‘Smart Cards in Public Health Care’

GlobalPlatform Smart Card Technology implemented to optimize the quality of delivery and efficiency in Taiwan’s health care system

Overview

In April 2001, Taiwan’s Bureau of National Health Insurance (BNHI) commissioned a project to design, manufacture, and distribute a Java Card based open platform health insurance card system for Taiwan’s 24 million citizens.

After a successful trial that significantly reduced the overhead cost in Taiwan’s health care system and increased customer satisfaction, the BNHI, an agency of the Government of Taiwan under the Ministry of Health, selected GlobalPlatform’s smart card technology to roll out a nationwide program. German technology group, Giesecke & Devrient and Taiwanese TECO Electric Machinery formed a joint venture, GD TECO, to implement and manage what has become the world’s largest and most modern smart health card implementation with over 23 million smart health cards issued, and the first GlobalPlatform Java Card project for health applications.

Over the past twenty years, smart cards have become increasingly important in a specific number of business sectors including, banking, corporate uses, mobile communications and transportation. In these sectors, uses of smart cards range from storing data to processing information, to proving identity, to acting as a key to securely access information.

The Taiwan National Health Insurance card implementation suggests that smart cards are now being implemented more broadly and in a greater number of businesses. In a report issued in January 2003 by HBS Consulting, the industry organization, Eurosmart, predicted that future shipments of microprocessor cards to the government sector worldwide would rise from 32 million cards in 2002 to an estimated 60 million cards in 2004. This growth is being driven in part by the ability of smart cards to securely store data and carry multiple applications. For the health care industry, this translates into an ability to securely store patients’ and medical data, verify entitlement to health care services and benefits, and grant access to health care networks, both for physicians and patients, under different insurance schemes but all on one card. This one card approach created significant cost savings for Taiwan’s Bureau of National Health Insurance and provided considerable benefits for all involved – patients, service providers and health organizations.

Principle components of the smart e-health system include the Patient Health Card (PHC), the Health Professional Card (HPC) and the background system. Patient Health Cards allow patients to permit the physician of their choice to access their personal data, additionally protected by means of a PIN. Health Professional Cards allow physicians and pharmacists access to patients’ medical data; however, only with the explicit consent of the patient. The background system allows secure storage of patients’ personal files, which can include medical records, test results, X-rays, ECG’s and more medical and administrational information.

Background

The Taiwan National Health Insurance System (NHI) is a single-payer national health insurance scheme administered by Taiwan’s Bureau of National Health Insurance (BNHI) and financed through a mix of premiums and taxes. The NHI covers over 22 Million patients, or 97% of Taiwan’s population, 86% of all its hospitals, 65% of all hospital beds, and 90% of Taiwan’s doctors. The NHI has three main objectives:

1. To provide equal access to health care for all citizens;
2. To ensure quality and efficiency of health care delivery to all citizens; and
3. To grant each patient the right to choose his or her own provider, treatment or therapy.

To administer the insurance scheme, the BNHI had introduced a paper based voucher system that allowed the health provider to identify insured patients and administer health care delivery expenses. Taiwan’s paper based program vouchers included four different types of vouchers: children’s health book, prenatal exam handbook, catastrophic illness certificate, and a regular paper card.

In 2001, the BNHI commissioned a project to improve its paper based voucher system with the goal of improving Taiwan’s health care delivery quality. Historically, following each doctor visit, the BNHI administration system would receive a patient’s medical and insurance data from his or her doctor, any necessary additional providers, the laboratory, or the pharmacy via mail. This process required the generation and administration of separate messages to each of these providers resulting in redundancy, wasted time and extra cost as each message translated into a significant amount of paperwork, and a considerable amount of time to reach the recipient for processing. The Taiwan paper based voucher system allowed a limit of six credits per paper card, i.e. each patient could use the card up to six times before it required replacement. These six credits could include a visit to up to six different doctors, visits to the laboratory, a prescription refill at the pharmacy, before a trip to the BNHI for verification and processing of the applicant claims became necessary. The BNHI would only have the ability to track a patient’s outstanding fee balances after six credits per card. This would expire the card and force the patient to return to one of the BNHI branch offices for verification. This inefficient tracking system, resulted in fraud and loss of revenue for the BNHI. Patients could incorrectly use the paper card for several visits to different doctors for the same case or even medical abuse at the pharmacies.

