

The Card Management System, CMS, The Multi-service, multi-agent Service Delivery System

Ass. Prof.. Magdy E. Elhennawy, Dr. Sherief M. Badr

Abstract - The social and support service delivery systems are a common practice for most developing countries. The Family Card System, FCS, in Egypt, have been developed since 2006. It is responsible for the delivery of governmental support services in Egypt. The FCS starts with one service, today it delivers four services, and other services are ongoing. It proofs good performance, save budgets, allow family database for various statistics, and simplify delivery process. It uses smart cards as a tool to deliver various services. The system uses multi-application smart card technology to allow using one smart card to deliver all services delivered to the one family or individual. But the system suffers from some difficulties due to the delivery of more than one service belonging to more than one service owner having service providers each. Besides, the responsibility of more than one vendor to build applications on the same service delivery tool, smart card. Also, the need to build service delivery application by more than one vendor on the same service delivery unit, Point Of Sale, POS. this might cause the interchangeability and interference between services during service delivery, if not managed appropriately. The above difficulties lead to the need to follow a new approach to build and evolve the current system. This paper introduces a new concept

S for building the FCS, the introduction of the card management system, CMS. The paper introduces the benefits of CMS, the roles and basic functionalities that are needed to achieve the management and operation of the system more appropriately.

Index Terms— Smart card technology, Social programs, Service delivery system.

1. INTRODUCTION

Smart cards [1] have been used in several governmental applications such as identity management [2], e-passport [3], e-voting [4], electronic fare payment [5], and subsidy distribution [6] [7]. An automated system, the Family Card System, FCS, has been developed and implemented in Egypt by Ministry of State for Administrative Development, MSAD, in cooperation with Ministry of Supply and Interior Trade, MoSIT, and other ministries, to deliver governmental support services to deserved families and individuals. In this paper, we describe our vision for evolving the FCS in Egypt using smart cards. We introduce a new architecture for managing such systems, via the Card Management System, CMS, our best practice in developing as a new concept.

In this paper the following topics are introduced. The introduction is presented in this section; the overview is presented in section two, while section three surveys the current FCS system, covering the system operational aspects, the system technical architecture, and the development and implementation methodology. The current system drawbacks have been stated in section four and a worldwide CMS solutions have been surveyed in section five. The CMS have been stated in section six as the proposed solution to overcome the current system difficulties, including the proposed system architecture and capabilities. Finally the conclusions and future work are stated.

- Ass. Prof.. Magdy E. Elhennawy, High Institute of Computers and Information Technology, Computer Dept., El-Shorouk Academy, Family Card Project Consultant, Ministry of State for Administrative Development, Cairo, Egypt, E-mail: mhennawy@ad.gov.eg
- Dr. Sherief M. Badr, Computer science Dept., Modern Academy, E-mail: Sheriff_badr@afmic.com

2. OVERVIEW

Since 2005, a governmental subsidized and support services delivery system has been developed by MSAD, in Egypt, using smart card, the FCS, for two services belonging to same governmental entity, the Ministry of Social Solidarity, MSS. The two services are the ration commodity and social pension. In 2010, MSS has decomposed into two different ministries, the Ministry of Supply and Interior Trade, MoSIT, and the Ministry of Social Affairs, MOSA. Now the MoSIT is the owner of the ration commodity service

The nature of the system dictates that one family may deserve one service; other families may deserve more. Furthermore, it dictates that one service may be family-based while others may be individual-based. This leads to the need to restrict managing two basic issues, namely: 1) to control the eligibility of the families and individuals to such services, and 2) to control service delivery to guarantee the correct delivery of the services to eligible and deserved people.

Normally and by law, to add a new service to the system, a tendering process should be followed for transparency issues. This process might lead to contract new vendors. In the current system, more than one vendor is responsible for implementing and operating more than one service, while others are responsible for only one, and geographical overlapping exist in application of some services. For example, in one governorate, one vendor is responsible for the implementation and operation of ration commodity and other vendor is responsible for the supported bread. Both need to use same POS and same smart card. The existence or introduction of new vendors in the system to develop and induce a new service in the system leads to complicate the service development process.

The existence or introduction of new vendors in the system to implement and operate a new service in the system lead to complicate the service development process. On other words, it dictates the need to a very strong rules to control cooperation between new and already existing vendors to avoid any mistakes, or service delivery problems that may arise.

