TECHNISCHE UNIVERSITÄT DRESDEN

**Faculty of Compter Science** Institute of Systems Architecture, Chair of Computer Networks

# MapBiquitous: An integrated System for Indoor and Outdoor Location-based Services

## Motivation

### Presetting

- Ubiquitous outdoor location services available to general audience
- Available not only for desktop computers, but also mobile devices
- Limited to outdoor areas, e.g. navigation between two buildings

### Idea

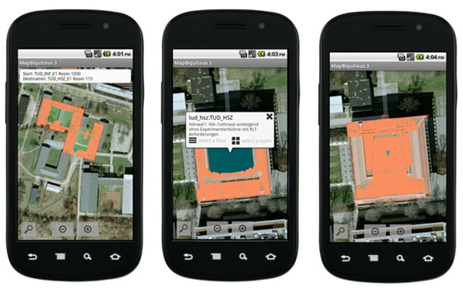
- Expansion to the indoor area
- Overcome lack of global coverage
- Integrate outdoor and indoor aspects into one location-based system

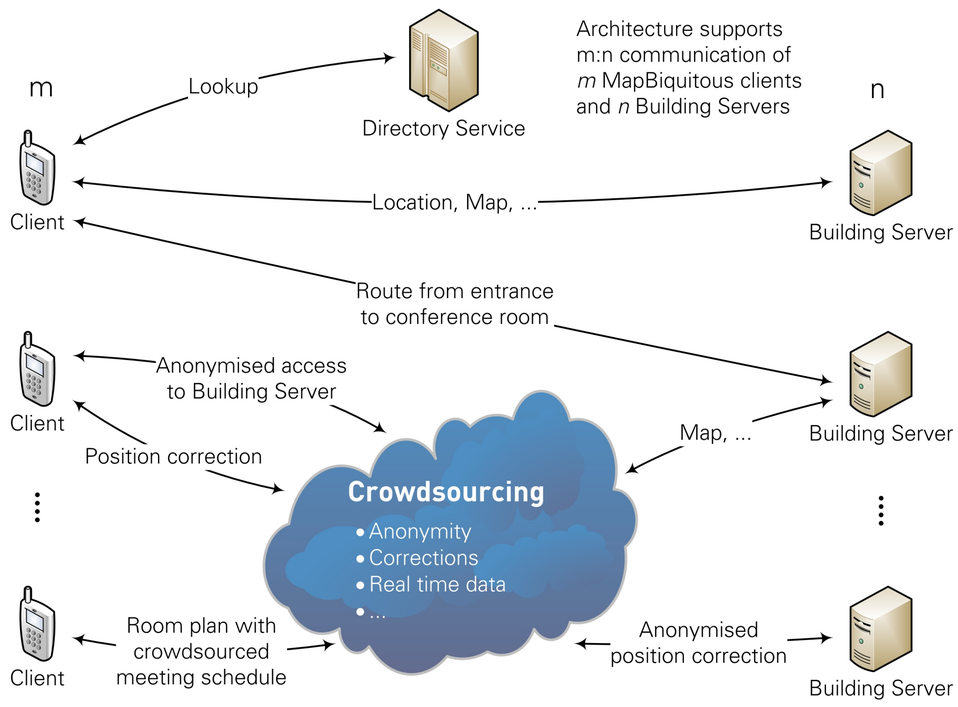
## Questions and Challenges

- Functionality of indoor navigation must be
  - Providable ad hoc
  - Independent of underlying infrastructure
- Interoperable and scalable provisioning of building information
  - Availability of building information
  - Source of way points
  - Crowdsourcing
- Cross-building navigation with paths inside and outside buildings
  - Catenation of indoor and outdoor routing (“Which door to use?”)
  - Support of heterogeneous indoor positioning technologies, e.g. based on various technologies like WiFi, RFID, or smartphone sensors

MapBiquitous

# MapBiquitous Platform and Architecture






## Client

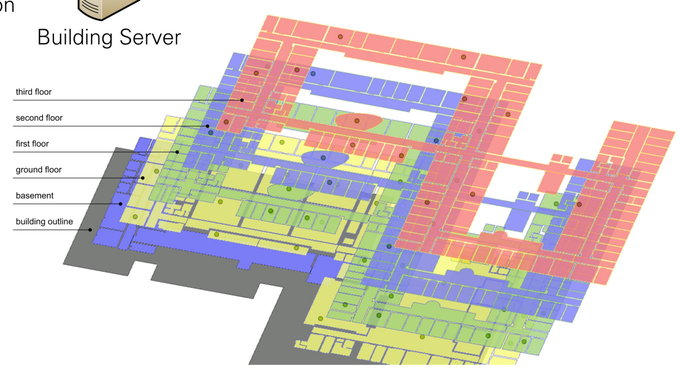
- Location data based on GPS, GSM, gyroscope, or combination of these
- Integrates general outdoor location-based service (e.g. GoogleMaps)
- Utilises MapBiquitous for indoor location-based services
- Thin Client → Navigation handled by Building Server
- Looks up building servers via Directory Server utilising GPS-based bounding box of WGS-84 coordinates

