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The Smart-Chip Credit Card: A Current Solution

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GLOSSARY

Card-not-present (CNP) transaction: A card transaction in which the card itself is not physically present. The cardholder provides information including the card number, expiration date, name of cardholder, and security code to a merchant.

Card-present (CP) transaction: A face-to-face card transaction in which the card is physically swiped or inserted into a card reader terminal.

Card reader: A device designed to read or decode the encoding on plastic cards.

EMV chip specifications: Specifications developed by Europay, MasterCard, and Visa defining requirements for using chip cards worldwide.

Fraud: Intentional and deliberate misrepresentation of information in violation of laws and regulations.

Issuer: Any financial institution that issues or causes credit cards to be issued.

Magnetic stripe: A magnetic stripe on the back of a plastic card that activates card information stored on the card when swiped through a card reader; also called a magnetic strip or magstripe.

Personal identification number (PIN): A required code known only by the cardholder that is used to make transactions; the PIN is entered into a terminal and sent to an authorizing entity to verify the account.

Point-of-sale (POS) terminal: An electronic device for the acceptance of payment cards; POS refers to the area or location where customers can pay for their purchases.

Skimming: An illegal method of stealing credit card information by using a small electronic device that scans and stores card data. The stolen credit card information can be used to make fraudulent purchases or clone new cards.

SmartPay Program: The world's largest government charge card and commercial payment program that allows authorized government employees to make purchases on behalf of the U.S. government.

> "Once a new technology rolls over you, if you're not part of the steamroller, you're part of the road."
>
> —Stewart Brand, Editor of the *Whole Earth Catalog*

"New and improved" credit cards are appearing in wallets of consumers across the United States. Designed for additional security for consumers and businesses, the new cards command the attention of consumers, merchants, and financial institutions. They look like the traditional old cards with one difference: a small, square, metallic computer chip appears on the front of each card. The card is known by several names, including smart card, smart-chip card, chip-enabled smart card, chip card, chip-and-signature card, chip-and-**PIN** (personal identification number) card, and EMV (named for Europay, MasterCard, and Visa) chip card (see the table).[1] Given all these names, it's understandable that the transition to the new card has prompted questions and even some confusion. For simplicity, this essay primarily refers to the new cards as *smart cards* or *chip cards*.

Changes in Procedures and Processes

For a point-of-sale (POS) transaction, the smart card functions the same as the traditional **magnetic stripe** card but some procedures and processes have changed. When a magnetic stripe card is swiped for a transaction, unencrypted data stored on the card are read by the terminal. The terminal processes and sends the uncoded information to the card **issuer**. Within seconds, the issuer's computer verifies and either approves or declines the requested transaction.[2] In a smart card transaction, the card is not swiped but is inserted, or "dipped," into a chip **card reader** terminal. Payment data are embedded on the chip[3] and the terminal enables the chip to process information. The payment application embedded on the chip completes processing, stores encrypted (coded) data, and generates a new code for each transaction. During a transaction, encoded data flow between the smart card and the issuing institution for account authorization to approve or decline the transaction.

Credit Card Terminology

Term	Definition
Chip card	A card containing a computer chip that stores, processes, and encrypts (encodes) information when used at a chip card reader terminal.
Chip-and-PIN card	A chip card that requires a personal identification number (PIN) at the point of sale (POS) to complete a transaction.
Chip-and-signature card	A chip card that requires a signature at the POS to complete a transaction.
Credit card	A card that represents an agreement between a lender—the institution issuing the card—and the cardholder. Credit cards may be used repeatedly to buy products or services or to borrow money on credit. Credit cards are issued by banks, savings and loan associations, retail stores, and other businesses.

A Credit Card Timeline

As the forerunner of the smart card, the magnetic stripe card was the hub of the credit card market for years. In 2011, the magnetic stripe was listed as one of IBM's top 100 contributions to society as part of the company's 100-year anniversary celebrations.[4] Since the 1970s, this development has boosted rapid growth in the credit card market. Federal Reserve statistics validate the impact of the magnetic stripe: U.S. credit card balances grew from $9 billion in early 1973 to $890 billion in October 2015.[5] But as the saying goes, "All good things must come to an end." After decades of low-cost efficiency in the credit card market, new technologies and security concerns demanded a change in card design and the magnetic stripe era began its descent into history.

