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## 1 Introduction

Smart Card and Radio frequency identification (RFID) technology transforms the way enterprises, manufacturers, distributors and retailers do business. Introduction of Smart card/RFID technology changes more than the way data is collected. It dramatically alters traditional ways of supply chain and customer interactions. And it is poised to improve overall efficiency, customer satisfaction and security.

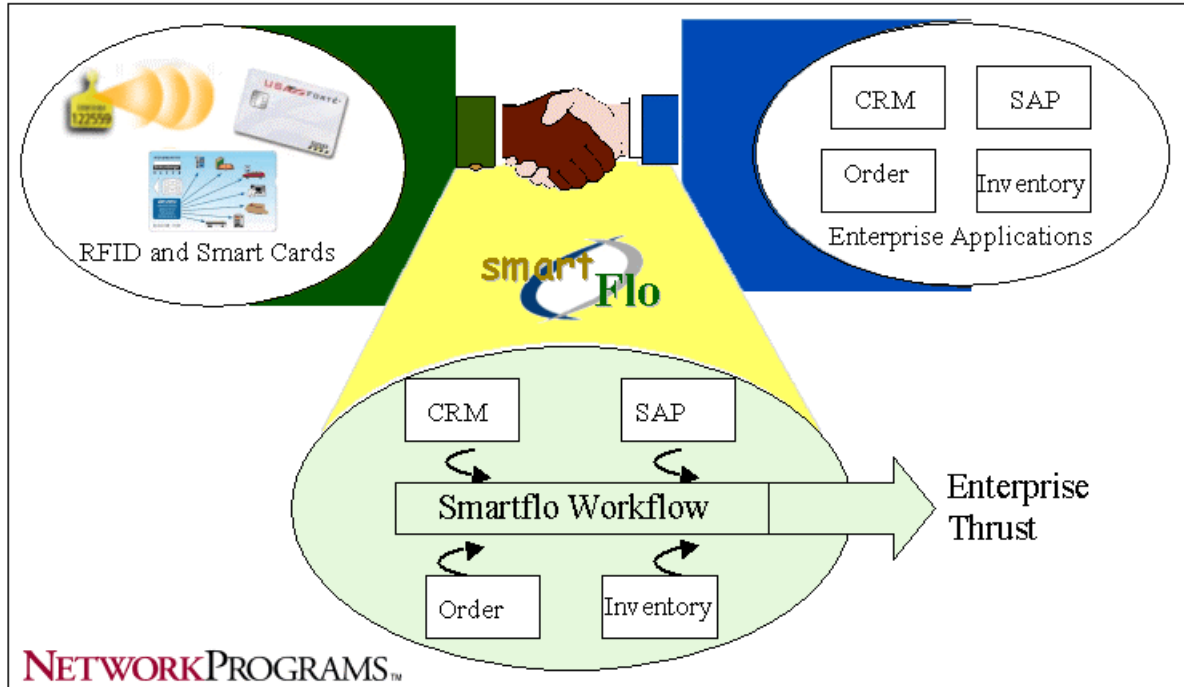


Fig: RFID Ecosystem

Smart card/RFID technology can provide visibility into operations that were previously inaccessible because of limitations to bar code and other data collection technologies. Organizations can take advantage of ability to track items in more places, without human intervention, to create new features and applications. These capabilities are new, so software applications will need to be modified or developed to take advantage of them, and the IT infrastructure may need to be extended to support Smart card/RFID operations. Most, if not all, of the RFID pilots and beta implementations are customized for individual companies and industries. But, at this point of time, there is a lack of interoperable mechanisms, solutions based on open standards. That's where SmartFlo comes in. SmartFlo is an intelligent framework developed by Network Programs for easy deployment of the technology in enterprises. The SmartFlo provides new types of actionable information that create opportunities to do things differently and more efficiently.

The figure shown below describes some of the areas where the solution can be deployed:

