



Smart Parking for Smart Cities Technology Drivers

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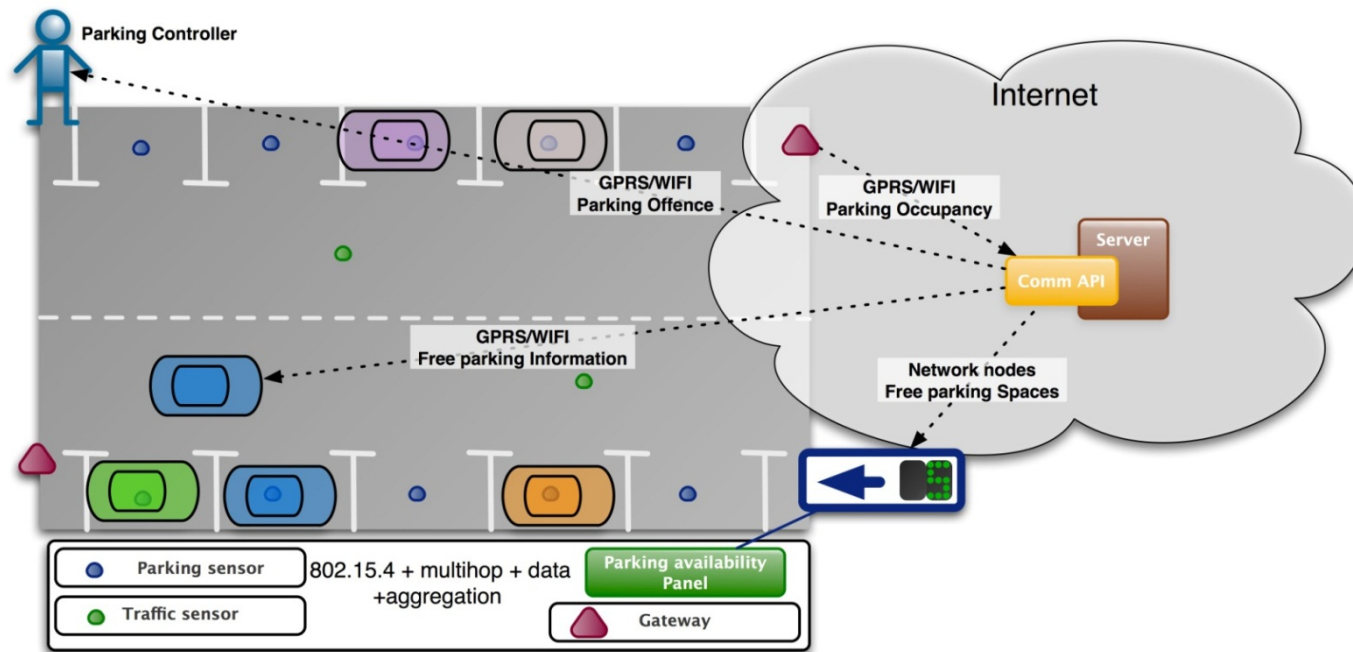
info@worldensing.com

+34 699 896 471

Application Scenario

■ Smart Parking for Smart Cities:

- today, more than 1 in 2 people is living in urban environments
- 80% of our travel is daily commute with the highest Commuter Pain Index
- idea is thus to help commuter with real-time parking information
- to this end, sensors are deployed in each parking lot which get info to citizen



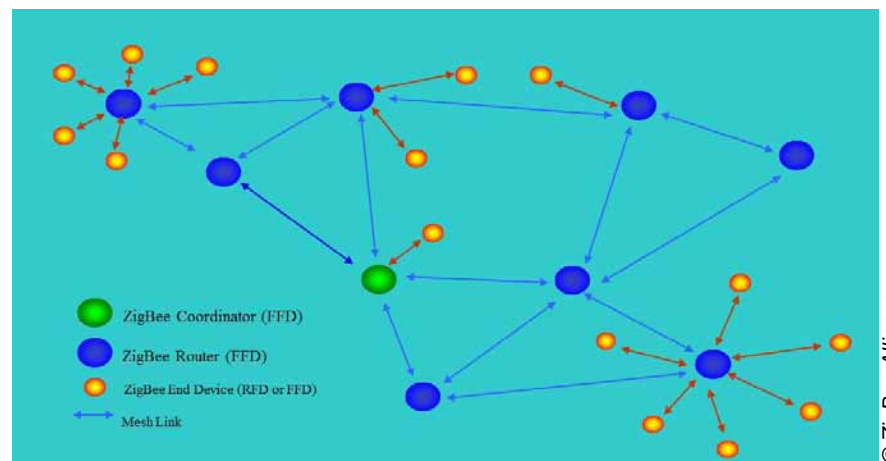
Design Challenges

■ Standards Compliance:

