

## Location Based Services(LBS)

**Context aware information delivery:** People prefer information based on time (when), location (where) and preferences (user settings), rather than being bombarded with information.

Outdoor LBS like in-car navigation GPS devices are a great success.

Indoor LBS is a system within buildings providing services to the users based on their location.

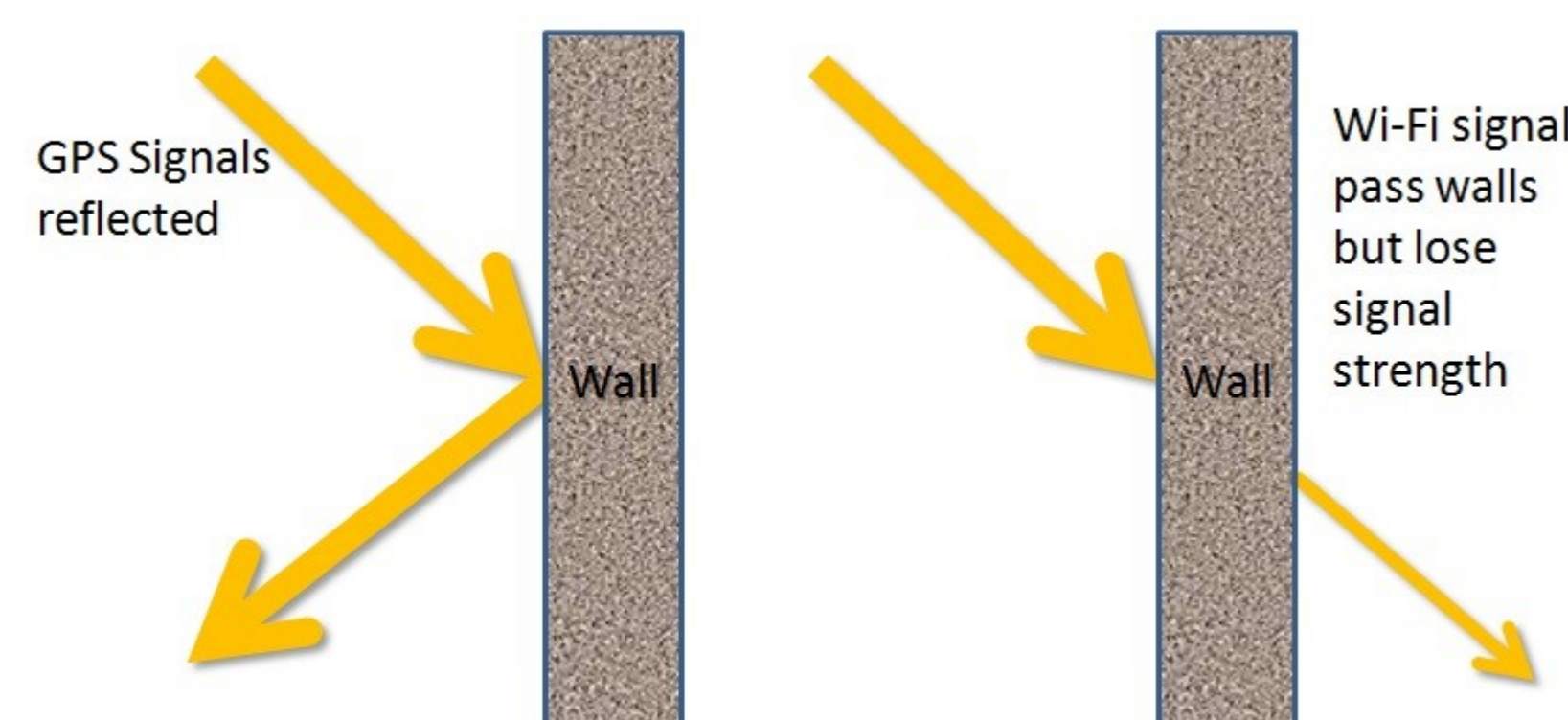
**Example:** Navigational assistance in unfamiliar buildings like malls, museums, etc.