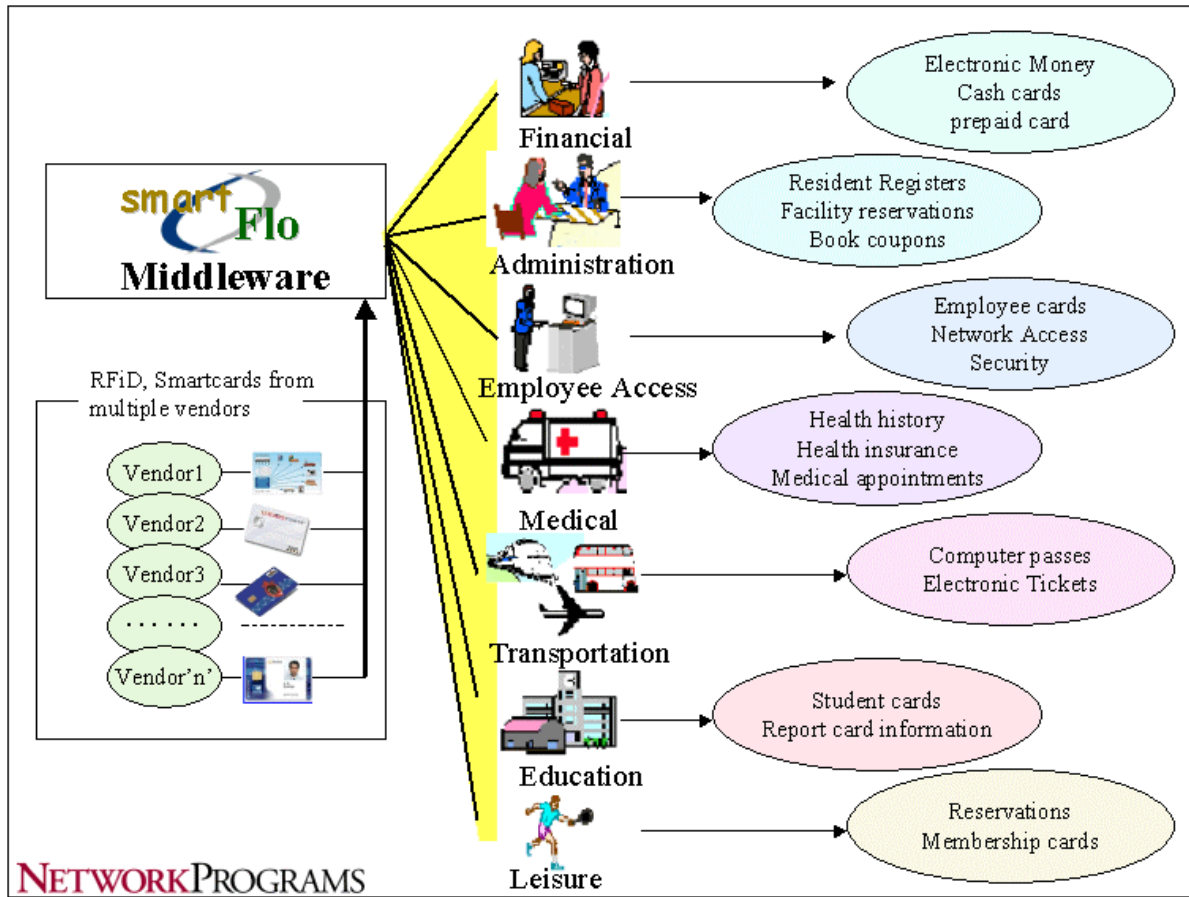


Fig: Smart Card/RFID Technology Application Areas


As shown in the figure, the framework's architecture is quite adaptable and scalable. E.g., It allows concurrent usage of smart cards and RFID tags from multiple vendors.

## 1.1 About Network Programs

Network Programs (India) Ltd. (NPI) provides Smart Card and RFID based software solutions and services. NPI has provided innovative and cost-effective solutions to some of the world's largest corporations.

Network Programs, with its extensive telecommunication domain expertise provides new generation solutions and cost-effective services across Network Management for devices, telecom wireline, wireless, Convergent & Broadband networks, Switching systems, OSS/BSS, basic telephony and Internet infrastructure.

Network Programs is certified for ISO 9001-2000 and at level-5 of the CMM and is on its way to attain BS-7799.



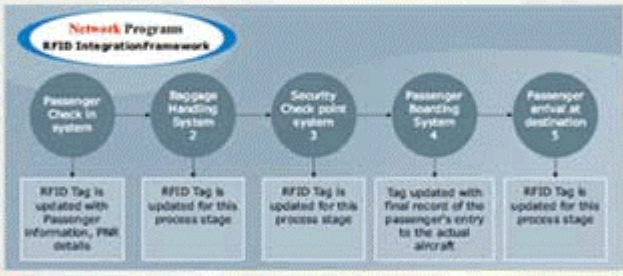
### Taking off with the airlines !

#### A Network Programs R&D project shows how RFID can streamline end-to-end passenger travel processes

Network Programs, a well known name in the RFID solutions space, has developed an RFID Integration Framework that enterprises can use to streamline their own business processes by speeding the identification and processing of massive inventories and reducing the amount of hands-on product handling. Here's how Network Programs helped an airline improve its passenger baggage tracking system:

**VENDOR**

Network Programs, a provider of RFID-based software solutions.



```
graph LR; S1((1. Passenger Check in system)) --> S2((2. Baggage Handling System)); S2 --> S3((3. Security Check point system)); S3 --> S4((4. Passenger Boarding System)); S4 --> S5((5. Passenger arrival at destination));
```

**THE PROJECT**

An R&D pilot to demonstrate the benefits of deploying RFID technology. To streamline end-to-end passenger travel processes.

**THE SOLUTION**

The process started at the check-in counter. A 13.56MHz RFID Tag was attached to every checked-in bag. Each tag carried a unique identifier and was read while the bag was transported to a new location around 20 feet away. The RFID Tag stored all the necessary details about the passenger and baggage. The tag information was read by a PDA with a Palm operating system.

The RFID Integration Framework developed by Network Programs was used to inform various airport applications about the baggage check-in event. Applications that were notified were the baggage control system, the airline reservation system, airline check-in process system, security system, baggage reconciliation system etc.



## 2 Solution Overview

Network Programs's SmartFlo provides key functions for deploying RFID/Smart Card technology in an enterprise.

1. A Channel of communication.
2. Data and Functions Abstraction Layer
3. Message Broker
4. Workflow

### 2.1 Communication Channel

Information is sent to and read from card (smart card or RFID Tag) by a reader. Data collected from the card is then passed through the SmartFlo to host computer systems for interpretation, storage, and action. SmartFlo supports both cable and wireless interface. SmartFlo allows the enterprise to close the loop between acquiring data, converting it to meaningful information, and automating all associated transactions, processes and applications. It has an in-built work-flow and rule engine through which the enterprise can define how the data read from the card is going to impact various applications in the enterprise.

