

# Smart Cards: Enablers for Electronic Commerce

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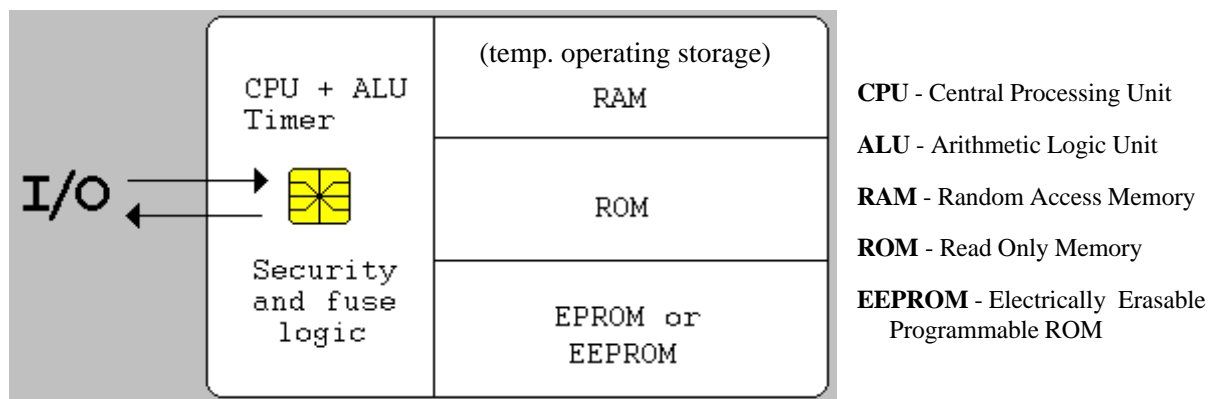
### Introduction:

The interest in Smart Cards as enablers for electronic commerce is taking hold in the United States as banks, as well as non-banks, have announced pilots, alliances and services. The introduction of Visa Cash in the 1996 Atlanta Olympics, the recent smart card pilot in Manhattan, NY of both Visa Cash and Mondex, numerous governmental and private sector pilots may mark the beginning of the potential growth of chip cards as enablers for electronic commerce in the United States.

### What is a Smart Card?

*“A Smart Card is a credit card sized plastic card (85.6mm x 53.98mm x 0.76mm), embedded with an integrated circuit chip (ICC) which provide memory storage and processing power. Smart Card ICC allows the implementation of cryptographic and authentication algorithms for secure storage and access.”*

### Smart Card Layout:



### Features

- ◆ Secure information storage
- ◆ Access controll
- ◆ Encryption/ decryption
- ◆ Random key generation
- ◆ Digital Signature and Verification
- ◆ Hash function and computation

### Business Uses for Smart Cards as Enablers of Electronic Commerce:

The following are the five key business functional areas for use of chip based Smart Cards in the United States:

#### 1. Smart Cards as Payment Vehicles:

## **Smart Cards - Enablers for Electronic Commerce**

The smart card technology enables credit and debit and e-purse “cash” transactions to occur in a much safer, faster and fraud resistant environment. A new payment revenue stream emerges in stored value cards, where cash equivalents are loaded onto the micro-processor chip decrement at point of sale. Banks view the float and transaction fee as part of this new income stream.

In the U.S., about 88% of transactions are still in cash and checks and 83% of those are for transactions under \$10 items. Electronic Purse schemes and SVCs target this market. Some SVC issuers are considering a credit line attached to the card - creating a new credit vehicle.

The emergence of Internet as a viable purchasing medium and the development of standards like Secure Electronic Transactions (SET) and EMV chip-card specifications provide an excellent opportunity for Smart Cards to emerge as a highly secure payment device to make Internet transactions using credit-cards.

