SmartCities

IST Project Number 12252

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D1.6
Public Final Report

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Abstract

This document is the Final Report for the SmartCities project, "Multi-Application Smart Cards in Cities". The three-year project (May 2000 to June 2003) has developed an open, multi-application smart card architecture that may be replicated in cities and other regions throughout Europe. The process and lessons learned have been shared with local authorities and other interested organisations who will take the results and concepts forward beyond the lifetime of the project.

The architecture has been developed and implemented in a medium-size European city. Importantly, the SmartCities card issued to citizens was developed in co-operation with the City's University, which already had its own smart card and applications for students and staff. Now, the City card and the University card are interoperable. City applications (e.g. library, leisure centre) are uploaded to the University card, while University applications (e.g. Uni-link bus) are uploaded to the SmartCities card. The citizen and the student can share services across the City using separately issued multi-application cards.

The card has open e-purse functionality, which has been demonstrated in a closed environment at the University. The project has also demonstrated the capability to upload or download applications onto the card via a mobile phone.

Cross-analysis of multi-owner card data addressed European and National data privacy and protection requirements. SmartCities multi-owner data analysis model can be used to improve services and reduce costs.

The results of SmartCities form the basis for a CEN standards workshop that has been initiated with the support of the SmartCities Interest Group (SIG). SIG was founded in October 2001 by the project to bring together European cities that have an interest in applying the SmartCities model to their own smart card schemes. SIG is a membership organisation and is committed to taking the results of the project forward.

Executive Summary

This document is the Final Report for the SmartCities Project (IST-1999-12252), "Multi-Application Smart Cards in Cities" (incorporating IST-2001-38705: *Smart*Hub). It summarises the project's objectives, findings and main achievements, and provides overall conclusions.

SmartCities involved the following partners: Schlumberger Systèmes, Schlumberger Industries, Sema UK, Southampton City Council, University of Southampton, MasterCard Europe, Technolution, Crid, City of Goteborg, IT Innovation and Black Sea Consulting.

The project commenced on 23 May 2000 and officially ended on 22 June 2003.

SmartCities research objectives

SmartCities is a pan European research project with the aim of building an open architecture, multi application smart card environment for use in mid-sized cities and communities.

SmartCities aimed to design a dynamic smart card and multi-application management architecture, which would allow citizens to benefit from the numerous advantages of a smart card environment without the card issuer being tied to a unique, proprietary, applicative model. SmartCities also aimed to prove the technical and commercial feasibility of exploiting multi-owner data sources gathered from the use of the smart card scheme.

To achieve these objectives SmartCities set out to demonstrate the technical feasibility of a plug and play management platform by defining an architecture that can support multi-industry standards interfaces. Associated to this standard architecture SmartCities also set out to demonstrate the technical feasibility of dynamic management of applications at the card and scheme level (including terminals). Technical innovation included the use of a CEPS (common e-purse standard) open e-purse and the use of the mobile telephone networks for application management and cash upload.

To facilitate data exchange between the scheme participants SmartCities included the design of a centrally managed high performance scalable engine for secure data movement, transformation and interface management across all scheme applications. This system is known as *Smart*Hub.

In particular, the SmartCities objectives were to:

- develop and publish an open multi-application city card architecture (open in the sense of this project means not tied to a single supplier of cards, terminals and applications - including e-purse applications; open therefore means supporting multiple industry-standard programming interfaces (APIs));
- implement a smart card framework conforming to the multiple industry standard architecture APIs;
- research and develop dynamic loading, unloading and display of applications via fixed and mobile terminals;
- develop a technical, operational and commercial architecture for the exploitation of the multi-owner data sources gathered from the use of the smart card scheme;
- demonstrate the successful operation of an open multi-application single city card scheme;

- exploit the information gathered from use of the city card for city-wide public and private sector planning for community benefit, whilst respecting privacy of citizen information;

- identify and prove how the information gathered from use of the city card will contribute to other Information Society aims, such as social inclusion and economic development;

- provide other European cities with an open, easily replicable solution with reduced implementation costs for future schemes; and

- create a network of European cities and share ideas, lessons and results via specific city card workshops and exploiting the Internet.

Main Challenges and Outcomes

Multi-Application Smart Cards

Multiple applications on a single card (library, bus, e-purse, loyalty scheme, etc) raised a number of issues that needed to be explored and resolved. These included utilisation of the space on the card, ownership, card external design, and compatibility with different standards and issuance by different organisations. As pioneers in this area, the SmartCities consortium had to explore these matters in depth, particularly the organisational and contractual relationships related to a multi issuer scheme. It developed commercial and business models, which will be applied to schemes in the future.

Mobile download

One of the leading edge, differentiating goals of the project was the ability to manage the application portfolio dynamically, post issuance of the card. The original intention was to use a dual interface mobile phone provided by Consortium partner Motorola. When Motorola withdrew from the project an alternative solution was found and e-purse loading and application management is now possible using the mobile networks through PDA and mobile phone connection.

e-purse

The interest shown by a banking partner before the start of the project proved unsustainable and although banks continues to watch the developments of smart card schemes, the project could generate no interest in investment in the infrastructure for an open e-purse. SmartCities did however build the technical capability following the CEPS open e-purse standard and demonstrated the feasibility in a closed environment within the University.

Data Analysis and Security Issues

The usage data from multi-application, multi-issuer card schemes is potentially very rich and could provide businesses and local authorities with valuable planning information. SmartCities undertook groundbreaking research to ensure that it complied with data privacy legislation as it is interpreted in different countries across Europe. SmartCities implemented an innovative data privacy and protection compliant multi-owner data analysis system that enabled information workers to securely access and analyse card data over the Web.

Other Main Achievements

Card platform, Terminals, back-office system and network

The SmartCities card may be the only access token to multiple services available throughout the city. In order to be effective, this token has to be powerful enough to handle many requirements, like ease of use, speed, security, versatility and being future-proof. One major aspect of the trial is the card's built-in capability to accommodate future services, which are not known at the design phase, without the burden of re-issuing new cards each time a new application/service is made available to card users.

In order to achieve this, the technology governing the Card Acceptance Devices, back-offices systems and various peripheral systems that constitute the scheme infrastructure must also be 'open' and able to accept new applications as the scheme evolves.

Therefore, the architecture of the system used for the SmartCities project encompasses a Javacard powered card and terminals and back-office systems that are interconnected to the application system through an open, well-defined interface; the Application Protocol Interface (API).

*Smart*Hub

The *Smart*Hub design philosophy is to offer SmartCities Application providers, for example Southampton City council, with a simple and easy way to interface to other systems. The *Smart*Hub design has been predicated on the ability to interface with Application providers of varying levels of technical sophistication and associated functionality. The *Smart*Hub encourages standards of communications between multiple data providers to be conducted in a standardized format.

