# Low Cost Positioning:
## Necessary or Obsolete?

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# Contents

1. Current Situation of Location Based Services

2. Low Cost Positioning with CIT+

3. Application of CIT+

4. Summary

# Current Situation of Location Based Services

# Introduction - Current Market Situation

- Location Based Services (LBS) do not play the role expected two years ago

- The only driver for implementing positioning technologies in the networks is the FCC rule in the U.S.

- Commercial LBS still wait for success, although many applications were proposed

- Operators stated, that the current condition is also a technology issue

# How Location Based Services look like today

- Typical Location Based Services offered by operators

    - Find nearest points of interests (e.g. cash machines, gas stations, pharmacy, friends)

    - Local area information (e.g. weather, traffic jams, events)

    - Navigation service (e.g. route information, current location)

- Usage via WAP or SMS

- Results are presented mostly as text lists

- Positioning results are often based on Cell Identification with poor accuracy



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## About Today's Location Based Services

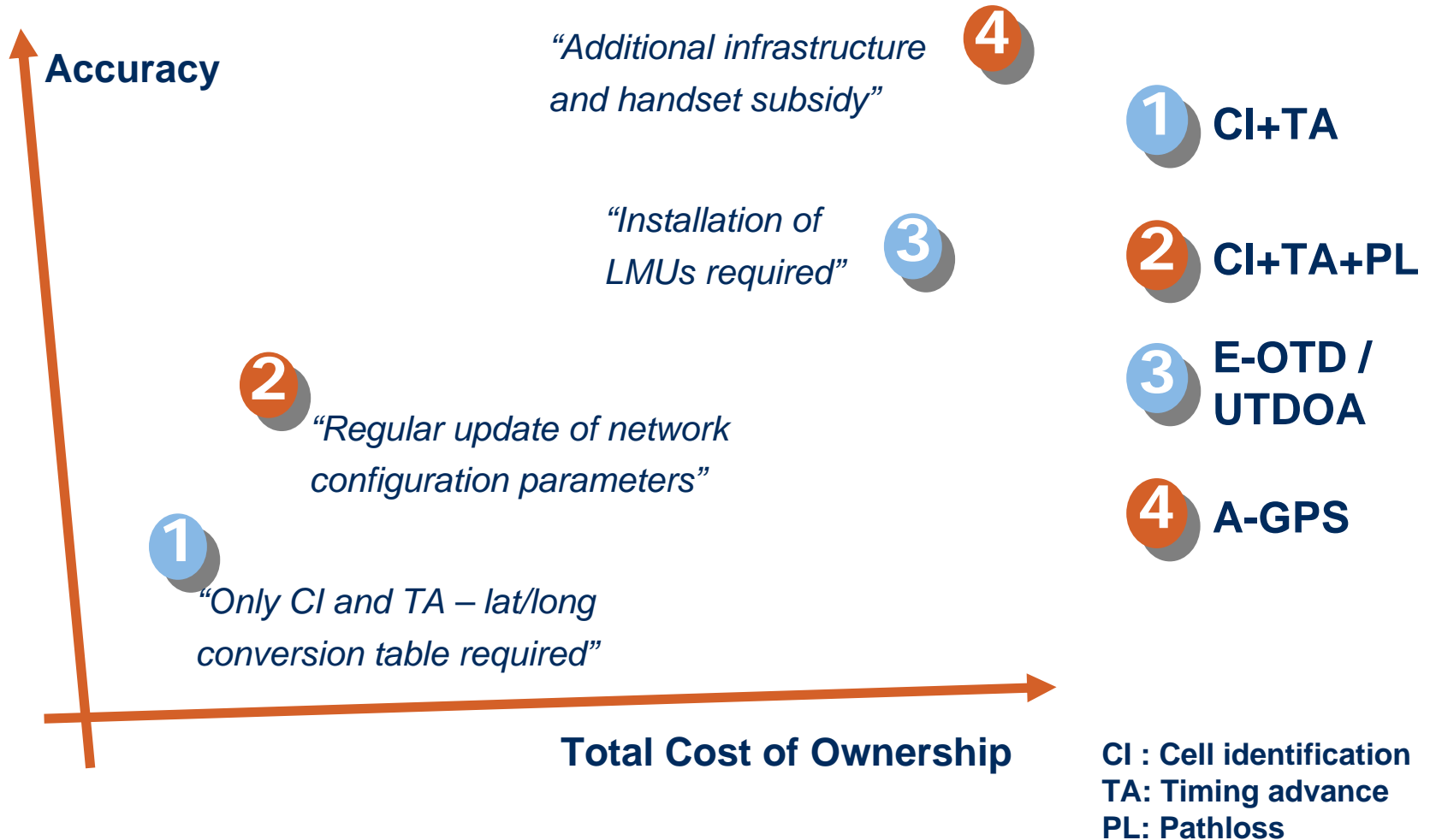Popularity of today's LBS is limited due to …