### **2. Smart Cards as Remote Access Keys:**

Many businesses looking to deliver goods and services over the Internet and other publicly accessed networks are looking to use Smart Card technology for encryption and authorization of data to transactions and financial information delivered securely. Citibank currently uses Smart Cards for access to home banking via screen based telephones. Set-top box manufacturers such as Scientific Atlanta and interactive cable companies such as Time Warner Cable are exploring the use Smart Cards for access, program control and payments. Since chip-cards can hold public and private key encryption that scramble sensitive information as it is sent and unscramble at the designated place, Smart Cards will be used for anonymous payments over the Internet or dedicated payments such as pay-per-view on TV.

### **3. Smart Cards as Information Managers:**

Banks are planning to use Smart Cards to provide customers with linked account information and balances as well as related information based on card use such as payments, ticketing, and frequent flier points. Co-branding and shared information will become important. Recent consumer research conducted by the Smart Card Forum shows strong consumer interest in managing information on cards and reducing the number of cards they carry. Corporate treasurers and cash management departments will be able to use Smart Cards as part of tracking of expenses or other transactions.

### **4. Smart Cards as marketing Tools:**

Loyalty programs such as frequent flier points, gift certificates, electronic coupons and discounts are being administered by Smart Cards. These are likely candidates for stored value applications. Hilton Hotels, Delta Airlines, Continental Airlines and American Airlines have on-going smart card pilots in the USA.

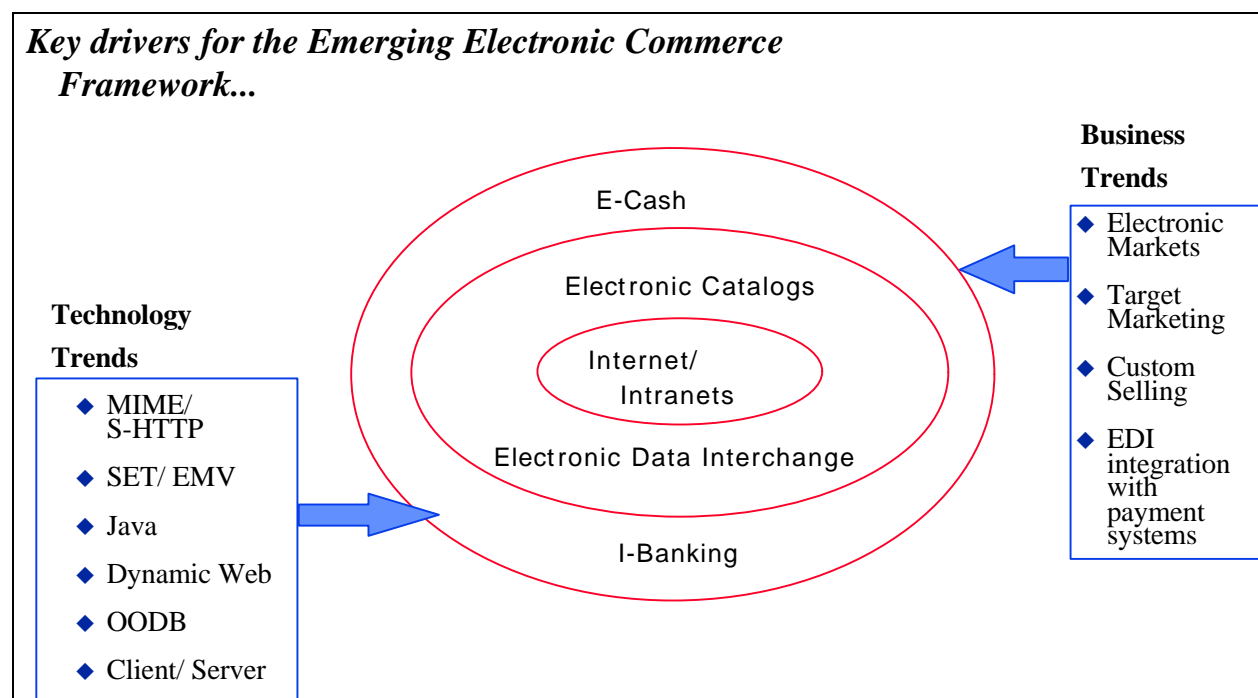
### **5. Smart Cards as Customized Delivery System:**