Conclusions

All the original research goals have been attained during the three-year life of the project. The main results are listed as follows:

- capture and analysis of user requirements;

- development of an open system architecture for multi-owner multi-application schemes;

- application management systems build for loading and upgrading applications;

- development of systems to enable citizens to use a mobile terminal as a display and upgrade terminal;

- development of architectures for information analysis covering security, performance, legal, ethical and commercial issues;

- development of the *Smart*Hub data exchange engine;

- integration of the above components into two demonstrator smart card schemes;

- operation of demonstrator smart card schemes;

- evaluation of the demonstrators;

- exploration and planning of the exploitation of the solutions developed in the project;

- dissemination of the results and lessons learned; and

- creation of an active pan-European Interest Group (SIG).

The work of the SmartCities project is demonstrable, quantifiable and fully documented. The most significant overall result is that the Southampton City and University smart card demonstrators have been adopted in Southampton as fully functional and operational schemes, which will be further developed and exploited. The benefits to the citizen and student population have been recognised and the schemes given executive approval. Through a CEN/ISSS workshop process, sponsored and supported by the SIG, the SmartCities model will continue to develop and other cities and communities will follow the Southampton example using the open interoperable architecture the project has designed.

1   Introduction

This report describes SmartCities' achievements, performance against objectives and conclusions. Section two gives a summary of the main achievements as defined by the success criteria set out in the EC contract, Description of Work. Section three provides further detail of each of the stated objectives, including references to the roles of the different partners. Section four describes each of the 15 work packages and lists the main tasks. Finally, section five sets out the conclusions regarding SmartCities' technical and business objectives.

1.1   Overview

The purpose of SmartCities was to design a dynamic smart card and multi-application management architecture to allow targeted markets (middle size cities) to benefit from the numerous advantages of smart card environment without being tied to a unique, proprietary applicative model. SmartCities also aimed to prove the technical and commercial feasibility of exploiting multi-owner data sources gathered from the use of the smart card scheme. Aligned to this was important legal work exploring and resolving the issues relating to data privacy legislation in the context of multi usage data.

SmartCities has demonstrated the technical feasibility of a plug and play management platform by defining an architecture that can support multi-industry standards interfaces. Associated to this standard architecture SmartCities also demonstrated the technical feasibility of dynamic management of applications at the card and scheme level (including terminals).

To demonstrate the business benefits of a card data analysis system, an innovative multi-owner data analysis system was developed. The data protection and privacy compliant SmartCities information analysis system gave Southampton Council and University staff over-the-Web access to powerful tools that enabled them to analyse card data remotely. To facilitate data exchange between the scheme participants, SmartCities designed a centrally managed, high performance, scalable engine for secure data movement, transformation and interface management across all the scheme applications.

As proof of concept the solutions were validated by two demonstrators, these demonstrators include all the elements of a full scheme (smart cards, terminals, software tools, data analysis servers). An early demonstrator proved the feasibility while identifying problem areas to focus on. The second demonstrator was delivered in two phases and now forms the foundation for a full city scheme in Southampton City. The two-demonstrator approach allowed time for the project to take advantage of planned advances in card technology.

2 Measuring achievements against success criteria

The following achievements are presented under headings defined by the success criteria set out in the Description of Work

2.1 Written contribution to standardisation bodies

Material developed by the project will be submitted to CEN to launch a SmartCities multi-application smart card standard workshop. The project has prepared and submitted a proposal for CEN and it is expected that the material will be subject to review by a wide audience, including SmartCities Interest Group (SIG) members and suppliers before the CEN/ISSS workshop is launched

The scope of a CEN workshop has been based upon the practical experience of the SmartCities consortium, the market information received from the SIG members and other contacts including discussions with CEN. The results of the project will be subject to consensual development within the workshop with the aim of determining the SmartCities standard.

SmartCities is an example of a multi-application smart card scheme, though it goes much further in defining fundamental principles of operation, methods of operation and, indeed, an architecture that makes these feasible. It has also investigated and resolved the legal issues associated with the access to and use of data in respect of the Data Privacy legislation. The written submission to CEN encompasses these three major results of the project.

2.2 Demonstrator one

The goal was to provide information on the technical feasibility of integrating multiple applications on one smart card system. In the project definition phase it was decided to integrate existing applications that already use some kind of card. This meant that for the first demonstrator existing infrastructure could be used (e.g. networks, transaction processing and management systems). The SmartCities project developed a module that allowed the legacy systems to interface to the smart card; this was placed into the existing terminals. A further aim of the first SmartCities demonstrator was to help establish procedures and working practices for card issuing and scheme operation. The target technologies were not available at the time this demonstrator was introduced but it provided a valuable test bed for the City and lessons learned were used directly in the planning of the second demonstrator.

2.3 Demonstrator two

This is a key innovation

The second demonstrator (Demo 2) has proved to be the first multi-application scheme with such a wide and varied portfolio of applications on the same card. This demonstrator will provide an on-going powerful evaluation environment for suitable applications from other EC projects.

Building on the application portfolio developed for the first demonstrator and using advanced technology, several new applications were developed for Demo 2:

- Secure PKI applet, known as 'SmartPath';
- Loyalty applet, provided by WorldCard;

- Cardholder applet;

- School applet;

- Generic Balance check applet;

- Service Environment; and

- Open e-purse.

The SmartPath PKI and the open e-purse applications are the most innovative applications included for Demo 2. SmartPath was developed by the City using UK Government 'Path Finder' funding and provides personal identification and authentication for secure access to particular services. The e-purse was built using the CEPS open specification for electronic payment systems and comprises several programs deployed on PC's, terminals and smart cards.

2.4 Information analysis

This is a key innovation.

Data collection and exploitation has not featured highly in the majority of existing smart card schemes, although the card technology is well suited to this. The application of information analysis techniques in card schemes, particularly outside of retail loyalty applications, is rare. To ensure that data collected in a City card scheme is exploited to best effect, more sophisticated data analysis techniques were required. SmartCities introduced an innovative multi-owner data analysis solution that allowed information workers to analyse data remotely. The developed solution is unique in its approach to data protection and privacy issues and serves as a model solution for EU wide smart card schemes.

2.5 Sustainable business models

SmartCities is a concept that will allow cities, universities and other major card issuers to jointly run a local multi-application smart card scheme without compromising their individual interests and without prejudicing existing related investments. It allows smart card interaction at application and schemes level, promoting interoperability.

SmartCities is an open scheme management standard, which defines rules, guidelines and features. This enables dynamic application portfolio management by the cardholders, and scheme interoperability. It allows free procurement choice of cards, terminals, systems and applications

When introducing a multi-application smart card scheme, every scheme operator must recognise that the scheme cannot work independently or within fixed geographical boundaries. The local SmartCities scheme is likely to consist of a mix of partners, some operating exclusively in the geographical boundaries and other organisations operating regionally, nationally and internationally.