- Inaccurate positioning result

- Inadequate presentation of results in text lists

- Bad usability (e.g. SMS, latency, error messages)

- Small graphic displays of legacy handsets

**LBS will only break through when …**

**… more accurate positioning techniques allowing direct indication on maps are available**

# Positioning Techniques Available

**Accuracy**

*"Additional infrastructure and handset subsidy"*  **4**

*"Installation of LMUs required"*  **3**

**2**  *"Regular update of network configuration parameters"*

**1**

*"Only CI and TA – lat/long conversion table required"*

**Total Cost of Ownership**

**1** CI+TA

**2** CI+TA+PL

**3** E-OTD / UTDOA

**4** A-GPS

**CI : Cell identification**
**TA: Timing advance**
**PL: Pathloss**

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## Summary of Possible Positioning Technologies

- Simple Cell Identification is too inaccurate

- More accurate positioning methods require installation of additional hardware

- Premium market can be addressed with satellite based positioning, but fallback is necessary for indoor and dense urban environments

- Many applications become possible with mid-range precision positioning techniques (mean error 100-300 m)

**A low cost technology addressing the commercial LBS sector with mid-range accuracy and requiring less modifications to handsets could be the key for a push**

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Martin Kuipers   2005/06/09

# Low Cost Positioning with CIT+

## Motivation to go for CIT+

**Reduce significantly the barriers for an introduction of LBS by providing a mobile positioning technique which …**

> **… lowers the overall costs**

> **… provides acceptable performance for consumer applications**

> **… addresses a big market, preferably all subscribers**

> *… therefore has the potential to push the LBS business*

# Use case – Find a cash machine


*46 cash machines in your vicinity*

*1. Deutsche Bank distance approx. 1 km Siemensdamm 43-49 13629 Berlin*

*2. Sparkasse distance approx. 1 km Popitzweg 18 13629 Berlin*

*3. ING-DiBa distance approx. 1 km Zossener Straße 10 14974 Ludwigsfelde*

**Enabling by CIT+**

- **Provided accuracy enables direct indication on maps**
- **User expectations are fulfilled**
- **Investment costs are very low while addressing all subscribers**


*Cash machine* X
*Your Position*

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# CIT+ Overview
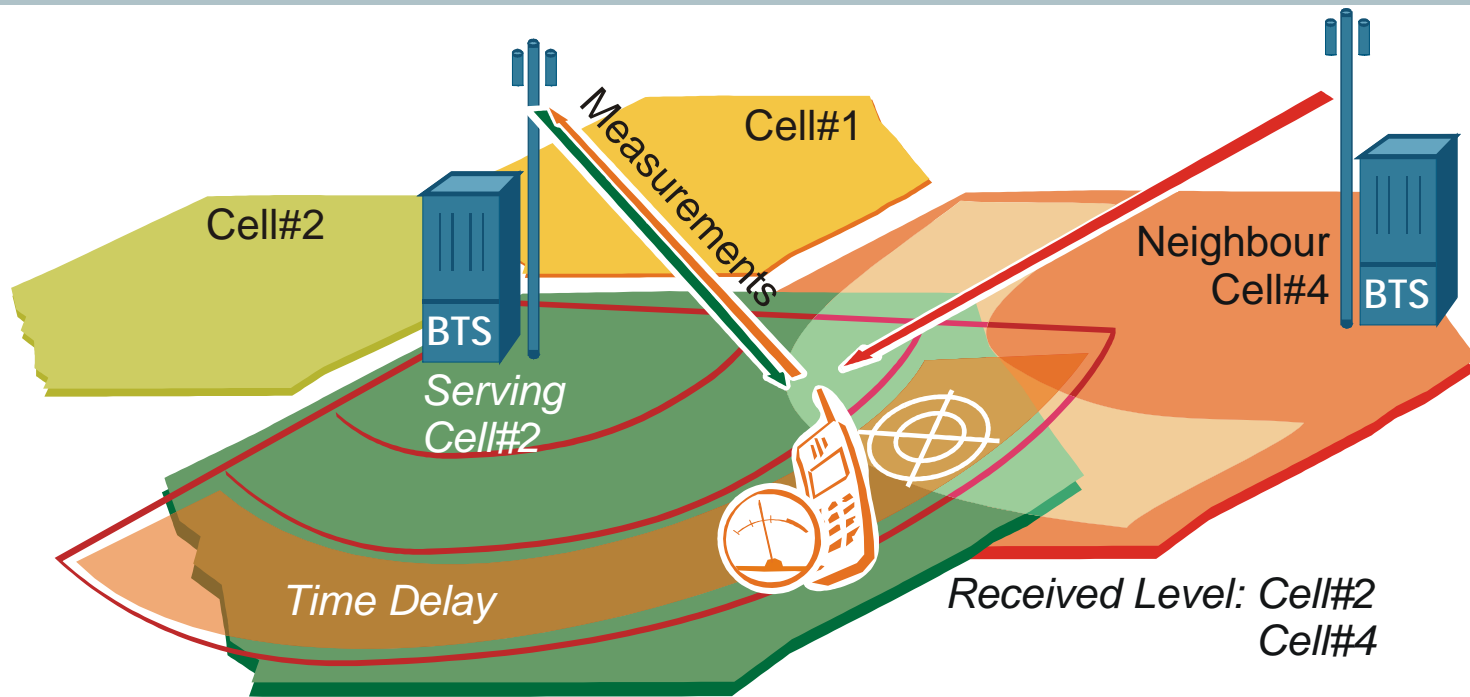


