

A stylized, light blue map of Europe is visible in the background of the top section of the slide.

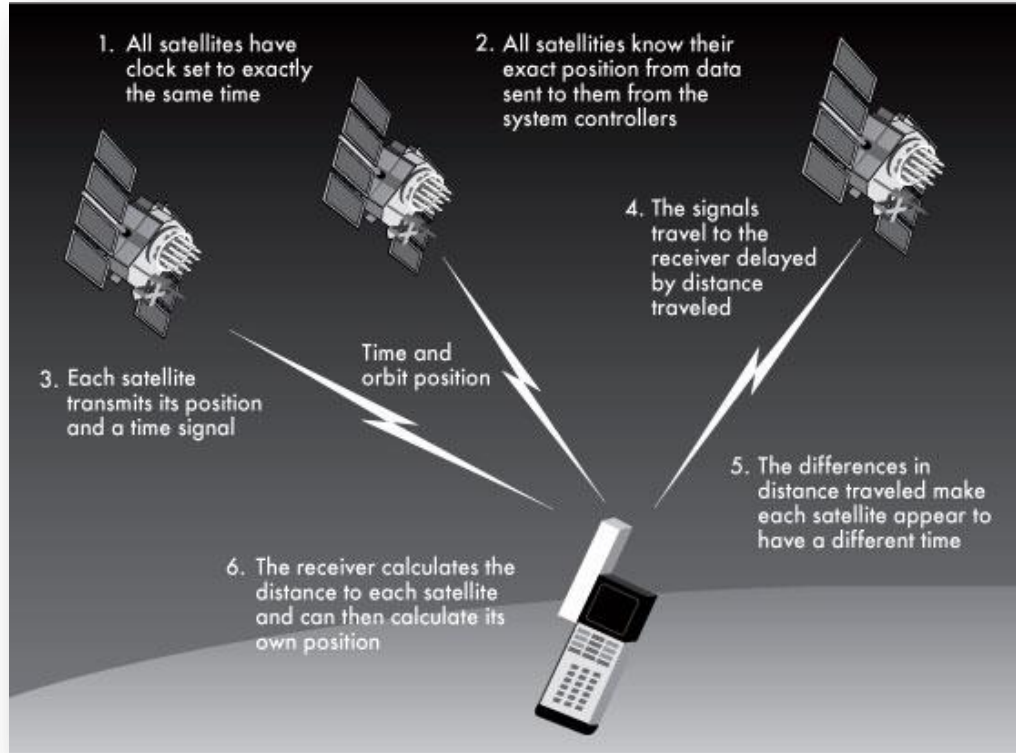
Geomedien und Geokommunikation

# **Mobile Systeme**

**Satellitenpositionierung, Mobilität,  
Location-based Services**

Bernd Resch, Alfons Koller

# Gruppenarbeit ::: Genauigkeit von GPS



The screenshot displays the ArcGIS web interface. At the top, there is a navigation bar with options like 'Details', 'Hinzufügen', 'Bearbeiten', 'Grundkarte', 'Freigeben', 'Messen', and 'Lesezeichen'. A search bar on the right contains the text 'Adresse oder Ort suchen'. Below the navigation bar, there are tabs for 'Info', 'Inhalt', and 'Legende'. The 'Inhalt' panel on the left lists several layers, including 'GPS-Track Bike 2015', 'Forschung', 'UIA Buildings Footprints Salzburg - Buildings OSM WGS84', 'UIA Buildings Footprints Salzburg - Buildings OSM Points', 'gip salzburg subset', 'Sport Bearbeitung 1 21.7.2014 csv', and 'Dunkelgrauer Hintergrund'. The main map area shows a street grid with a yellow track overlaid. Street names visible include 'LAUFENS TRABE', 'STAUFFENEGG STRABE', 'RECHTE SALZBURGER STRASSE', 'FASANERIE STRABE', 'REVIER STRABE', 'SIEBER STRABE', 'SCHIERSTATTS TRABE', 'STEINER STRABE', and 'ERAL-KEYES-STRABE'. A scale bar at the bottom left indicates 0, 50, and 100 meters. The Esri logo and 'POWERED BY esri' are visible in the bottom right corner of the map area.