An open architecture permits these organisations maximum flexibility outside this scheme. It should also be recognised that the cardholder themselves may want to use their card outside of the geographical boundaries. Without this openness cardholder usage will always be limited, and issuers will be tied to suppliers. This locks out competition and locks out card issuers. In this scenario it will be much more difficult to realise the benefits of multiple application schemes, and thus their development will be seriously impeded.

Within the SmartCities model, partners can be card issuers as well as application providers but the local authority is central to the scheme and likely to be the predominant card issuer.

Not all the benefits of the SmartCities model are unique to SmartCities, access and loading via remote media for instance would benefit basic multi-application schemes. We believe, however, that the fundamental model and core principles supporting SmartCities add real quantifiable value.

2.6 Exploitation plan

The SmartCities model will be taken forward and promoted through the SIG. This is the SmartCities Interest Group that was created to provide a forum for the validation of the SmartCities model and to ensure that the project objectives were being met in terms of the requirements of cities and communities across Europe that had a serious interest in the introduction of citizen smart card schemes. As described in 2.1 above, the project results will be submitted to CEN as the fundamental baseline for a European standard for multi-application card schemes. In addition to the work on technical architecture, the commercial modelling and data privacy results will form part of the CEN submission. Each of the Consortium partners is committed to continued support of the standardisation process and membership of the SIG.

The SIG will be the vehicle for promotion and guardianship of the emerging SmartCities standard. Plans are in place for the SIG to be reconstituted as an independent standards and accreditation body with membership from public and private sector organisations with vested interests in smart card technologies and standards.

The individual Consortium partner exploitation plans are dependent on organisational strategy and market forces. Southampton City Council and the University of Southampton, for instance, will continue to develop their respective SmartCities schemes for the citizens and student population. They will continue to explore common services and new commercial relationships. Goteborg is engaging with potential partners in the city with view to rolling out a scheme in 2004/2005. SmartCities enriches the Schlumberger smart card portfolio; Black Sea Consulting will look initially to develop and exploit the SmartCities concept and its SmartHub product in Bulgaria. Other partners have plans in line with their business strategy.

2.7 *Smart*Hub

This is a key innovation.

The *Smart*Hub is a data router that provides a two-way communications/interface between multi card applications systems, for example University student or Local resident transport card, and a central Card Management System (CMS). Typically the *Smart*Hub interface can be used for the following activities:

- Support of the Customer enrolment process;
- Capturing and exchange the Customer/Client transactions;
- Exchange the application related data; and
- Download of card usage information.

The *Smart*Hub design philosophy is to offer SmartCities Application providers, for example Southampton City Council, a simple and easy way to interface to other systems. The *Smart*Hub design

has been predicated on the ability to interface with Application providers of varying levels of technical sophistication and associated functionality. The *Smart*Hub encourages standards of communications between multiple data providers to be conducted in a standardized format. The standardisation of complex interface technology actively assists scheme operators to successfully create a true and valued single customer view and offer the full range of key Customer Relationship Management functionality.

3   SmartCities Objectives and Results

This section describes how SmartCities achieved its objectives and delivered tangible results. The words in italics are taken from the EC contract, Description of Work.

3.1   Open multi-application city card architecture

Contributing partners: Schlumberger, Technolution.

To Develop and publish an open multi-application city card architecture (open in the sense of this project means not tied to a single supplier of cards, terminals and applications - including e-purse applications; open therefore means supporting multiple industry standard APIs).

This is a key innovation.

The project partners have defined an open card architecture as part of the design of a complete city card scheme architecture. The project has extended its work to define open interfaces at terminal and scheme management system level to ensure that the application integrations are completely standardized and can be replicated to other schemes. Based upon existing and recognized standards for smart cards, the definition of the Application Protocol Interfaces (APIs) for the scheme architecture is original work from the Schlumberger Technical Architect. The project has contributed to the development of standards through, for instance, membership of UK LASSEO, the UK Local Authority Strategic Smart card Standards Organisation.

3.2   Implement a smart card framework conforming to industry standard APIs architecture

Contributing partners: Schlumberger, Southampton City Council, University of Southampton

To Implement a smart card framework conforming to the multiple industry standard APIs architecture.

Schlumberger led the planning and implementation of the demonstrators, working from the User Requirements developed by the City and the University. The first demonstrator was used as a test bed for operational procedures and card issuing processes. The second demonstrator was implemented in two phases in line with roll-out plans for library, leisure and transport services. New applications were introduced in Phase 1 using contactless technology; Phase 2 saw the introduction of a hybrid card with loyalty, e-purse and secure access PKI applications using the contact technology. The project has used a hybrid card based on Javacard and Mifare technologies. Schlumberger supplied software required for the demonstrator schemes.

3.3   Dynamic loading and unloading via fixed and mobile terminals

Contributing partners: Schlumberger, Technolution

To Research and develop dynamic loading, unloading and display of applications via fixed and mobile terminals.

This is a key innovation.

The open multi-application smart card architecture, built on industry standards, enables applications to be easily added or removed. This feature is essential for lowering future development costs and hence ensuring easy replication and success elsewhere across Europe.

The project has developed solutions both for contact and contactless cards, over a secure channel on the Internet or via GSM using a card reader integrated in a PDA, which communicates directly with a mobile telephone. The project has proven the technology on Javacard and Mifare platforms but the implementation can be adapted to other platforms.

3.4   Architecture for exploitation of multi-owner data sources

Contributing partners: IT Innovation

To Develop a technical, operational and commercial architecture for the exploitation of the multi-owner data sources gathered from the use of the smart card scheme.

Sophisticated data analysis techniques were required, to handle complex legal requirements regarding data privacy. This innovative work was led by IT Innovation, experts in data warehousing and data analysis. IT Innovation worked closely with Crid, experts in international data privacy laws.

3.5   Demonstrate an open, multi-application single city card scheme

Contributing partners: Southampton City Council, University of Southampton, Schlumberger

To Demonstrate the successful operation of an open multi-application single city card scheme.

This is a key innovation.

SmartCities developed an open interface framework that enables migration of legacy systems and interoperability between the scheme partners and multiple card issuers.

The main SmartCities card issuer is Southampton City Council, but the City card is interoperable with the University of Southampton's smart ID card issued to staff and students. City applications (e.g. library, leisure centre) can be uploaded to the University card, while University applications (e.g. Uni-link bus) can be uploaded to the SmartCities card.

Two demonstrators were implemented in Southampton, the second providing the base infrastructure for a full city scheme. By co-operating as partners of a 'local scheme', the University and the City are able to offer reciprocal services. Potentially they can offer new services on the SmartCities cards through agreements or partnership with other local authorities and educational establishments or indeed with private card issuers.

