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ICiNG Location Client

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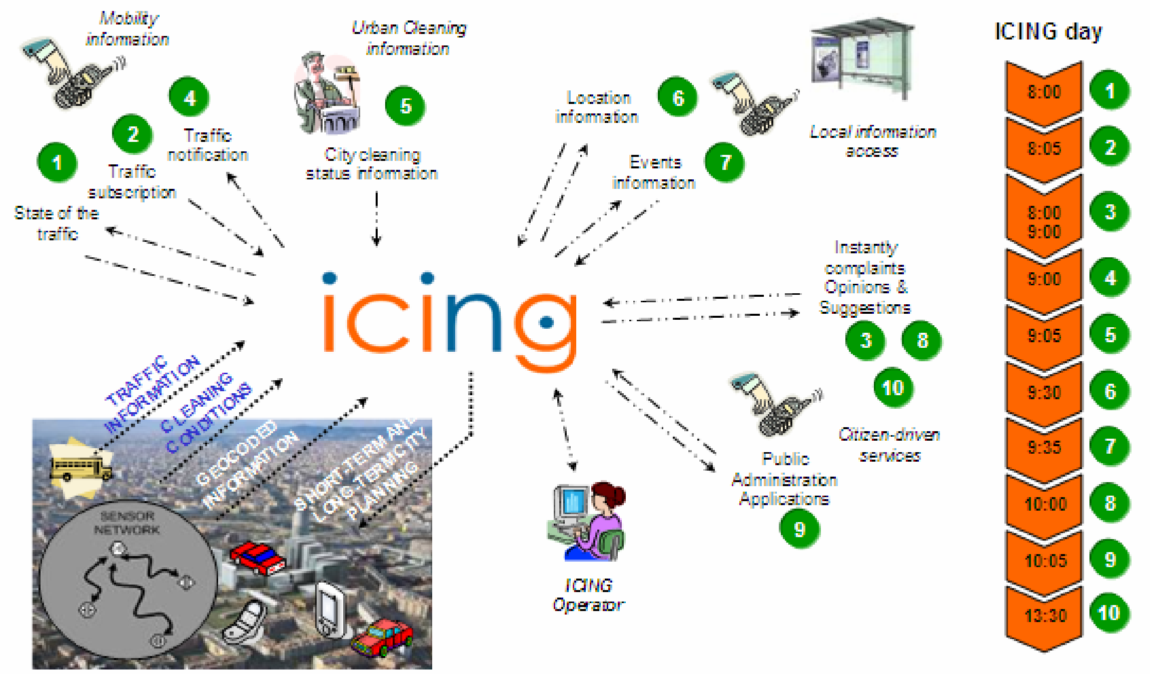
Introduction

The **ICiNG** (**I**nnovative **Ci**ties for **N**ext **G**eneration) project is researching a multi-modal, multi-access model of e-Government. It develops the concept of a "thin-skinned City" that will be sensitive to both the citizen and the environment through the use of mobile devices, universal access gateways, social software and environmental sensors. Intelligent infrastructure will enable a Public Administration Services layer and a Communities layer. Communities will interact with the infrastructure to avail of ICiNG services created by the administration, and will also create their own information-based services.