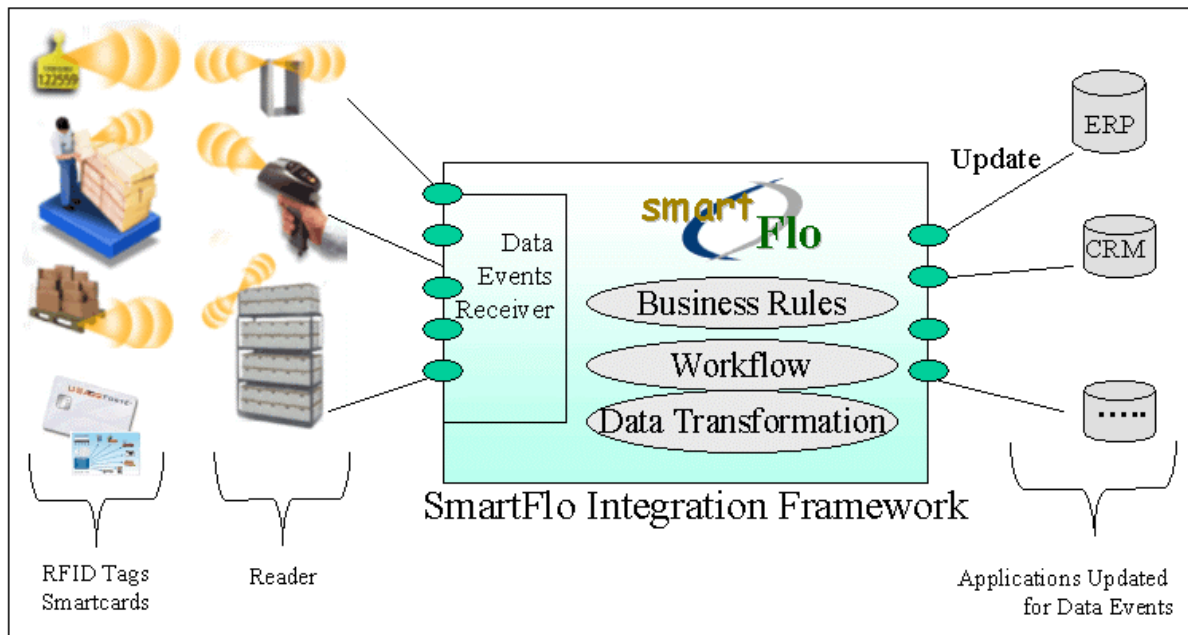


Fig: Network Programs's Integration Framework

As shown in the figure above, existing applications get enabled for Smart card/RFID technology without undergoing any major system modifications. The SmartFlo protects existing investment.

## 2.2 Data and Functions Abstraction Layer

SmartFlo provides the abstraction layer using J2EE and/or XML and/or Web Services. Abstraction is the process of representing the data and functionality of your existing applications in some consistent form. This alleviates the need to translate and work with the diverse and different protocols, data, and programming models used by each of applications.

## 2.3 Message Brokers

In an integrated system, information is passed between disparate applications in the form of messages. SmartFlo's 'Message Brokers' offers the capability to manage the flow of messages in the integrated system. Message Brokers are responsible for guaranteed delivery, data transformation, and intelligent routing of messages. The performance and reliability of the messaging engine is primary, as these directly affect the scalability and robustness of the integrated system.

## 2.4 Workflow

SmartFlo offers the feature of electronic workflow. It integrates distributed applications for data/information exchange. It is designed to streamline collaboration and accelerate the completion of critical organizational tasks.

SmartFlo's workflow includes a powerful, easy to use, graphical user design tool (Designer) that allows workflow designers to "paint" the workflow and routing rules. Workflow can be defined as objects themselves and designers can embed workflow objects into workflow.