The e-purse functionality has been demonstrated in a closed environment at the University.

3.6   Data analysis for community benefit, whilst respecting citizens' privacy

Contributing partners: IT Innovation, Crid, Southampton City Council, University of Southampton,

To Exploit the information gathered from use of the city card for city-wide public and private sector planning for community benefit, whilst respecting privacy of citizen information.

Analysis as a vehicle for integration is a key innovation.

Cross-analysis of data owned by different scheme partners has raised issues regarding data ownership, data privacy and data protection law. SmartCities' investigative work has led the field for interoperable, multi-application, multi-owner schemes. Data analysis can be used to improve services and reduce costs.

SmartCities has demonstrated how card usage data can be gathered and used for the benefit of the community through city-wide public and private sector planning, whilst respecting privacy of citizen information.

3.7   Social inclusion and economic development

Contributing partners: All

To Identify and prove how the information gathered from use of the city card will contribute to other Information Society aims, such as social inclusion and economic development.

New models for providing services to citizens are core to effective city-wide smart card schemes. They have the potential (subject to resolving socio-political as well as technical issues) to underpin personal health systems, health management and telemedicine, and numerous systems and services for citizens with special needs, including the disadvantaged, the disabled, and the elderly.

Open multi-application smart cards enable improved effectiveness and user friendliness of administrations, on-line support to democratic processes, and provide a single modality for access to interactive services relating to public administration. The integrated analytical capability to be developed in the project has the potential to considerably improve planning and integration - e.g. urban transport infrastructure and services.

The project required technologies for identification and authentication, and secure electronic financial transactions, particularly in the context of e-purses. Its results will facilitate electronic trading and distributed virtual marketplaces, and will enable improved access to education and training, particularly in lifelong learning.

3.8   Solution for other European cities

Contributing partners: All

To provide other European cities with an open, easily replicable solution with reduced implementation costs for future schemes.

By developing an open, multi-application city card architecture, SmartCities offers for the first time the possibility to set up a European standard scheme to enhance the use of IT tools to manage both civil services/facilities and city planning in general. Indeed, it is important to notice that this architecture enables an evolving and tailor-made application card. This card scheme can be adapted easily to meet the specific requirements and needs of the various cities; the card can easily be modified later if integrated services are not targeted at the beginning.

The underlying vision for the open multi-application smart city card aims at a unified interface between city authorities, commercial organisations and citizens. It allows the city to provide added-value services to its citizens while integrating the administration of services within the city and enabling more effective planning. By making provision for a single interface between city and citizen, services appear much more cohesive and administration management is greatly facilitated. Moreover, thanks to the card, the city can identify which services the citizen uses and can build a significantly more accurate usage profile and achieve more effective planning.

The card has a broad spectrum of possible applications. For instance, the city can at the same time identify the cultural demands of its citizens as well as better target its social aid allocations. Furthermore, a natural reduction in urban fraud activities will stem from smart card authentication technology. This will result in improved, more cost-effective services.

The open multi-application city card can save substantial costs through a more efficient administration. It also improves and customises services for its citizens while encouraging economic development. This standardised smart card will work in every city and will facilitate the interchange of data between administrations (statistics, social security data…) at both national and European levels, thus strengthening the administrative European cohesion between city networks.

The integration of commercial applications, such as loyalty card schemes, will develop commercial relations between citizens and private organisations. However, it is important to note that privacy will be ensured in accordance with the EU 1995/46/EC Directive on the protection of personal data. Commercial data will not necessarily have to be communicated to the city and vice-versa.

3.9   Network of European cities

Contributing partners: Schlumberger, Southampton City Council, University of Southampton, IT Innovation and Black Sea Consulting.

To Create a network of European cities and share ideas, lessons and results via specific city card workshops and exploiting the Internet.

To ensure that the SmartCities project was successful it was essential that information was gathered from and disseminated to as many commercial and social sectors as possible. The creation of the SmartCities Interest Group (SIG) was considered an appropriate method of helping to achieve these aims.

The consortium was composed of partners having particular strengths that reinforce each other. Each partner had its own expertise in a given stage of the project. Since user partners were not IT providers, systems integrators or legal experts, the project needed other European expertise to fulfil these objectives. This mix of competences and nationalities ensured that we reached the best quality solution. Furthermore, the diversity of the partners participating in the project provided different points of view. This was necessary to meet European-wide market requirements and not to focus on any particular country. The creation of the SIG brought an independent dimension to the project. The participants shared the aims of the project and therefore had a vested interest in the value and quality of the outcome but with no obligation to the project they were able to examine results critically.

SIG quickly became a key vehicle for dissemination and indeed exploitation of the project. The SIG process provided a means to present the objectives and current status of the project in order to:

i)   define and update user needs and market requirements for SmartCities;

ii) raise awareness of the project and prepare for commercial replication;

iii) understand the differences between the current test city (Southampton) and other European cities; and

iv) include the comments of the participants in any exploitation plans to ensure true replicability of the designed architecture.

Guidance papers have been produced by the SIG and include:

- User Requirements;

- Business Models;

- Card Design;

- Card Applications;

- Best Practice Standards;

- Project Structure;

- How to get Backing for a Card Scheme; and

- Data Protection and Privacy.

The Data Protection and Privacy Guidance Note provides an overview of the key legal issues surrounding the manipulation and use of personal data arising from a multi-owner, multi-application smart card scheme, and the legal issues surrounding their establishment and operation.

The project established an Eastern European SIG specifically designed to adapt the overall SmartCities/SmartHub solution to this region.

4   SmartCities deliverables

The SmartCities deliverables are results of work within the following 15 Work Packages. For a complete list of the SmartCities deliverables, including their dissemination level (i.e. public or confidential), see Appendix A. The words in italics are taken from the Description of Work, work package descriptions.

WP1 – Project Management
WP and project leader: Schlumberger

The objectives of the project management activity were to:

- *facilitate communication and co-operation between project participants;*

- *monitor project progress, report to the EC and provide a point of communication for the project with the EC;*

- *ensure that goals are set for each project activity;*

- *maintain accurate records of cost and effort;*

- *promote quality in project work; and*

- *anticipate and manage changes related to the project.*

The deliverables in the Project Management Work Package consisted of a Project Presentation, six Progress Reports and this Final Report. The Project Presentation is a video presented on CD-ROM. The Progress Reports have described the main activities in each specific period, including comment on project progress, highlights, potential issues and risks. The progress reports also include details of resource usage. The agendas, minutes and tabled papers for all Board meetings and Formal Project meetings have been archived.

WP2 – Requirements
WP leader: Southampton City Council

To establish the requirements for a sustainable multi-application, multi-partner scheme in general, and to establish the requirements for the project demonstrators. Requirements for both the card operation and the information analysis will be covered.

