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Mobile Technologies

ICING: Building the Cities of the Future

Joan Batlle-Montserrat, Irma Merino-Zapirain, and Carlos Paternain-Soler

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The ICING Project explore new uses of mobile technologies to increase citizens' quality of life in urban areas by means of improving their communication and interaction with the urban environment, communities, and public administration. This paper presents the project and describes the main goals, technological contributions, and benefits.

Keywords: Cities, e-Services, ICING, Innovation, Mobile Technologies, Social Networks, Strategic Planning, Web 2.0.

1 Introduction

Nowadays more than half the world's population already lives in cities and this tendency is increasing [1]. This makes it difficult to manage cities and provide a good quality of life to their citizens. Large urban areas require public administration to react efficiently while being aware of the reality of the city. If we are to make city

management possible it is necessary to involve the citizens themselves in some way. Fluent lines of communication are needed between citizens and their city council. Citizens should know and be able to communicate easily with their city council. Only then will it be possible to manage cities efficiently. Meanwhile, mobile phone use in Spain has already reached a penetration higher than 100% [2], meaning there is more than one mobile phone per person. This technology offers a number of easy communications channels, some of which are already accepted by

their users. However, mobile devices have many embedded technologies which either have not yet been used or did not prove to be a real solution for users. This context provides public administrations with the opportunity to use the mobile channel to offer new services, thereby improving communication with their citizens.

2 How ICING was born

During 2005, the City Councils of Barcelona, Dublin and Helsinki decided to work together on an R&D project with the purpose of finding a

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way to deploy citizen-oriented services through mobile phones and Web 2.0 technologies. These services aim to make it easy for urban society to merge, and to improve urban space management and council services by means of promoting citizens' active participation.

The Innovative Cities for the Next Generation project (ICING) [3] has eleven partners, a budget of 5 million euros, and a scheduled length of 30 months. The project is partially financed through the European Commission as a part of the sixth framework program of the Information Society and Technology. Project co-ordination is provided by the Dublin Institute of Technology. Also from Dublin, eSpatial is in charge of geospatial applications development. The Art and Design University of Helsinki contributes with its knowledge in the field of citizen participation and social software development. From Barcelona, 22@Barcelona and the Pompeu Fabra University are taking part through Barcelona Media, while the Barcelona Agency of Urban Ecology (BCN Ecologia) and the companies T-Systems and Telefónica I+D are also participating in the project.

ICING is exploring a new city model in which a city, by means of ambient intelligence and information provided by citizens, is able to react and adapt to the changing needs of urban society (see Figure 1).

There are a number of other projects around the world working in the same direction. Emerging information and communication technologies make it possible to redefine the way in which users relate to their immediate environment. In the case of cities, we are talking about the way citizens interact with their urban environment. Can we imagine a city in which inhabitants have access to the information everywhere, and at any time, by means of various devices; in other words, a ubiquitous city? A good example is to be found under construction at Songdo [4] (Korea). The MIT SENSEable City Lab, is working on various projects [5] aiming to create ambient intelligence and use it to study urban dynamics to improve city management. The OXIGEN Project of the Laboratory for Computer Science in the MIT [6] is also worth mentioning. Large IT companies [7] and important universities such as the University of Washington [8] or the Carnegie Mellon University

[9] are also working on similar projects focusing on user interfaces, distributed services, and city ICT-enabled infrastructures to allow a richer and more efficient interaction of users with their immediate environment.

The ICING city model requires us first to address the problem of how to install new infrastructure in the city to provide lines of communication between citizens and the city (such as Wi-Fi networks or Bluetooth access points in addition to existing GSM and 3G networks). We also need to deploy a sensor network to transmit information about the city (CCTV for traffic, sound meters, pollution meters...).

Secondly, the project studies the applicability of technologies already used for the identification of logistics products (Semacodes [10], RFID labels, etc.) to identify and even "connect" urban elements.

Finally, return channels must be qualified. Citizens who use innovative services to communicate with the public administration must receive feedback; they have to know that their contribution has been considered and they should be able to see the result of their contributions and even of the contributions from other citizens. And although services may have been especially designed to be used through mobile phones, the return channel could be of a different nature going from an SMS to, say, a written letter, email or phone call.

Due to the varied nature of the services of the type described so far, for the purposes of the project the possible services were divided into three main categories:

1. Services for citizens and communities, which are services intended to facilitate contact between members of a defined community;
2. City services or e-Government services, especially designed to be used through mobile phones despite their multichannel inception and construction.
3. Services based on ambient intelligence and an ICT-enabled city infrastructure. Services enabled by deploying city sensors and through citizen involvement will help councils be more aware of the reality of their city



Figure 1: ICING City Model.