In the beginning of the development of the current system, the common specifications of the system implementation has been delivered to already contracted vendors to allow defining the frame of system implementation without defining a more restricted implementation rules, leading to

and MOSA is the owner of the social pension. Moreover, the LPG service, belonging to Ministry of Petroleum, MOP, and supported bread service belonging to MoSIT have been contracted to be implemented under the same system. The health care services are ongoing to be implemented on the same system. All mentioned services are managed by the same system using the same smart card as a delivery tool.

compatibility issues between vendors' modules. That is why current system suffers from the introduction of both new services, and eventually service owners, and new vendors to implement and operate such new service. That is why we should evolve the current system. The introduction of the CMS could solve such difficulties. To avoid any miss leading or incorrect behavior of the system, the current approach of the system should be evolved by applying card management system, CMS.

In this paper, we use the notion of service owner to refer to the governmental agency or ministry that is responsible for providing the environment to deliver a service, such as MoSIT, MOSA, or MOP. The service owner has service providers, such as grocers for ration commodities, Bakery for supported bread. Meanwhile, the service owner has service managers such as supply offices in ration commodities and supported bread to manage service provider quotas. The vendor is the contracted company which is responsible for implementation, maintenance, repair, and operate the system. The service coordinator is the MSAD, which is responsible for managing and enforcing the eligibility for both families and individuals for various services. MSAD is responsible for build and managing CMS.

3. CURRENT SOLUTION: CURRENT FCS, THE SERVICE DELIVERY SYSTEM

The family card system has been proposed, studied, analyzed, designed, contracted and is currently operationally monitored by the Ministry of State for Administrative Development, MSAD. The stakeholders of the system include the Ministry of Supply and Interior Trade (MOSIT), Ministry of Social Solidarity (MoSS), Ministry of Petroleum (MOP), and the Egyptian society.

MSAD has outsourced the implementation of the system to a vendor, which is in fact a consortium availing a set of components,

such as: service centers to conduct family's data manipulation, and call center to allow interaction with the citizens. It also avails technical support center to guarantee the system security and service provision continuity.

The FCS was intended to build a complete system for achieving a set of objectives. Such objectives are: guaranteeing the delivery of the support services to the deserved people, provide a families database to support the services delivery, allow civilized environment to provide the service. The system was composed of a set of basic components as shown in **Figure 1**.

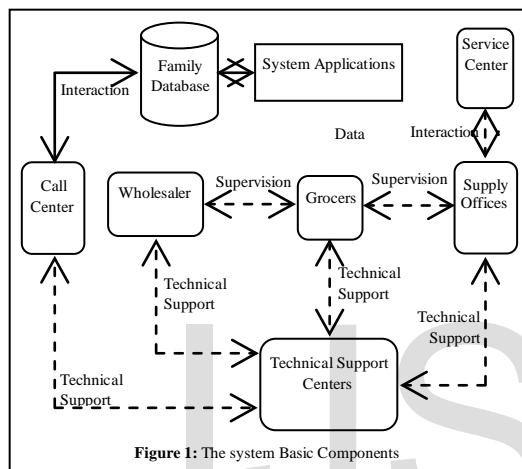


Figure 1: The system Basic Components

The system components are: the family database hosted in a data center, set of applications to achieve the system functionalities, call center, technical support centers, supply offices automation to supervise system activities, and service centers.

The centralized database receives periodically the modified version of the family database and the transactions database from the contracted vendors responsible for implementing and operating the system services delivery. To allow delivering more than one service to the citizen using the same smart card, the system employs a multi-application smart card technology [7].

A. System Operational Aspects

The family card system consists of operational components, which allows the successful delivery of services to eligible families; each family receives a smart card. Smart card contains indicators for the service allowed for that family. The grocer is equipped with a point of sale, POS, to register the commodities delivery

transactions. Transactions are sent to the central system through the network. Accordingly, a lot of processing and many statistical reports can be issued to plan for the service delivery. **Figure 2** shows the system operational aspects.