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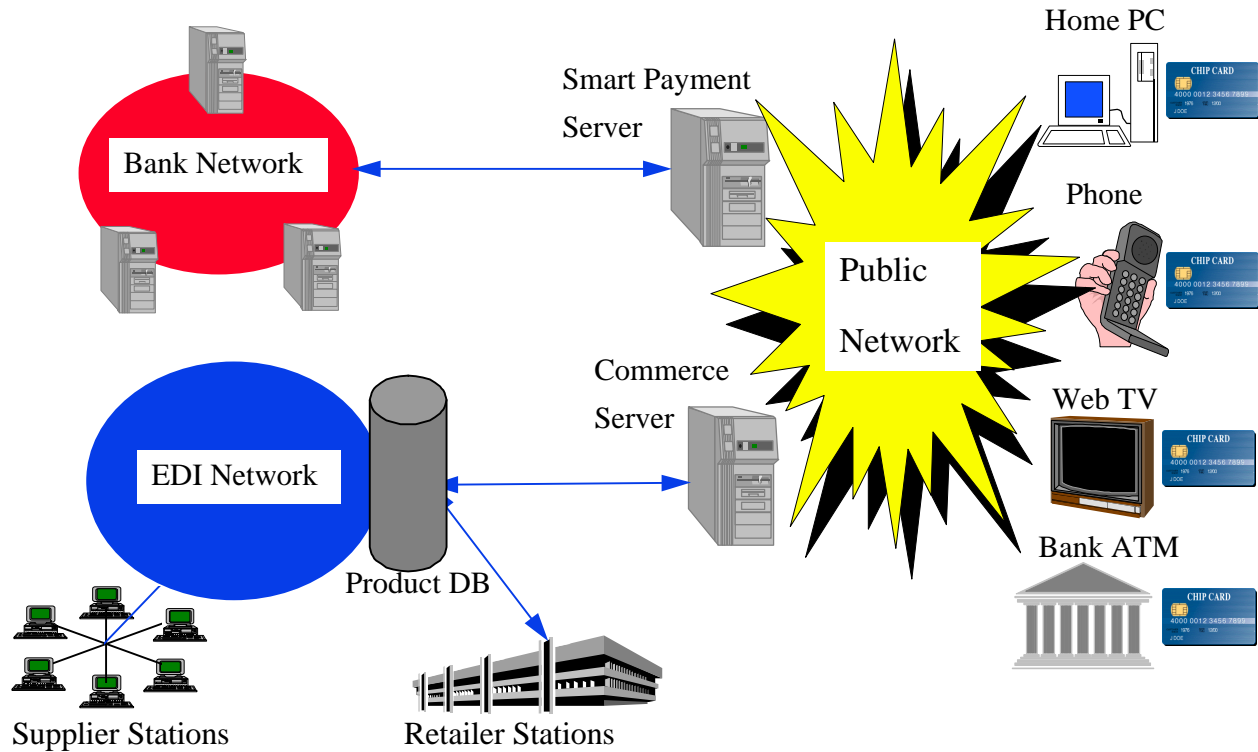
Ultimately, the cards could be used to carry personalized screen sets and other branded or individualized information and accounts for the customers - a way to keep customer interfaces under the bank's control. This "one card" will carry stored value as well as credit and debit. Many state governments such as Ohio, California and Wyoming are exploring smart cards as an electronic benefits transfer (EBT) payment mechanism.

The convergence of Smart Cards as payment mechanism for electronic commerce is illustrated by [Fig:1](#). A schematic diagram of Smart Card enabled Electronic Commerce architecture is represented by [Fig: 2](#). The key business areas of smart card applications and their internal architecture are shown in [Fig: 3](#).

