

Workshop "The Story of Mobile Experience"

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The Next Generation of LBSs Functions and Challenges

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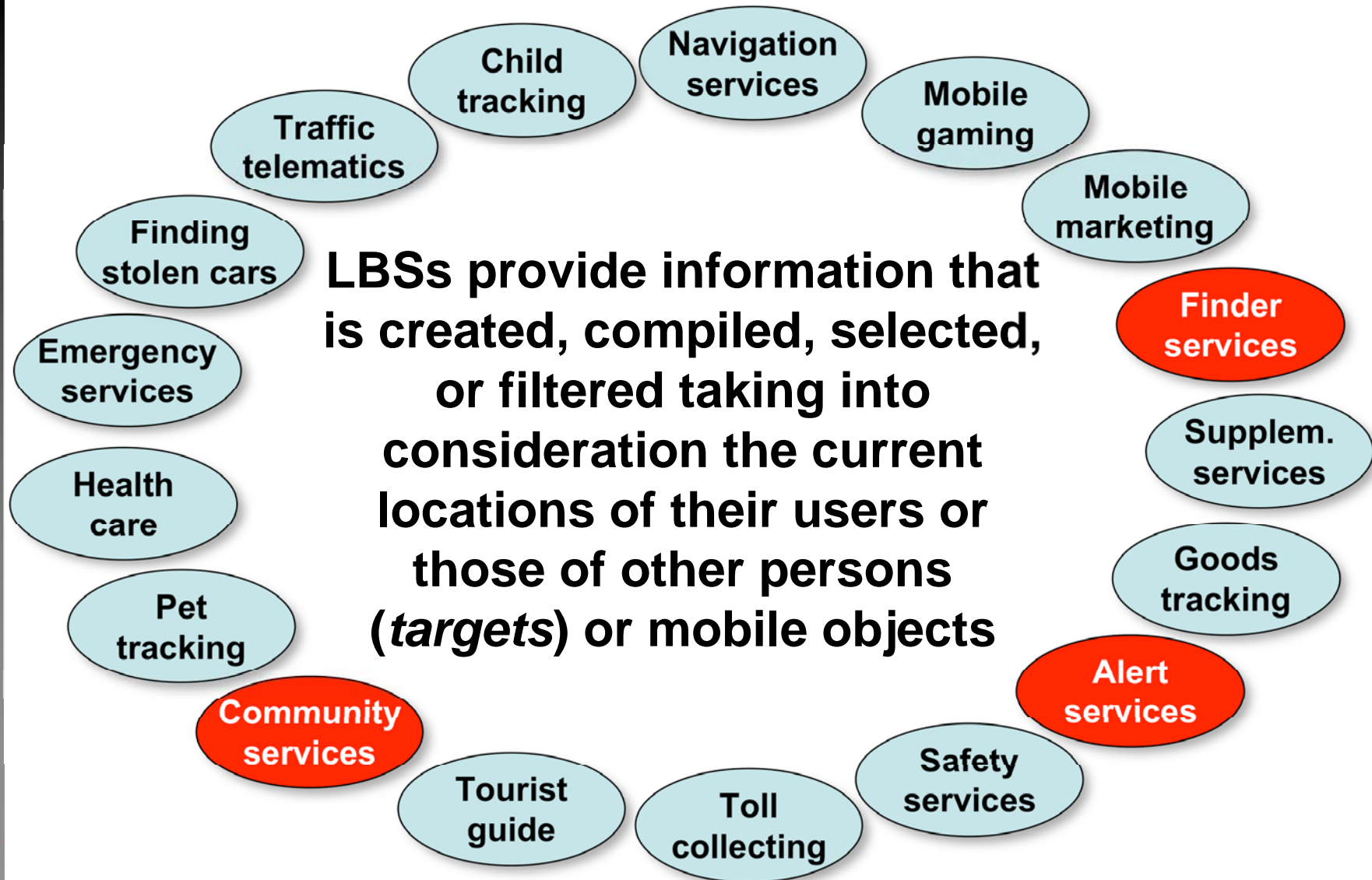
Lehrstuhl für Mobile und Verteilte Systeme
Ludwig-Maximilians-Universität München

- **LBS Classification**
- **Breakdown of the 1st LBS Generation**
- **LBS - The Next Generation**
- **Challenges**
- **Conclusion**



LBS Classification

Application Areas



LBS Classification

Finder Services - Self and Cross Referencing

Restaurant Finder

- Shows the user on request a list of nearby restaurants
- **Reactive/self-referencing**

Buddy Finder

- Shows the user on request a list of nearby buddies
- Displays only distance to the buddies, not their position
- **Reactive/cross-referencing**