- Use of measurements that are already available:

  - Cell identification

  - Propagation delay or round trip time measurement

  - Reception power or pathloss measurement

# Principle of CIT+ Positioning

- Measurements are available in many cellular networks including 2G (GSM) and 3G (UTRAN) networks with legacy handsets

- Comparison of measured pathlosses with values from a propagation model

- Simple models like Okamura-Hata are sufficient. No field strength predictions or recordings required.

- Operator needs only to provide network configuration data
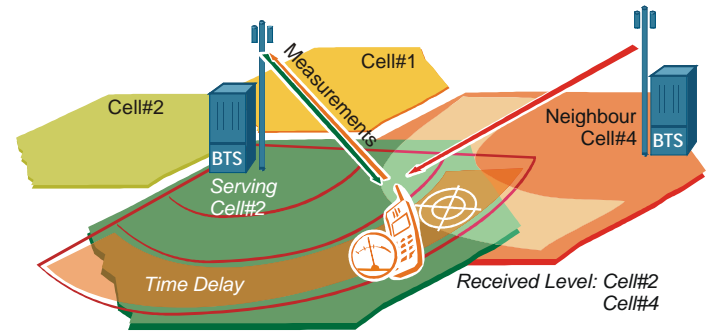


**Outline of the algorithm**

1. Determination of the serving cell(s)

2. Restriction of the area of interest to the zone corresponding to the reported TA/RTT values

3. Assessment of distances to base stations from timing advance and comparison between measured pathloss and pathloss models

4. Estimation of user position by optimization of a log-likelihood function ("Cost function")

## Data Processing

Network data to build a framework, e.g.:

- Transmitter coordinates, power, and frequency

- Antenna type, height and azimuth

Architecture of the method:

- Off-line preparation of network database:

  - Assignment of coefficients of propagation and round trip time distributions according to transmitter type and environment

  - Estimation of areas served by antennas based on other transmitters data

- On-line calculation of the user positions using network database and measurements
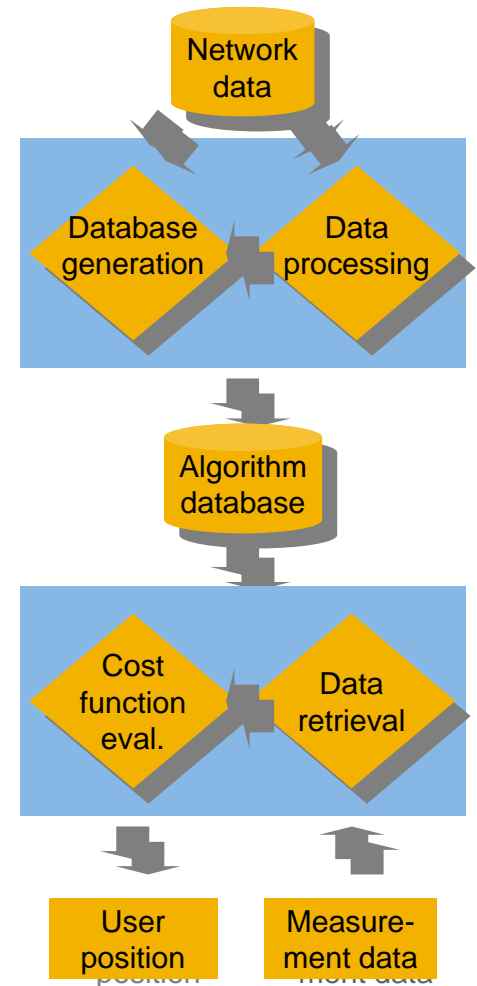
# Cost Function Example

