




# Location Based Service

 Files & media	<a href="#">06-LocationBasedServices.pdf</a>
 Name	Lecture 6
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## Location Based Service

- current location, geo location, physical env, relative location, user activity / behavior
- find geo location, provide desired content based on location, increase efficiency provide customized access to data on user preference & location

intersection technology of internet, wireless communication, location tech, geo info system

## LBS application

- emergency services
- intelligent transportation services - mapping, navigation, traffic info
- info service: weather info based on nearest weather station
- tracking service: logistic tracking, asset tracking, health passport
- advertising: notify relevant product info to mobile users when enter defined zone
- game

## LBS Components

- mobile devices

- wireless network infrastructure
- mobile positioning component
  - determine mobile device geo location by base station / GPS
- service content provider
  - offer services & content to user based on geo location
- geographic information system
  - computer system manipulate geo data
  - link location info w/ other relevant info to give it meaning and value for both mobile & fixed users

# Mobile Positioning Techniques

## Outdoor Positioning Technology

### Network-based solution

- geo location info with network infrastructure, cost-effective but less accuracy
- location get from base station
  - location calculated by signal from 1/more BS
  - response time
- cell identity: determine which cell locates and reports BS location
  - accuracy depends on size of cell, simple & cost-effective way
  - improve accuracy
    - divide cell into section: sector
    - timing advance(time diff b/t BS and device to fine how far away
    - cell global identity w/ timing advance: more accurate in city, higher density of BSs
- **Time of Arrival(TOA)**

- phone send signal at time  $T_0$ , signal received by SD at time  $T_1, T_2, T_3$
- $t_i = T_i - T_0, i = 1, 2, 3, d_i = t_i * c$
- triangulation calculation
- clock of BS & MS need sync, MS clock clock drift → error in calculation
- **Time difference of arrival(TDOA)**
  - no MS synch error
  - BS sync tightly
  - estimated distance are good approximation
  - $d_{12} = d_1 - d_2 = (t_1 - t_2)c = (T_1 - T_2)c$
- Angle of Arrival(AOA)
  - compare data among  $\geq 2$  BSs, not commonly used, hard good accuracy

## Handset-based solution

- location info stored in terminal, higher accuracy, higher cost for device manufacture & network operation
- **Enhanced Observed Time Difference(E-OTD)**
  - similar to EDOA, handset make time measurement
  - location of BS known, data sent from BS must be sync
  - mobile device: record signal's arrival time, measure time diff b/t BS to calculate
  - accurate & cost-effective

## GPS-based solution

- satellite provide signal to GPS receiver
- comm w/ 3/4 satellites at any single point of time
- line of sight b/t receiver & satellites
- latitude, longitude and altitude - 3-dimensional info

- Components: satellites, control & monitor station, receiver

### **Technique**

- satellite constantly broadcast signals
- device measure time determine distance, take different, location coordinate
- GPS measure time very precise
- provide accurate position result
- limit: line-of-sight, no work indoor, long time delay for location info

### **Enhanced GPS - Assisted GPS**

assistance server - place at regular interval, high computation power, high speed access to reference network

GPS signal → send reading to assistance server

AS fetch data that complement the reading of handset calculate location

data help GPS receiver determine location quickly

## **Indoor Positioning Technology**

- Network-based tech
- device-based tech

### **infrared-based**

active badges - network-based

Locust Swarm - Device-based

### **ultrasound-based**

Active Bat - Network-based

### **radio-based**

WLAN Positioning

iBeacon

RFID