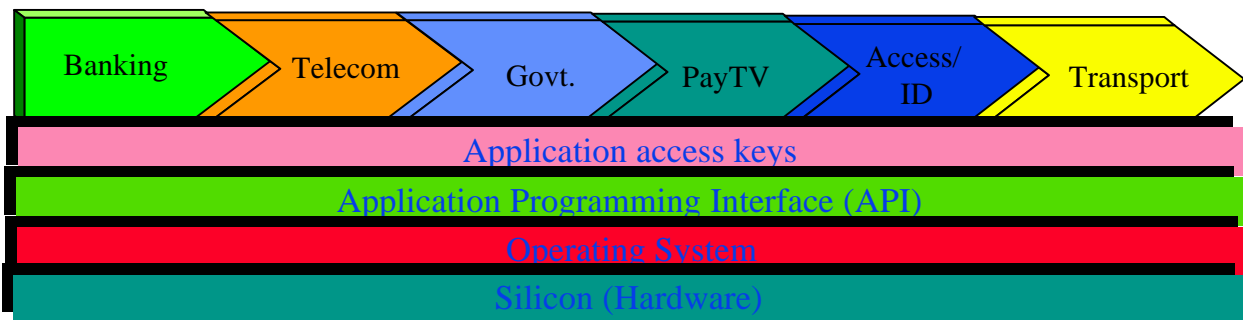
**Fig: 1 Smart Cards as Electronic Payment Mechanism**



**Fig: 2 Smart Cards enabled Electronic Commerce Architecture**



**Fig: 3 Smart Card Applications and Internal Architecture**



**Fig 4: Smart Card Interoperability**

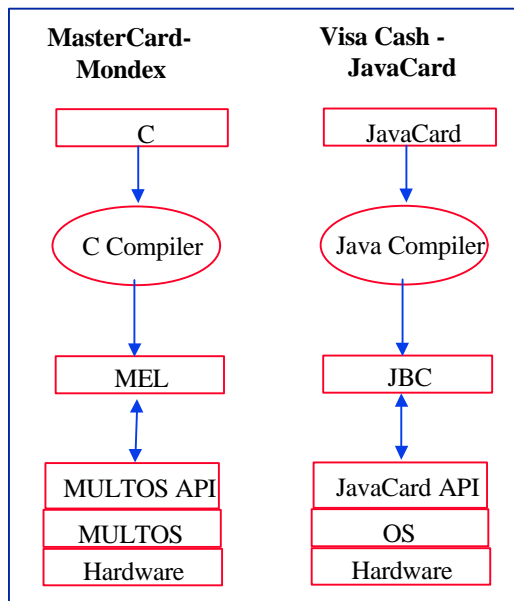
Smart Card interoperability is critical for the development of a truly multi-application, multi-functional smart card system – as enablers for electronic commerce.

***Why Open Smart Card OS?***

- ◆ Vendor Independence
- ◆ Faster time to market
- ◆ Top down definition of products
- ◆ Evolution of the card within the application

***Smart Card OS developments:***

- ◆ JavaCard 2.0
- ◆ Mondex MULTOS
- ◆ IBM OpenCard Framework
- ◆ Microsoft Windows SDK



*Similar architecture for interoperability...*

**Smart Card Interoperability = Open Smart Card Operating Systems**

- *Physical interoperability*  
Ability to establish communication with a smart card, using electronic and mechanical specifications.
- *Syntactical interoperability*  
Ability to create the same functionality using different smart cards with different protocols and data structures.
- *Semantical interoperability*  
Ability of different applications to share information stored in different formats.

### Smart Card Industry Drivers

The primary drives for smart card initiatives and pilots in the US are financial institutions, banks, US military, US Federal and State governments and Universities.

