AN INTRODUCTION
TO EMV

The Smart Card Industry Standard
AN INTRODUCTION TO EMV, THE SMART CARD STANDARD

INTRODUCTION

A magnetic stripe card generally provides single functions such as...

- payment with access to a savings or checking account (debit card)
- payment access to a line of credit (credit card)

Thanks to the advent of the microprocessor, smart cards can combine payment with other value added applications like loyalty, identity, transportation, e-purse, and e-commerce onto a single card. This provides convenience to consumers while lowering the cost of issuance. This is called multi-application capability and EMV is the key to providing such capability. In a multi-application card, payments become one important application in the midst of other allowed applications.

This paper will help the reader understand what EMV is and its benefits.

"Chip Cards To Be 'The Story' of 2000 Season"

Nov 21 2000: With Forrester Research finding over 15 million people to shop online and to spend an average of USD 270 each month, smart cards and e-commerce are expected to become ‘the story’ of this holiday season. Just last month, Forrester noted over USD 4 billion to have been spent online, a trend Visa is tapping into by releasing its ‘smart Visa’ cards in September. MasterCard, meanwhile, is said to be gearing its smart cards for launch “at the same level of prominence as our competitors, if not more prominently”.

Since credit cards account for almost 99 percent of online payments, the credit card associations and their member banks are looking to ‘smart credit cards’ to achieve their slice of the online pie. Visa, for one, will use smart cards to reduce its annual bill of USD 250 million for resolving disputes related to online transactions, and to cut the 10 to 40 percent fraud risk for these transactions. The member banks of Identrus already use smart cards and PKI to support the entity’s role as a digital notary for e-payments.

Until now, the uptake of smart cards has been ‘stymied’ by the lack of common standards, the reluctance of retailers to chip-enable their systems, and consumer ambivalence. However, the Internet is catalyzing smart cards as a means for consumers to secure their online privacy, while simplifying online purchases as a vehicle for personal details and digital certificates. The case for chip cards is again bolstered given that the presence of cookies on a PC is known to simplify the misappropriation of credit card numbers.
WHAT IS EMV AND THE EMV STANDARD?

The EMV standards were started by a working group created in 1993 by the world’s three main payment organizations: EUROPAY (EPI), MASTERCARD (MCI) and VISA. In fact, the name EMV is derived from the first letter of each of these three organizations. The group’s objective is to define a common set of standards (EMV standards) for smart card based payment applications. These standards allow the card and the acceptance device to work seamlessly and securely together.

The EMV specifications were written with the following goals in mind:

- The card and acceptance device must communicate together and indicate what applications the card and acceptance device have in common.
- The acceptance device can run common applications and ensure that minimum standards for risk control and security are applied for debit/credit applications.
- The microprocessor-based payment card provides worldwide acceptance and interoperability.

The EMV specifications provide a set of rules that allow a chip card and the acceptance device to communicate with one another. The EMV specifications are based upon the common set of standards developed by the International Organization for Standardization (ISO) for integrated circuit (chip) cards and related acceptance devices (e.g., a point-of-sale terminal). The current version of the EMV ’96 specifications (version 3.1.1), published in May 1998, defines requirements for the interaction of debit and credit card functions on a chip card and a terminal. The components in these specifications cover requirements for cards, applications, and terminals. A new release EMV2000 (EMV 4.0) is currently available.
**EMV CHRONOLOGY**

1993: Creation of the EMV working group

1994: First specifications

1996: Basic EMV specifications

1996: UKIS 3.0 (VISA) specifications

1996: VIS 1.2 published

1997: First EMV pilot (UKIS) in England

1998: VIS 1.3.1 specifications

1998: EMV’96 3.1.1 specifications

1998: “EPI minimum requirements” specifications


1998: First EPI pilot (Off the Shelf) in Eastern Europe

1999: National rollout of UKIS in England

1999: “EPI Off the Shelf 3.0.3” specifications

1999: National rollout of “Off the Shelf” in Slovakia

2000: VISA EMV projects (VSDC) in United States

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**WHAT ARE THE BENEFITS OF EMV STANDARDS?**

There are three primary benefits that payment terminals and smart card readers, which adhere to the EMV standards provide. Those are:

**FRAUD REDUCTION**

Fraud is not as prevalent in U.S. as internationally, but is expanding rapidly in e-commerce. Increased cardholder security, could increase use of the Internet for online shopping. Recent consumer surveys have found that the e-commerce market could easily see double-digit growth if cardholder security fears are alleviated. Additionally, internet merchants accepting smart card chip enabled transactions could receive incentives, such as a discounted rate.