Since the card was paper based, counterfeiting also proved to be a problem. A segment of the insured population duplicated cards to provide counterfeit versions, providing uninsured patients with free medical coverage. Moreover, patients could submit incorrect applications to the BNHI from which the BNHI could not verify their authenticity.

To address these problems, the BNHI commissioned a project to design, manufacture, and deploy a Java Card based open platform health insurance card system. This “smart card” project needed to address several objectives:

- Improvement of health care delivery quality,
- Elimination of waste, abuse (incorrect usage, visiting, checking and medication abuse) and fraud (counterfeit and incorrect fee application),
- Higher transparency through efficient communication between health care providers and BNHI,
- Future ability to introduce new payment incentive systems towards greater accountability for quality (e.g. incentive systems based on fee-for-outcome instead of fee-for-service),
- Efficient processes through full use of electronic media,
- Further reduction of administrative costs.

The primary goal was the replacement of all paper voucher cards into one smart card that could store all medical history data and treatment expenditures.

**The Solution**

GlobalPlatform smart card technology provided a comprehensive and flexible solution to address all of these functional and technical requirements defined by the BNHI. As a standardized technology, GlobalPlatform provides an open platform, secure chip technology, high data and communication security, memory capacity, flexible programming options including post-issuance of applications, and a standardized interface. It also grants access to value-added services planned for the future of the program thereby eliminating the costs associated with infrastructure upgrades.

GlobalPlatform’s technology was chosen to replace the paper-based system with ONE secure electronic chip card that could securely store all medication history data for the patient, doctor, pharmacy, laboratory, and BNHI, improving communication within the health care system. This would result in the enhancement of overall health care delivery quality and efficiency. Real-time data on insurance status and medical records would provide
convenience and efficiency. The card could store patient’s medical records, doctor visits, medication information, and enable physician’s to access those records by means of a PIN through the explicit consent of the patient.

GlobalPlatform’s open Java Card based platform allowed for multiple applications to co-exist on a single smart card, thereby granting patients the option to consolidate different functions on the card such as medical records, insurance information, personal data, and medication information. Counterfeit issues and incorrect fee applications would significantly decrease, as each patient would be authenticated to their individual card.

The high security of GlobalPlatform’s technology would provide a significantly higher measure of transparency for the patient with regards to their medical records and treatment costs. The smart card would enable patients to gain control over the use of their own medical data. Medical practitioners, equipped with their own physician smart card, would only gain access to the electronic files with the patient’s consent. Moreover, the storage capacity would allow the physician to store the diagnosis, treatment details, and prescriptions directly on the smart card. The card’s security features would provide for BNHI’s need to address the user’s insecurity over transferring confidential information between patient, provider, and insurance company.

The high frequency of card replacement due to the limit of six available credits per card lead to high maintenance fees and employee turnover rates for group insurance applicants. This system did not provide a mechanism to track the outstanding balance. A smart health card would not expire and thus allow patients continued access to medical resources and health care institutions the technology to track the outstanding balances via electronic media.

All of these outlined benefits inherent to GlobalPlatform’s smart card technology lead to a reduction in administrative costs for the BNHI. After each patient visit to the doctor, laboratory, and pharmacy, the BNHI would need to update the card data. With GlobalPlatform technology, updating the information on the patient’s medical history, storing their payment information and contribution to medication costs, facilitated considerable cost savings. According to estimates, updating this information could lead to savings of up to EUR 250 million a year for example in the German health care system.