## System Components

Indoor LBS have 2 primary components:

1. **Indoor positioning system** – provides the position of the user with in the building
2. **Indoor content provider system** – provides content (maps and other details) to the user.

## Positioning Systems



GPS cannot be used for indoor positioning as signal cannot penetrate walls and are subject to multi-path distortion.

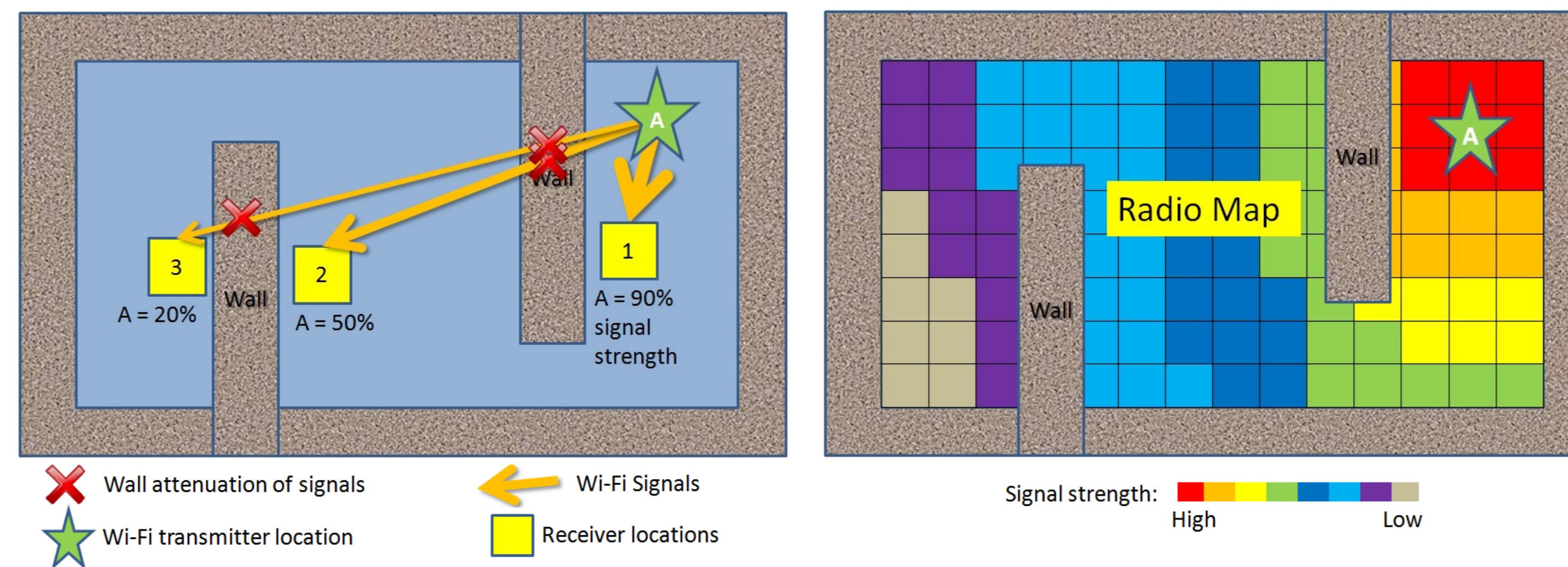
Wireless internet signal (Wi-Fi) which is freely available in the building can penetrate walls and the signal is potent enough for Indoor Positioning.

Other technologies like RFID tags, ultrasound, infrared and Bluetooth can be used for indoor positioning, but require infrastructure changes which are costly.

## Wi-Fi Indoor Positioning System

**Pre-recorded Radio Map Method:** Wi-Fi signal strength is a function of the location of the receiver in the building. Signal strength depends on:

1. Distance between the transmitter and the receiver
2. Number of wall crossings between the transmitter and the receiver



**Radio Map:** A map of signal strength values from a Wi-Fi transmitter created by recording signal strength at all discrete cells which make up the building floor space. The image shows the radio map of one Wi-Fi transmitter with varying signal strength received.