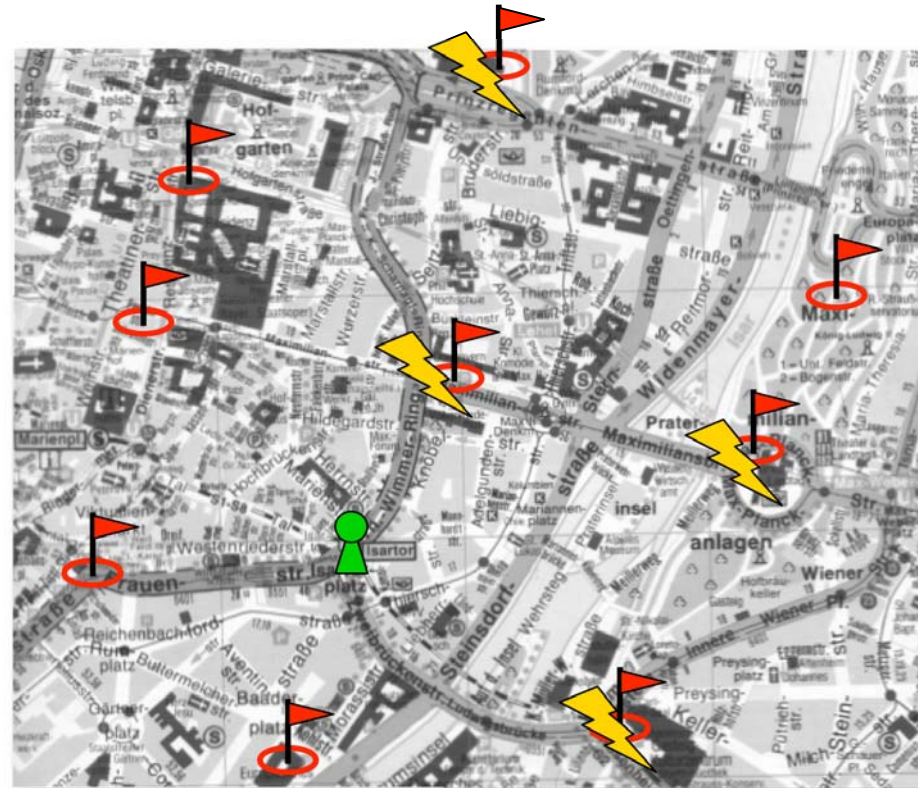
Source: Mobiloco GmbH (<http://www.mobiloco.de/>)



LBS Classification

Alert Services

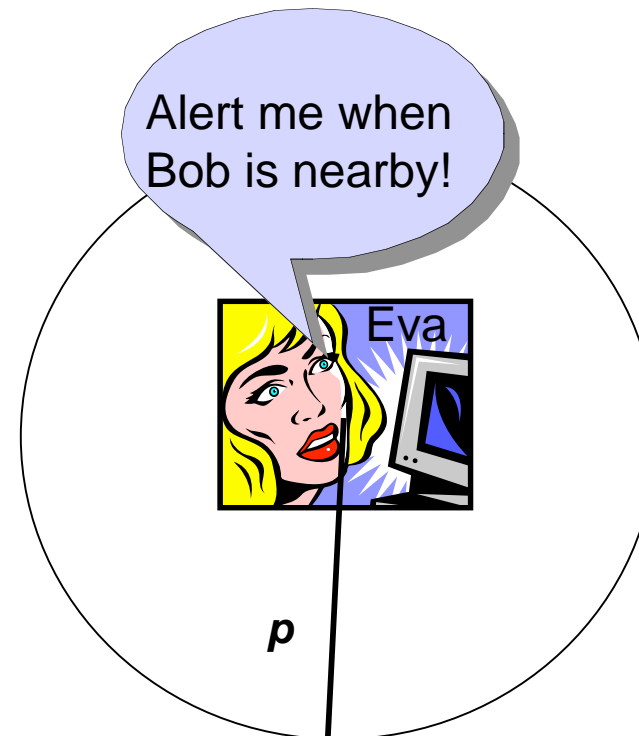
- **Alert Services**
 - Notify user when she enters or approaches pre-selected points of interest (e.g., landmarks) and deliver background information to her
 - **Proactive/self-referencing**



LBS Classification

Proactive Location-based Community Services

- **Notify the member of a community when...**
 - ... another member approaches her or
 - ... departs from her.



- **Proximity is defined by proximity distance p**
- **Correlation of position data at the application server**
- **Proactive/cross-referencing**

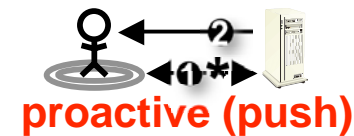
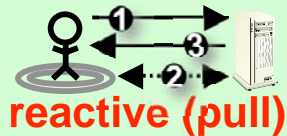


LBS Classification

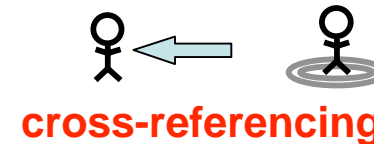
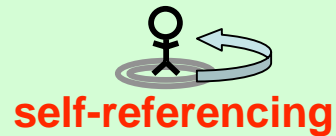
Functional Classification

1. Generation

User/service-
interaction:



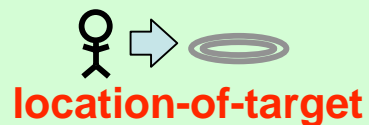
User/target
relationship:



Target/target
relationship:



Direction of
mapping:



Environment:

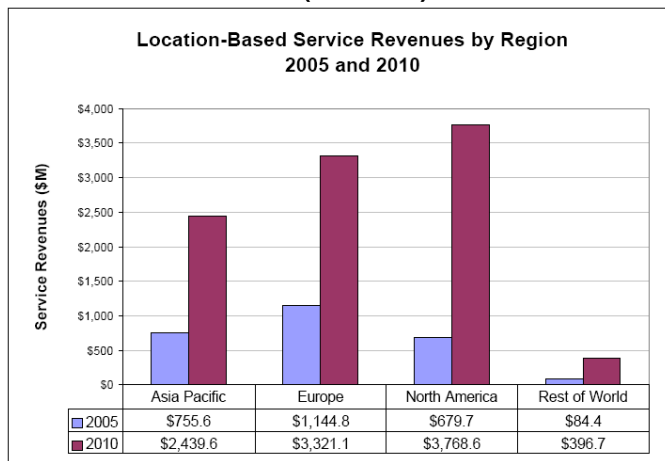


Breakdown of the 1st LBS Generation

Overview of Predicted LBS Revenues

- LBSs turned out not to be the next big thing as often proclaimed by market analysts in 2000

UMTS forum (2000):



Source: Telecompetition Inc., July 2000.

Research firm Berg Insight (2005): "Revenues from mobile location-based services (LBS) in the European market will grow by 153 percent during 2005 to reach 274 million euros

- Different situation in different regions of the world
 - Japan: success of navigation services
 - Korea: success of mobile entertainment/gaming
 - Europe: some finder services but no commercial success
 - US: E-911 but no commercial success



Breakdown of the 1st LBS Generation

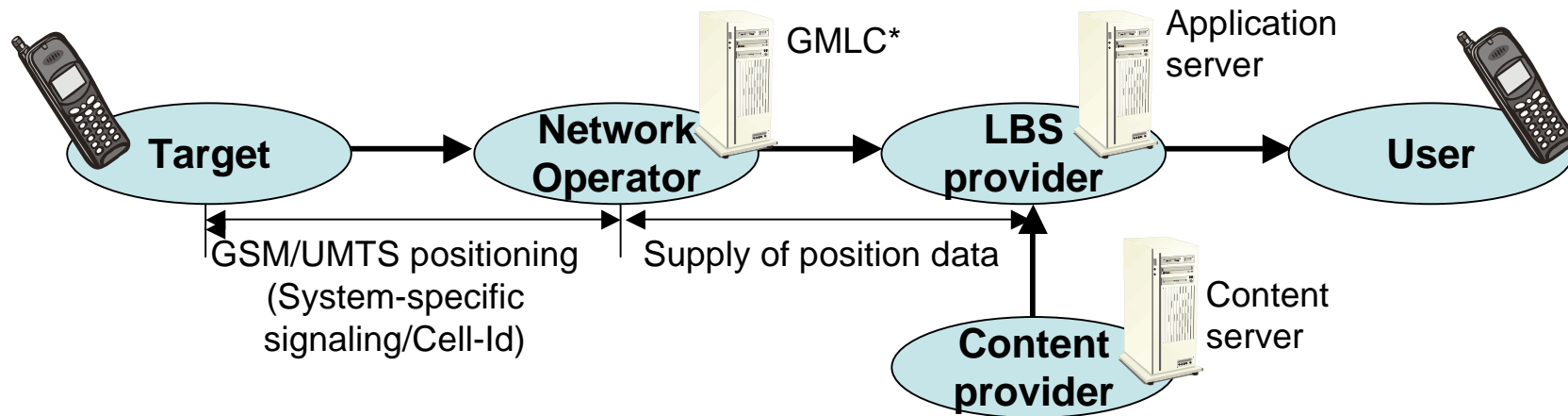
Reasons

- **Indifference of Mobile Network Operators**
- **Network-centric approach created by standardization**



Breakdown of the 1st LBS Generation

Network-centric LBS Supply Chain



*) Fees for purchasing location data from an operator at the *Gateway Mobile Location Center* (GMLC):

VODAFONE (UK) LOCATION REQUESTS	
MONTHLY VOLUME	CHARGE
0 - 50,000	£0.088
50,001 - 250,000	£0.075
250,001 - 500,000	£0.069
500,001 - 5,000,000	£0.063

T-MOBILE (UK) LOCATION REQUESTS	
MONTHLY VOLUME	CHARGE
0 - 99,999	£0.095
100,000 - 249,999	£0.085
250,000 - 499,999	£0.075
500,001 - 5,000,000	£0.065

Quelle: ZIM Corporation (<http://www.zimepl.com/>)



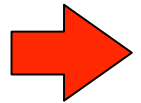
Breakdown of the 1st LBS Generation Reasons

- Indifference of Mobile Network Operators
- ▪ Network-centric approach created by standardization
- Little interest for data services in general
- No research and development before 2000
- ▪ Inaccurate/premature positioning technology
- No position management
- Unavailability of geographic content
- ? ▪ Lack of mechanisms for saving privacy



LBSs - The Next Generation

Basic conditions are changing ...