## Pathloss distance models
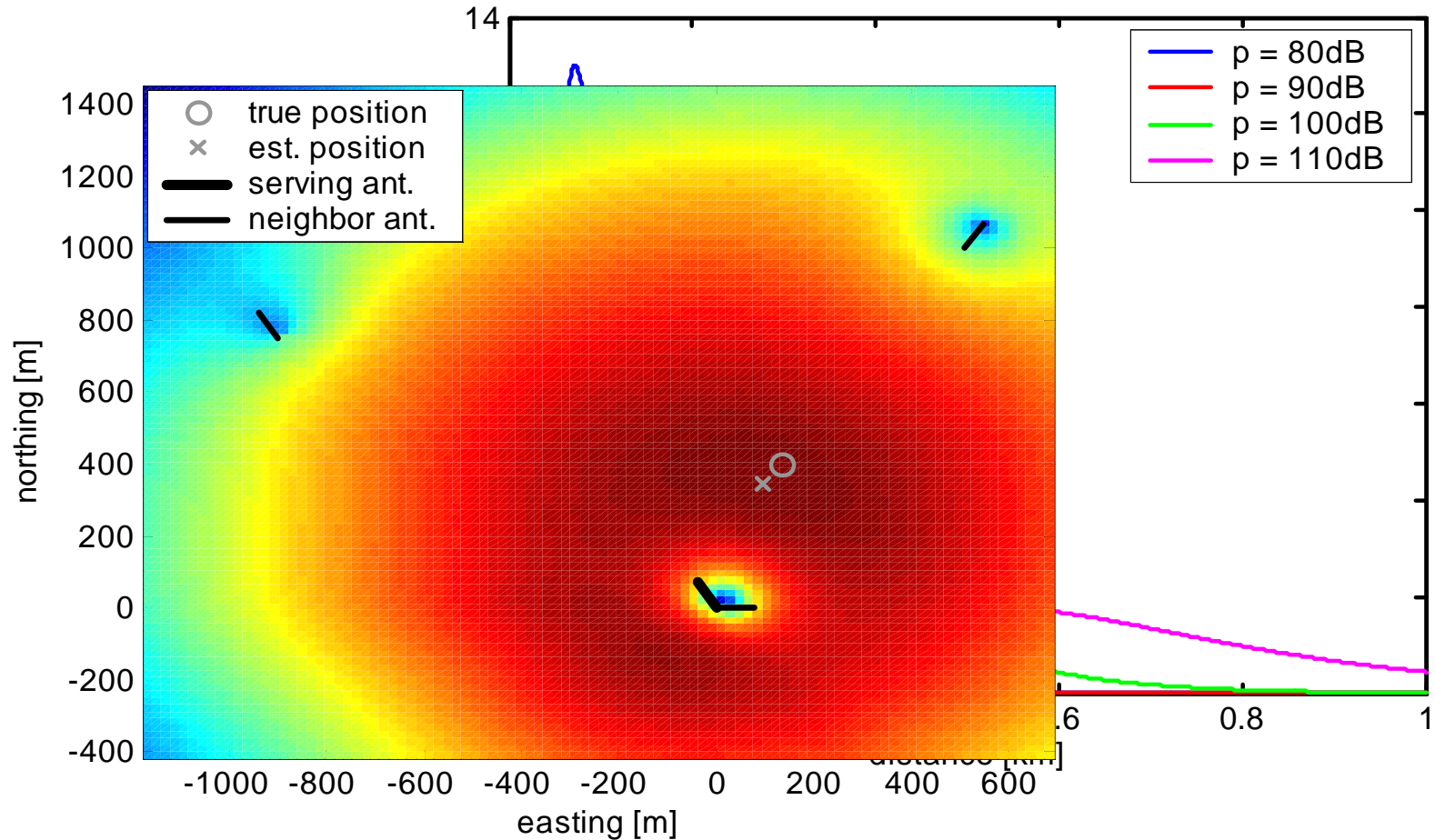
# Application of CIT+

## Application of CIT+

- **Measurements available:**

  - **Round trip time (Timing Advance) of serving transmitter. Resolution: 550 m**

  - **Reception power levels resp. pathloss of serving and neighbouring cells**

- **Comparison with results obtained by simpler method based on cell identification and TA**

### Comparison of achieved mean accuracy:

| Positioning Technique | Dense urban | Urban | Rural |
|---|---|---|---|
| CITA | 305 m | 305 m | 545 m |
| CIT+ | 105 m | 210 m | 415 m |

*Rural situation*

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# Summary

## Low Cost Positioning with CIT+

- Addresses all subscribers (biggest market volume) by support of legacy handsets

- Performance figures are promising, outplay poor CITA performance and fit to consumer applications

- CIT+ lowers the overall costs:
  no new handsets and no additional infrastructure necessary

- CIT+ is an ideal fallback solution for A-GPS and can therefore serve as intermediate solution for the indoor problem

- Applicable for GSM and UMTS and other networks and on various platforms

**The gap between the poor performing
Cell Identification and the high
accuracy A-GPS is filled: CIT+**