**Project Scope**

Worldwide, the Taiwan National Health Insurance Card Project became the most innovative e-health project with over 23 million cards issued. The parameters included a redesign of the complete health care system infrastructure, the installation, deployment, and usage of computers throughout Taiwan’s medical institutions, and the elimination of any media disruption that occurred with the paper based voucher program and all parties involved in the BNHI.

The timescale for design, production, and implementation of this project was April 2001 to May 2003 and included the following:

- Design, manufacturing and distribution of 24 million IC cards (HCC and HPC)
- Design, manufacturing and distribution of 300,000 reader SAM
- Design, manufacturing and installation of 20,000 reader
- Establishment of computer network for BNHI Head Quarters
- Operation Management
- Training to end user and provider

The project cost was approximately NT $4 Billion or $110M US Dollars.

**Development of the Solution**

Together with its joint venture partner, TECO Electric and Machinery Co. LTD, Giesecke & Devrient set-out to build Taiwan’s largest production facility, GD TECO, that was responsible for the production of the smart health cards. Located in Kuang-In, Taoyuan County, GD TECO is the biggest personalization plant in Asia, with the capacity to produce 3.4 million cards per month. Their production services included printing, card body production, module preparation and chip card assembly, cards personalization, and lettershop.
GlobalPlatform Member solution providers involved in this project include Giesecke & Devrient, Hitachi, Infineon, and Sun Microsystems. Hitachi and Infineon manufactured the chip technology for the patient and physician cards based on Sun’s Java Card technology.

Based on the motivating factors for this project, functional and technical requirements defined by the BNHI, and the following security criteria needed to secure the storage of patient’s data, Giesecke & Devrient selected GlobalPlatform’s Card Specification v2.1:

- Authentication of card user
- PIN Identification
- Patient data access (read) with Health Professional Card (HPC) only
- Write access in authorized terminals only
- Crypto - technology
  - Symmetrical for HCC access
  - Asymmetrical in the system (PKI)
- Multi-layer security system
- Protected entire logistic chain including tracing of information
- Online and offline security

The high security concept for the Health Insurance Card also translated into a high security card body and design, including security technologies like rainbow printing, guilloche design, OVI and micro text, as well as many more security features to make counterfeit impossible. The design of the card and information about the smart card can be accessed at [http://www.nhi.gov.tw/00english/e_index.htm](http://www.nhi.gov.tw/00english/e_index.htm)

There are four sections of information stored on the NHI IC Card, including personal information, NHI-related information, as well as medical services and public health administration information. The contents of the NHI IC Card are as follows:

- The Personal Information Section mainly includes the card’s serial number, the cardholder's name, gender, date of birth, ID number, picture and the date of issue.
- The NHI-related Information Section mainly includes the remark of the cardholder’s status, remarks for catastrophic diseases, the number of visits and admissions, the utilization of the NHI health prevention programs, the cardholder’s premium records, the records for accumulated medical expenditures, and the amounts of cost sharing.
- The Medical Services Section mainly includes the drug allergic history and the long-term prescriptions of the ambulatory care and other medical treatments. This section will be gradually phased in depending on how the health care providers adapt themselves to the system.
- The Public Health Administration Section mainly includes the personal immunization chart and the willingness for organ donation.

The overall project implementation lasted from April 2001 until mid 2003 and included the roll out of 23 million GlobalPlatform smart health cards. The initial roll out of personalization was done at the central high security card bureau of the GD TECO factory, whereas replacement cards were personalized at the decentralized branch offices of the BNHI. The roll out of the 23 million GlobalPlatform smart health cards took place on a regional basis and included multiples stages such as ongoing infrastructure upgrades, public education, and acceptance of the new card system.

**Results**

Driven by the need to provide a secure electronic information exchange and cost effective infrastructure to support health care applications, the Taiwan National Health Insurance Card has yielded positive results in all areas that have been described as the motivation for this project.