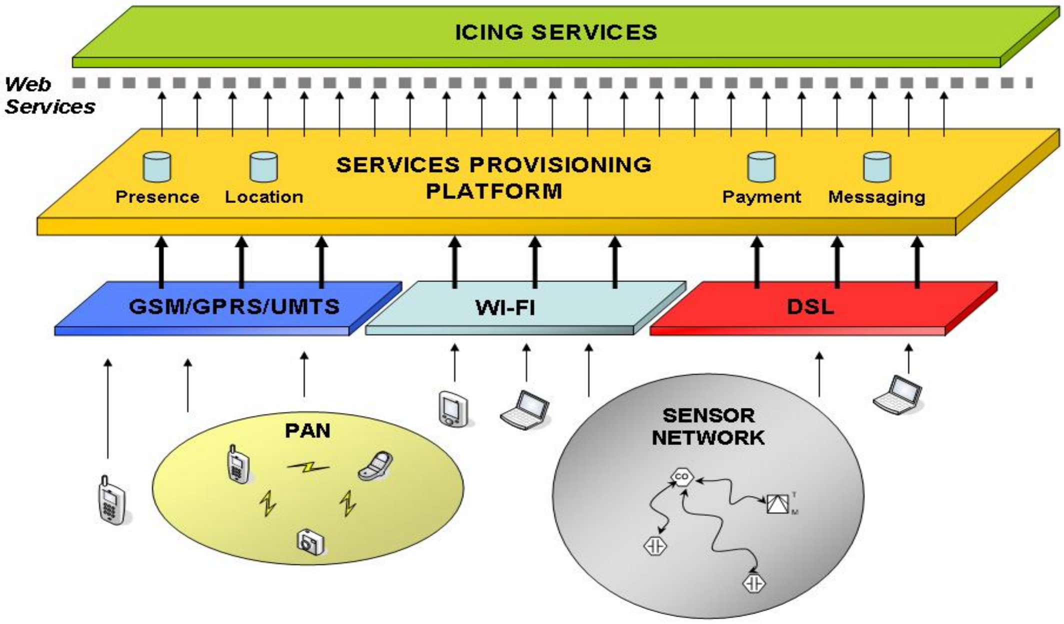


As an EU-FP6 sponsored three nation collaborative project, ICiNG (http://www.fp6-project-icing.eu/) will set up test-beds in high-profile European locations of Dublin, Barcelona and Helsinki to act as "city laboratories" for researching, evaluating and demonstrating technologies and services using intelligence in the environment.

The first stage from the DMC (Digital Media Centre - www.dmc.dit.ie) point of view is to investigate contemporary methods of determining a mobile devices location. To date, we have looked at several techniques and technologies to do this and have decided to use a combination of Semacode (http://www.semacode.org/), Bluetooth and Wi-Fi access points, GSM towers, and GPS. In general, the ICiNG *Location*

Client application we develop will scan for available radio signals and determine location based on intelligent integration and processing of these signals. We will be utilising the Placelab (http://www.placelab.org/) work already done for triangulating Wi-Fi/GSM signals but also improving on it to provide location to citizens both indoors and outdoors.

This is the first in a series of quarterly articles that introduces the four technologies we are using for developing the ICiNG Location Client. Further articles will document our observations and highlight any problems/solutions we encounter with integrating these technologies into ICiNG – as rarely are they as "plug&play" as their makers would have us, "the user", believe!



Semacode

Semacode works by embedding a URL into a two-dimensional barcode which looks like a dense crossword puzzle (pictured) — called the tag. The SDK software contains the capability to detect and decode the tag very rapidly with the camera on your phone. It extracts the URL and sends you to that address using the phone's built-in browser. With this technology we intend for a citizen to take a picture of the Semacode barcodes that will be placed around our test bed area. The barcodes have a geo coded location embedded into them which the software interprets. Once this location is determined, the citizen selects a request of a local service from a list and the geo coded location is sent along with the request. This type of location technology is considered exact to within one meter and requires a camera phone for it to work correctly.

Bluetooth

Bluetooth enabled electronic devices connect and communicate wirelessly through short-range, ad hoc networks known as piconets. Each device can simultaneously communicate with up to seven other devices within a single piconet. Each device can also belong to several piconets simultaneously. Piconets are established dynamically and automatically as Bluetooth enabled devices enter and leave radio proximity. We will be focusing on Class 2 radios for our implementation for various reasons. Class 2 radios have a range of about 10 meters. This will enable us to use Bluetooth as the second best location signal after Semacode for indoor and outdoor location determination. Using a Class 3 radio would increase the range to 100 meters but that in turn would lessen the accuracy. For later implementations it will be possible to triangulate Class 3 Bluetooth alongside Wi-Fi for increased accuracy.