Increasing market penetration of mobile devices equipped with...

- ... GPS or Assisted GPS
- ... data services (GPRS, UMTS PS, and WLAN)
- ... Symbian or J2ME

- **Stronger consideration of LBSs in R&D activities than a few years ago**
- **Emergence of new enablers and technologies**
- **Higher acceptance rate of innovative data services in general**



LBSs - The Next Generation

Example: GPSoverIP



Quelle: GPSoverIP GmbH (<http://www.gpsoverip.de/>)

Example for Monthly Cost*:

eg. Transmission every second	63 hrs.	40,90
eg. Transmission every 2 second	126 hrs.	40,90
eg. Transmission every 4 second	253 hrs.	40,90
eg. Transmission every 8 second	506 hrs.	40,90
eg. Transmission every 20 second	100 hrs.	36,90

For cost calculation refer to www.GPSoverIP.de

*Calculation above based on Vodafone. Prices may vary with different telecom providers. All prices are subject to the prevailing GST



LBSs - The Next Generation

Consequences of changing conditions ...

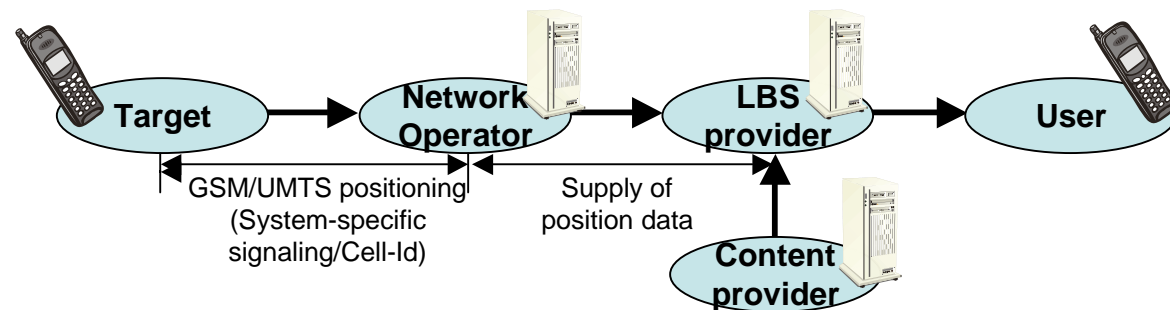
- **LBS supply chain changes**
 - Network-centric supply chain is replaced by a device-centric one
 - New actors (content providers, web hosting companies,...)



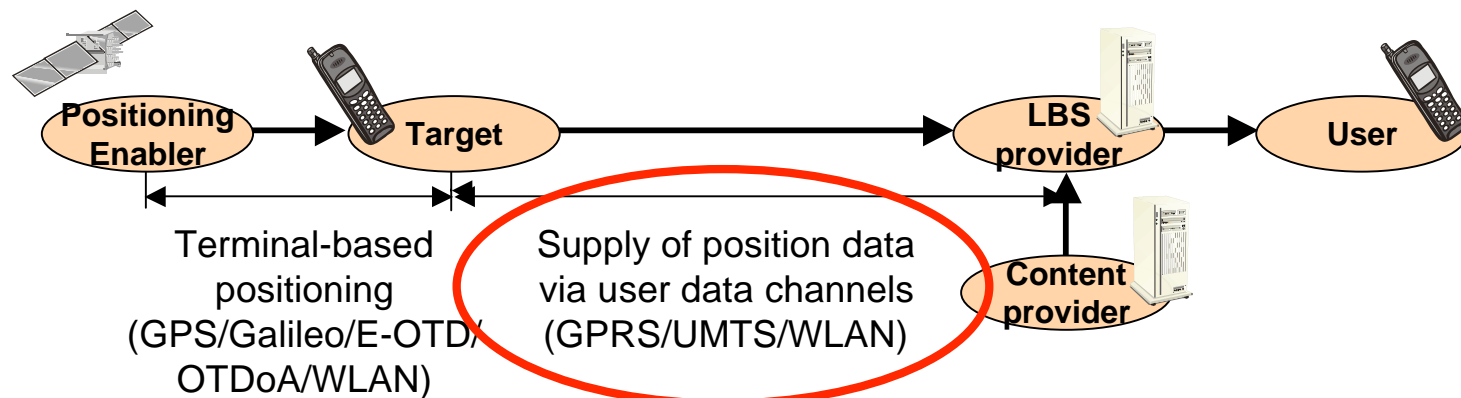
LBSs - The Next Generation

Device-centric Supply Chain

Classical Supply Chain:



Device-centric Supply Chain:



LBSs - The Next Generation

Consequences of changing conditions ...