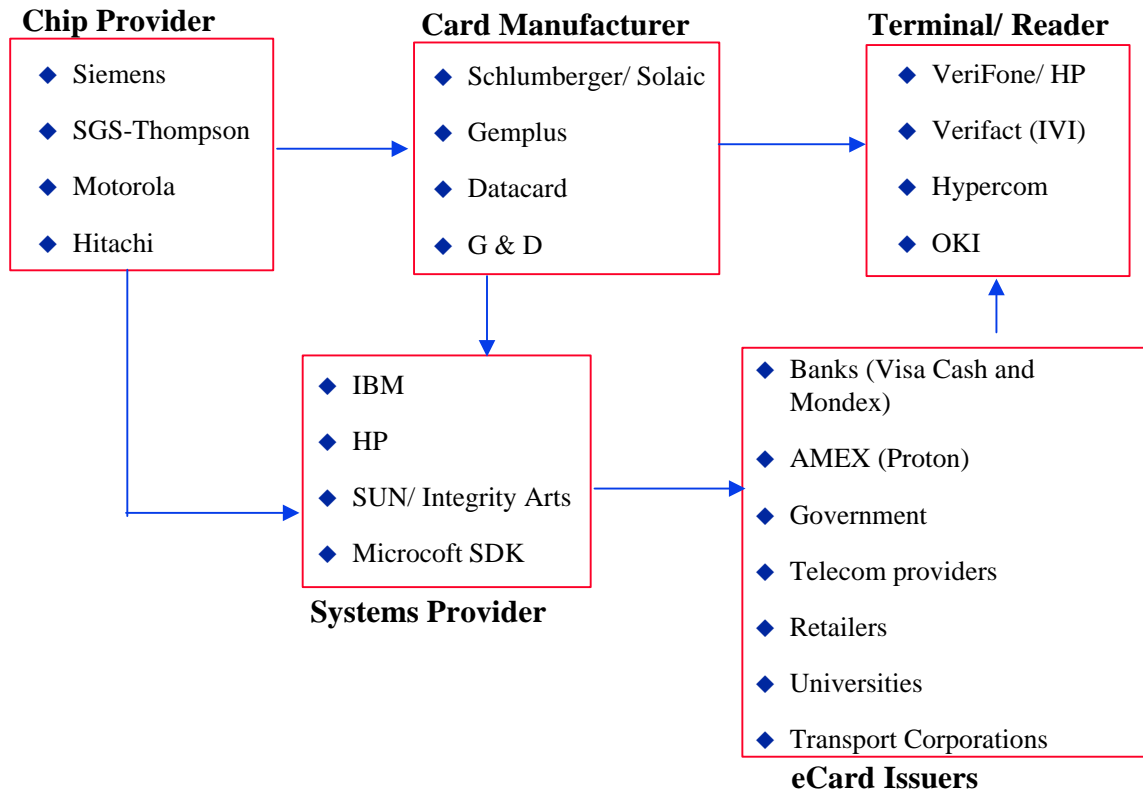
Unlike Europe, where governments or monopolies drove the adoption, there are based alliances being formed to promote adoption of smart cards in the US, motivated by the profit potential the new technology can offer.

The key private sector companies that are driving the adoption of smart cards are listed below:

Industry Segment	Smart Card Drives
1. Banking	Visa, MasterCard, American Express, NationsBank, First Union, Citibank, Bank of America, Chase-Chemical Bank
2. Campus	Florida State U., U. of Michigan, Washington University, NACCU
3. GSM-PCS	US West, Northern Telecom, Global Chipcard Alliance
4. Pay TV	Thompson's RCA/DSS; Sony/DSS; DirecTv, PrimeStar, Hughes Electronics (Satellite), Scientific Atlanta, SCM Inc.
5. Electronic Health and Electronic Benefits Transfer (EBT)	RealMed, Federal and State Agencies, Citibank EBT, Western Governors Alliance
6. Travel	Hilton Hotels, Airlines, IATA, Local Transport Authority (Washington, Ann Arbor, San Francisco), IBM Smart Cards
7. Access and ID	Government (Federal and State) Agencies, Biometric Consortium, Financial Institutions

The key players in the smart card industry and their inter-dependencies are illustrated in Fig: 5.

**Fig 5: Key Players in the Smart Card Industry**



The two major smart card organizations, *Smart Card Forum* based in Washington, DC and *Smart Card Industry Association (SCIA)* play an active role in promoting smart card initiatives in the United States and act as a liaison between the private sector and governmental agencies.