As already mentioned, over 23 million Health Cards have been issued. The cards have been in full scale usage by the Taiwanese citizens in the health care system since January 2004 and have witnessed a high acceptance rate. The card is already being used to identify citizens outside of the health care system. The card yielded another interesting result during the time of the GlobalPlatform business seminar in February 2004 in which some travelers used the card as an ID document on a domestic flight from Taipei to Kaoshung.

As of March 2004, approximately 45,000 Health Professional Cards have been issued and this process is still ongoing. The Health Professional Cards enable...
the 2nd phase of the program which is the processing of medical data in addition to the administration data. More than 50,000 chip enabled readers have been installed in hospitals, clinics, etc., all based on the BNHI specification. The installed infrastructure and the full-scale usage of the Health Insurance Cards now enable the BNHI to realize the possible cost reductions targeted with this project.

From July 2003 onwards, de-centralized card issuing centers are operational at six BNHI sites around Taiwan and the Government Bureau. The BNHI is driving the program with a roadmap of additional systems and card functions, such as merging the health card replacement issuing system with the health care card system.

GlobalPlatform card technology offers the health bureau possibilities for further introduction of new functions that include the dynamic loading of information onto the existing card.

Due to the following critical success factors, GD TECO’s card factory and card personalization bureau built for the Health Insurance project is now also being used for businesses in other segments such as banking, telecom, and transportation:

- Highest security implemented for the Taiwan National Health Care Card Project
- Built according to MasterCard, Visa, and JCB Standards
- G&D card technology, COS, application know-how, system design and implementation
- Latest production technology; highest efficiency in personalization center
- Local manufacturing & personalization center, large project management and technical support, consulting service

This national project has laid the foundation for Taiwan’s smart card infrastructure and acceptance for the usage of smart cards with multiple applications.

Lessons Learned – Moving Forward

The Taiwan National Health Insurance Card project demonstrates how a Government can successfully deploy a proven smart card technology to improve the quality and cost efficiency of services to an entire nation. Due to the strong support from all parties involved, this project was implemented within record time, within budget and full functionality, and achieved a high acceptance rate. How was this possible? The answer is three fold:

1. The right application design,
2. The right technology and
3. The right implementation team

The right application design: The definition and design of the use-cases of the application and the security in both the system and the smart card was crucial to the success of a nationwide program. Only with the detailed knowledge of the user processes and the technical skills of a state of the art security design house could this type of application be successfully implemented. However, the success is not only attributed to the card. Another primary success and consideration was the card’s ability to collect accurate data from the entire population.

The right technology: GlobalPlatform’s open technology ensured a fast time to market, cost efficiencies, and superior functionality. GlobalPlatform not only provided a large number of potential suppliers, but also provided the interoperability of solutions and reduced the time associated with implementation. The advantages of GlobalPlatform’s technology are:

- Portability of applications which allows the "Write once - Run anywhere" principle
- Standardized and secure card and application management
- One or more applications on a single card
- Cross-industry and card schemes interoperability
- Independent application development
- Dynamic pre-issuance or post-issuance load/removal of applications
- Faster time to market

The advantages of GlobalPlatform technology influenced the concurrent development of the project and enabled a reduced amount of time for the implementation. This not only applied to the first roll out phase, but also applied to future enhancements. GlobalPlatform offers an advanced, scalable, secure, and proven platform that provides the option to add applications in the future.

The right team: In addition to the strong support from the Government Bureau, a key success factor of
this project was the professional large scale project management concept that involved several vendors with overseas technical support and strong local partners who possessed a clear understanding of the processes and needs of the user. The ability of the team to react to new situations and challenges during the project proved to be a determination of success.

For Further Information

If you would like to know more information on the Taiwan National Health Insurance Card project please contact the GlobalPlatform Secretariat at secretariat@globalplatform.org or alternatively at +1 650 432-3219.

Sources

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