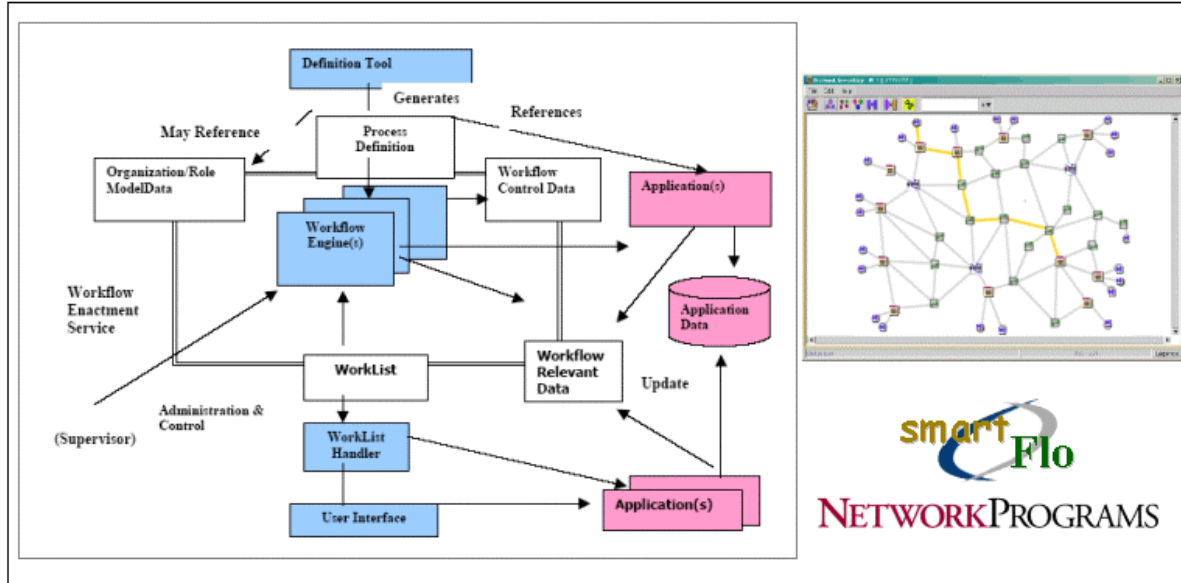


Fig: SmartFlo Workflow

### SmartFlo Features

- SmartFlo Workflow has a user-friendly interface that features drag and drop icons for rule definition.

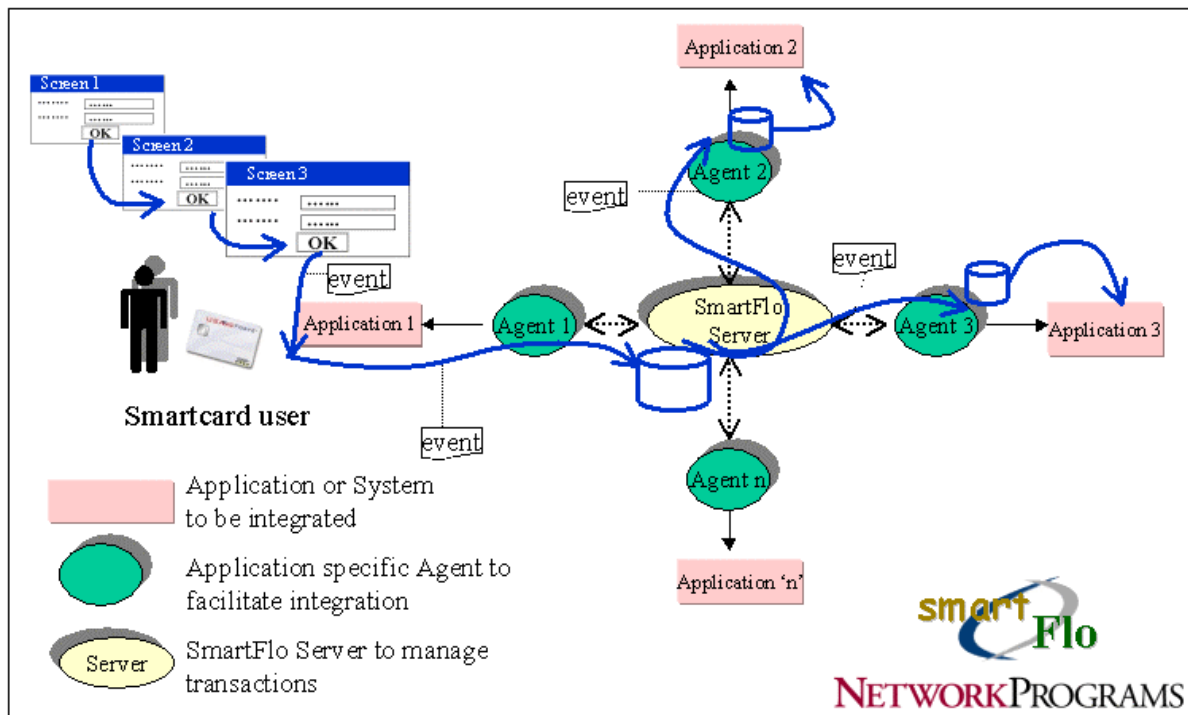
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- SmartFlo Workflow is easy to learn and maintain. You do not have to be a programmer to define or modify the workflow. You simply draw a graphical representation of the current manual process – or perhaps an enhanced version.
- Through use of SmartFlo's Application Programmer's Interface (API) toolkit, more advanced users can create custom workflow processes which can include third party programs. In addition, in-house custom programming by SmartFlo is available.
- Workflows can also be processed via the Internet/Intranet/Extranet, allowing for worldwide processing of workflow and leading to advanced e-CRM and fulfillment processes. Imagine the possibilities!
- Upon completion of each step, the workflow document is automatically routed to the next step for processing. An email notification can also be set up to notify a user that new work-item has arrived for them to complete.
- Logging Function - SmartFlo Workflow automatically logs all workflow activity such as what documents were assigned to each group, how long it took to process each action, and what items were rerouted. Log data can be exported to other programs for statistical analysis, providing a valuable tool for evaluating work process efficiency.
- A workflow can be split to have two or more flows running concurrently.
- Ability to monitor all workflow in progress.



## 2.5 How SmartCard /RFID Tag is integrated with existing application?

SmartFlo provides an Application Programmer's Interface toolkit. API can be used to create custom workflow processes, which can include third party applications like SAP, CRM etc. SmartFlo has a workflow engine embedded within it. The workflow engine has the ability to run external applications. This permits SmartFlo to trigger virtually any process and to use an external process to perform powerful decision logic functions. For example, a workflow could be configured to query a billing system to get a billing information. The billing information could then be analyzed in an Excel spreadsheet using a complex formula. The workflow could interpret the results and decide who should receive the object. Powerful stuff!