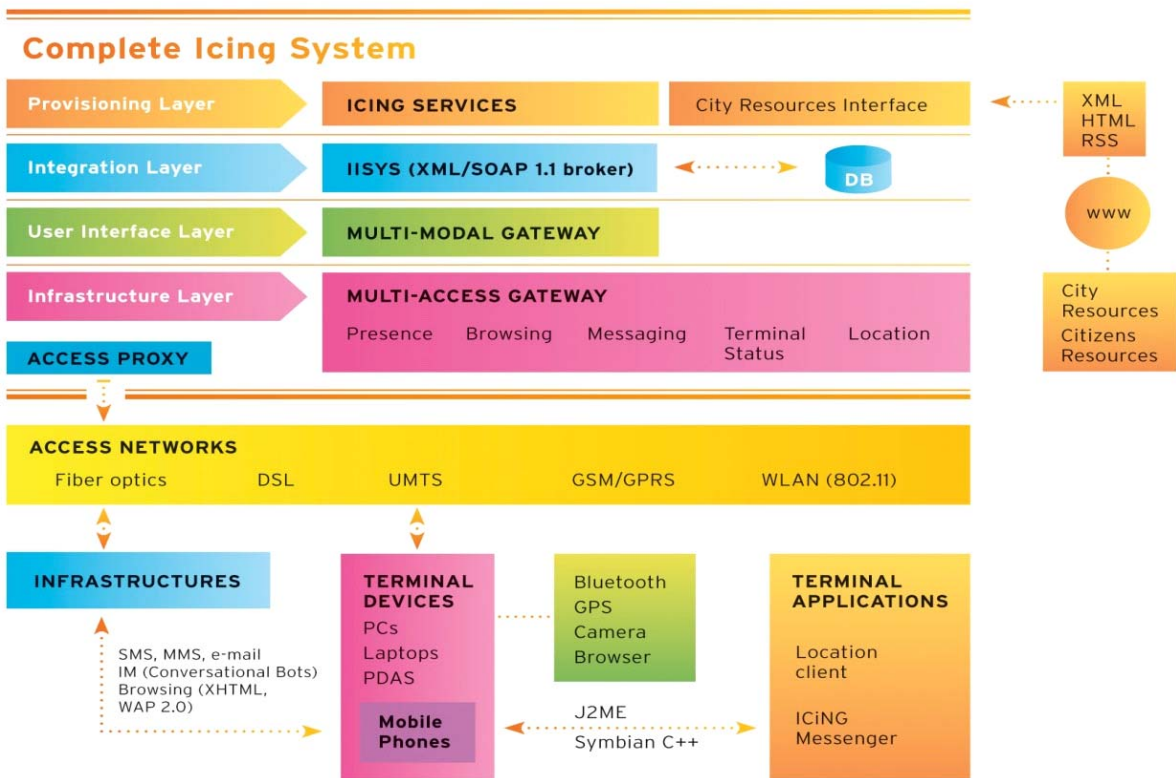


Figure 2: Architecture of the ICING'S Platform.

and allow them to respond more efficiently to its needs.

3 ICING Architecture

From a technical point of view, the Project's main aim is to develop a platform capable of integrating all the types of services mentioned above, adaptable to any city requirements and easy to maintain. The platform is based on a Service Oriented Architecture (SOA) built in multiple layers: infrastructure, user interface, integration layer, and ICING services provision layer. See Figure 2.

Firstly there is an "infrastructure layer" also called Multi-Access Gateway (MAG) which provides service access to citizens. Thanks to this gateway, citizens and digital sensors communicate with ICING services using interface based web services, which follow the Parlay X 2.0 standard defined for this purpose, independently from protocols and network functionality (hence the term Multi-Access).

This layer acts as a protocol translator to connect several networks with

different technologies in just one system. In this way, MAG is a node which acts as a single entry point to the ICING platform from the several access technologies available.

As well as detecting the state and presence of terminals, messaging is one of the main functionalities provided by this layer. This functionality allows citizens to send and receive messages, (SMS or MMS messages for mobile networks and emails for Wi-Fi or DSL using SMTP protocol). Also an immediate message service has been included, which uses the XMPP protocol (Extensible Messaging and Presence Protocol) to allow any device to communicate with any other.