Although new to the United States, chip cards have coexisted with magnetic stripe cards for several years. Because the magnetic stripe card was already successfully in use, the chip card industry enjoyed the benefit of time to test, improve, refine, and perfect the new technology. Invented in the early 1970s, chip cards were first tested in France in the 1980s. By 1994, a French-developed chip was used for all credit cards issued by French banks. That same year, as more countries became interested in using the chip card, three international payment systems—Europay, MasterCard, and Visa—began a global partnership to develop specifications for a chip card that could be used worldwide. Several versions evolved, with improvements made before the most recent chip specifications were released.[6] Finally, in 1999, a separate company—EMVCo—was created to manage and oversee **EMV chip specifications**.[7]

At least for some time the new smart cards will include the traditional magnetic stripe on the back. This dual-technology is necessary since some businesses have not yet upgraded to the new chip card reader terminals.

Smart Cards Provide a Solution

As much of the world embraced the EMV global standard chip technology, the United States resisted and became the last developed country to rely on magnetic stripe cards.[8] The United States already had advanced **fraud** management methods in place for magnetic stripe cards and the perceived benefit of migrating to the smart card, with inherent cost and investment by issuers and merchants, did not seem justified.

However, as more cases of credit card hacks surfaced and the number of high-profile data breaches swelled, the growing fraud problem garnered increased attention. Concerns regarding fraud involving **card-present (CP) transactions** included credit card counterfeiting, **skimming** of personal and financial data, and fraudulent transactions made with lost or stolen credit cards. In each case, fraudulent transactions are made with an altered, stolen, or cloned card.[9] The smart card, designed specifically to reduce fraud and significantly improve security for POS payment transactions, offered a solution. Because smart cards generate a new security code for each transaction, the specifications make cloned, stolen, or skimmed data useless to fraudsters. The unique and changing

security code is the key for addressing CP fraud and providing a more secure payment system.

To strongly encourage merchant participation in the chip card solution, the major U.S. credit card issuers—MasterCard, Visa, Discover, and American Express—established October 1, 2015, as the date for merchants to establish responsibility for CP fraud. After this date, if merchants had not upgraded to accept the new chip cards, they would be responsible for any fraud liability and risk the high costs of possible data breaches. Liability-shift dates are set for October 2016 for ATMs and October 2017 for fuel pumps. This extended time allowance was granted because of the increased cost and complexity of the transition.[10]

Government Endorsement

Although the government did not mandate the switch to the new chip card, it did endorse the change through an executive order signed in late 2014. In early 2015, the federal government began to use chip cards through its **SmartPay program**.[11] This program provides credit cards to government employees for use in conducting government business. The government-issued cards are designed as chip-and-PIN cards, which provides an additional layer of security, although most other U.S. issuers are implementing primarily the chip-and-signature card initially. Additionally, upgrades have been initiated for all government-owned **POS terminals** to become chip card reader terminals.[12] These actions clearly illustrate the U.S. government's commitment to adopt smart card technology.

Migration Schedules

Migration schedules for the smart card rollout vary by issuer. While some issuers have committed to issuing the new cards to all customers as quickly as possible, others have issued the cards first to customers who are new, have requested new cards, travel internationally, or have greater fraud risk. Regardless of the rollout plan, the number of smart cards continues to increase substantially. An estimated 50 percent to 70 percent of U.S. cards had undergone the transition to chip cards by the end of 2015.[13] For comparison, a Federal Reserve study reports that as recently as 2012 only 74 of every 100,000 CP credit card transactions were made with a chip card.[14]

Transition Cost and Issues

The transition to the smart card is a huge task in terms of investment, cost, and procedural changes. First, it is a tremendous task for issuers to update the vast number of credit cards in circulation. At the end of 2012, the Federal Reserve reported approximately 333.6 million credit cards in force[15] and the number continues to increase. And card issuance bears its own cost: The average cost for issuing a new smart card is $3.50[16] compared with slightly more than $1.00 for issuing a magnetic stripe card.[17]

