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The Challenge of Multi-application Smart Cards: The SmartCities Experience

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1 The SmartCities Concept

The genesis of "SmartCities", was the recognition that cities throughout Europe were looking to exploit the benefits of using smart cards for local applications. Smart cards have the potential for becoming an essential element of the local government strategies to improve services, reduce costs and offer more comprehensive city management. However, while the focus is centred on local governmental strategy, the SmartCities concept is to deliver an "open" multi-owner, multi-application card that secures business benefits for private companies as well as publicly provided services.

The smart card industry is currently growing rapidly, with many potential uses for smart cards across a variety of sectors. There is a risk that divergent initiatives will arise, leading to a proliferation of incompatible smart card schemes. However, achieving a true multi-operator, multi-application card scheme is challenging. For different organisations, there are different pressures and time-scales involved which are compounded by the need to standardise at the technical and commercial level. Furthermore, the scheme must facilitate organisations with both divergent, but also competing interests.

2 The SmartCities Project

2.1 Strategy

The SmartCities project, initiated in March 2000, aims to design a dynamic smart card and multi-application management architecture to allow targeted markets (middle size communities) to benefit from the numerous advantages of smart card environment, without being tied to a unique, proprietary model. SmartCities is also aiming at to prove the technical, legal and commercial feasibility of exploiting multi-owner data sources gathered from card use within the scheme.

SmartCities is attempting to demonstrate the technical feasibility of a plug and play management platform by defining an architecture that can support multi-industry standards and interfaces. Associated to this standard architecture, SmartCities is also seeking to demonstrate the technical feasibility of dynamic management of application at the card and scheme level (including terminals). As proof of concept, the solution is being validated by two demonstrators (in Southampton - UK), incorporating all the elements of a full scheme (smart cards, terminals, software tools, data analysis servers).

In order to lower the commercial barriers associated with rolling out a large number of applications, it is essential that the technology facilitates the addition and removal of scheme components. Downloading (or upgrading) applications to a card held by a citizen will be made as simple as possible. The citizen will take the card to an issuing point where it will be placed in a terminal and the card updated as necessary. This means that new scheme components can be added or updated, without requiring an expensive re-issue of cards to the citizen. Citizens will use different kinds of terminals for these aspects, including mobile devices and home terminals with an Internet connection.

In order to validated the work being undertaken, a number of SmartCities Interest Groups (SIGs) have been established including an ongoing European SIG made of a number of partner cities across the EU who are committed to exploring and developing the SmartCities model.

The SIG Core group, made up of representatives from Reykjavik (Iceland), Dundee (Scotland) and the SmartCities Consortium, are developing guidance notes on four areas of greatest interest/concern:

- User Requirements;
- Best Practice Standards;
- Business Models;
- Data Protection & Privacy

2.2 Key objectives

The objectives of SmartCities are 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);
- Implement a smart card framework conforming to the multiple industry standard APIs architecture;
- 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 to share ideas, lessons and results via specific city card workshops and the Internet.

2.3 Success Criteria

The overall success of the project will be measured by:

- The publication of APIs - written contributions to standardisation bodies are a key deliverable;
- The implementation of demonstrator schemes to prove the concept of the open architecture interfaces on a unitary test basis and then to prove commercial feasibility (in terms of card usage), and technical and management feasibility (including the dynamic part of application management);

- The implementation of an innovative information analysis system architecture and data model to exploit the information for planning purposes;
- The delivery of sustainable business models;
- The delivery of an exploitation plan demonstrating the sustainability of the open city card concept.

3 Experience

SmartCities has proved a catalyst for considerable investment from Southampton City Council to introduce a sustainable SmartCard scheme that will continue and, indeed, expand beyond the lifetime of the project. The project is based around two distinct demonstrators. The first demonstrator has now been completed. This involved the introduction of a contactless card for libraries and leisure centres and integration with the University smart ID card (bus/sport/Athletics Union/cycle stores/catering). The first demonstrator has provided the opportunity to develop and adapt technology with the emerging needs of the Project, and to increase awareness and confidence in the system. The second demonstrator will introduce hybrid cards with an accelerated roll out of cards and new applications over summer/autumn 2002. Pre-existing systems are being upgraded and new applications will come on line: toll bridge, schools catering, universal loyalty, concessionary bus pass, PKI functionality and a trial of the CEPs E-purse. Ultimately, the scheme will look towards migration to a "Combi-card", when commercially available at an affordable price.