The figure shown above depicts the functional architecture of how SmartFlo integrates multiple applications distributed over network, installed over distributed servers.

SmartFlo takes snapshots of messages at every stage of a business process. The snapshots create a complete historical record of a message as it passes through the business processes. Messages may be retrieved and viewed through a simple and user-friendly GUI in real-time. SmartFlo provides full tracking of audited messages through an entire chain of transactions.

## 2.6 Proposed Methodology

Network Programs has sufficient knowledge and experience in service delivery in Information Technology. The basis of our methodology is to ensure a technically superior and cost-effective implementation solution for any size project. **We have worked on several enterprise level projects, involving more than one tool and projects where teams are distributed over geography.**

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Network Programs employs a software engineering processes that are complaint to SEI CMM 5 and ISO 9001-2000. We do early project analysis and planning. It results in careful definition of the right number and type of resources needed together with early risk assessment and mitigation strategies.

Structure is provided by five distinct project stages: Requirements Understanding, Project Strategy and Scope layout, Design, Solution Build, Testing, Field Implementation and Support. Within each of these stages, specific project steps, activities and deliverables are conducted in a planned and controlled manner to ensure complete requirements analysis, software implementation, quality assurance testing, and product deployment is accomplished in a cost-controlled and on-schedule project context.

The project methodology is flexible to allow development in a customized manner.

Management team of Network Programs closely monitors the progress of all current projects. Detailed reviews are undertaken at several monitoring points. The client participates at each milestone and provides feedback thus ensuring a clear communication. This concept helps us to evolve an efficient process management methodology, which is tailored to suit the needs of the client which will eventually improve our productivity and quality.

Our Rapid Application Development and Implementation Methodology provides high-quality results within a reduced time frame.

### **Project Stage 1: Requirements Understanding**

Our software engineering processes starts from involving with the customer. This means learning about customer's industry and company. We try to figure out preconceptions about the project, if any. We work with the end users to identify goals, objectives and Critical Success Factors. We perform hi-level cost justification analysis, conduct Web analysis. We present our understanding of the proposed technical architecture with analysis and help customer evaluate potential products (buy vs. build decision) that may help meet customer's objectives. At the end of this step, we present a requirements document that contains:

- Executive Summary
- Quantitative and qualitative business case analysis
- Project Matrix - highlighting all functionality
- Analysis of current and future technical architecture
- High-Level Technical Architecture
- High-level Project Plan
- Skill set and Training assessment of your project team
- Buy vs. build decision for tools/products suggested
- Fixed-time/fixed-price bid

### **Project State 2: Project Strategy and Scope**

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We focus at building a solid project strategy and aim to build a good case identifying both quantitative and qualitative benefits of the projects. Our team members interact with customer's key personnel and prioritize and phase the release of critical features. We construct a detailed project plan. The scope is laid out by defining an architecture that satisfies user's requirements. At the end of this step, we present a project's strategy and scope document that contains:

- Detailed hardware and software requirements
- Application architecture

**Project State 3: Estimate Size, Effort of Project.**

We layout the system interfaces, messaging standards, integration parameters to other tools and hardware requirements so that accurate estimates of size and efforts can be arrived at. We work with users to define screen design and navigation and ensure consensus across all business groups. In some occasions, where possible, a prototype is also created. A training and release plan is prepared as well. At the end of this step, we present a strategy and design document that contains:

- Estimate of size and efforts
- Detailed technical and application architecture
- Detailed Project plan outlining each phase of the build
- Screen design and layout
- Training Plan
- Release Management Plan
- Test Plan
- Resource and Project Team profile
- Prototype, if needed

**Project State 4: Build Solution**

In this step we put our heads down and concentrate on what we do best. All of our energy and expertise is put to develop and fine tune the solution; combining all the components of the project into a final product. During the build process we constantly keep the business owners of the project updated so as to include any last minute feature enhancements (yes, we are flexible and accommodating) and help spread the development knowledge.

**Project State 5: Test Application**

We test the application from multiple perspectives -System, Integration, and User. We achieve end user acceptance prior to rollout. At the end of this step, we present the following as deliverables:

- Completed and signed off application
- System Testing, Integration Testing and User Acceptance Testing Document

### **Project State 6: Application Launch**

The exciting phase. We seek end-user feedback. Monitor any bugs and error logging. Keep an eye towards maintenance and backup recovery plan. Provide in-depth assistance to the client's IT groups. We assist if any data need to be installed on the client side on laptops or workstations. Our training approach begins with the classroom or virtual training sessions. And finally, we build end user excitement for upcoming changes.

### **Project State 7: Support**

Often, however, everything does not stop at application launching stage. A project may need to incorporate complex new functionality, hook into existing back-end systems, or simply require content updates or expansion. In any of these cases, we work with the client to constantly tune their project, allowing improvement as necessary over the long-term.

## 3 System Requirements

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### 3.1 SmartFlo Server Requirements

One Windows XP based PIV, 1GB RAM, 40GB HDD machine.

One Weblogic server license

### 3.2 Smart Card Reader Specification

Smart Card Readers: Two built in ISO 7816 compliant smart card readers with 3V interface and with both T=0 and T=1 protocols

### 3.3 Smart Card Specification

SmartFlo supports Smart Cards with following specifications.