A substantial cost is involved for retailers as well to install an estimated 12 million new POS terminals to accept the new cards. The estimated cost of each EMV-compliant POS terminal is between $500 and $1,000.[18] And of course, employees need training for the new procedure, which also requires time and can be costly. Smart cards slow the transaction process by a few seconds, which affects the checkout process. But more importantly, each retailer must weigh the cost and benefit to its business of changing to the smart card technology. Upgrading may be expensive, but the liability for any fraud and possible data breaches could be disastrous. As mentioned earlier, the party that does not support EMV technology will bear the liability for counterfeit and lost/stolen (MasterCard, Visa, American Express, Discover) cards.

Finally, the transition will likely be viewed as a short-term inconvenience for consumers. First, the smart-card transaction process takes a few seconds longer than the magnetic-stripe process to transmit the data and complete a transaction. Second, breaking the habit of swiping the card may be initially awkward and require practice. The smart card terminal prompts the customer to insert, or dip, the card into the terminal and leave it there until the transaction is completed. The terminal may instruct the consumer visually and/or with a beep when the card should be removed. There may be a PIN required rather than a signature, a possible inconvenience, but most smart cards will continue to require a signature.

Conclusion

The history of credit cards is already defined; the future is under construction. The huge task of transitioning to the smart card is underway, so what's to be expected in the future? First, as the migration progresses, an increase

in fraud related to **card-not-present (CNP) transactions**—such as for e-commerce—is anticipated.[19] The smart card does not change anything for CNP transactions. As fraudsters move the focus of their attacks to the CNP environment, more changes in the smart card may evolve to address both CP and CNP transactions. Also, most initial smart cards are designed to require a signature. Future changes may include the requirement of a PIN as another layer of security. Overall, there appears to be consensus that the transition to smart cards is on the right track. Staying on the right track means monitoring, adjusting, and making changes. Even though the magnetic stripe card worked well for decades, changing technology and security concerns prompted adjustments and changes—just as they will for smart cards. ■

Notes

[1] Kossman, Sienna. "8 FAQs About EMV Credit Cards." Creditcards.com, updated December 21, 2015; http://www.creditcards.com/credit-card-news/emv-faq-chip-cards-answers-1264.php.

[2] Frellick, Marcia. "The Rise and Fall of the Credit Card Magnetic Stripe." Creditcards.com, June 14, 2011; http://www.creditcards.com/credit-card-news/history-credit-card-magnetic-stripe-1273.php.

[3] Tressler, Colleen. "What to Know about the New Credit and Debit Chip Cards." Federal Trade Commission, October 5, 2015; http://www.consumer.ftc.gov/blog/what-know-about-new-credit-and-debit-chip-cards?utm_source=govdelivery.

[4] See Frellick (2011).

[5] Board of Governors of the Federal Reserve System. "Consumer Credit–G.19." Various years; http://www.federalreserve.gov/Releases/g19/hist/cc_hist_r_levels.html.

[6] EMVCo LLC. "A Guide to EMV Chip Technology." Version 2.0, November 2014, p. 8; http://www.emvco.com/best_practices.aspx?id=217.

[7] See EMVCo, LLC (2014, p.13).

[8] King, Douglas. "Chip-and-Pin: Success and Challenges in Reducing Fraud." Retail Payments Risk Forum Working Paper, Federal Reserve Bank of Atlanta, January 2012, p.1; https://www.frbatlanta.org/rprf/publications.aspx.

[9] Cordray, Steven. "Why Is the U.S. Card-Present Fraud Breakout Not Present?" Retail Payments Risk Forum, Federal Reserve Bank of Atlanta, September 8, 2015; http://takeonpayments.frbatlanta.org/2015/09/why-is-the-us-card-present-fraud-breakout-not-present.html.

[10] See Kossman (2015).

[11] Kitten, Tracy. "What's the President's Influence on EMV?" Bankinfosecurity.com, October 20, 2014; http://www.bankinfosecurity.com/whats-presidents-influence-on-emv-a-7454.

[12] Kitten, Tracy. "Government Rolls Out Chip and PIN: But Will Banks Be Influenced by the Strategy?" Bankinfosecurity.com, January 23, 2015; http://www.bankinfosecurity.com/government-rolls-out-chip-pin-a-7826/op-1.