## Smart Cards Use By Industry Segments

### 1. Financial and Banking Segment

The attention focused by banks and financial services in the chip based Smart Cards over the past 2-3 years can be attributed to several factors:

- The changing attitudes of consumers and growing acceptance of technology, especially card based payments.
- The declining chip costs even at higher memory and security make smart cards attractive for multi-applications.

The increasing concern about fraud associated with magnetic stripe based card systems. The chip card improves card authentication and also off-line PIN verification using the crypto-chip.

- The growth of consumer interest in transacting remotely - over the Internet, phones, PCs, screen phones, cable TVs and the need for enhanced security.
- The search for new revenue opportunities by banks and financial services firms. Stored Value Cards (SVC) and multiple applications Smart Card offer opportunities for cost reduction, future revenue growth and loyalty programs.
- The commitment of major financial services and banks such as VISA, MasterCard, American Express, Citibank, Bank of America, First Union, and NationsBank to support and promote chip based Smart Card payment systems.

The growth of Smart Cards in the Banking sector is primarily due to the issuing of Stored Value Cards (SVCs) and reloadable chip cards by the major US banks. The publicity and adoption of Visa Cash in the Atlanta Olympics' 96 has enabled the first mover banks such as First Union, NationsBank, Bank of America and Citibank to further pursue with pilot projects in reloadable SVC in other sites. The banks and credit-card agencies also await the acceptance of Secure Electronic Transactions (SET) protocol for Internet based purchases to trigger the use of smart cards as a viable and secure payment mechanism.

The cooperation of Visa and MasterCard to test the interoperability of Visa Cash and Mondex using the same terminal readers in the on-going Manhattan pilot along with the participating member banks Citibank and Chase-Chemical will further increase the visibility and acceptance of SVCs by other banks and consumers.

In 1996, there were about 500 million credit cards in circulation in the United States. Visa has an aggressive goal of converting 1/3 of its 600 million credit cards world-wide into smart cards. Mondex (MasterCard) is yet to make any major issuance but has been very successful in Canadian pilots. The European Proton technology (from Banksys) with about 20 million smart cards has been licensed by American Express for its pilots and programs in the United States. Royal Bank of Canada, Canadian Imperial Bank of Commerce and ABN AMRO are using smart cards for customer authentication for account information and payment transactions.

## **2. Campus Segment**

Another important trend in the Smart Card sector is the increasing use of chip based Smart Cards by US Universities and Colleges. The banking component is a primary function of these multi-function cards. Already, among others, Florida State University and University of Michigan have issued more than 40,000 and 100,000 respectively. Washington University has issued about 10,000 campus smart cards.

The potential for smart card adoption by schools are bright. There are about 25.7 million students, faculty and staff in universities and colleges in the US. The National Association of Campus Card Users (NACCU) is the major organization bringing together interested Universities and Smart card providers.

## **3. GSM-PCS**

In 1996, Europe, being a leader in the adoption of GSM technology, had about 55 percent of the total world market of about 28 million GSM chip cards. But, the GSM-PCS market is only at its infancy in the United States but is poised to grow rapidly.

Telecom companies like Sprint Spectrum, BellSouth, US West and regional Bells are very active with pilot programs all over the country. Over the next five years, the full-fledged adoption of PCS variation in the US market will push the market share of US to grow rapidly. Already, in late 1996 the GSM adaptors such as Omnipoint, APC, Bell South and Western Wireless have firm orders for over 4 million chip cards from Orga and Gemplus. The introduction of low power/ low voltage microcontrollers with about 16 KB EEPROM at low cost (about \$5.00/each) will increase the wide use of GSM cards. Motorola last year formed a separate Smart Card SBU and has recently licensed JavaCard technology from Sun Microsystems to target primarily GSM-PCS markets.