<table>
<thead>
<tr>
<th>Years</th>
<th>Fraud</th>
<th>Charge-offs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>206.8</td>
<td>4,224.5</td>
</tr>
<tr>
<td>1990</td>
<td>317.5</td>
<td>5,374.3</td>
</tr>
<tr>
<td>1991</td>
<td>505.8</td>
<td>7,924.2</td>
</tr>
<tr>
<td>1992</td>
<td>657.8</td>
<td>9,099.3</td>
</tr>
<tr>
<td>1993</td>
<td>665.0</td>
<td>8,483.5</td>
</tr>
<tr>
<td>1994</td>
<td>734.0</td>
<td>7,460.0</td>
</tr>
<tr>
<td>1995</td>
<td>710.0</td>
<td>10,514.9</td>
</tr>
<tr>
<td>1996</td>
<td>751.5</td>
<td>17,356.2</td>
</tr>
<tr>
<td>1997</td>
<td>794.4</td>
<td>22,424.6</td>
</tr>
<tr>
<td>1998</td>
<td>576.3</td>
<td>21,029.0</td>
</tr>
</tbody>
</table>

*Card Industry Directory, 2000, Faulkner & Gray*
MANAGE A GROWING NUMBER OF TRANSACTIONS

Global debit and credit transaction volume has increased dramatically over the last few years and will continue to do so for the foreseeable future. POS terminals that read magnetic stripe cards require an ONLINE connection to obtain the bank’s authorization. Smart cards can increase the security of online debit and credit transactions through dynamic cryptograms which can prevent skimming.

If smart cards are used for debit/credit applications, the main part of the transaction can be performed OFFLINE, saving time and money. Additionally, the ability to perform transactions offline expands the retailer’s ability to reach a consumer anytime, anywhere without need for network and telephone availability.

ENSURE INTEROPERABILITY OF DIFFERENT DEBIT/CREDIT APPLICATIONS¹

A prerequisite for the establishment of a global payment card scheme is that the card be able to work and that the associated transactions be processed regardless of geographic boundaries. This prerequisite is generally referred to as interoperability.

Interoperability has two important aspects. From the payment industry’s perspective, interoperability means that a device can process payment cards from different payment schemes. From an issuer’s perspective, it connotes the ability to use a credit or debit card at any location that displays the associations logo, regardless of card or the acceptance device’s technology. This includes cross-boundary transactions and card not-present environments, such as Internet purchases. Wherever the logos are displayed, the card must work. Consumers must be able to use their credit or debit card throughout the world with the same ease and convenience as in their home country.

<table>
<thead>
<tr>
<th>CREDIT AND DEBIT PURCHASES FOR GOODS AND SERVICES VOLUME $ BILLIONS</th>
<th>1999</th>
<th>2005</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visa</td>
<td>561.54</td>
<td>1,171.49</td>
<td>2,027.67</td>
</tr>
<tr>
<td>MasterCard</td>
<td>277.90</td>
<td>589.33</td>
<td>974.92</td>
</tr>
<tr>
<td>Amex</td>
<td>185.60</td>
<td>330.63</td>
<td>464.20</td>
</tr>
<tr>
<td>Store</td>
<td>116.88</td>
<td>125.26</td>
<td>132.92</td>
</tr>
<tr>
<td>EFT Systems</td>
<td>70.35</td>
<td>200.38</td>
<td>330.27</td>
</tr>
</tbody>
</table>

¹ The Nilson Report, Number 726, October 2000
Associations, issuers, acquirers and terminal manufacturers have created global interoperability for magnetic stripe cards by developing and implementing industry standards. For interoperability to continue, payment cards using chip technology require the same commitment to standards.

**HOW DOES EMV ACHIEVE INTEROPERABILITY?**

EMV achieves interoperability between cards and devices through two key mechanisms. First, it defines the minimum requirements that chip cards and card acceptance devices must meet to communicate with one another. These requirements also ensure that the device does not damage the card. This initial set of procedures is called the **EMV Level 1** requirements. Second, EMV specifies how debit and credit transactions are to be executed once the basic physical contact between the chip and the device is established. This set of rules is called the **EMV Level 2** requirements.

EMV Level 1 and Level 2 requirements must be met in order for the payment industry to maintain its current level of global interoperability while migrating debit and credit products from magnetic stripe technology to chip technology.