Smart Card Specifications
Microprocessor based Integrated Circuit(s) card with contacts and with a minimum of 4KB EEPROM
Compliant with ISO/IEC 7816-1, 2& 3
Supply Voltage 3V - nominal
Protocol T=0 or T=1
Data retention min. 10 Yrs
Min of 3,00,000 EEPROM write cycles
Operating ambient temperature range- 25 to +55 Degree Celsius
Plastic Construction PVC/ABS with overlay to allow color dye sublimation printing
Surface-Glossy
Smart Cards must have data objects for card sequence number (Tag 5F34) and cards primary account no (TAG 5A) at the MF level as per ISO 7816-6. One programmed these data can not be changed.

## ***4 Past Experience- Projects Executed***

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Network Programs has executed many projects using RFID and Smart Card technology. Network Programs offshore software development center in India assists customers in the selection of smart card solutions including software, cards, card operating systems (JavaOs/MultOS), tools, card readers and card printers. Network Programs develops smart card software, customize and install card solutions.

### **1.1. Project: Smart Card OS Optimization**

This scope of this project was to understand, test and optimize the smart card OS (HiperSIM), a modular, high-performance, smart card OS for the Fujitsu HIFERRON (Fujitsu series of LSI chips used in multipurpose integrated circuit (IC) cards embedded with FRAM technology) family of 32-bit processors.

#### **Solution**

HIPERSIM is firmly founded on the European Telecommunications Standards Institute (ETSI) Smart Card Platform (SCP) series of smart card standards. These standards underpin the most widely used and most demanding smart card application, the Subscriber Identity Module (SIM).

The FRAM memory provides a powerful software platform for current and future smart card and wireless applications. This smart card is having a micro kernel derived from mach OS. The Hiper SIM is divided into three layers Manufacturer Set, Developer Set and Telecommunication Set. The manufacturer set is having kernel, file system, cryptography, IO library (T 0 and T 1 protocol) and IO Task implementation. The developer set is having Application Manager and ISO 7816 based file system and cryptographic API. At the top of developer set, is the telecommunication set which gives a framework for the application developers to write applications specific to telecommunication.

The reverse engineering of the HiperSIM OS (proprietary OS based on Mach micro kernel, an OS kernel developed at Carnegie-Mellon University) is done to understand the OS functionality and then some of the core components of the OS like File System are optimized to fit the whole thing in limited space in FRAM, which was earlier taken large space.

In telecommunication set, the wireless Identity module (WIM) as per the standards is developed and tested out and then finally integrated to the other parts of OS. This involved Asymmetric Key Pair generation, MD5, SHA1 algorithms support.

#### **Benefits of the Project**

Following were the benefits from HiperSIM OS based smart card project's implementation:

- **Security**



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- Chip is tamper-resistant
- Information stored on the card can be PIN code and/or read-write protected
- Capable of performing encryption
- Each smart card has its own, unique serial number

➤ **Intelligence**

- Capable of processing, not just storing information
- Communicate with computing devices through a smart card reader.
- Information and applications on a card can be updated without having to issue new cards

➤ **Convenience**

- Smart cards provide a portable, easy to use way
- The HiperSIM OS provides a rich set of APIs at each level.
- The OS architecture is scalable and modular.
- It is a multiple application card that can support different types of applications on the card itself thereby reducing the number of cards in the wallet.
- The most of application running over HiperSIM OS are in Java that's why it is also a Java Card capable of running Java byte codes. This makes the card more powerful, that little card will be able to run some of the applications run on personal computer.
- There are many significant smart card applications. These are in
- **Banks:** Small trials in the U.S.; entire countries using the card in Europe and places like South Africa.
  - **Medical applications:** In Germany 80 million people uses smart cards when they go to the doctor.
  - **Voting** In Sweden people votes with smart card, which serves as a non-repudiation device.
  - **Entertainment:** Most DSS dishes in the U.S. have smart cards.
  - **Telecommunications:** Many cellular phones come with smart cards in Europe and will soon be shipping in the United States.
  - **Mass Transit:** British Air relies on rail and air connections more than most airports. There were many delays because customers could not be tracked while they were in transit, so no one knew where the customers were, which caused aircraft to be held for phantom customers. To solve this problem, British Air gives passengers contact less smart card, and radio receivers track them throughout the facility. Now flights only wait when necessary, controllers can be given estimated ready times, and new departure slots can be calculated.

## 1.2. Project: RFID based Visitor Tracking System for Exhibition

In this project, Network Programs developed a RFID based application to keep a track of visitors who visit an exhibition. Using this application of Network Programs, the organizers get to know how many visitors visited the exhibition on a particular day. The organizer can split the premises into various zones and statistics about visitors can be managed at zone level.

As a first step on the process, a visitor is registered with the system. The system provides a simple user interface to capture visitors details like Name, contact address and details about subscription. Following screen is used to register a visitor.

The screenshot shows a web application window titled "New Registration". The form is organized into several sections:

- Personal Information:** Prefix (Mr.), First Name (Gaurav), Last Name (Singh), Designation (FSA), Company (NFI), and Category (Whole Conference).
- Postal Address:** Address 1 (1234, Fite Nagar), Address 2 (1233 Fite Nagar), Postcode (1111), City (New Delhi), State (New Delhi), and Country (India).
- Contact:** Telephone (987 6543), Mobile (98 76543), Alt. Telephone (987 6543), Fax (12 3456), Email (gaurav@networkprograms.com), Personal Email (ga@networkprograms.com), and Web Site (www.networkprograms.com).
- User Information:** ID Status (Unknown), Membership (No), and Payment Status (Not Paid).
- Comments:** Remarks field.