This Work Package included User Requirements, Technical recommendation and a state of the art study.

D2.1 - Technical and User Requirements for Phase 1

D2.2 - Technical and User Requirements for Phase 2

D2.3 - Technical and User Requirements for Replication

These reports document the requirements as expressed by the SmartCities users (Southampton City Council and the University of Southampton) prior to and during the development of the demonstrator systems. The initial requirements were used as input for the development of supporting software and for planning of changes to working practices and business procedures with the City and University.

The final document gives advice for replication of the SmartCities model in other local authorities across Europe.

WP3 - Open System Architecture Developments
WP leader: Schlumberger

To design and implement an open, flexible system architecture, covering both the readers and the cards themselves. The architecture will enable new applications to be easily and dynamically added to an individual smart card scheme.

D3.1 - Initial Architecture Design Report

D3.2 - Phase 2 Architecture Design Report

D3.3 - Architecture Framework and API Specification

These documents form the basis of the submission to the CEN standardisation process. They describe the emerging and final technical architectures.

WP4 - Application Management Systems
WP leader: Schlumberger

To design and implement the card, terminal and network systems in order to mange the addition/removal/upgrade of applications to the scheme; including:

- *manage the addition/removal/upgrade and display of applications on a card-by-card basis.*

- *manage the addition/removal/upgrade of applications for terminals*

D4.1 - Application Management System Description

Post-issuance management of card applications was a key innovation of the project and an essential element of the SmartCities model. Cardholders are able to add or delete applications at a number of locations; remotely via internet-based PC's or kiosks, one-to-one at the card issuing stations, or directly with the application service provider, e.g. at the library or leisure centre.

WP5 - Mobile Implementation
WP leader: Technolution

To enable the three mobile applications to be used within the general system:

- *over the air downloading/upgrading/removal of applications onto the card, using a PDA and mobile phone solution;*

- *use PDA as a display terminal to read information stored on the card; and*

- *over the air reloading of e-purse and payment via PDA and mobile phone.*

D5.1 - Over-the-air Application Management Report

This is a key differentiator for the project, adding to the functionality available to the card holder by providing application and e-purse management via the mobile telephone network. A card reader connected to a PDA is used to access the mobile network.

WP6 - Application Software Technology Development
WP leader: Technolution

To create specific applications by translating existing applications to the open architecture and by developing innovative applications

D6.1 - First Application Suite Report

This document contains the application considerations regarding the first demonstrator functionality and implementation issues.

The goal was to provide information on the technical feasibility regarding the integration of applications onto one smart card system. In the project definition phase it was decided to integrate some existing applications that already use some kind of card. This means that for the first demonstration existing infrastructure can be used (like networks, transaction processing and management systems, and etceteras). Therefore the SmartCities project had only to develop a module for interfacing a smart card reader, which is to be placed into existing terminals.

D6.2 - Second Application Suite Report

Within the first demonstrator several applications were developed to be placed on a customer smart card. None of these applications offered sufficient security for a "real" electronic payment system.

In an electronic payment system customers are using their cards (electronic purses) for payments at merchant points of sale. During the lifetime of the electronic purse it is reloaded again and again with money from the customer's account. Because of the reuse of the electronic purse and the fact that the money is transferred from the customer's account, a very secure system needs to be in place.

The CEPS electronic payment system comprises several programs deployed on PC's, terminals and smart cards. It is developed to support secure electronic payment on the SmartCities smart card.

WP7 - Information Analysis System Development
WP leader: IT Innovation

To develop a system for analysis of the multi-owner transactional information gathered using the smart cards. The system will enable council planners and business users to visualise and analyse the information in order to better inform council and business strategic planning. The system will be accessible remotely using extranet technology.

D7.1 - Phase 1 Information Analysis Design Report

D7.2 - Phase 2 Information Analysis Design Report

D7.3 - Information Analysis System Report

D7.4 - Best Practice for Smart City Card Information Analysis Report

SmartCities experience showed that setting-up a multi-owner data analysis system has many advantages including:

- giving user organisations' analysts powerful analysis tools that can be accessed over the web from anywhere using low band-width connections;

- clearly defining the organisation hosting the Data Analysis System as a Data Processor – thus establishing lines of accountability;

- reducing the cost of setting up the Data Analysis System as setup and ongoing maintenance costs can be spread amongst participating organisations/departments;

- increasing collaboration between different department in the same organisation by allowing them to cross reference and cross-analyse their data; and

- centralized management of security and access controls, thus enhancing privacy and data protection in general.

In setting up the Data Analysis System, three distinct components were identified:

- data collection;

- data storage and

- analysis tools.

The data collection module should allow for a seamless data collection from various systems and deliver collected data to the data storage modules securely and safely. The storage module should allow for the safe and secure storage of the data. Analysis tools should allow access to complex analysis functionalities over a low bandwidth connection in order to enable information workers to access the data from anywhere through a basic web connection.

The data collection module will in most cases require development of bespoke tools integrated with available modules (such as ftp, encryption and cryptographic tools), as there are no stand-alone off-the-shelf data collection system that will perform exactly the function required. In the case of SmartCities Data Analysis System, in-house development resulted in an on-line/off-line set of data collection tools.

In selecting data storage and analysis tools, existing data storage and analysis products are likely to address most Data Analysis System's requirements. Oracle database and Oracle OLAP offerings were selected to store data and to enable web-based analysis for SmartCities but alternatives should not be ruled out.

In order to illustrate the technological possibility of the SmartCities Data Analysis System a Dissemination System was set up. This was populated with realistic-looking dummy data and made available to users to explore proposed solution features and comment as necessary.

The Dissemination System was enormously beneficial in giving potential users a good idea of what the Data Analysis System was capable of, and in generating interest in general. Through a number of seminars, the Dissemination System was introduced to users and comments gathered, which were fed into design process. Furthermore, the Dissemination System was used to construct case study scenarios to further demonstrate business benefits of a Multi-owner Data Analysis System.

WP8 - Systems Integration
WP leader: Schlumberger

To provide the technical infrastructure for the demonstrators, both before and during their operation.
The deliverables from this work package were integrated with deliverables for work package 9.

The work from   WP8 has been merged with WP9 and is reported in D9.2.

For the first Demonstrator the project used a contactless 1k Mifare Card. However in addition to the requirement for an open platform card type, some of the new applications planned for the second demonstrator required a contact chip. Following careful deliberation it was agreed that a Hybrid Card – a card which includes both a contactless chip and a contact chip would be used. The card used was manufactured by Schlumberger and included the same 1k Mifare chip and a Palmera Protect 32k Java contact chip.

