortable and familiar with using a card for payment. The fact that a traditional magnetic stripe payment card has evolved into a chip-based contactless smart card that can be waved by a reader makes the new payment device even easier to use. The additional security provided by the smart card also provides greater comfort to consumers who are increasingly aware of the risk of card fraud and identity theft. By providing a payment device that is familiar and that can be used at a wide variety of retailers, issuers can increase its acceptance and usage.

Datamonitor estimates that contactless smart cards across all applications (e.g., payment, transit, access) will grow from approximately 100 million cards in 2002 to 280 million in 2006. Although conventional contact smart cards still represent more than 95 percent of the $42.3 billion smart card market in 2002, the market for contactless cards is growing at twice the rate of contact smart cards.[47]

The benefits of using contactless smart cards for payment applications can be summarized as follows:

- Increased security.
- The flexibility to develop product partnerships and differentiators.
- Greater consumer convenience.
- Increased throughput for high-volume traffic.
- Potentially lower staffing costs.
- Greater reliability for reader terminals.
- Lower maintenance cost for reader terminals.
- Longer card life due to no mechanical wear from reader insertion.
- Longer life for unattended terminals.
- Support from all payment associations.
- Potential synergies with local transit agencies.
- Global industry standards to ensure the availability of the required product.

Visa, MasterCard and JCB have all launched programs based on contactless smart card technology. The recent announcement of MasterCard's PayPass trial states that 63% of the consumers surveyed said they would "definitely" or "probably" use PayPass if their bank offered it to them. Achieving such percentages would clearly indicate that the contactless smart card provides a desirable payment option.

[47] *Card Technol*ogy, October 2002, op. cit.

Conclusion

An increasing number of payment applications worldwide are using contactless technology. Such applications range from automatic fare collection systems to retailer acceptance of transit payment methods to payment systems that use the existing credit and debit payment infrastructure. The benefits of contactless payment for the consumer and retailer have been proven in numerous implementations. Increased convenience for the consumer has resulted in increased sales and faster transaction times for the retailer. The retailer also has lower costs due to fewer requirements to handle cash, improved operational efficiencies, and lower maintenance costs resulting from improved reliability of card readers.

Although interest in contactless payment is growing, currently no single technology is being used for contactless payment in the United States. Several technologies are now vying to become the solution of choice for retailers. Both contactless smart cards and ultra-high- and low-frequency RFID have been used in a number of implementations. It is also possible that future solutions could be based on IR, Bluetooth, Near Field Communication, and carrier-based mobile technologies. The contactless payment process also varies, depending on the solution, with some solutions using a traditional credit/debit card transaction and others implementing a unique closed-system approach.

Retailers who would benefit from the speed and increased convenience of contactless payment should evaluate the different technologies and assess which best meets both short- and long-term requirements for their payment processes. Important factors to the retailer's choice include payment device issuance and management processes, integration with current payment and business processes, availability of necessary system components, and long-term stability of the technology, products, and services.

Contactless smart card-based systems offer an excellent choice for retailers. Contactless smart card technology is based on international standards and has been proven in implementations worldwide. Smart cards are being used for payment throughout the world, with Visa, MasterCard and JCB leading initiatives to extend the use of smart cards for contactless payment. In addition, large-scale implementations of smart card-based transit payment systems are scheduled for a number of major cities in the United States in the next 18 to 24 months. The combination of standards-based technology, extensive security features, availability of products and services from multiple vendors, potential to use the existing payments infrastructure, and support from major financial industry players offer compelling benefits for contactless payment implementations based on smart cards.

Retailers can create a strategic competitive advantage and increase sales by accepting new forms of payment. The Smart Card Alliance urges retailers to evaluate the benefits of implementing contactless payment and to consider smart card-based solutions.

For more information about smart cards and the role that they play in retail payment and other applications, please visit the Smart Card Alliance web site at www.smartcardalliance.org or contact the Smart Card Alliance directly at 1-800-556-6828.

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Appendix A: Contactless Transit Implementations

Mass transit agencies have been using stored value pre-payment cards for electronic ticketing since the early 1970s. Through the 1990s this segment steadily began transitioning from magnetic stripe technology to contactless smart cards for a variety of operational and user convenience reasons. This led to large-scale investments in standards and product development by the semiconductor and card manufacturing communities. Today, virtually all new transit fare payment systems either in the delivery or procurement stages involve the use of contactless smart cards as the primary ticket media. Already, major deployments are up and operational in a variety of cities including Hong Kong, Seoul, Pusan, Washington DC, and Shanghai.

Over the course of 2003 and 2004, a number of major cities across the United States and Europe will be rolling out large-scale contactless smart card deployments for mass transit. These include London, Los Angeles, Chicago, San Diego, Minneapolis, Houston, San Francisco, and the expansion of the Washington DC program to include all of northern Virginia and the entire state of Maryland.

Transit communities are deploying this technology to establish integrated fare solutions across a broad regional geography and multiple modes of transport (including rail, bus, transit van, and ferry). Many are being extended to include parking and access control applications.

Many countries are in the midst of establishing interoperability standards, which will govern the application file record contents, access conventions, communications protocols, and inter-system messaging conventions. Examples include ITSO in the United Kingdom, VDV in Germany, and the Universal Farecard Standards Task Force working under the American Public Transportation Association (APTA) in the United States. Universally, these standards initiatives reference the ISO/IEC 14443 standard as the basis for card and reader specifications.