[13] Mecia, Tony. "Poll: Wealthy Getting EMV Cards First." Creditcards.com, February 25, 2015; http://www.creditcards.com/credit-card-news/wealthy-get-emv-cards-first.php.

[14] Federal Reserve System. "The 2013 Federal Reserve Payments Study: Recent and Long-Term Payment Trends in the United States: 2003-2012; Summary Report and Initial Data Release." December 19, 2013, p. 17; https://www.frbservices.org/files/communications/pdf/research/2013_payments_study_summary.pdf.

[15] Federal Reserve System. "The 2013 Federal Reserve Payments Study: Recent and Long-Term Payment Trends in the United States: 2003-2012; Detailed Report and Updated Data Release" July 2014, p. 66; https://www.frbservices.org/files/communications/pdf/general/2013_fed_res_paymt_study_detailed_rpt.pdf.

[16] See Kossman (2015).

[17] Frellick, Marcia. "What's It Cost to Get a Credit Card in Your Pocket?" Creditcards.com, August 2010; http://www.creditcards.com/credit-card-news/cost-getting-credit-card-in-your-pocket-1276.php.

[18] See Kossman (2015).

[19] See Cordray (2015).

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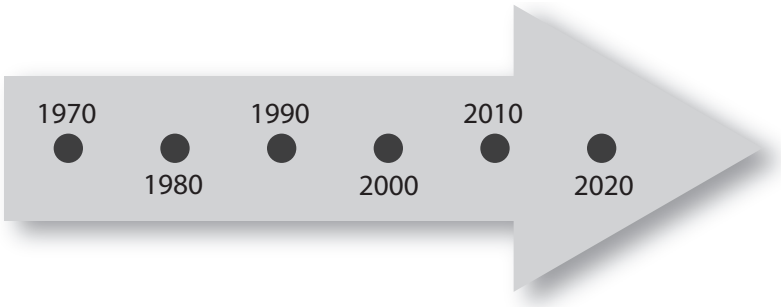
Name_____ **Period**_____

Federal Reserve Bank of St. Louis *Page One Economics*®:

"The Smart-Chip Credit Card: A Current Solution"

After reading the article, answer the following questions:

1. The timeline below is divided according to decades (10-year increments) of time. If you were asked to add events to the timeline to illustrate the development and implementation of the chip card based on information in this essay, what entry would be first on the timeline? What entry would be last on the timeline?



2. What evidence is provided to prove the endorsement of the chip card by the U.S. government? Check all that apply.

   A. ☐ Mandate issued to transition to smart cards by October 2015

   B. ☐ Smart cards issued to government employees who use credit cards to conduct government business

   C. ☐ Chip card reader terminal upgrades initiated for all government-owned POS terminals

3. Give reasons why the United States is the last developed country to transition to chip cards.

4. Why did the United States finally transition to chip cards?

5. Why do newly issued chip cards use dual technology with a magnetic stripe on the back and the chip on the front of the card?

6. The title of this essay is "The Smart-Chip Credit Card: A *Current* Solution." Give reasons why this is a better title than "The Smart-Chip Credit Card: A Solution."

7. How would the transition to the smart card in the United States have differed if fraud and security concerns were not problems?

8. People choose from a variety of payment methods to buy goods and services. Given a choice, which credit card payment method would you choose—magnetic stripe or chip card? Why?

9. Reading this essay is one way to acquire information and become familiar with the advantages of the new chip card compared with the traditional magnetic stripe card. An information graphic (infographic) would also be beneficial as a tool to acquire information and increase understanding of the transition to the chip card. An infographic condenses information into a visual representation and may include a combination of charts, diagrams, images, and text to convey information.

   Create an infographic using the information presented in this essay. The infographic must address at least these topics:

   - What are chip cards?
   - How do chip cards work?
   - What are advantages of the smart card?
   - What steps are involved in using a smart card?

   Examples of infographics are available at

   https://www.stlouisfed.org/education_resources/alternative-financial-services/index.html and https://www.stlouisfed.org/education_resources/college101/index.html.