The space available on the chips has to be managed carefully and it is recommended that in future schemes, standard applets are included in the ROM of the chip (e-purse, PKI container, Debit/credit) to keep the EEPROM available. If a Mifare based chip is used, it is recommended that the sectors between several applications are shared and a 4k chip is used. The project undertook further development of the Card Management system to incorporate the new hybrid card and the new applications as described in section 3.

Effort was also put into the development of new software functions for the scheme operations. These are call logging, blocking cards, generating letters and mails and registration of card dispatching date.

WP9 - Demonstrator Card Schemes
WP leader: Southampton City Council

To carry out the non-technical aspects and implementation of the card schemes

D9.1 - Report on Integration and Implementation - Demonstrator 1

D9.2 - Report on Integration and Implementation - Demonstrator 2

The first demonstrator involved the integration of three existing cards within one technical solution, these included Southampton City Council's Library card, Southampton City Council's Leisure card and the University of Southampton's Smart ID card. The overall objective was to test the technical feasibility of issuing a multi-functional card. It was agreed that for the purposes of the first demonstrator this would be carried out using a simple 1k Mifare card. The first demonstrator successful illustrated that cards issued by separate organisations could co-exist within a wider scheme.

The first demonstrator provided the project with an opportunity to develop and test the necessary hardware and software that is required to run a scheme. This included, amongst other things:

- Card Management System (manages cardholder details, cards and applications);

- card printer;

- smart card terminals for library and leisure venues;

- terminal software; and

- digital cameras and supporting software.

Furthermore it also allowed for the assessment of a range of non-technical procedures, policies and documentation and associated training of staff. These included the following.

- The integration of this service within the existing Leisure Card Department.

- The testing of the application form and the authentication procedure.

- The lost and stolen card procedure.

- The set up and training of staff at the registration locations.

New applications that have been added following the first demonstrator include:

- University secure cycle areas;

- University catering application;

- Athletic Union membership;

- University staff club membership; and

- Uni-link Bus application

The Uni-link service is principally designed to operate a number of routes that facilitate the swift movement of students to, from and between the University campuses. However, many of these routes run through the main arteries of the City, so the buses are also available for public use with their SmartCities cards. .

Following the request of the operators and the public, the City has enabled the use of passport photos to register with the scheme. They were initially captured over the same web cams but this was too labour intensive. An additional development has enabled the scanning of the photos, which proved to be a reliable and rapid solution.

The addition of new applications led to the design of a new application form. This is now a booklet that includes the application form, information about the scheme and card usage and the terms and conditions.

WP10 - Evaluation of Demonstrators
WP leader: Southampton City Council

To evaluate the effectiveness of the demonstrators.

This will cover both functional and technical evaluation, incorporating feedback from public and private organisations and citizen feedback.

In the case of the first demonstrator, to provide feedback to the requirements analysis and development work packages so that the rest of the project builds on the lessons learned in the first demonstrator; and to provide material for early dissemination. In the case of the second demonstrator, to provide the basis of the main part of the dissemination and exploitation activities.

D10.1 - Report on Evaluation of Phase 1

D10.2 - Report on Evaluation of Phase 2

The overall objective of this work package was to provide feedback to others engaged in developing a multi-application smart card scheme whilst helping to improve the scheme in Southampton.

D10.1 and D10.2 details the activity that has taken place with the two Demonstrators, in order for the reader to have a complete understanding of the schemes. The evaluation was divided into 9 relevant sections:

- Card Production and Registration;

- Card Usage;

- Helpdesk;

- Information Analysis Considerations;

- Technical Considerations;

- Security Considerations;

- Legal & Privacy Considerations;

- Social Considerations; and

- Commercial Considerations.

One of the key issues that has resulted from the evaluation is that card production is one of most difficult technical challenges, in particular the smart card printers. Procedural and operational issues proved to be of more concern than technical implementation issues. For instance; the development of an application form that was easy to understand by the public, was easy to use by staff yet provided enough information about the various services was surprisingly difficult to develop. Apart from the technical issues surrounding card production the other technical components have worked effectively. The biggest challenges by far were changes in business processes & procedures and the training of staff, rather than the anticipated technical issues.

WP11 - Exploitation Planning
WP leader: Schlumberger

To produce sustainable business model(s).

To produce an exploitation plan.

D11.1 - Sustainable Business Models and Marketing Study Report

This document reports the essential foundations of the SmartCities concept, its development and how it is already being used as a model for multi-application smart card schemes in Europe. It analyses legal issues, commercial issues, financial issues, technical issues, and investigates the sustainable business model (covering issues associated with the operator of the scheme). It is written with potential SmartCities concept adopters in mind and highlights the issues they must address. The document reviews the fundamental aspects of the SmartCities model and outlines the unique benefits it can bring to users of the card, issuers and application providers, and local authorities. It also relates these benefits to European policy objectives. This is followed by a description of the "Principles" that underpin the SmartCities concept. These have evolved throughout the project, and they act as a focus when considering best practice for city or regional schemes. They cover: the user; confidentiality and data protection; the scheme; interoperability; scheme management. These have been validated in conjunction with the SmartCities Interest Group (SIG).

The plug and play architecture is detailed, together with the card and terminal architecture, and the Global Management System, which is used to manage the multi-application/multi-issuer environment.

Legal considerations surrounding the SmartCities concept are addressed in two key areas: ownership and liability issues within the multi-application/multi-issuer scheme and confidentiality and data protection.

Commercial aspects of SmartCities give guidance on how the business model can be built, and covers aspects of costs, potential revenue streams, subsidies and commercial risk considerations. This is built upon the experiences of building a financial model for SmartCities Southampton.

The concept and generic model are validated by three individual case studies that also include a cross-case analysis, highlighting both the generic core elements and the flexibility of the model.

D11.2 - Technological Implementation Plan

This document summarises the results of the project and the individual exploitation plans of the partners.

WP12 – Dissemination
WP leader: Southampton City Council

To ensure that the achievements of the project and the lessons learned are widely disseminated, particularly to other European cities, but also to technology suppliers, systems integrators, consultants and service providers.

Partners will be able to bring experience to the project to aid dissemination within their individual business sector.

The Dissemination work package will work closely with work package 9 to raise the awareness of the project to potential cardholders.

This work package will also work closely with work package 11 and contribute to a sustainable business model.

D12.1 - Dissemination and Use Plan

This reports describes the dissemination plan for the project.

D12.2, D12.3, D12.4 - SmartCities Interest Group (SIG) Reports

These documents report on the launch and activities of the SIG. To ensure the success of the SmartCities project it was essential that information was gathered from and disseminated to as many commercial and social sectors as possible. The creation of the SIG was considered an appropriate method of helping to achieve these aims and a key vehicle for dissemination and indeed exploitation of the project. The SIG process has provided a means to present the objectives and current status of the project in order to:

- define and update user needs and market requirements for SmartCities;

- raise awareness of the project and prepare for commercial replication;

- understand the differences between the current test city (Southampton) and other European cities; and

- include the comments of the participants in any exploitation plans to ensure true replicability of the designed architecture.