- **LBS supply chain changes**
 - Network-centric supply chain is replaced by a device-centric one
 - New actors (content providers, web hosting companies,...)
- **Open service market and multi-provider environment**
 - Basically each person can create its own LBS (possibly supported by tools offered by web hosters)
- **New functions**
- **Service diversity and broad range of niche market applications**



Challenges

Overview

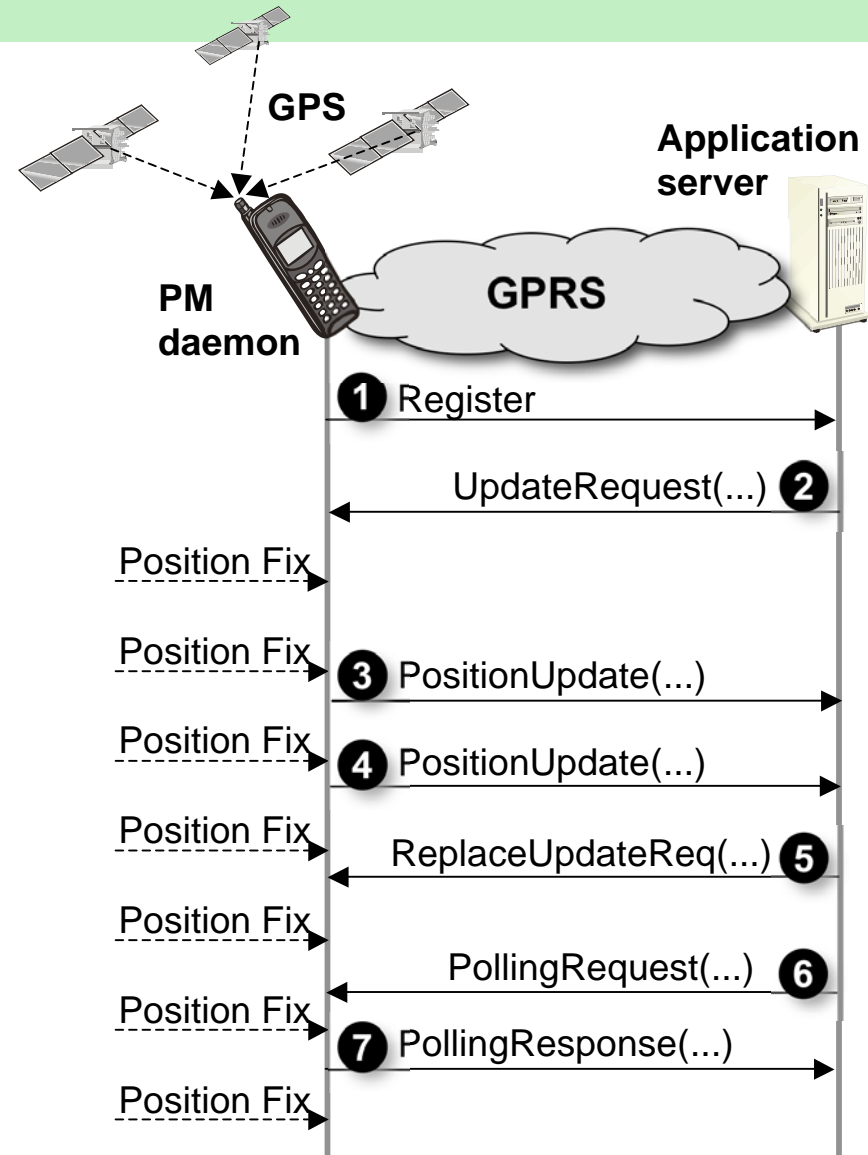
- **Positioning**
 - Higher availability of positioning services
 - Standardized technologies for indoor positioning
 - Positioning handover
- **Position Management**
 - Low level position management: exchanging position data between GPS device and application server
 - High level position management: correlating position data of several targets