At the bottom right, there are "OK" and "Cancel" buttons.

Fig: Visitor Registration

The organizers can monitor the exhibition using a dashboard like the following:

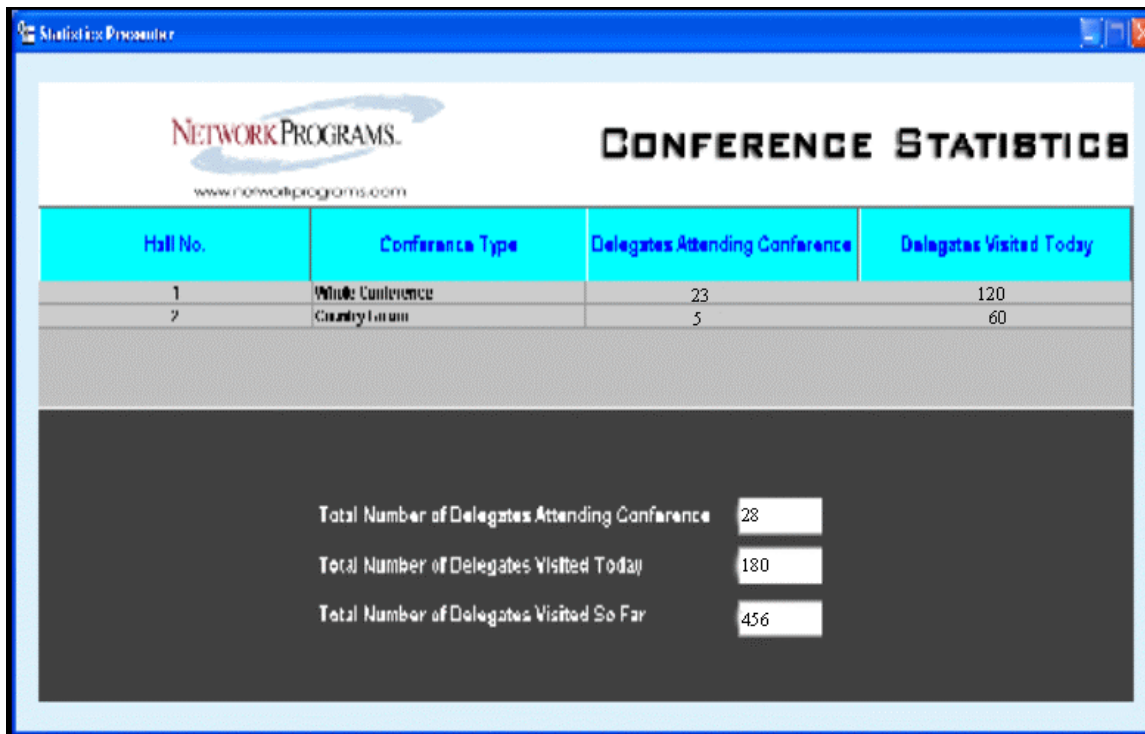


Fig: Monitoring Dashboard

### 1.3. Project: RFID based Access Control System

Network Programs has developed and implemented an access control security system based on RFID technology. This system control access to the computer lab where IPR (Intellectual Property Rights) are stored. A card reader is placed at the entry door of the lab. The person who wants to gain access of the lab, has to submit his/her access card.