The SIG has developed a range of guidance papers so that the experience gained by members can be disseminated effectively. The papers are not intended to be too prescriptive, it is anticipated that guidance papers might form the basis for some of the SmartCities Standards in the future.

The SmartCities Interest Group has continued to grow, with new members joining from throughout Europe and membership rising to 70 by June 2003. This reflects the growing development of smart card schemes and the growing interest in the SmartCities model. SIG meetings have been held across Europe; in Paris, Dundee, Southampton, Tampere, Reykjavik and Sofia.

The enthusiastic core group has continued to provide the members with useful up to date smart card and SmartCities information and the project end denotes an important time for the SIG as it establishes itself as a self governing, self financing organisation. A key part of the Group's work is to progress the CEN-ISSS proposal to develop the appropriate smart card standards.

D12.5 - Written contribution to Standardisation Bodies

This document embodies the SmartCities standard and is the basis of our CEN submission.

D12.6 - Final Dissemination Report

The objective of this report is to provide a summary of the key dissemination activities undertaken during the lifetime of the SmartCities project.

Work Package 12 had an overall objective 'To ensure that the achievements of the project and the lessons learned are widely disseminated, particularly to other European cities, but also to technology suppliers, systems integrators, consultants and service providers'. Achieving this with the limited resources available was one of the most challenging aspects of the SmartCities project.

One of the initial tasks that this Work Package undertook was the development of the SmartCities website. The website has provided an excellent medium to disseminate the project results and has been

particularly useful in providing information to those within Europe and further afield. The development of a news service proved to be a simple way of keeping interested parties up-to-date with the project progress. As the project progressed so did the development of the Cardholder website. The SmartCities website can be found at http://www.SmartCities.co.uk.

The SmartCities partners have attended and presented at a vast number of events during the course of the project in a number of different countries. The appearance of the project on national television and radio has proved significant, and local radio and television has played an important role.

Fortunately the SmartCities concept of an 'Open' multi-application smart card that was not tied to a proprietary solution quickly gained the interest of other organisations planning to embark in similar activity. This interest helped in the formation of the SIG.D12.7 - Report on Legal Aspects of Data Exchange

In contrast to mono-application card schemes, the implementation of multi-application smart card schemes, integrating an undefined number of application providers in one single card, implies certain risks in the field of personal data protection. In particular, attention should be paid to the use of global unique identifiers, i.e. a card holder identifier common for all the application providers. Although the use of global unique identifiers (GUI) for cross- profiling purposes is not by definition infringing Directive 95/46/EC on the protection of personal data, it must be underscored that such activities are a priori subject to the data protection principles.

After having identified the specific risks resulting from the implementation of multi-application smart cards schemes, some recommendations and solutions will be taken forward to reconcile data protection legislation with the opportunities offered by multi-application smart card schemes.

A first solution consists of the use of single key cryptography to scramble the GUI with the personal key of each application provider. As a result, the data warehouse will not be able to link the identifier of application provider A with the identifier of application provider B, or with the original unscrambled global unique identifier. This solution can be easily circumvented to allow cross- profiling activities, e.g. each application provider can reverse the encryption process by decrypting its ID.

For this reason, an alternative could be that before the application providers send personal data to the data warehouse; they must strip the information from all information that could, even indirectly, identify the person concerned. This way, the data warehouse will only contain anonymous data to which data protection legislation does not apply. To allow the cross-profiling of data and by consequence the generation of value-added information, the application providers may add general information, e.g. age category, gender, etc., to the anonymous data.

Eventually, one has to consider that smart cards can be built in a less privacy-killing way, e.g. , without a global unique identifier. If such a GUI still remains, it is possible to replace the global unique identifier by a cryptographic random function. In addition, it can be recommended that the identification procedures embedded in a smart card be replaced by an identity verification procedure.

WP13 - Assessment and Evaluation
WP leader: Schlumberger

The assessment and evaluation activity will assure project success by continuously assessing and evaluating progress against goals and objectives, informing management in a timely fashion.

(Functional and technical evaluation of SmartCities Phase 1 and SmartCities Phase 2 is the subject of work package 10.)

D13.1, D13.2, D13.3 - Self-Assessment and Evaluation Reports

These documents describe the project managements methods employed and how a number of project issues and risks were addressed.

WP14 – *Smart*Hub Requirements
WP leader: Black Sea Consulting

To establish the requirements for a centrally managed, high-performance, scalable engine for data movement, data transformation and interface management across all the scheme applications providers and issuing organizations

D14.1 - Technical and User Requirements

The overall objective of this work package was to ensure that the initial and important stages in design and development are successfully met. The result of this work is a key factor for the final success of SmartHub development and implementation and the project as a whole.

The document addresses two kinds of integration: intra-enterprise and inter-enterprise. Intra-enterprise integration is actually the SmartCities business case where it involves linking together various types of applications - different by functionality, interface, technology and platform. It also includes mapping data and translation between the various systems.

The information processed in SmartCities model could be one or all from the following data sources:

- application transaction data from the application providers' back office systems;
- CMS data, data from a Card Management System that contain general information such as cardholder personal details;
- infrastructure transaction data from card terminals and readers; and
- other supporting information such as specific for the application provider data or application-specific data.

The document reports:

- the *Smart*Hub architecture;
- the user requirements of Southampton City Council and University of Southampton;
- an analysis of those requirements;
- *Smart*Hub technical requirements; and
- further requirements relating to flexibility, security and extensibility.

The *Smart*Hub is a unified framework providing functionality for integrating virtually all ICT systems within the city, and linking those systems in a collaborative environment.

WP15 – *Smart*Hub Design, Implementation and Evaluation

WP leader: Black Sea Consulting

To design and implement a centrally managed, high-performance, scalable engine for data movement, data transformation and interface management across all the scheme applications providers and issuing organizations

D15.1 - Architecture Design Report and Interface Specifications

D15.2 - Architecture Implementation and Evaluation Report

As a proactive SmartCities partner and leader of Work Package 15 Black Sea Consulting is committed to ensure the successful deployment of SmartCities business model by developing *Smart*Hub, as a centrally managed engine for secure data movement, transformation and interface management that will facilitate data exchange between the scheme participants. The specifications and results are represented in the above-mentioned documents.

The documents demonstrate why *Smart*Hub could be considered as a robust data exchange system performing seamless cross-platform interfacing. The *Smart*Hub provides a number of business benefits such as full data exchange between various applications, database reconciliation between the different network entry points, robust and reliable communication with automated recovery options, easy and cost-effective inter-application communication, facilitated migration from legacy applications.

Major development milestones have been set up in designing and implementing the *Smart*Hub engine and corresponding components. Thorough testing procedures have proved the reliability of the software.