- standards compliance ensures compatibility with other smart city product vendors
- ZigBee certification gives generally a good framework for achieving this
- however, new standards are constantly emerging

■ Technical Compliance:

- many smart city applications have machine-to-machine requirements
- this essentially means ultra-low power, mesh/multihop communications, security
- propagation conditions for smart parking applications are particularly difficult



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Technical Difficulties

■ Propagation Channel:

- power losses are significant, often reaching 60-70dB
- multihop/mesh is thus needed to ensure gateway is reached

■ Support of Mesh/Multihop:

- mesh networking is supported by suitable arrangement of FFDs & RFDs
- standard (v.2006) however does not allow FFDs to be duty-cycled
- best available solutions (apart from WOS) reach 1-2% duty cycle

■ Role of Duty-Cycling:

- assume 2400mAh (AA battery), 14mA when radio on (AT86RF231)
- no duty-cycled ZigBee FFD: 171 hours of time budget (7 days of lifetime)
- best-available 1% duty-cycled routers: 2 years lifetime (more impossible!)
- WOS 0.2% duty-cycled routers: 10 years lifetime

Standardized Stack

| | | |
|------|-------------|---------------------------|
| IETF | Application | IETF CORE |
| | Transport | UDP |
| | Networking | IETF ROLL (routing) |
| | | IETF 6LoWPAN (adaptation) |
| IEEE | MAC | IEEE 802.15.4E-like |
| | PHY | IEEE 802.15.4-2006 |

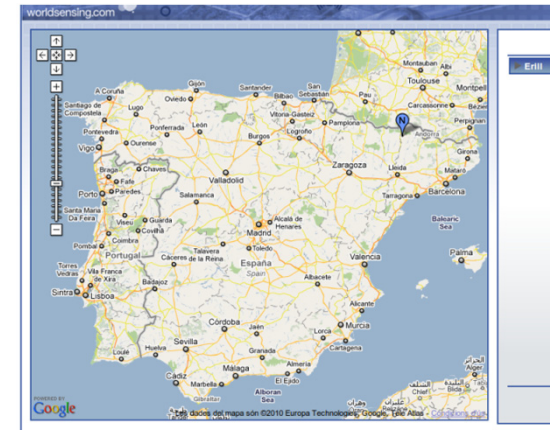
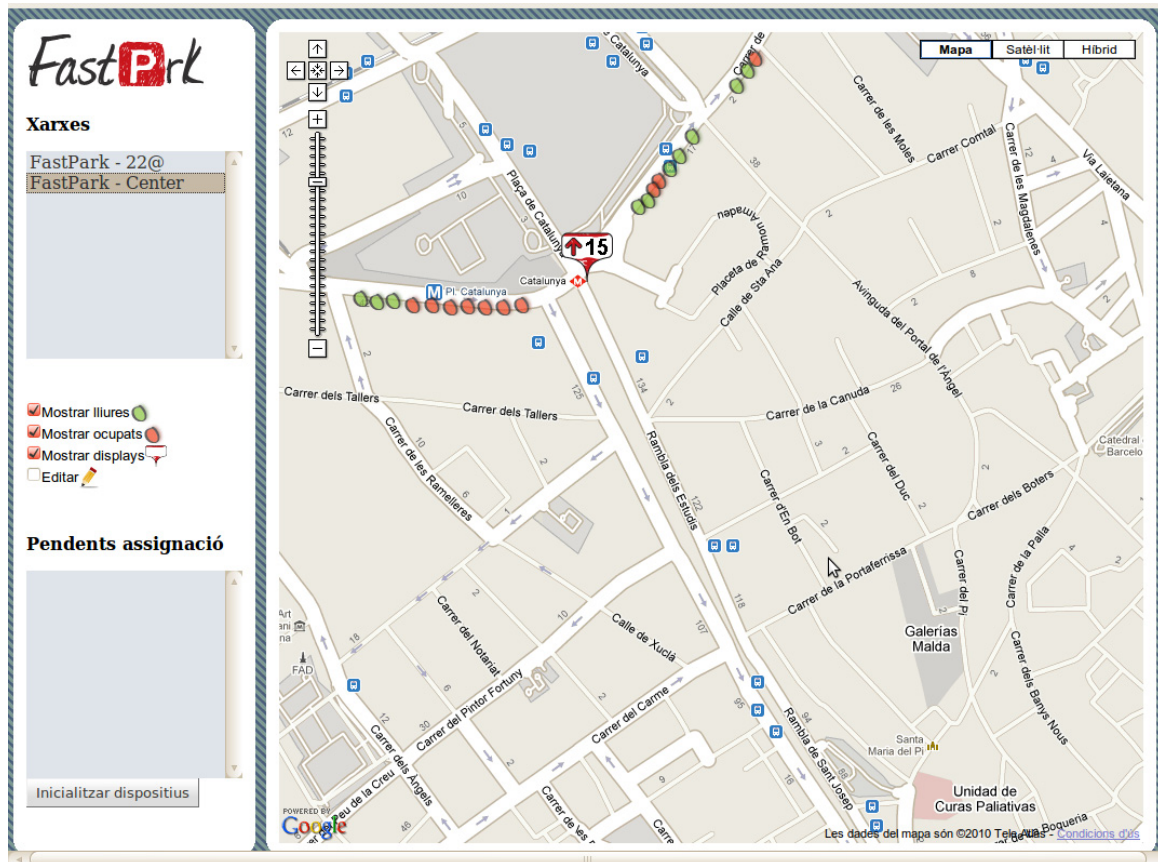
Installation In The Field

