# Smart cards

Imagine you are driving to your workplace in car. You show a plastic card to cop instead of your license and he lets you go. Midway you stop at the gas station and a coffee bar and use the same card to clear your bills.

This card also helps you to withdraw cash from ATM and provide access to your password protected cabin. You carry the card every time you visit your doctor or insurance agent. The card can also help others to track your location in case you met with an accident on your way back. This technology of size as small as a visiting card can carry out all your transactions accurately and securely. It makes one possible to move carrying all the information on a single card in his pocket.

Envisage a day when all offices will turn virtually paperless courtesy this small chip based card.  Welcome to the world of – " Smart Cards". Smart Card: Smart card is a plastic card which has computing capabilities. It has an embedded microprocessor which can be programmed to perform versatile operations.

It also has an operating system to interact with hardware and carry out data manipulation tasks. Memory chip is used to store data. The data can be added, deleted or modified by the microprocessor. However smart cards without microprocessor are also available. They possess only memory.

They can perform only predefined operation and are non-programmable. Smart cards also require a " card reader" to read, write and process information on cards. Magnetic Strip Cards Vs Smart Cards. Smart cards are often mistaken with the magnetic strip cards (such as ATM cards). The

magnetic strip card has to connect to a remote data base to access data. It does not store data on it .

Magnetic strip cards mainly perform the user authentication. In the case of smart card all the required information is stored in the card itself. Hence it does not require connecting to any remote databases. Some of the applications where these cards find smart application are identification, cash transactions, communication, mapping and location, security etc. we cover these applications in greater detail in the later part of the paper.

History And DevelopmentSmart cards were invented and patented in 1970's. However there is a dispute over the inventor of Smart Card between Jürgen Dethloff of Germany, Kunitaka Arimura of Japan, and Roland Moreno of France [6]. Roland Moreno finds a wide acceptance amongst the three. Since its invention the Smart cards have witnessed a continuous evolution in technology and its commercial viability.

The Purdue University makes an attempt to tracks the progress of smart cards since their invention on their website which is reproduced below [3]1971 – U. S. patent 3702464 filed for an information card for credit and accounting system having monolithic or solid state memory for storage of information responsive to computer controlled systems by Paul Catrucci. This patent was the basis for a card with an IC chip.

1974 – Concept of a credit card with a micro processing chip by French journalist Roland Moreno. This concept started the movement towards a truly " smart" card. 1976 – A Smart Card is developed by Cii Honeywell Bull, a French computer company. 1980's – Testing of the Smart Card in France by

the National Communication Laboratory. 1982 – Point of Sale (POS) applications in France. 1983 – Deutsche Bundespost carries out study on Smart Card technology for phone systems in Germany.

1983 – U. S. Department of Defense tests the IC card for military identification systems. 1984 – Groupement des Cartes Bancaires (CB) uses Smart Card technology for banks in France.

1993 – Three payment systems recognize that comparable specifications for the interchange of information between Smart Cards and readers are required. 1994 – Europay, Mastercard, and Visa (EMV) specifications created for electronic cash. 1996 – 1. 5 million contact less cards issued in Korea for bus fare. 1996 – Smart Cards used at the Summer Olympic games in Atlanta for use in local merchant stores. 1996 – Applications are not just for telecommunications and financial transactions.

Future – Multifunction and multiple application cards with new uses. (Achieved presently in 2007)Types Of Smart Card  [1]Smart cards can be broadly classified on the basis of functionality as follows: Microprocessor based cards: They offer good storage and data security. The current cards come with an 8-bit processor, up to 16KB ROM and 512 bytes RAM. These cards find applications in diverse fields that are discussed later in the paper. Memory Cards: They have memory chips that can hold up to 4 KB of data. They do not posses embedded microprocessor and hence cannot process data.

They are generally limited to single predefined operation. (E. g. Phone Cards.

)Optical Memory Cards. They use optical medium (such as compact disc) to store data instead of chip. The data once written is permanent i. e. It cannot be deleted or modified. Such cards are used mainly for record keeping applications.

Storage capacity up to 4 MB can be obtained from these cards. Smart Card Readers [4]They are used to read and write information on smart cards. They are usually interfaced with the PC. The readers are available in various interfaces such as serial, parallel, USB, PCMCIA, Infrared etc.

When the card comes in contact with the reader both match their identities by following adhering to a predefined communication protocol (generally ISO 7816). No further data processing takes place if there is a conflict. The reader provides an interface to execute commands on card's data. The reader uses the functions of Card operating system to process information. Smart card can communicate with the reader mainly by two types. Accordingly they are classifies as -Contact Smart Cards: These types of cards have golden plate or contact pads.

These plates make a direct electrical contact with the Card reader. Contact less Cards: In these cards direct contact with the card reader is avoided. Radio frequency is used to establish contact between the card and the reader. Combo Cards: These cards can operate in both modes i. e. either contact or contact -less.

Working Of Smart CardGeneral cycle of interaction is mentioned below: 1. Establish contact with reader2.    User authentication using PIN (Personal Identification Number), biometrics etc. 3.    Selecting operation from Menu4.

Data entry / Command executions5.    Conform actions6.    Exit and disconnect contact. Smart Card Operating SystemJava Card Operating system developed by SUN Microsystems is a popular operating system used on Smart Cards. The main feature of this operating system is it is architecture independent and hence applicable to smart cards with different architectures. It also facilitates upgrading of application loaded on smart card or installing new applications.