On the basis of the work completed and the findings some recommendations concerning the use and application of *Smart*Hub are reported in the documents.

- SOAP rather than TCP/IP connection is recommended for *Smart*Hub implementations.
- *Smart*Hub training is recommended to ensure that all benefits have been fully utilised.

The SmartCities Project demonstrated the technical feasibility of a plug and play management platform by defining an architecture that can support multi-industry standards and interfaces. More specifically, based on SmartHub the SmartCities project makes feasible the dynamic management of applications at the card and scheme level.

The review of *Smart*Hub features, as well as architecture design and configuration are reported in the documents. The evaluation of the *Smart*Hub key features shows how it achieves the objectives set up by the project and European Commission directives.

The documents cover the following topics.

1. *Smart*Hub architecture and components.
2. Interface Specifications.
3. Installation and configuration procedures.
4. Implementation description.

5. Deployment evaluation.

This project implementation in Southampton illustrates the benefits derived from the *Smart*Hub deployment. It also demonstrates how the *Smart*Hub system is going to be maintained throughout the project lifecycle. Evaluation results are summarised in order to establish the basis for recommendations for future implementation and conclusions.

5　Conclusions

SmartCities is a complex and multi-facetted project; the results of the project are far reaching and cover every aspect of smart card scheme implementation. Technical innovation has been complemented by important research into the legalities surrounding usage data, based on the interpretation of data privacy legislation; commercial models for multi-issuer schemes have been developed and enhanced by the provision of flexible business case tools. SmartCities developed tools to enable smart card scheme operators to extract card data from various application providers systems, analyse collected data and facilitate data exchanges amongst application providers. The SmartCities results are being taken forward through the SIG; SIG has the potential to become a powerful exploitation vehicle.

Despite early difficulties, the Consortium has sustained its commitment to deliver the original project objectives and delivered them well.

5.1　Project performance against goals and objectives

Scientific and technical innovation

SmartCities has defined an open architecture for a multi-application smart card scheme. The specifications and definitions will be submitted to a CEN/ISSS workshop with the aim of setting a European standard.

Technological and business objectives of partners

Each partner has contributed fully to the project bringing with it specialist knowledge and expertise. On-going exploitation of the results is described in deliverable D11.2, Technological Implementation Plan.

Appropriate economic development

The success of the SmartCities Interest Group provided a very good barometer for economic development of the emerging model and standards. The level of interest was generated because local authorities all over Europe have an interest in delivering a value for money, interoperable smart card scheme to their citizens. The SmartCities approach has proved highly attractive to where dependence on single supplier, proprietary solutions have previously been the only option.

Contribution to EU social objectives and policies and community added value

Smart cards provide a secure and convenient vehicle for the introduction of electronic services and electronic access to typical community based services. The introduction of a smart card scheme gives local authorities potential to meet eGovernment and social inclusion targets. Secure applications (PKI digital signature) applications are proving highly valuable tools for prevention of fraud and for faster more convenient service delivery to citizens.

Overall, with high-profile demonstrators and results disseminated through the SIG to all interested parties - cities, chambers of commerce, and public and private enterprises throughout the EU - the project serves as a showcase for the Information Society in Europe.

Appendix A - SmartCities Work Package Deliverables

Deliverable No[1]	Deliverable title	Delivery date[2]	Nature[3]	Delivered only on Request by Commission	Dissemination level[4]
D1-1, D1-2, D1-3, D1-4, D1-5, D1-8	Progress Reports	PM7,PM13, PM19,PM25 PM31,PM36	R	No No	CO
D1-6	Final Report	PM36	R		PU
D1-7	Project presentation	PM2	R	No	PU
D2-1	Technical and user requirements for phase 1	PM5	R	No	RE
D2-2	Technical and user requirements for phase 2	PM18	R	No	RE
D2-3	Technical and user requirements for replication	PM34	R	No	CO
D3-1	Initial architecture design report	PM10	R	Yes	CO
D3-2	Phase 2 architecture design report	PM22	R	Yes	CO
D3-3	Architecture framework and API spec	PM34	R	No	RE
D3-31	Architecture framework and API spec	PM34	R	No	PU
D4-1	Application management system description	PM28	R	Yes	CO
D5-1	OTA application management report	PM28	R	Yes	CO
D6-1	First application suite report	PM11	R	No	RE
D6-2	Second application suite report	PM30	R	No	RE
D6-11	First application suite report	PM11	R	No	PU
D6-21	Second application suite report	PM30	R	No	PU
D7-1	Phase 1 information analysis design report	PM6	R	Yes	CO
D7-2	Phase 2 information analysis design report	PM18	R	Yes	CO
D7-3	Information analysis system report	PM30	R	No	CO
D7-4	Best practice for smart city card information analysis report	PM36	R	No	PU
D9-1	Report on integration and implementation – demonstrator one	PM19	R	No	PU
D9-2	Report on integration and implementation – demonstrator two	PM34	R	No	PU
D10-1	Report on evaluation of phase 1	PM22	R	No	PU
D10-2	Report on evaluation of phase 1	PM34	R	No	PU
D11-1	Sustainable business models and marketing study	PM36	R	No	PU
D11-2	Technological Implementation Plan	PM36	R	No	CO

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[1] Deliverable numbers in order of delivery dates: D1 – Dn

[2] Month in which the deliverables will be available. Month 0 marking the start of the project, and all delivery dates being relative to this start date.

[3] Please indicate the nature of the deliverable using one of the following codes:
  R = Report
  P = Prototype
  D = Demonstrator
  O = Other

[4] Please indicate the dissemination level using one of the following codes:
  PU = Public
  PP = Restricted to other programme participants (including the Commission Services).
  RE = Restricted to a group specified by the consortium (including the Commission Services).
  CO = Confidential, only for members of the consortium (including the Commission Services).

Deliverable No[1]	Deliverable title	Delivery date[2]	Nature[3]	Delivered only on Request by Commission	Dissemination level[4]
D12-1 D12-2, 3, 4 D12-5 D12-6 D12-7	Dissemination and Use Plan SIUG Reports Written contribution to standardization bodies Dissemination report Report an legal data privacy aspects of data exchange	PM6 PM12,24,30 PM36 PM36 PM35	R R R R R	No No No No No	CO PU PU PU PU
D13-1, D13-2, D13-3	Self-assessment and Evaluation Report	PM 12, 24, 36: Review Meetings	R	Yes	CO
D14-1	Technical and user requirements	PM29	R	No	PU
D15-1 D15-2	Design and development report, Implementation and evaluation report	PM31 PM35	R R	Yes Yes	RE RE
D15-11 D15-21	Design and development report, public version Design and development report, Implementation and evaluation report, public version	PM31 PM35	R R	Yes Yes	PU PU

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