- Example installation in Barcelona:



Control Center Application

Client View:

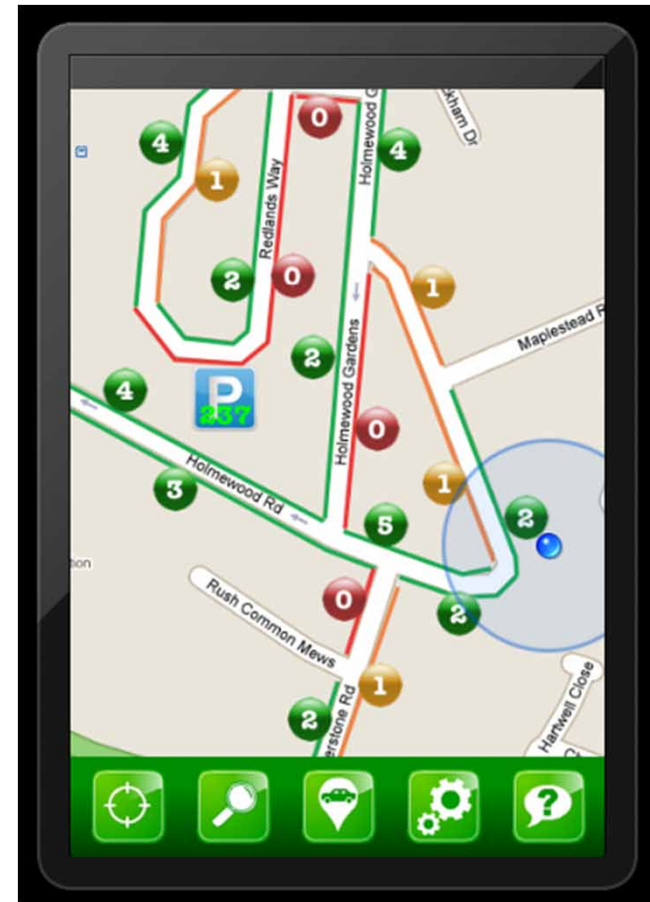


Driver Guidance System

- Street Panels:



- Smart Phone Applications:



About Worldsensing

■ Company Facts:

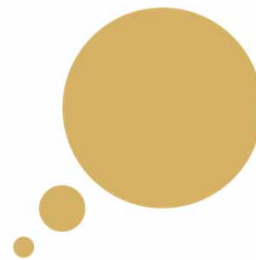
- founded in 2008 in Barcelona, Spain
- 20 full-time staff, growing
- international presence

■ Major Achievements:

- labeled by prestigious Spike Research as one of 17 global smart city players
- major press coverage (eg BBC, Wall Street Journal, TVs, newspapers)
- Spain's first company to run on IBM's cloud computing capabilities

■ Major Awards:

**IBM
Smart Camp
London 2010
Winners**



WINNER
LIVING LABS
GLOBAL
SHOWCASE
AWARD 2011

Concluding Remarks

■ Potentials & Limitations of ZigBee:

- standards compliance is great; profiling even more
- “capillary M2M” requirements can only be met with some tuning

■ Real-World Deployments:

- propagation environment has turned out to be very tricky
- ultra low power mesh networking is a must
- real-world deployments with technology using parts of ZigBee stack works

■ Importance of R&D Centres:

- bridge between industrial needs and academic drive is important
- R&D centres are taking more and more leading role in real world deployments
- their knowhow and expertise is important for near-term deployments