The significance of these initiatives extends beyond mass transit as regional fare implementation programs include the broad distribution of smart card terminals across concentrated geographies. Transit ridership profiles also extend over all segments of regional demographics since most people who live in major metropolitan areas (particularly those with rail service) use public transit. As such, mass transit is serving to establish both a broadly distributed card base and a broadly distributed infrastructure base. This includes the population of merchant sites with POS terminals capable of processing both contactless smart card and conventional credit and debit payment cards. For example, it is expected that the number of merchants in London, Los Angeles, Washington/Baltimore, Houston and Minneapolis with terminals that accept a contactless transit smart card in addition to other payment cards will grow from 2,300 to over 4,000 over the next 24 months.[48] The introduction of smart card-enabled terminals, particularly in the United States, provides an entry point for new smart card programs aimed at adding other contactless applications.

The following is a list of some of the current or planned North American implementations of contactless smart cards for transit payment. It is not a

[48] Source: Cubic.

complete list. The American Public Transport Association (APTA, www.apta.com) and Intelligent Transportation Society of America (ITSA, www.itsa.org/payment.html) web sites have additional information about smart cards used for payment in North American transit agencies.

- **Atlanta, Georgia**: The Atlanta transit system has issued a request for proposals for an AFC system.
- **Baltimore, Maryland**: The Maryland Transit Administration has awarded a contract for a smart card-based AFC system that will allow riders to pay for travel on bus, subway, light rail and commuter rail systems statewide, using the Washington, DC, area SmartTrip® card. The MTA plans tests in Baltimore in 2003, and implementation by late 2004.
- **Boston, Massachusetts**: The MBTA is in the final stages of a contract award for a new AFC system that includes smart cards, with plans to replace monthly passes and tokens with smart cards by June 2004.[49]
- **Camden County, New Jersey and Philadelphia, Pennsylvania**: The PATCO High-Speed Line is in the design phase of a smart card AFC system to replace a 30-year old magnetic-card system.
- **Chicago, Illinois**: The CTA tested 3,500 smart cards in a pilot in 2000. Issuance of an additional 300,000 cards is expected within 3 years, following the system-wide launch completed in November, 2002.[50]
- **Honolulu, Hawaii**: The city of Honolulu has issued a request for proposals for a smart card-based payment system for the city's bus service.
- **Houston, Texas**: The Houston transit system is upgrading to a smart card-based system.[51]
- **Las Vegas, Nevada**: The Las Vegas monorail will connect seven major casinos to the airport (starting in 2004) and will be based on contactless smart cards.
- **Los Angeles, California**: Implementation of a smart card-enabled infrastructure is underway that will link all public transit (bus, light railway and subway) by 2003.[52]
- **Minneapolis-St. Paul, Minnesota**: Implementation of a smart card-enabled infrastructure is underway with a "smart" regional ticketing system for light rail and bus rapid transit planned by late 2003.[53]
- **Montreal, Quebec, Canada**: The Montreal transit system issued an RFP for AFC modernization.
- **New York, New York**: Plans by the Port Authority of New York New Jersey to rebuild the PATH station destroyed at the World Trade Center include a smart card AFC system that will allow riders to pay fares on buses, subways and PATH.
- **Pittsburgh, Pennsylvania**: The Port Authority of Pittsburgh is planning to use pre-paid contactless smart cards for fare collection for bus and rail networks.
- **San Diego, California**: A joint committee of the county's transit districts has agreed the districts should purchase a smart card AFC system for the area's bus systems.[54]

[49] "The Public Sector Takes the Lead, *Card Management*, February 2002.
[50] Cubic press release, November 27, 2002.
[51] "Cubic Receives Contract to Integrate Smart Card Technology into Houston METRO's Fare Collection System," Business Wire, December 13, 2001.
[52] http://www.mta.net/press/stakeholders/scoop_stories/smart_cards.htm
[53] Cubic press release, January, 18, 2002.

- **San Francisco, California**: The TransLink® system[55] pilot of over 5,000 cards started February 2002, allowing one card to be used for bus, train, light rail or ferry service. Six transportation agencies are using the card (AC Transit, BART, CalTrain, Muni, Santa Clara VTA, and Golden Gate Bus and Ferry Transit).[56]
- **Seattle, Washington**: The Seattle transit system is planning a 2003 implementation of a new contactless AFC system.[57]
- **Toronto, Ontario, Canada**: Go Transit has operated a smart card AFC pilot since July 2001, and plans to extend the program to the Greater Toronto region. A full rollout with issuance of 80,000 cards is expected within 2 years.[58]
- **Ventura County, California**[59]: Ventura County has installed a smart card system on 100 buses, involving 6 public transit operators in the county.
- **Washington, DC**: The Washington Metropolitan Area Transit Authority (WMATA) launched their contactless smart card called SmarTrip in May 1999. With 325,000 cards in circulation, SmarTrip is used for paying fares throughout the Metrorail system and fees at all WMATA-operated parking facilities. WMATA will be expanding the use of SmarTrip to their bus fleet in 2003. Other regional transit operators will become SmarTrip-compatible and included in a unified regional fare payment clearinghouse operated by a third party.

[54] http://www.sdcommute.com/RiderInfo/whatsnew/PDFs/pressreleases/current/02_24a.pdf
[55] http://www.translink.org/jsp/index.jsp
[56] "San Francisco's Transit Smart Card Pilot Grows," *Card Technology News Bulletin*, June 12, 2002.
[57] http://transit.metrokc.gov/prog/smartcard/smartcard.html
[58] "Toronto Transit Jumps on the Smart Card Bandwagon," Card Technology News Bulletin, July 3, 2002.
[59] http://216.103.38.3/sc.htm