This paper draws on experiences from the initial demonstrator and shows how the lessons learnt have been translated to the development of the second demonstrator. In addition, the conference presentation will provide an up-to-the-minute insight into the large-scale second demonstrator, and experience of the first batch of cities adopting and implementing the SmartCities model via the SmartCities Interest Group. The following section outlines some of the live issues that have been encountered and which will be developed in the presentation. These encompass both the operational issues of delivering a live scheme and some of the higher level issues concerning the interoperability and replicability of the open city card concept.

4 Issues and Proposed Solutions

4.1 Interoperability

Consortium partners have worked extensively on the definition of levels of interoperability that would be desirable/deliverable between city schemes across Europe. Issues have centred on whether it is the card, the scheme or the individual applications that are interoperable.

The SmartCities concept based on the available standards and Java platform enables to reach the essential interoperability at application level (but which in most cases still require definition of application standardization). However, the management of the card platform which will remain under control of the different schemes, who must be able to adhere to a common standard to handle application loading from other schemes.

4.2 Electronic Purse

Even pre-dating the inception of the project, consortium partners have negotiated tirelessly with potential partners from the banking sector to secure their involvement in the second demonstrator. Unfortunately, banks have felt unable to commit resources. However, there is a wealth of knowledge within the scheme relating to the economic concerns and practical considerations of bank association with multi-application cards. Similarly, partners have met with the UK Financial Services Authority to discuss the implications of EU and UK regulation on the e-money directive.

While continuing a dialogue with the banking sector (with reference to future schemes), for demonstration purposes, the project will trial the CEPS open banking e-purse in a closed environment, without the involvement of a bank. This proves the platform will be able to host Epurse applications, which are expected to be part of the core application group in some countries.

4.3 Multi-Vendor Programmes

Quite beyond of any desire to introduce an interoperable bank e-purse, the project has come up against other issues relating to different vendor applications co-existing on the same card. For example, Southampton has several private bus operators and, while all can appreciate the benefits that smart cards (and city cards in particular) might offer, there are a number of barriers to progress in this area. One of the often cited difficulties is that of common fares structures which, it has been suggested can be perceived to be anti-competitive and contravene UK legislation on price-fixing.

It is hoped that the obvious benefits of a joint operator card based ticketing system can be realised by changes in the interpretation of legislation. SmartCities is working to achieve this.

Perhaps the most obvious source of potential conflict in a multi-issuer scheme is the issue of card branding. There may be a fundamental problem for application providers sharing a card upon which their own logo is not present. It is envisaged that the management board of local schemes would be best placed to address this issue.

Within the Project, a branding/card design working group is looking at potential sources of conflict together with the downstream implications. Currently, it is envisaged that application providers who wish the card to carry their logo even if they are not the issuer, may only do so in the context of card sponsorship, which would form a separate commercial agreement to that which governs the application being hosted on the card.

4.4 Card readers/terminals network and systems personalisation

The project identified the need for an innovative management solution to substantially facilitate data exchange between the different organisations collaborating in the card scheme, especially on the user level to ease the citizen's acceptance of the technology. Indeed, current manual and complex data synchronization between the systems constitute a major bottleneck to the implementation of multi-application card schemes.

The proposed solution is to develop a online automation of data exchange between all systems that will complement and complete at system level, the open architecture developed at card and terminal level by SmartCities. This will enable a to have a single

customer management and offer value added services to the participants in the scheme, for example instant application post issuance.