Teacher's Guide

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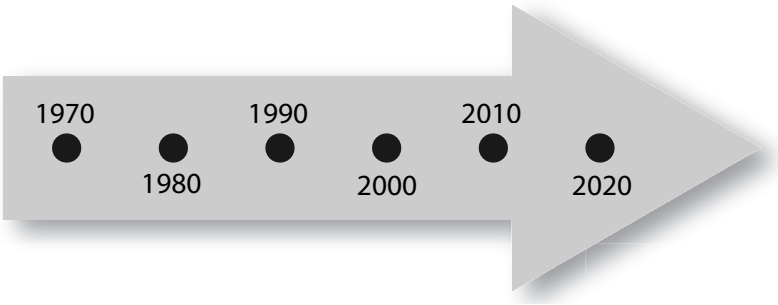

First entry: Invention of the chip card in early 1970s
Last entry: Liability-shift responsibility date for gas pumps in the United States set for October 2017

2. What evidence is provided to prove the endorsement of the chip card by the U.S. government? Check all that apply.
   A. ☐ Mandate issued to transition to smart cards by October 2015

   B. ☒ Smart cards issued to government employees who use credit cards to conduct government business

   C. ☒ Chip card reader terminal upgrades initiated for all government-owned POS terminals

   Only selections B and C are correct. No mandate was issued to transition to the new chip card.

3. Give reasons why the United States is the last developed country to transition to chip cards.
   The United States had advanced fraud management methods in place for the magnetic stripe card and the cost of the investment necessary for migrating to the new card did not seem justified.

4. Why did the United States finally transition to chip cards?
   The growing number of credit card hacks and high-profile data breaches involving credit card counterfeiting, skimming, and fraudulent transactions became problematic. The smart card offered a solution to these problems.

5. Why do newly issued chip cards use dual technology with a magnetic stripe on the back and the chip on the front of the card?

   Some businesses have not yet upgraded to the new chip card reader terminal, so the dual technology allows the chip cards to also be used at older terminals.

6. The title of this essay is "The Smart-Chip Credit Card: A *Current* Solution." Give reasons why this is a better title than "The Smart-Chip Credit Card: A Solution."

   Responses may vary but should include the fact that a good solution to a problem today may not be a good solution in the future. The word "current" is necessary because new technology advances and usage changes will force changes to the design of smart cards. Future security concerns may include requiring a personal identification number (PIN) for all transactions. Card changes may be required to address card-not-present (CNP) transactions since the current cards address only card-present (CP) transactions.

7. How would the transition to the smart card in the United States have differed if fraud and security concerns were not problems?

   If fraud and security had not surfaced as major issues, the magnetic stripe card technology would probably have continued for many years and the cost of the transition could have been saved.

8. People choose from a variety of payment methods to buy goods and services. Given a choice, which credit card payment method would you choose—magnetic stripe or chip card? Why?

   Answers may vary but should include information on fraud protection and added security measures the chip card provides in CP transactions.

9. Reading this essay is one way to acquire information and become familiar with the advantages of the new chip card compared with the traditional magnetic stripe card. An information graphic (infographic) would also be beneficial as a tool to acquire information and increase understanding of the transition to the chip card. An infographic condenses information into a visual representation and may include a combination of charts, diagrams, images, and text to convey information.

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National Standards

Common Core State Standards

Grades 6-12 Literacy in History/Social Studies, Science, and Technical Subjects

- **Key Ideas and Details**

  RH.11-12.1: Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.

  RH.11-12.2: Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

- **Integration of Knowledge and Ideas**

  RH.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

Grades 6-12 Reading Standards for Informational Text

- **Key Ideas and Details**

  RI.9-10.2: Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.

  RI.11-12.1: Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

National Standards for Financial Literacy

Standard 2: Buying Goods and Services

People cannot buy or make all the goods and services they want; as a result, people choose to buy some goods and services and not buy others. People can improve their economic well-being by making informed spending decisions, which entails collecting information, planning, and budgeting.

- **Benchmark: Grade 8**

  3. People choose from a variety of payment methods in order to buy goods and services.
  4. Choosing a payment method entails weighing the costs and benefits of the different payment options.