Challenges

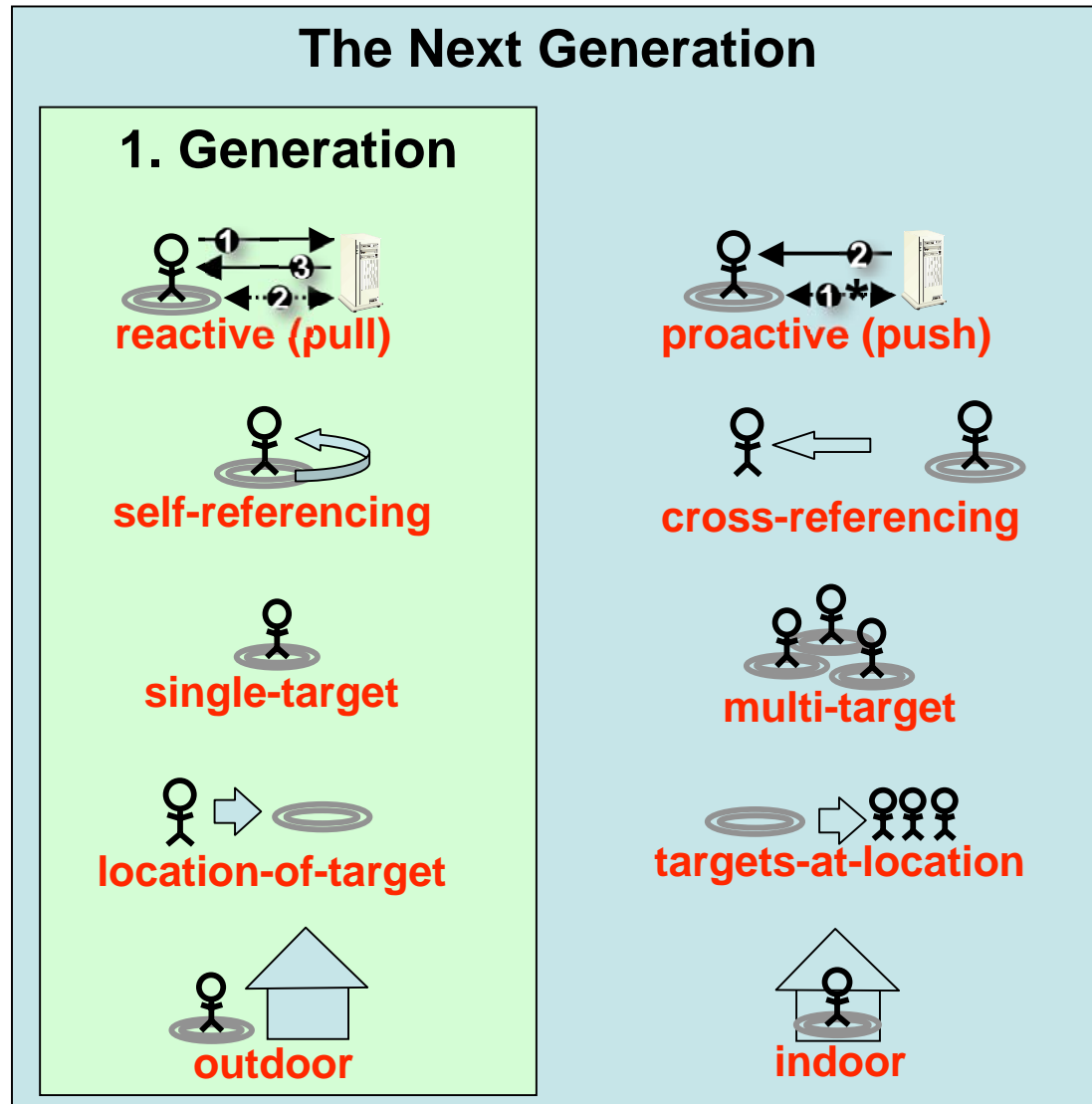
Position Management

- Deals with the exchange of position data between a GPS-capable mobile device and the application server
- **Temporal/Spatial triggers**
 - Immediate position update
 - Periodic position update
 - Distance-based PU (e.g., child tracking)
 - Zone-based PU (e.g., Pol alert)
- **Request of position data**



Challenges

Functions covered by the Next Generation



Challenges

Overview

- **Positioning**
 - Higher availability of positioning services
 - Standardized technologies for indoor positioning
 - Positioning handover
- **LBS Middleware**
 - Low level position management: exchange of position data between GPS device and server
 - High level position management: correlation position data of several targets
- **Privacy protection**
 - Anonymization
 - Privacy policies
 - Mechanisms for reducing peer-group pressure



Challenges

Privacy Policy



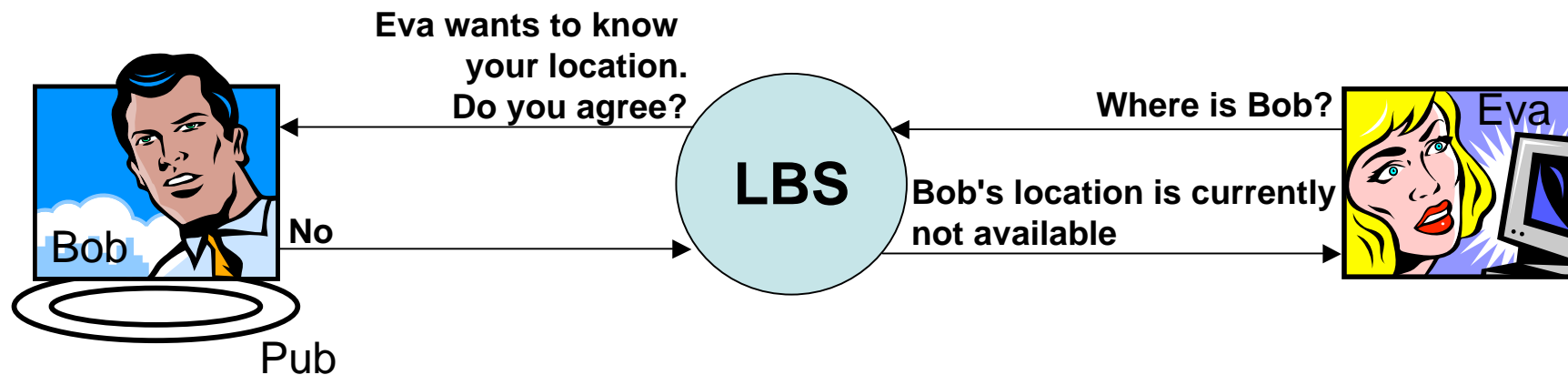
- Alan Westin (1970): "**Privacy** is the claim of individuals, groups, and institutions to determine for themselves, when, how, and to what extent information about them is communicated to others."
- **Privacy policy**: assertion that a certain amount of information may be released to a certain entity under a certain set of constraints
- Examples
 - *"My wife is allowed to know the city in which I'm currently staying."*
 - *"My superior is allowed to automatically track me in terms of exact coordinates if and only if*
 - *it happens during the working hours, and*
 - *I'm staying on the company's premises, or*
 - *I'm visiting clients."*
- Risk: peer-group pressure if superiors/relatives/friends are excluded