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**GENERAL PURPOSE CARDS WORLDWIDE (CREDIT AND DEBIT COMBINED) - 1999 VS. 1998 ($ BILLIONS)**

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>1999</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visa</td>
<td>$1,631.54</td>
<td>60.8%</td>
<td>59.55%</td>
</tr>
<tr>
<td>MasterCard</td>
<td>727.00</td>
<td>27.09%</td>
<td>27.69%</td>
</tr>
<tr>
<td>Am Exp</td>
<td>254.10</td>
<td>9.47%</td>
<td>9.76%</td>
</tr>
<tr>
<td>JCB</td>
<td>37.16</td>
<td>1.38%</td>
<td>1.56%</td>
</tr>
<tr>
<td>Diners Club</td>
<td>33.80</td>
<td>1.26%</td>
<td>1.43%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2,683.60</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The Nilson Report, Number 715, May 2000*

Worldwide acceptance and use of general purpose credit cards is growing. This growth will fuel the adoption of chip card-based technology – promoting worldwide interoperability and optimal transaction security.

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1 From Visa’s VIS and EMV Primer v2.0
EMV LEVEL 1 REQUIREMENTS

The first level of the EMV standard provides the baseline requirements for all chip cards and terminals, including:

- the physical and electromechanical characteristics
- logical interface
- transmission protocols, to facilitate basic interoperability

It defines the essential elements that allow chip cards and terminals to communicate with one another. This ensures that when an EMV Level 1 compliant chip card is inserted into an EMV Level 1 compliant acceptance device, neither will be damaged.

Specifically, the card and device must be able to physically connect to allow the exchange of information. From a card's perspective, the size of the card, the position of the chip on the card, and the embedded microprocessor's contacts on the chip must follow EMV specifications. From an acceptance device's perspective, the terminal must have the correct size slot for the card to fit into, and its contacts must be in the correct position to make physical contact with the chip on the card.

Contact smart cards must be inserted into a smart card reader. They have a small gold plate about 1/2 inch in diameter on the front, instead of the magnetic stripe on the back like a credit card. When the card is inserted into a smart card reader, it makes contact with electrical connectors that transfer data to and from the chip.

The size of the card is determined by the international standard (ISO 7810). The ISO 7816 standard also defines the physical characteristics of the plastic, including the temperature range and flexibility, position of the electrical contacts and how the microchip communicates with the outside world.

A number of standards have also been defined for specific applications, including digital cell phones, credit card functions (Europay, MasterCard, Visa) and electronic purses (Visacash, Mondex, Proton).

www.gemplus.com
The EMV Level 1 standards also specify the voltage that the device must apply to the chip to supply the smart card with the power it needs to participate in a transaction. Other EMV Level 1 requirements include the definition of the communication protocols for transmitting data between the card and the device, such as the sequence in which the characters are sent, speed of transmitting information, and the number of characters sent at a time.

The EMV Level 1 requirements were developed to create a cross-industry interoperability platform, on top of which any financial or non-financial application can be built. These requirements are followed by key organizations in other industries with similar needs that are developing their own chip products. All Visa chip products are and will continue to support EMV Level 1 requirements.

**EMV LEVEL 2 REQUIREMENTS**

EMV Level 2 requirements define the specifications for execution of the functions associated with debit and credit transactions. Among the functions included are application selection, the individual data elements, commands, and security.

Once a connection has been established between the card and the accepting device using EMV Level 1, EMV Level 2 specifies the mechanism that allows a card and acceptance device to determine whether there is reason to continue with the conversation. The acceptance device extracts information from the card to find out what applications are resident on the card. Based on the cardholder preference and the same application’s presence in the acceptance device, the acceptance device decides on the application to be used to complete the transaction. This decision making process is called **application selection**. For example, after a cardholder inserts a chip card, the terminal will display the applications that are common to both the card and terminal (e.g., credit, debit, and loyalty) and allow the cardholder to select the application that they want to run.

The application selection process has been designed to support multi-application cards. Any application that both the card and terminal have in common can be selected following this process.
WHAT IS VIS?

The Visa Integrated Circuit Card Specification (VIS) is Visa’s implementation of the EMV specifications. VIS builds upon the EMV standards, incorporating some of EMV’s optional features, along with additional Visa risk management best practices. It was developed to help Visa Member Banks implement chip card programs for Visa Smart Debit/Credit.

Because VIS is based on EMV, the two specifications are used jointly for reference and development purposes. VIS requires that both the card and the device support the basic signaling and transmission formats specified in EMV. Any deviation from this could potentially result in a chip card not working across different devices. It is worth noting that while the chip card will conform to a specific card scheme’s specification (e.g. VIS); an EMV device should support any EMV-based card application. Devices implementing Visa Smart Debit/Credit must meet EMV Level 1 and EMV Level 2 requirements as well as be compliant with VIS.