## **4. Pay-TV**

The market for Pay TV Smart Cards in the US is primarily driven by the advancement in the chip technology, especially in EEPROM and crypto-processors. In 1996, there were about 4 million Smart Cards in use in the US Pay TV market. The major players in the US Pay TV market, DirecTV and PrimeStar are growing with about 1.7 million and 1.3 million customers respectively. DirecTV expects to have a customer base of about 8-10 million and PrimeStar about 4-5 million by the end of the decade.

Though there are smart card initiatives in the US Pay-TV market, the visibility and success has been low due to competing standards and high price for crypto-cards. Scientific Atlanta, and SCM Inc. based in San Jose, CA are the leaders in this market segment.

## 5. Electronic Health and EBT

In the United States, the use of Smart Cards for social welfare is already in place in the form of Electronic Benefits Transfer (EBT) projects. The primary driver for EBT projects has been the Department of Agriculture's Food and Consumer Service (FCS).

Since 1996, 10 States have operational EBT projects, and about 40 States are considering EBT projects in the very near future. The welfare benefits being first transferred using EBT are Food Stamps, Women, Infants and Children (WIC) and Aid to Families with Dependent Children (AFDC). There are about 25,805,640 persons getting food stamps and AFDC each month in the US. The average benefit per person is currently at \$73.37 a month. The total caseload for all Federal and State benefits is about 31 million persons and about \$112 billion in benefits transfer each year. Though most States are trying magnetic stripe card based EBT systems, some States such as Wyoming and Ohio are implementing Chip based Smart Cards. In 1997, the Western Governors Alliance (WGA) contracted Siemens North America for a smart card based Health Passport Project (HPP) pilot.

But, unlike in Europe, the use of Smart Cards for health care has not made any significant inroads yet in the United States. Due to concerns about cost and confidentiality, and the lack of a comprehensive national health policy, the US health care industry has so far shield away from Smart Cards in favor of cardboard or magnetic stripe cards.

A major push in the Electronic Health Smart Cards is being undertaken by *RealMed* targeting major health insurance issuers. RealMed is taking an active role in familiarising insurance companies of the benefits and cost reductions of smart cards as IDs.

## 6. Travel Segment

The use of Smart Cards in the US transport industry is growing steadily. The primary areas of smart card use in the Transportation segment are:

1. Automatic toll fare collection (contactless type)
2. Mass transit (contact/ contactless type)
3. Ticketless travel (contact) and
4. Loyalty based multi-application cards

There are several pilot projects underway in the US using the Smart Cards for public transportation. Most of the Smart Cards will be Contactless type. California, New Jersey and Connecticut are early adopter States for using Smart Cards for the automatic toll collection. Also, major US airlines such as American, Delta and Continental are testing the viability of a smart card solution for ticketless travel programs through several pilot programs in conjunction with IATA.

## 7. Identification and Access Segment

The primary drivers for the use of Smart Cards for identification and access control in the United States are Federal and State Government Agencies. State Drivers' licenses, State Fishing & Hunting licenses, Federal ID programs such as INSPASS (Immigration Pass for US Permanent residents), Military inventory control and staff ID cards, and private sector employee access control card programs such as the MasterCard pilot using biometrics based Smart Cards.

There are about 180 million driver's licenses in circulation in the US and about 4-5 million new cards are issued each year. Many States have started pilot programs either using magnetic stripe or chip based Smart Cards. In 1996, the US market for chip based ID cards was very small at about 300,000. This figure is bound to grow steadily in the coming years. The availability of computer chips with high speed crypto processors and faster encryption execution time will propel the adoption of multi-function Smart Cards in the Identification sector.