Challenges

Reducing Peer-Group Pressure (I)

- **Plausible deniability**

- Potential observer of another person cannot determine whether a lack of disclosure is intentional or not
- From a user's point of view (*Louis*) it is not clear whether the *temporal untraceability* of the target (*Eva*) is deliberate or due to missing radio coverage
- Positioning attempts must be deniable without reporting the reason of failure to the requesting user

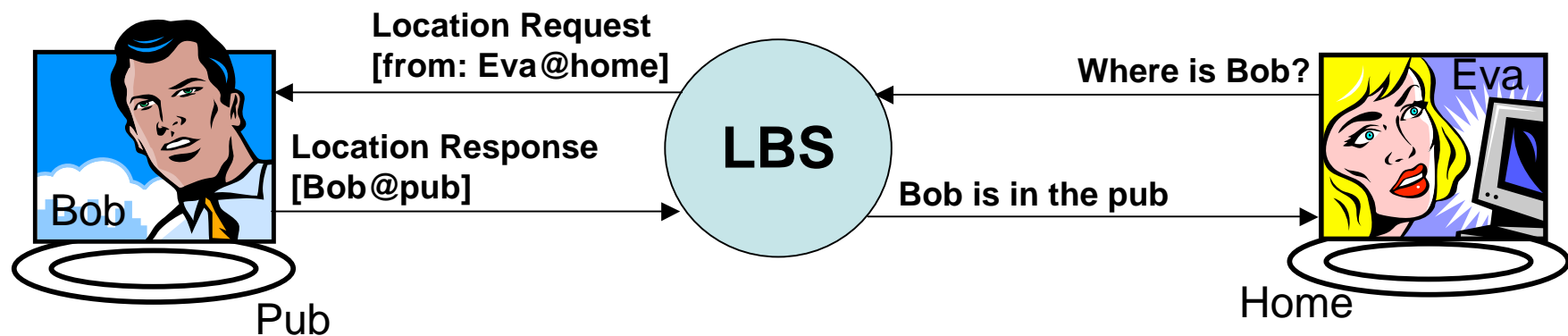


Challenges

Reducing Peer-Group Pressure (II)

- **Fair trade of location data**

- "Tell me yours, I tell you mine"
- Target only agrees on positioning if the requesting user also discloses her location
- Should LBS tools/middleware permit the development of one-sided cross-referencing LBSs at all?

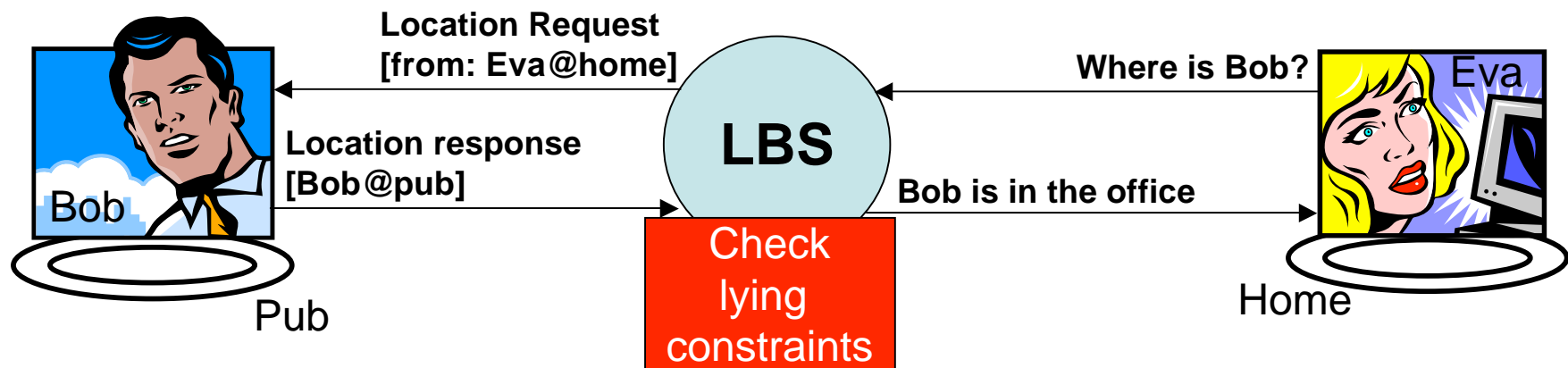


Challenges

Reducing Peer-Group Pressure (III)