## Building Server

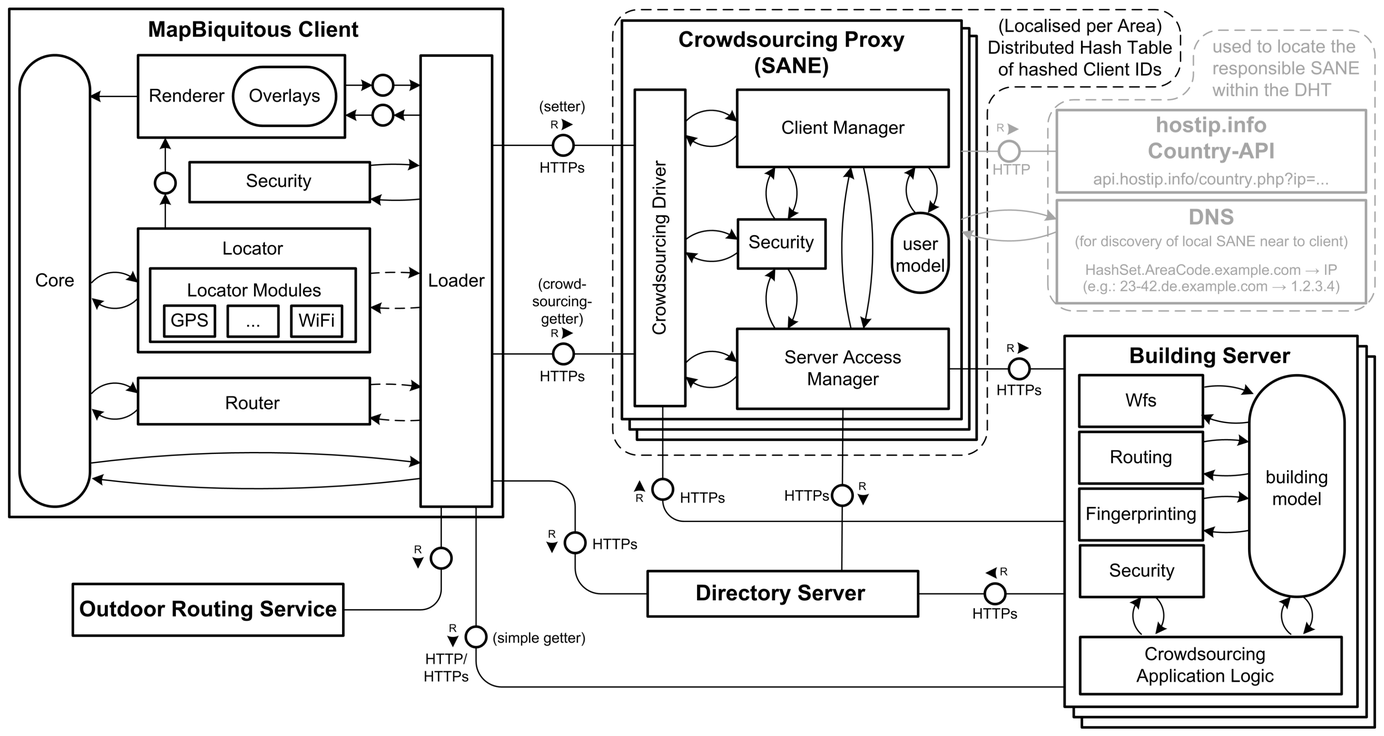
- Building-specific
- Use of Web Feature Service (WFS)
- Within maintenance and legal scope of building owner/maintainer
- Easy provision of additional information, e.g. reservation plan of a room
- One building server may provide for multiple buildings
- Register with Directory Service by providing WGS-84 position of their building as well as their contact URL and WFS version
- Native conversion of local coordinate systems into WGS-84

## Crowdsourcing

- Ascertainment and maintenance of building data
- Anonymous client→server access enabled
- Access to real time data
  (e.g. “How many persons are in the conference room?”)
- Collaborative localisation and positioning of clients
  (e.g. “The neighbour of my neighbour is in my proximity.”)




# Implemented Architecture




## General MapBiquitous

- Supports arbitrary localisation/positioning
- Navigation utilises shortest path algorithm
- Supports infinite client counts
  (only limited by server performance)
- Easily extensible

## Crowdsourced Version

- Allows usage without crowdsourcing participation (simple getter)
- Allows anonymisation
  (via crowdsourcing getter)
- Supports quasi infinite client counts
  (limited by SHA-256 collision space)
- Supports arbitrary crowdsourcing methods

**Contact**
Dr.-Ing. Thomas Springer
Dipl.-Inf. Tenshi Hara
{thomas.springer|tenshi.hara}@tu-dresden.de

Technische Universität Dresden
Faculty of Computer Science, Institute of Systems Architecture
Chair of Computer Networks, 01062 Dresden, Germany
http://www.rn.inf.tu-dresden.de/

Professur Rechnernetze