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## Appendix

### **I. Current and Potential Customers for Smart Cards by Industry Segment**

<b>Application</b>	<b>Target Customer</b>
<b>1. Banking</b>	AT&T Universal Card, ABN Amro Citicorp, First Chicago Corporation, American Express, Bank of America, Bank One, GE Capital, First Union Bank, Discover Card/ Greenwood Trust, MBNA America, Household Credit Services
<b>2. GSM-PCS</b>	AT&T Wireless Services, Bell South, Bell Atlantic, NYNEX Mobile, GTE Mobilnet, LA Cellular, Sprint Spectrum, Wireless Telecom, US West
<b>3. Electronic Health and EBT</b>	<u>Health Care:</u> Aetna Health Care, Blue Cross & Blue Shield, Columbia HCA, CIGNA Health Care, FHP, Health Net, Pacific Care  <u>Electronic Benefits Transfer:</u> Federal Government Agencies, State Governments, Southern Alliance of States(SAS), EBT Council
<b>Pay TV</b>	<u>MSO:</u>

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	<p>Cablevision Systems, Comsat Cable, Cox Communications, Rogers' Cablesystems, TCI Corporation, Time Warner Cable, US West, Viacom Inc.</p> <p><u>DBS:</u> RCA, USSB, AT&amp;T/ DirecTV Primestar</p>
<b>4. Identification</b>	<p>Microsoft, Netscape, Visa/ MasterCard, American Express, America On-line, CompuServe+Prodigy, Universities</p>
<b>5. Transportation</b>	<p>State Transport Authority, Delta Airlines, Continental Airlines American Airlines, United Airlines, City Transport Authority</p>

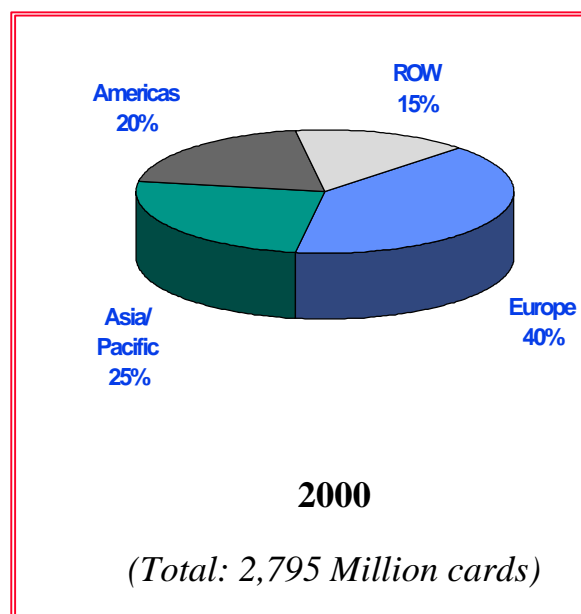
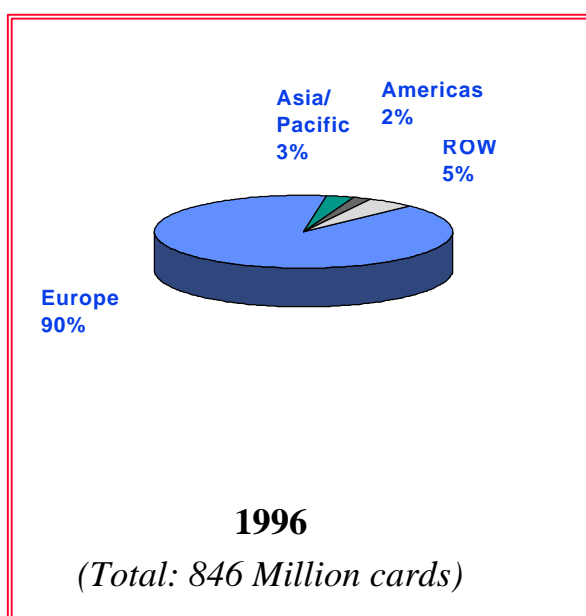
## II. Smart Cards In Numbers

**World-wide Chip based Smart Cards By Category (Millions of Cards)**

Category	1996	2000
GSM cards	28	76
Financial cards	65	414
Health cards	46	414
ID cards	2	294
Pay TV	28	137
Transport	9	110
<b>Total</b>	<b>178</b>	<b>1445</b>

Source: Card Technology research, Faulkner & Gray Company, 1997.

### *Smart Card Market By Region*



Sources: Card Technology; Dataquest