The location functionality is another of the most important functionalities provided by this layer. Thanks to this layer service, applications can resolve a user's location or a group's location.

The next layer is also called the "user interface" layer and is implemented as a Multi-Modal Gateway (MMG) providing multi-modal functionality to ICING services. This layer

uses the MAG interface to send or receive all kinds of messages from/through the users. It is responsible for providing format to higher layers. To achieve this, it fits the information data to the active device in real-time, and to the return channel chosen by the user in its ICING profiling registry.

The method used to carry out this functionality is based on the idea of "content adaptation", which is a neutral representation of the interface produced by the service to make the final interface representation (user interface) based on device capabilities and user preferences. The kind of research which provides this technology is the "Single Virtual Terminal" paradigm (Helver, 2002), which is nowadays used to join a number of physical devices to a virtual terminal to access specific services with improved capabilities.

The MMG also manages user profiles, and so preference requests and device features are provided in this layer.

The integration layer is provided by

the ICING Integration System (IISYS). This component is responsible for integrating all the platform subsystems and is found in the architecture's core. Apart from integration, it offers data base accessibility functionalities, file management, access management, user, groups and alert management.

At the same time it allows each system to be provided in a distributed architecture. The services that have been described tend to be heterogeneous by nature and they require different functionalities apart from simple data storage to come from the sensors to allow complex communications flows and data analysis. In the aforementioned layers, some of the computing requires services and provider systems. The latter have a distributed architecture; they come from various providers and they have been implemented using deferment techniques.

In a SOA, services are treated like first class entities; therefore new services are created by combining existing services rather than by writing all the code again. Following this concept, it is very helpful to create a set of service components which are able to exist on top of each other. What is more, service users will need to find the service providers in order to execute the service. Although it is possible to make a "hard code" of the service's providers at the service's request, implementations of this method increase connections and dependencies and reduce the reuse capacity, and it is generally better to eliminate code dependencies and split up the use setting up. SOA architecture follows this principle providing a brokerage subsystem which acts as a mediator of the request between requesters and providers. The IISYS performs this mediating task and is responsible for the integration of the various subsystems. It also provides a set of computing services for normal use. The IISYS acts like an operating system; it performs tasks such as data storage and data retrieval, and makes this data accessible to the services.

Finally, the last architecture level is the "provisioning layer" where the ICING services are located. These are made up of modules and back-end applications which contain the service

logic necessary to provide the three families services mentioned above.

4 ICING Pilots

To validate the architecture mentioned above and the proper operation of the existing platform, three prototypes will be implemented, one for each city involved. Helsinki is where the Urban Mediator service is being tested. The Urban Mediator is a software application which allows citizens to create and share location-based information about their neighbourhood, set up their own topics of interest, and process the available information through various on-line tools. Urban Mediator can also be used by cities as a channel to relay location-based information to citizens and ask them to report issues. Citizens can report any issue that may be of interest to the council. This is a public administration tool which, through citizen collaboration, provides information to public administration about which issues are interesting for, of concern to, or disliked by citizens. City-point comments added by citizens are displayed on a map. This information is publicly accessible by any citizen and as a result of this a forum discussion may be initiated about any issue. Helsinki will make a general test of this service for any issue suggested by citizens.

Dublin is also testing Urban Mediator, but in this case lack of accessibility is the discussion issue. Thus, anyone finding an architectural barrier in Dublin could create a discussion point linked to that geographic point and would be able to add a comment and a picture of the reported issue.

In the Barcelona 22@ district, three different pilot schemes are being implemented. Testing is being conducted using an application developed within the project to help members of a community open lines of communications between one another. The service is based on a real-time messaging software for mobile phones, the ICING Messenger, developed by one of the project partners. This software allows fast communication between two people and it displays their proximity to one another as well as their proximity to the rest of the connected group. This

powerful tool helps create social networks while facilitating communication between members of existing networks despite the fact that the pilot scheme is so far only demonstrating its functionalities and not exploring all the applications of this tool.

The second prototype is based on city traffic data reception and processing to provide citizens and city managers with real-time traffic information. This pilot project involves modifying city infrastructure. It is based on an advanced network of Bluetooth sensors deployed along the streets of a city area located in the 22@ district of Barcelona. At the same time, a second network of video cameras to monitor traffic on streets has also been deployed in a nearby area. These two networks of "sensors" are acting as a complement to the existing network of "magnetic loops" to count traffic on the streets. All the information provided by the three sensor networks is processed and adjusted to create "from-to" arrays of city mobility. These arrays indicate how pedestrians and cars are moving around the city, and they constitute an essential tool for urban planners. As a by-product, citizens obtain real-time information about traffic on the streets.