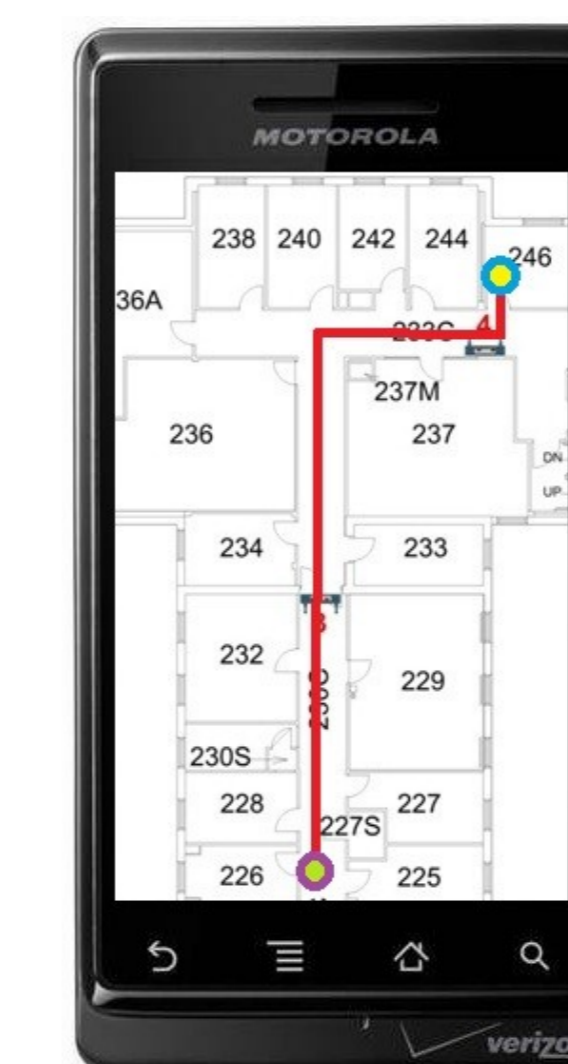
Given the signal strength vector from different Wi-Fi transmitters at the user's location we can do reverse radio signal mapping to find the user's location. User can be located with an estimation accuracy of 2 meters.

**Advantage:** No special receiver devices are required; a Wi-Fi enabled mobile phone is enough for Wi-Fi based Indoor Positioning System.

## Our Current Work

Designing a Wi-Fi based indoor positioning prototype system for a part of Boardman Hall, UMaine using a Wi-Fi enabled mobile device and will conduct experiments on:

1. Various application scenarios in Indoor LBS
2. Various multi-modal interfaces like visual maps combined with non-visual spatial description using spatial language, spatialized audio, and touch-based (haptic) interfaces.