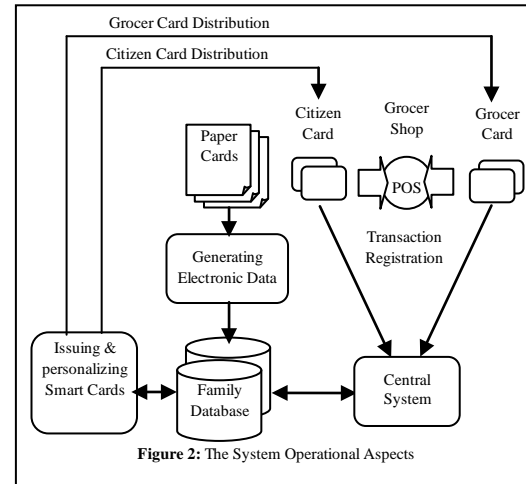
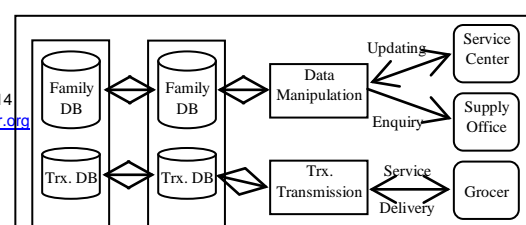


Figure 2: The System Operational Aspects

B. System Technical Architecture

To avoid monopoly, the system has been implemented by more than one vendor, each has assigned group of governorates. MSAD has studied the system requirements, prepared its specifications, and then delivered specifications to such vendors for implementation. MSAD has restored master and backup copies of family database for security reasons.

The system is a transactional processing system-based one; it records the commodities delivery to the citizens, in the grocer shop, which can be communicated to the central system, in which the system applications and database are hosted. The applications and database are hosted in data center that provides the standard specifications needed to secure database and applications. **Figure 3** shows an overview of the system technical architecture. In such architecture, service centers can access directly data hosted in vendors to update whenever requested by citizen. Meanwhile, supply offices which are responsible for managing the grocers quotas and control the quantities allowed for each one of them, can access directly system for querying only. One the main issues are the separation between service provider and service manager. On other hand, the grocers POS are communicating with and sending transactions to central system.



As the family card system is a national and process critical system; expandability, system resilience, system robustness, key management and security, interoperability, and continuity, were critical factors taken into consideration during its design process [7].

C. The development and implementation Methodology

The Egyptian government has planned to enlarge and empower the subsidy of commodities, the social pension, health insurance, and other services to cover underprivileged families. The family card is geared towards achieving such goals. As a key development issue, MSAD has followed the spiral methodology to implement the system development life cycle.

The key development and implementation steps includes; the establishing of an electronic database for Egyptian families including underprivileged families, defining the overall system technical architecture, and technologies and implementation strategies. Meanwhile, software development lifecycle has been followed. Multi-application smart cards have been employed for services delivery [8] [9]. On the other hand, the building of the network infrastructure of the system allows all stakeholders to communicate with the system. Service centers have been built for data manipulation. Call center, has been established to receive the citizens' requests and complaints. Training the system users has been executed. Then, hardware and software installation and overall system launching has done. System testing was conducted to guarantee correct system operation.

4. CURRENT SYSTEM DRAWBACKS

During the early implementation of the current FCS, a family database has been established. When the services are

belonging to same governmental entity, the MSS, for example, the service delivery rules are clear and simply applicable. Later on, the distribution of services among several owners, service providers, and vendors makes it difficult to receive and apply the delivery rules appropriately. Moreover, the distribution of services among many service providers types, such as: grocers, LPG warehouses, and bakeries, make it more difficult to manage such rules by the current system.

This situation, in current system, leads to some drawbacks. **First**, some crucial functions are not possibly and appropriately applied, such as card management application, card numbering applications, and others. The difficulty in the current system was the inappropriate coordination between eligibility of family and individual to various services. The lack of some applications such as the card numbering system, for example, make it possible that two cards might be issued with same number.

Second, the cooperation between vendors, when new services are introduced and new vendors are interchange each other, this needs more complicated rules to apply. For example, the distribution of the system specifications among vendors make them implement own system, each, interoperable with each other. But no rules have been proposed when more than one vendor need to deliver different services in the same place, governorate for example. Also, when these services are delivered by different vendors using same tool, the smart card for example, which need each can build his own application on the one card. This can lead to interference between applications and data. The same problem when two vendors deliver different services using same POS.

Third, in the environment stated above, the coordination between different services is crucial, meaning, the exchange of data between vendors' servers is basic. In this concern, the compatibility between vendor's servers is needed to exchange such data.

Fourth, the communications of various system parameters between various vendors, during service delivery, need the provision of the compatibility between vendors' equipments', applications and system software. For example, the exchange of black listed cards to be managed correctly and appropriately over all service all over the service providers' should be exchanged between vendors on time and in the correct

format, else problems might happen. Meanwhile, it needs a centralized go control and cooperation.