MULTOS (Multi application operating system) is another operating system used by smart cards which supports multiple applications. Information SecuritySmart card stores sensitive information such as person's medical history or financial status. Smart cards are used to grant access to authorized users. They are used for money transactions. All these operations demand for safe and reliable data storage and data transfer.

Data security is thus an utmost concern with any smart card. Smart card implies various technologies for securing data and its transaction. Some of them are discussed below. Encryption: Data is stored and exchanged in encrypted form. This format is nearly impossible to interpret without key that decrypts it.

The key is shared between the source and destination and any unauthorized access is safely avoided. PIN: Personal Identification Number remains the simplest yet efficient way for user authentication. Only authorized persons should have access to card's information and application. The card ensures this by confirming the PIN of the user.

PIN protects the card form unauthorized access in case of theft or loss. Biometrics: This is an advanced and highly secure mode of user Identification. Biological features of individuals such as finger prints, eye, face or voice are unique. Instead of PIN such features are used to establish user identity.

This however is an expensive technology and needs additional sensors for identification. Digital signatures: They have come into wide circulation after large number of fraudulent transaction occurred on Internet. Users register themselves with digital signatures for carrying out transactions online. Each time a user performs transaction his signature is verified and transaction takes place only if user is genuine. Smart Card ApplicationsThe versatility of smart cards cannot be doubted sighting the wide range of application for which they are used.

Smart cards are used for identification, access control, transactions, remote location, accessing various services. Identification: Smart cards are used for identifying people at workplaces or in clubs etc. They can be used to mark attendance and calculate salary of the employees. They can be used to prevent gatecrashers from entering into a membership club. Access Control: They are used to provide data access only to privileged users.

For this Smart card uses various tools such as PIN and biometrics which are discussed earlier. They can restrict employee from entering into a restricted area at workplace (such as chief officer's cabin) or denying critical services (such shutting down server) for which he may not be authorized. Banking: Smart cards find major application in Banking. Smart cards can be used for

banking transactions such as deposit, withdraw cash form ATM. They can maintain records of all bank accounts and their transaction history for the user.

Personal Records: A single card can be used to store all vital information such as medical records, law and criminal records, driving license, Social Membership Numbers etc. Remote Location: Extremely important in search and rescue operations in case of natural calamities, hazardous occupations like mining or locating soldiers in wars. The position of smart card can be tracked with the help of Global Positioning System. They can be used to trace path while driving and even find the nearest ATM, restaurant, gas station or hospital. Services: They can be used to access various services like Telephone, Transportation such as train or air travel , Entertainment such as movies, discos etc , Other Transactions: Smart Cards can be used to carry out various transactions like paying electricity and phone bills, insurance premiums and filing of taxes.

All these transaction can be performed sitting at home without visiting any of the offices in person. Short Comings [5]All technologies have their disadvantages and smart cards are no exception to it. Smart cards face major limitations with respect to accessibility cost and security. Availability of Smart Card Readers.

The mobility of smart cards depends on the availability of smart card readers. The readers must be compliant with the smart cards. There is a need for universal smartcard readers that can read any kind of cards irrespective of the vendors or their architectures. Expensive Technology: The

latest technologies such as use of Biometrics and Satellite communication are expensive and hence limited to a specific few applications. Environmental EffectsCards are vulnerable to static Electricity, Magnetic field, Temperatures and Ultra-violet Rays. As one of them can always be found present handling of smart card needs great card in order to avoid corruption of data.

Loss or theft. It is not very difficult to loose or steal a smart card. In such cases one becomes entirely handicapped with respect to all transactions. In addition it is quite likely that sensitive information recorded on the card can be misused. Cracker attacks and viruses. The cards can encounter cracker attacks.

The most common among them are the phishing and unsecured transactions on Internet where sensitive information such as Card No and PIN No are retrieved from the user under pretext.  Smart cards are also susceptible to virus infections which can corrupt data or cards operating system. Porting Applications is DifficultDifferent operating system use different functions for communication. Due to this it is difficult to port application written for one card to another card. Sometimes two entirely different applications have to be written to perform same function on two different cards.

Future ResearchThe above short comings open up new areas of research in smart cards. Artificial Intelligence: To provide smart cards with artificial intelligence capabilities. This will assist them in decision making and customizing data according to condition. Say if the card gets stolen it sends the copy of data to the authorized user and formats the card.

Global Access: Achieve true mobility to smartcards irrespective of geographical areas. This calls for standardized manufacturing, universal card readers and drafting required communication protocols. Multiple Application Support: Enable cards to support maximum applications on single card with minimum cost. User can customize the card according to his needs. Hardware and Software:-        Enhancing the processor speed and increasing storage capacity.-        Make smart cards vendor and architecture neutral.

.-        Standardize card and reader API for different operating systems in order tofacilitate porting of application. Security:-        Design robust algorithms for protection against attacks.-        Using Biometrics for enhanced security features. Areas of Application: Discover new areas of application for smart cards such as forensics, manufacturing, agriculture, space etc. ConclusionSmart cards have found major application in our daily routine.

Smart cards have changed the way we handle our daily transactions and maintain records. It has made life more convenient. However there are also threats of theft, loss or attacks. Smart cards still have to go a long way in ensuring robust security before it truly become smart.