The third pilot is based on an issues-reporting service that directly involve citizens with the aim of enhancing city quality of life. The reporting service use semacodes to "tag" items of urban furniture while, at the same time, providing an easy way to report any issue related to the tagged furniture. An overflowing rubbish bin, a broken streetlight, a damaged container - anything a citizen might report could be an issue. In the actual prototype a citizen will be able to report an overflowing rubbish bin to the City Council by just one click on his or her mobile phone. This new facility will reinforce the already existing IRIS service provided by Barcelona City Council by adding a new channel to the existing service that up to now has allowed citizens to report any issue by phone (voice) or Internet.

5 A Useful Sample Case

To register a new issue it is necessary to have some information: firstly

the object related to the issue; secondly, the issue to be reported; thirdly, where the object is located; and finally, the personal details of the person reporting the issue. As well as adding a mobile channel to this kind of communication, the purpose of the project is to enable most if not all of the parameters required to set up an issue to be inputted automatically. This opens up city management to citizen participation.

City components are labelled with a Semacode (for MMS or browser communication) and an alphanumeric code (for SMS) so that every component will be related to the proper issue, as shown in Figure 3.

Not all components can be reported with the same issues: a street light may be blown, but a rubbish bin cannot be blown. We code each issue in relation to its associated element, therefore a 1 referring to a rubbish bin indicates that the rubbish bin is overflowing, while a 1 referring to street light means that it is blown. The reason for this type of coding is to use a unified "language". For example: an English speaking person will choose 1, meaning the rubbish bin is "full", and the same code would be chosen by a Catalan speaking person, meaning the bin is "plena".

The third parameter we need to know is the element's location, and this is the most difficult parameter in terms of making automatic input available to everyone. It will be much easier with the embedded GPS technology that most mobile phones will have in the near future.

Finally, it is essential to identify the person who reports an issue. Until now, whenever a citizen made use of this service he had to provide his personal and contact information. In the pilot scheme, citizens will have to register their personal information just once, when they will provide this information and their favourite incoming channel (SMS or email). The system will use this information whenever they report an issue.

Let's imagine the following situation. Imagine a citizen (we will assume a male citizen, for grammatical simplicity) who owns a GPS mobile phone with the bi-dimensional code or Semacode reader application installed

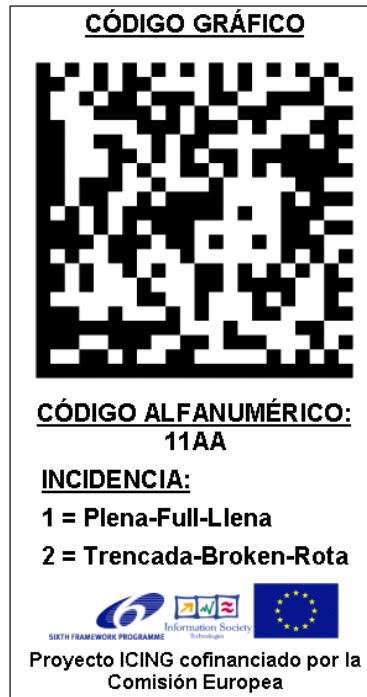


Figure 3: Rubbish Bin Tag.

and who has already registered with the council. This citizen comes across an overflowing rubbish bin and he wants to report it to the council, so the rubbish can be emptied. The citizen will open the application in order to read the rubbish bin code. Automatically the reader will recognize the Semacode and send a request to the City Council IRIS [11] service, including the user's ID, the ID of the offending element, its location, and the issue. With this simple action, the issue has been reported to the city cleaning company and a tracking code has been sent to the citizen through his preferred return channel. The issue reported is attended by the cleaning brigade according to the established SLA and the citizen is notified when the problem is solved. All this happens with just one "click", as if by magic!

6 Conclusions

This ICING project explores the opportunities provided by the new mobile technologies and Web 2.0 technologies implementation for improving urban quality of life. This project offers the community a platform which allows cities to deploy advanced services to encourage social integration making use of social networks and citi-

zen participation in the management of the city. Services which provide new information about the state of the city, allowing public managers to act faster and better while providing the citizen with qualitatively and quantitatively better information. The cities of Barcelona, Dublin and Helsinki will be the first to implement the pilot services provided by this platform.

Translation by the authors

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