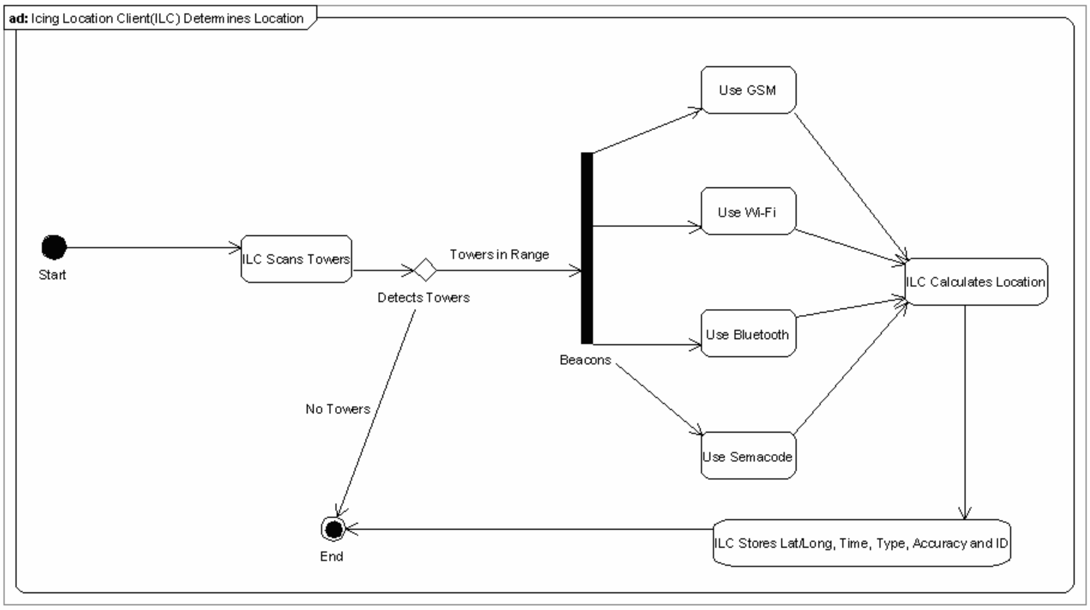
Wi-Fi & GSM

Wi-Fi and GSM will be used together to triangulate a best position if no Bluetooth signal is present. Wi-Fi range can vary tremendously depending on the urban environment, but using GSM and Wi-Fi together will help negate some of these factors. For example, if a router was picked up that had a signal range of 150 meters but only a portion of that arc overlapped the GSM cell you were in, then the Location Client will be able to determine this and narrow down the possible location of the mobile device. We will know the exact positions of GSM towers and we will know relative positions of surrounding Wi-Fi Access Points in our test bed, as would be the case in a real world environment.

GPS

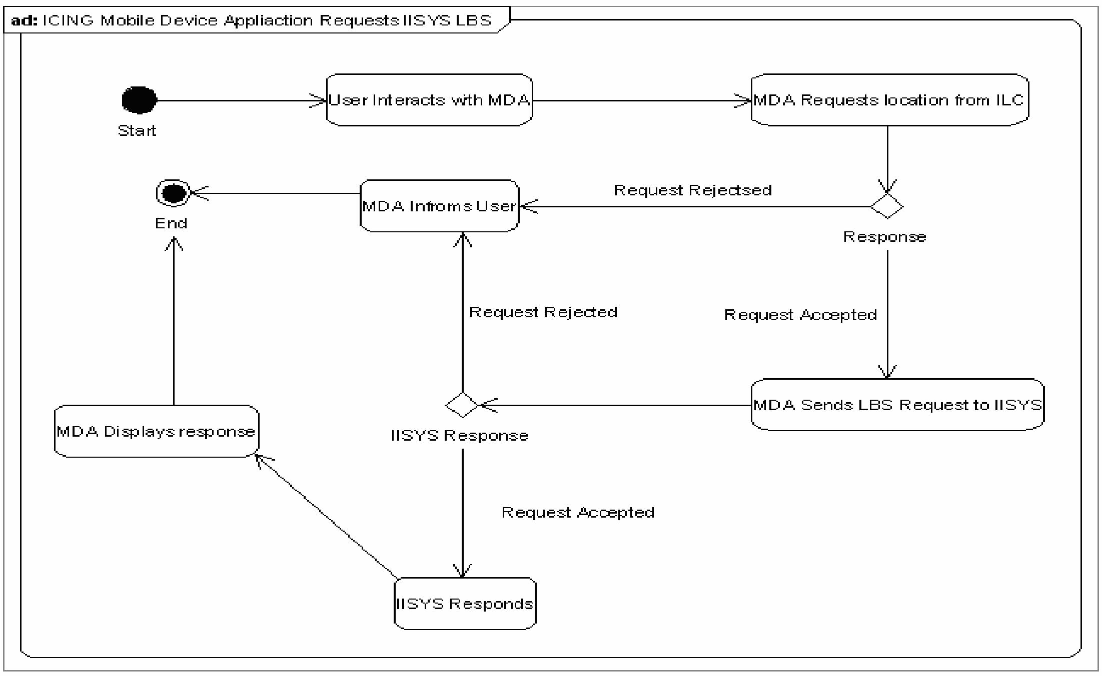
Where GPS is available this will be roughly 10-100 meters accurate for once off readings - depending on the urban environment, among other factors. This will also be used in conjunction with Wi-Fi; GSM & Bluetooth signals recorded within a 60 second window to further improve the accuracy of the location client. For example, as the user walks away from a Semacode tag (with 1m accuracy) or a Bluetooth access point (with 10m accuracy), this information can be used by the Location Client to refine any GSM triangulation or GPS readings.

The ICiNG Location Client runs independently and requires no user interaction or network connection. Figure 1 shows how we see the location client application working internally.



(Figure 1)

If a user requires a service, then the s/he will interact with the MDA (Mobile Device Application) and request a service through that. Once the user has requested this service, the MDA will interact with the ICiNG Location Client and the remote service independently of the user. With this methodology, the user does not need to worry about being tracked by "Big Brother" as the only time the remote system will know the user's location is when the user requests a service for this locality. Depending on user preferences, this location information could be stored on the remote server for future processing in other applications or it can be discarded as soon as the remote server has sent the requested service to the mobile device. See Figure 2 for MDA and ILC interaction.



(Figure 2)

Overall we expect to provide a cheap public service to all citizens that will present, initially, planning applications, amenity locations and public work plans, but can be extended to provide access to any other government activity that citizens might find useful. This first article serves as an introduction to how the ICiNG Location Client will work in general. Our next articles (published quarterly) will visit each of the technologies in turn, the problems we encountered, the testing we have done and any solutions we develop when implementing the system. The end goal for us (DMC) will be to have a test bed set up and running in Dublin by the first half of 2008.