4.5 Critical Mass

Whether single or multi-application, the commercial viability of card schemes is dependent on realising a large card carrying population in a short period of time. Many trial schemes have floundered because they have not achieved a "critical mass" to enable a fair evaluation of the potential of a mature scheme. In many ways, the multi-application nature of the SmartCities scheme both exacerbates the problem and provides the solution. On the one hand, potential application providers are unwilling to invest in an unproven scheme which has a relatively low coverage in terms of population. On the other, it is the number of key applications that will ensure that the card gains exposure and becomes a valued commodity to the citizen.

Scheme providers must ensure that they have **control** over a core portfolio of applications that will ensure high take up of the card. This may be secured primarily by the commitment of the local council to deliver key services (eg library/voting/entitlements/concessions) via the card. The scheme will be enriched if other application providers will commit from the outset, particularly if their product will attract key groups within the population.

The results of market research and a user needs analysis which have taken place within the project will be of interest to delegates in addressing this issue, and will provide a strong user perspective to the discussions.

The Southampton second demonstrator has a schedule to roll out up to 80,000 cards covering a diversity of applications.

4.6 Authentication for Card Issuance

A great deal of work has taken place on the security, customer friendliness and legality of authentication procedures for card issuance. One of the key issues is whether it is at card or at application level that the citizen is required to prove their identity. Indeed, does the card (with name and photograph) have an intrinsic value without a single application issued? Similarly, will stringent authentication requirements be prohibitive to people applying for cards and/or will they enhance the perceived value of the card?

A risk analysis has been undertaken by Southampton City Council resulting in a prevailing view that a high level of authentication is required at card issuance.

4.7 Business Model

The SmartCities Business Model is evolving to encompass all aspects of a multi-owner, multi-application card scheme. Underpinning the model are a list of "**Scheme Principles**" which convey the fundamental rationale for the SmartCities concept. These continue to be validated by city partners in our European Interest Group. The model also investigates the legal status of a scheme, the entities within it and the "**roles and relationships**" between all stakeholders.

Local models are being established for the Southampton demonstrator. Work is ongoing, though these currently demonstrate that at a worst case the local scheme will require a small percentage subsidy to implement a number of public service applications on a card, as well as one commercial application. This five year model does not take into account

the large potential savings which may be realised. In addition the small subsidy, in effect, becomes the small net cost of implementing an infrastructure which can become a flexible city/application provider policy tool.

The Project is also addressing the suppliers' business model, and issues surrounding the cost effective supply of goods and services to support SmartCities type schemes throughout Europe.

4.8 Issuance and Replacement

Who is responsible for issuing the card? Can this be done in more than one place? Can the card have a different physical design, depending upon who issues it? Who is responsible for replacing a lost/stolen/broken card? Should all applications and values be restored at the point of re-issue?

The essence of a demonstrator scheme is to deal with real problems at an operational level and to test if proposed solutions to these very difficult questions are really workable.

4.9 Use of Data

One of the most innovative aspects of the project is to demonstrate the how data generated by the use of cards may be used to create valuable management information beyond that generated at application level (eg an analysis of how people travel to sports centres though bus/parking data). The project has explored number of technical solutions that take account of UK and EC data protection legislation. These solutions extend to data preparation at source, secure and efficient transmission of prepared data and the cross analysis of multi-owner data.

The use of techniques to ensure anonymity and the wider issues surrounding the recording and holding of data are all under investigation by consortium members CRID and IT Innovation.

4.10 Standardisation

Possibly the greatest challenge for the project is to ensure compliance with existing and emerging standards both at system and application level.

The project is represented on, or has access to, Standardisation Bodies (such as GlobalPlatform, ITSO in the UK etc..) and is building on these requirements to establish the SmartCities scheme solution. The project plans to publish proposals for the scheme components requiring further standardisation to ensure that SmartCities schemes can be replicated across Europe.

5 Summary

These key issues, which have emerged from real implementation of the SmartCities model, will be of interest to other cities, together with consultants and professionals, who are looking at the development of multiapplication smart cards. The presentation will develop these further and will also provide and update on all aspects of the live project.