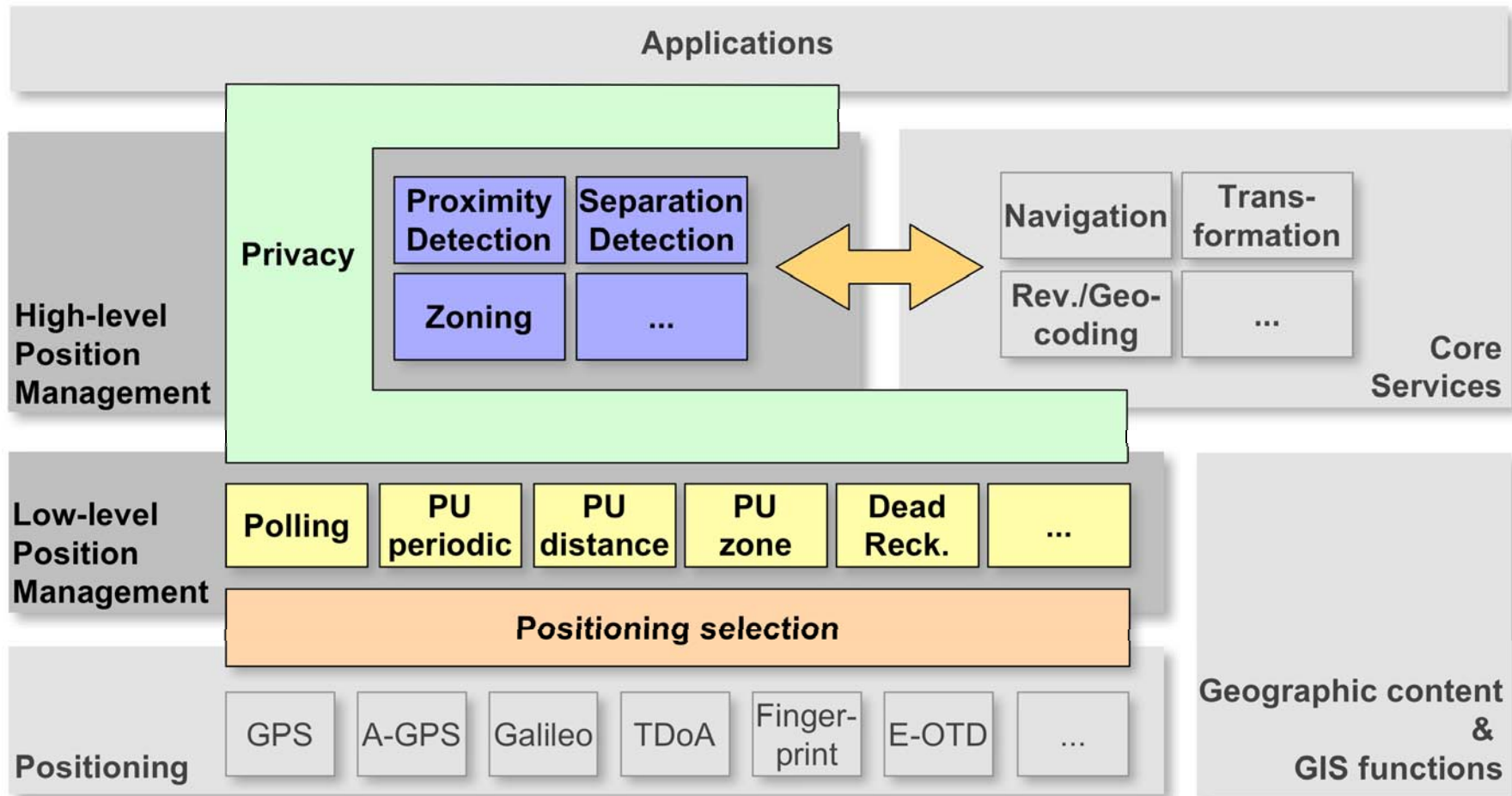
▪ White lying

- Deliberate falsification of locations reported to other persons
- Bob: *"If Eva wants to know my location, tell her I'm in office"*
- Risk: a target's lies can be discovered the more telltale and crude they are
- *"If Eva wants to know my current location and she is not in my office and we are at least 5 km apart, then tell her I'm in office"*



Challenges

LBS Middleware



Conclusions

- **1st LBS generation did not succeed**
- **GPS-capable phones and devices as driving force behind open service market and service diversity**
- **Functional identification of LBSs for identifying required basic mechanism**
- **Challenges for the next generation**
 - Advances in positioning technologies
 - Development of position management
 - New mechanisms for privacy protection