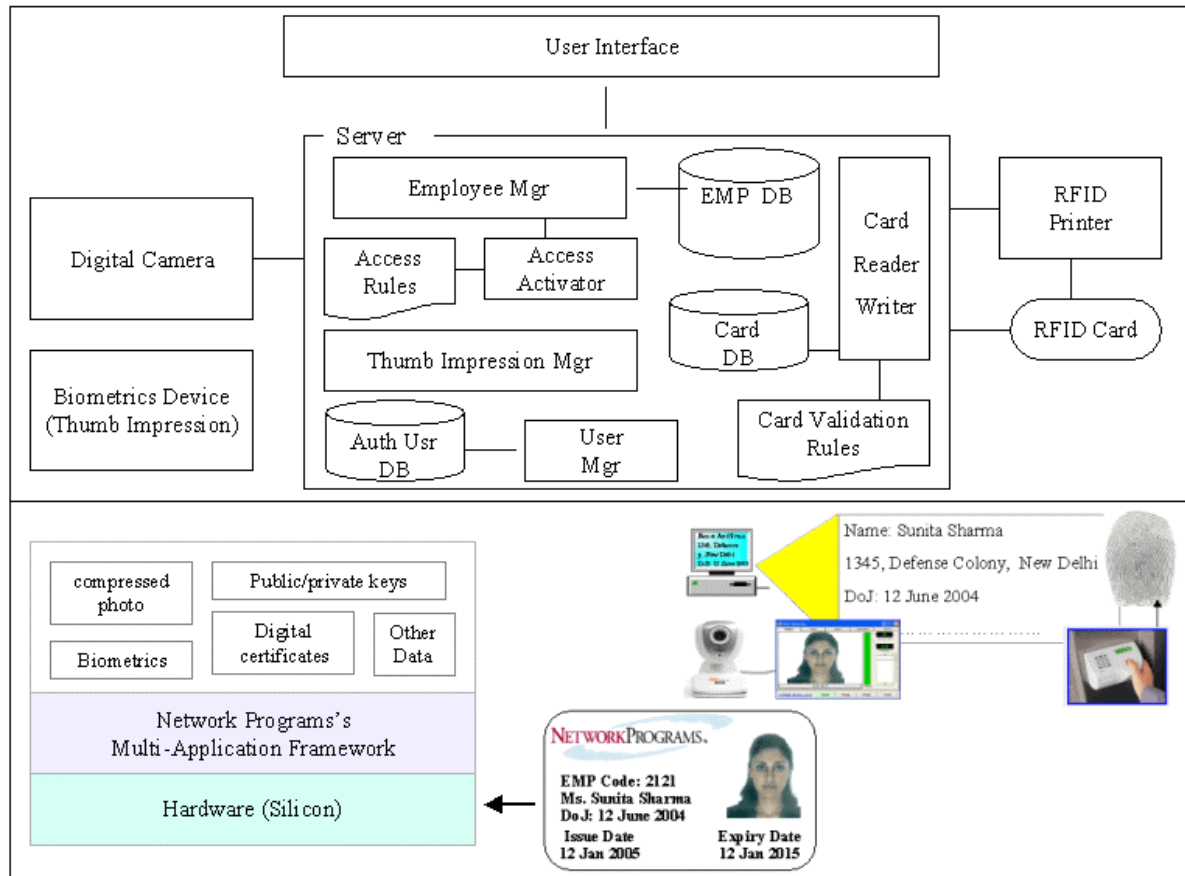


Fig: RFID based Employee Card

#### 1.4. Project: RFID Based Time attendance system

Each and every employee is issued a RIFD card using which he will be having his in time and out time of the person noted. This information will be used for his payroll. This application also works to keep track the moment of the employee.

#### 1.5. Case Study: Air Passenger Baggage Tracking System

Network Programs executed an R&D project demonstrating the benefits of deploying RFID technology. A large systems integrator and semiconductor manufacturer in Japan funded it.

The goal was to demonstrate how RFID technology and Integration Framework could streamline end-to-end passenger travel process. The solution coordinated various tasks such as "When did the passenger-baggage arrive...where did they go...what personnel were involved...did the same person get the ticket/boarding pass...did the same person go through security...did the same person get through the gate entrance did the same person go on the plane".

The process started at the check-in counter.

13.56MHz RFID Tag was attached to each checked-in bag. Each tag carried a unique identifier and was read while the bag was transported to a new location around 20 feet far. The RFID Tag stored all

the necessary details about the passenger and baggage. The tag information was read by a PDA with a Palm operating system.

The RFID Integration Framework developed by Network Programs was used to inform various airport applications about the baggage check-in event. Applications that were notified were baggage control system, airline reservation systems, airline check-in process system, security system, baggage reconciliation system etc.

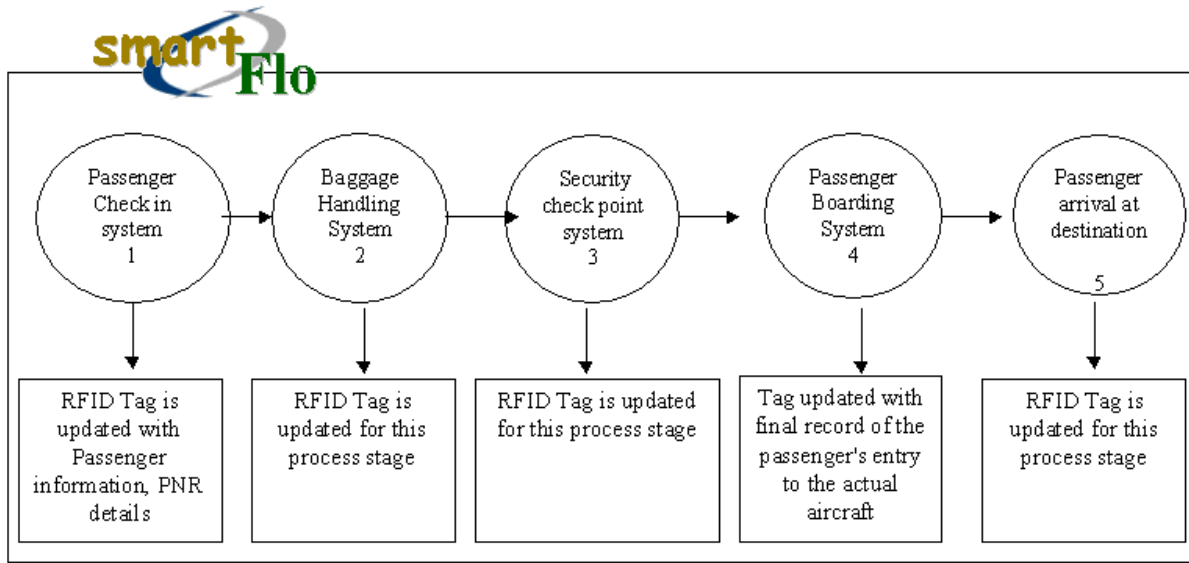


Fig: RFID based Baggage Tracking System

**Benefits observed are:**

- Overall efficiency improvement is observed in the baggage-handling related processes
- Tracking baggage position at each stage of the process identified congestion points in the process.
- Automated retrieval and use of customer knowledge across all touch-points
- Notification on events for corporate customers, travelers, staff and agency management
- Reduced wait time for passengers.
- End-to-end process visibility

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