5. WORLDWIDE CMS SOLUTIONS, the CURRENT STATE OF THE ART

The social security systems and subsidized services are common practice in many countries, today. Furthermore, various subsidy delivery system using smart cards [10] [11] [12] already exist in many countries. Some of them are not yet automated such as, Cambodia, in which the social security system is still at an early stage of development and currently includes mainly two schemes, one for the civil servants (NSSF-C) which is still under development, and one for the private sector employees (NSSF). Until recently, social security coverage of informal workers despite making up about 73% of workforce was rather negligible [13]. Other countries have an automated system such as, Thailand, in which a national centralized online registration database linking providers to public health insurance [13].

Meanwhile, some countries apply smartcards for service distribution, such as India, in which, a comprehensive, partly long-established, system of social security has been established. A subsidized health insurance, RSBY, is providing to population below the poverty line, using smart cards. Each enrolled beneficiary is provided with a biometric smart card; beneficiary can visit any empanelled hospital across India; and is provided cashless treatment, on the other hand, hospital submits paperless claims to the insurance company [13]. But, other countries apply the CMS, but for a specific card per service, such as China [14].

6. CARD MANAGEMENT SYSTEM, CMS: THE PROPOSED SOLUTION

A. ARCHITECTURE

The proposed solution includes the implementation of the Card Management System, CMS. It allows a more compact and detailed interoperability between the system components. For example, vendors can develop service delivery application on either a delivery tool, like smart card, or using a delivery unit, like Point Of Sale, POS, in a more convenient and reliable way and in a cooperative manner. This could prevent interference in service delivery applications, both in the code or the data. On the other

hand, this could guarantee the correct behavior of the developed applications.

The proposed solution allows, also, the system reliability, since the delivery rules are collected from service owner, centrally by only one agent, the CMS. Such rules, then, are delivered to various contracted vendors in a unified delivery rules.

The CMS is responsible for performing a set of tasks, namely: 1) Receiving the monthly updates of the worthiness and deserving of the Egyptian families and individuals for various provided services. 2) Managing the installation of various services on the smart card of individuals and families in such a way that each has only the deserving services. And 3) Controlling the delivery of such services to the deserving families and individuals.

For the CMS to do this, there might exist three distinct databases, namely: 1) The Egyptian families' database, including for each family the family holder and the family members. Each family holder and family member, in the database, is supported by the national numbers, PIN. 2) The cardholder database, which contains each cardholder holding a smart card. The card itself is identified by the card number while the card holder database, is identified by the national number. And 3) The transaction, Trx, database, which contains the services delivery status, one or more transactions for each cardholder delivering his service periodically, according to service delivery rules.

The CMS, on the other hand, and to guarantee achieving its tasks correctly, is supported by a set of facilities, namely: 1) The G2G gateway, which enables receiving the updates for the Egyptian families from its entities and ministries responsible for sending these updates. And 2) Set of technical tools to enable a group of tasks. The first task is the control of the issuance of new cards with the coordination with the executing company and the governmental entities responsible for defining the eligibility. The second task is the control of the installation of each service on the cardholder card to insure that it is identical to the eligibility status received from the related governmental entity, so duplicate service delivery is controlled. The thirds insuring the delivered services have gone to the deserving families, without any loss, leakage, illegal delivery, or informal quantities in service delivery.

The proposed system, in the frame of CMS, can be viewed as composed of four basic components' roles; the CMS, the Service Manager Role, SMR, the Service Delivery

Role, SDR, and the Contracted Vendors Role, CVR. **Figure 4** depicts the architecture of the proposed system.