VISA SMART DEBIT AND CREDIT

Visa Smart Debit/Credit (VSDC) provides the ability for retailers and consumers to transact debit or credit transactions using smart card technology. VSDC introduces new capability for chip-based debit and credit not available with magnetic stripe technology.

As debit and credit products move from magnetic stripe technology to chip, the functionality provided by the magnetic stripe will continue to play a key role. Magnetic Stripe Image (MSI), a method of replicating the card’s magnetic stripe data onto the chip, contains the basic data needed for transaction processing and account access in a chip environment. MSI forms the core of the Visa Smart Debit/Credit application, is EMV-compliant, and provides Visa Member banks with a stepping stone to implementing all the features of VIS.

By using chip technology, the VSDC product provides additional functionality while supporting risk control measures. One of these features is offline authorization, which allows a transaction to be authorized offline using card and terminal risk control measures. Another feature allows either offline or online PIN entry, in addition to signature as a cardholder verification method, which helps to decrease exposure to lost and stolen cards. Additional risk control enhancements
include protection against counterfeit cards (which ensures that the terminal is communicating with a valid card) and the ability of the Issuer to change the cardholder’s personal information without having to reissue the card.

These new smart Visa cards represent a new generation of payment products that can deliver personalized services designed to fit your needs and lifestyle. When you insert your smart Visa card in your reader, you unlock an array of exclusive benefits available only to smart Visa cardholders. These benefits can include promotional opportunities, customized deals and discounts from your favorite online merchants, easier ways to shop online, and valuable services designed to simplify your life.

This is only the beginning. The smart chip will enable Visa Issuers to continually enhance smart Visa cards with new features and services. Ultimately, these services will be customized based on your unique preferences. Best of all, you will not need a new card to take advantage of these upgrades. Instead, you will be able to download new applications from your Issuer onto your card using your smart Visa card reader. The result will be a more secure, versatile, and personalized card designed to make your life simpler, smarter, and better.

www.visa.com, November, 2000

**Summary**

As of September 2000, there were fewer than 5,000 chip-based Visa credit cards in the U.S. market. Within 12 months, there will be over 10 million. FleetBoston, Providian and First USA are Visa member banks that have answered Visa’s call to chip card technology. The smart Visa card will be primarily used for credit and debit payment and will have the ability to provide value-added services that create incremental revenue for the issuers. Transaction security, consumer convenience, incremental revenue opportunities and customer relationship management lend themselves to chip card technology. The EMV standards provide the basis for secure transaction processing, at the point of interaction, between the card and the accepting device.
THE ELITE TERMINAL FAMILY
MEMBERS THAT ARE EMV APPROVED

ELITE 510 COUNTERTOP EFT POS TERMINAL
This counter-top terminal from Ingenico is equipped with a 16-bit processor, which provides power and performance. Its memory can be extended up to 4Mb.

ELITE 712 COUNTERTOP POS TERMINAL
A compact, handheld, “hand-to-the-customer” POS solution for secure magnetic stripe and smart card applications. Screen addressable keys, communications base and small footprint add to the convenience of this countertop unit.

ELITE 770 SHORT RANGE WIRELESS POS TERMINAL
This new portable terminal from Ingenico has a 16-bit processor. It is available in two versions:

- Infrared allows payments to be made at the counter as well as offering an extra level of service to the cardholder.
- Radio is for users such as restaurateurs for whom portability is essential. Payment can be carried out at the table without the customer losing sight of his card.
**eN-TOUCH 3000 WITH eN-CRYPT 1200 PIN PAD**

eN-Touch 3000 is a versatile touch screen terminal with applications in retail payment, e-commerce, Internet messaging and more. Its large touch screen provides graphics programming flexibility, and enhances operating convenience. When combined with the EMVco approved eN-Crypt 1200 this solution provides secure PIN entry and a cost-effective way for users to upgrade their existing payment methods to include secure consumer-activated magnetic stripe and smart card transaction entry.
ABOUT INGENICO

Ingenico S.A. is a leading provider of smart card secured transaction products and systems with subsidiaries and partnerships all over the world and customers in over 70 countries and territories. Its subsidiary Ingenico Corp. provides hardware, software and services to the ever-expanding transaction needs of the North American marketplace, which demands quality and requires flexible and robust payment solutions. Our solutions include the Elite™ terminal family, which is built upon the Unicapt™ architecture for optimum application portability and secure multi-application acceptance, and was the first to be EMVco approved.

Major retailers need solutions that incorporate both magnetic stripe and smart card technology. Ingenico, the Power of One, has the technology and experience to make it all work together. See www.ingenico-us.com for more information.