## Indoor LBS - Applications

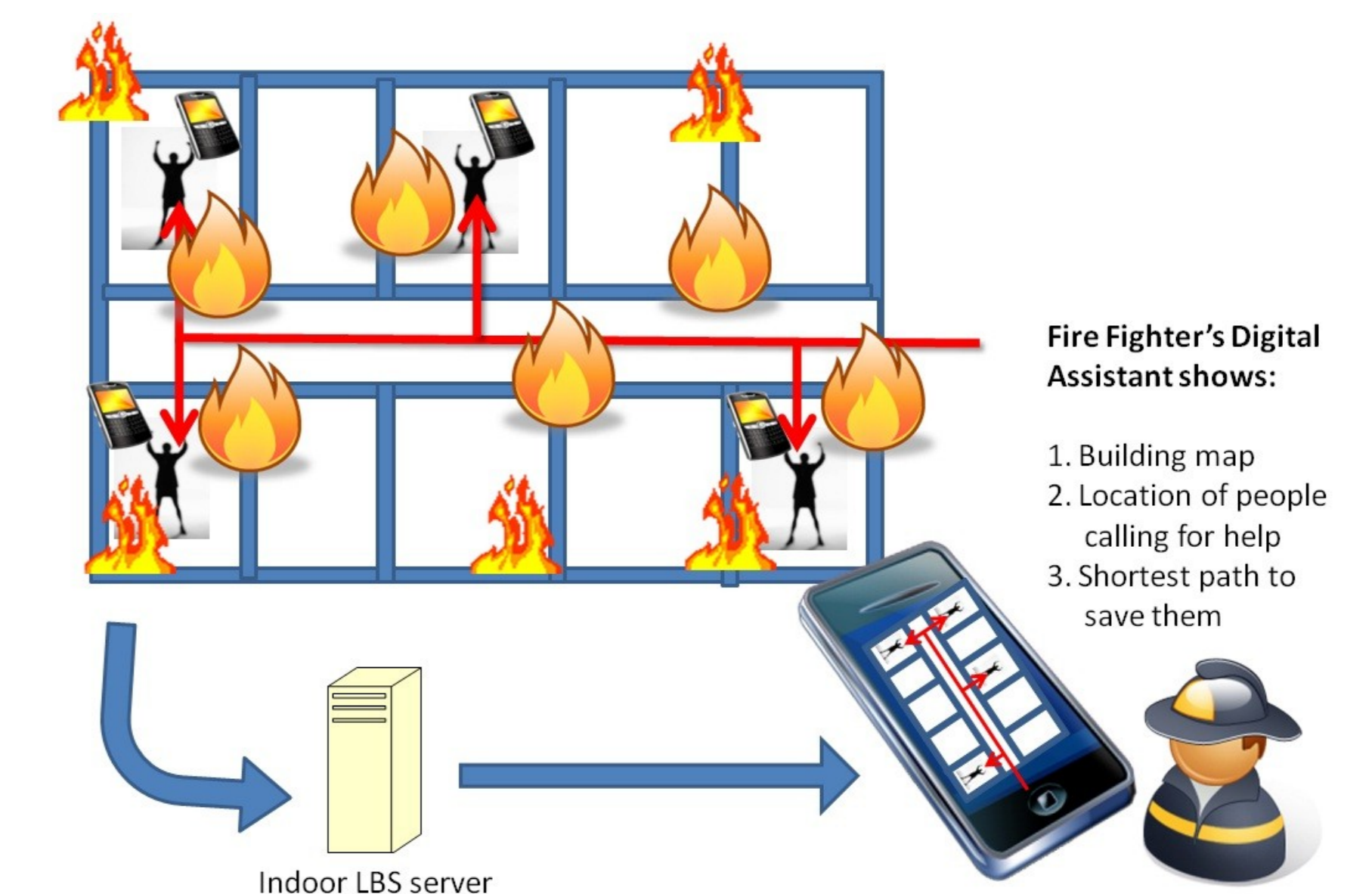
1. **Indoor Navigation Assistance**
  - Unfamiliar buildings like malls, museums
  - Low vision and blind users
  - Emergency rescue personnel
2. **Autonomous Robot Navigation**
3. **Movable Asset and Personnel Tracking** in industries, warehouses, hospitals, etc.

## Application Example

**Integrated Emergency Rescue:** Consider an emergency situation (fire breakout) in a building. The people trapped call for help using their Indoor LBS enabled mobile phone.

The location information for all trapped people in the building is processed by an Indoor LBS server and simultaneously sent to the digital devices of fire fighters and police on route to the emergency. They can then see a building floor map showing the shortest path from the door to the location of the trapped people.

This system avoids the time wasted by fire fighters in searching empty rooms thus, saving resources and lives.



**Summary:** Indoor LBS have many applications in home, office and industrial settings and has drawn many universities and companies to focus on researching commercial systems for Indoor positioning & Indoor LBS.