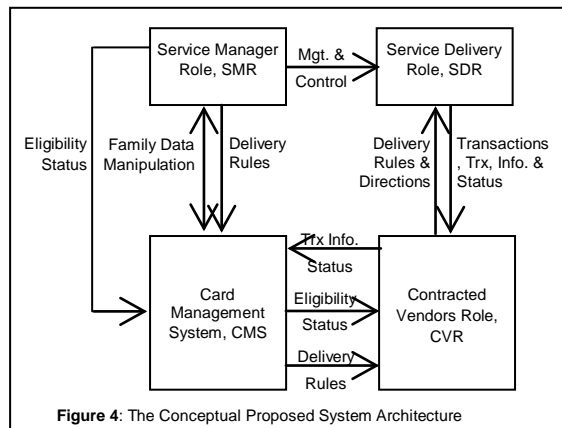


Figure 4: The Conceptual Proposed System Architecture

The various architecture roles are complementing each other. The CMS receives the delivery rules and eligibility status from SMR, allow family data manipulation according to a restricted access rules, fulfills any enquiry to SMR. CMS, then, send both and delivery rules and eligibility status to CVR, and receives the transactions data and status from the CVR. The SMR manages and controls the SDR, and manipulates family data in CMS. The CVR receives the transactions data and A set of functionalities has been developed to guarantee the correct delivery of services in the system. The capabilities and functionalities developed in the frame of CMS approach might be functionalities to control the issuance of smart cards in such a way that is reliable enough for the citizen convenience, the card numbering system,

status from SDR and deliver it to CMS after ensuring service delivery. It receives the eligibility status and delivery rules from CMS and delivers them to SDR to deliver services accordingly. The SDR receives the delivery rules and directions from the CVR and Send it the transactions data and status, under the control of the SMR.

B. THE CAPABILITIES

The objective is to allow controlling the delivery of multi-services belonging to multi-agents to both family-based and individual-based services appropriately. To prevent leakage of commodities through illegal delivery processes. A matrix of services against, services providers, and service type, whether family-based or individual-based is implemented through a well-designed database. The designed database keeps the needed relations that allow the restriction of the issuance of smart cards to deserved citizen to guarantee the service delivery.

the cross-reference between the eligibility status received from SMR and already delivered to control and audit leakage. **Figure 5** shows a family consists of one house hold, one wife and N members, and the eligibility of such family members to a set of m services.

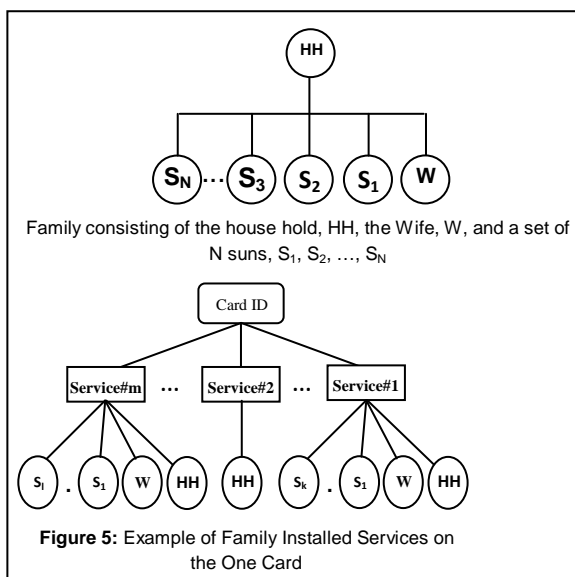


Figure 5: Example of Family Installed Services on the One Card

In the shown example, the family consists of the family holder, HH, the wife, W, and N family members. The family holder is assigned a cardholder smart card. For that smart card, there are, for example a set of services installed. The first service, Service#1, which is installed on the card, is composed of the card holder, HH, the wife, W, and k members of the family, $k \leq N$. The second service, Service#2, which is installed on the same card, consists only of the card holder, HH. The mth service, Service#m, which is installed on the same card, consists of the card holder, HH, the wife, W, and l members of the family, $l \neq k, l \leq n$. Other services might be installed on the same card. **Figure 5** depicts the above example.

7. THE CONCLUSIONS

The proposed CMS implemented by MSAD will play a vital role in the delivery of subsidy system using smart cards. It can receive the updates of the database concerning the worthiness and deserving the Egyptian families to various provided services, managing the installation of various services on the smart card of family in such a way that each have only its deserving services, and control the delivery of such services to the deserving families. The implementation of the CMS allows to overcome the deliberately or unintentionally leakage and loss subsidy due to the delivery of services to undeserving families leading to saving in budgets of such illegal services delivery and guarantee the social justice.

8. VII.FUTUR WORK

The system, in spite of its importance and success in providing the subsidized services to cardholders appropriately, can be evolved to guarantee more appropriate behavior. Two issues may still be needed to be introduced to improve the system. The first is the change of the technical architecture to collect the family database and transactions database and communication SW to the CMS. The second is application of targeting on the beneficiaries which is still under study. The targeting issue is under investigation by the project group in MSAD by the objective to define its criteria and application rules. Furthermore, for a more control on the development and installation of applications on smart card, access right policy should be applied.

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