

# **The City Knowledge Platform: a Demonstration of Agent-oriented Programming for Intelligent City Maintenance, Management and Modeling**

## **DEMO PROPOSAL**

For workshop on [Intelligent Agents in Urban Simulations and Smart Cities](#) in the [European Conference on Artificial Intelligence 2012](#) in Montpellier, France.

### **Abstract**

In this demo, we will introduce a new approach to Urban Asset Management and Simulations that relies on a City Knowledge Platform composed of intelligent agents, each “representing” an individual urban element, much in the same manner as human agents manage actors and athletes. Our intelligent urban agents act on behalf of urban assets and communicate with other agents to maintain an up-to-date picture of the status of the asset, with the ability to issue alerts when critical situations are detected, based on publish-and-subscribe feeds coming from legacy systems, as well as from mobile apps or web reports.

Our City Knowledge Platform employs agents to represent mobile as well as immobile assets, making it possible to model activities such as vehicular or pedestrian traffic, even in the presence of sparse data, leveraging and re-utilizing data from existing sensor networks as well as from human sensors deploying custom-designed smartphone apps.

### **Description**

Urban Data Management and Modeling have long relied on tried and true technologies like relational databases and geographic information systems, occasionally coupled with some higher level modeling. In this demo, we will introduce a new approach to Urban Asset Management and Simulations that relies on a City Knowledge Platform composed of intelligent agents, each “representing” an individual urban element, much in the same manner as human agents manage actors and athletes.

Our intelligent urban agents act on behalf of urban assets and communicate with other agents to maintain an up-to-date picture of the status of the asset, with the ability to issue alerts when critical situations are detected, based on publish-and-subscribe feeds coming from legacy systems, as well as from mobile apps or web reports. Each asset is assigned an individual wiki page, where the information is immediately published and can thus be reviewed (and partially modified) by citizens and municipal officers. As a sort of “guardian angel”, each agent will monitor what happens to the asset under its direct tutelage by scanning official documents, citizen reports, work orders and the like, while also keeping an eye on what is happening to

other nearby assets of the same type, by subscribing to other assets' wiki feeds and also by unleashing background "bots" that are constantly rummaging through API-enabled municipal systems.

For example, each streetlight in a city will have its own wiki page, with a set of structured attributes (e.g. info boxes) that will be constantly updated thanks to its own agent.

Citizen-based mobile apps will interact with these agents to provide up-to-date reports, such as the fact that a light is out, which in turn will trigger the agent to send alerts to the public works department to request that the light bulb be replaced. Scouring the city's work order system, the agent representing the defective streetlight will notice that there is a plan to replace the bulb of a nearby light pole, and will therefore request that its own light fixture be replaced concurrently, thus saving the city the cost of an extra trip to that street. The agent will also calculate the lifespan of the burnt bulb, based on its thorough knowledge of the maintenance history of the light pole it is in charge of. By communicating with all other agents in charge of streetlights in the city, it will discover that some are getting twice as many hours out of their bulbs, thanks to new technologies, such as fluorescent or LED lights, and will thus request that its pole be equipped with these latest fixtures, instead of the old inefficient ones. And so on...

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Our demo will consist of a collage of several of our past and recent projects that embody these principles, as we move towards a unified City Knowledge platform that will contain all of these elements, as one can begin to see in a recent system we have developed for UNESCO for the preservation of material culture in the world heritage city of Venice, Italy.

We are leveraging our last 15 years of agent-based modeling of cities to transition to *agent-oriented programming* of cities where we are deploying active agents in into the urban sensor/actuator fabric. This is a transition from simulating a city to operational deployment of agents. As technical infrastructure, we are developing our latest mobile and web applications using HTML5 and *Javascript everywhere*, which includes both client-side and server side deployments, with two proprietary technologies: (i) *Acequia* for message passing and publish/subscribe mechanisms to realize real-time systems and (ii) *Sensordomo* to allow HTML5 to interact with all of the sensors in smartphones.

## Related Links

Below is a list of links to smartphone apps, presentations, web sites and videos that will collated into a single 30-minute presentation for our workshop demo.

### Mobile Apps

- bus app ([autobus.cityknowledge.org](http://autobus.cityknowledge.org))

- streetbump ([streetbump.cityknowledge.org](http://streetbump.cityknowledge.org))
- DEW (<http://www.citizapps.com/products/digital-earth-watch-dew>)
- Venice Noise ([venicenoise.org](http://venicenoise.org))

## Hyperlocal Wikis

- Venipedia ([venipedia.org](http://venipedia.org))
- SantaFedia ([santafedia.org](http://santafedia.org))

## Modeling

- [Venice pedestrians](#)
- Venice Boat Traffic Model (Agent-based *Interpolation*) -- [video](#)

## Interactive Simulations

- Simtable ([simtable.com](http://simtable.com))
- flyto ([redfish.com/js/flyto](http://redfish.com/js/flyto))
- Secret Service Presidential Inauguration -- video

## City Knowledge Platform

- UNESCO presentation -- [powerpoint](#)
- City Knowledge theoretical foundation -- [MIT dissertation](#)