Details Hinzufügen Bearbeiten Grundkarte Freigeben Messen Lesezeichen Adresse oder Ort suchen

Info Inhalt Legende

Inhalt

- GPS-Track Bike 2015
- Forschung
- GPS-Track Bike 2015
- UIA Buildings Footprints Salzburg - Buildings OSM WGS84
- UIA Buildings Footprints Salzburg - Buildings OSM Points
- gip salzburg subset
- Sport Bearbeitung 1 21.7.2014 csv
- Dunkelgrauer Hintergrund

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- Geomedien Track Nawi Lea
  - 25\_Nov\_2016\_09\_44\_54
    - 25 Nov 2016 09:44:54 - Trackpoints
    - 25 Nov 2016 09:44:54
  - michi
    - 25.11.2016 9:44:41 Vorm. - Trackpoints
    - 25.11.2016 9:44:41 Vorm.
  - GeomedienTrackNAWIRoman
    - Track - Trackpoints
    - Track
  - 25
    - 25.11.2016 9:44:50 vorm. - Trackpoints
    - 25.11.2016 9:44:50 vorm.
  - Basemap
    - Topographic
    - Citations
  - Basemap
    - World Imagery



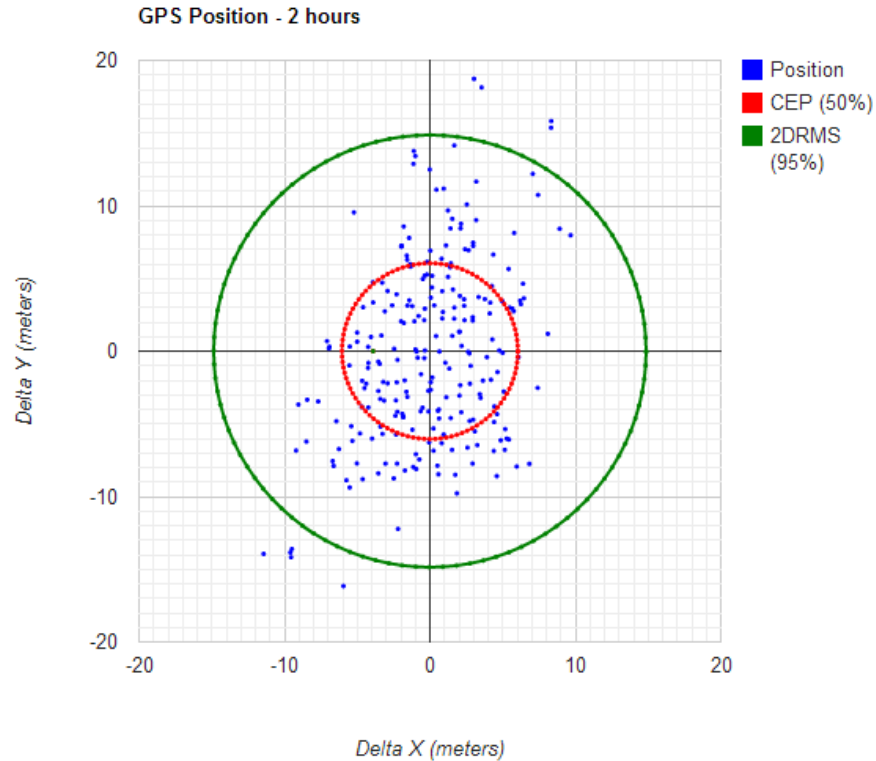
# Gruppenarbeit ::: Genauigkeit von GPS

- Warum ist die GPS-Position ungenau?





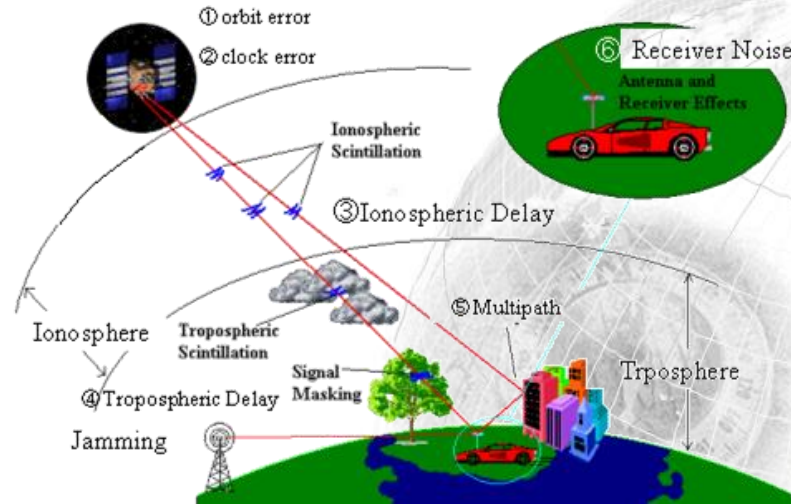
# Genauigkeit von GPS



Quelle: <http://blog.opioanax.ca>

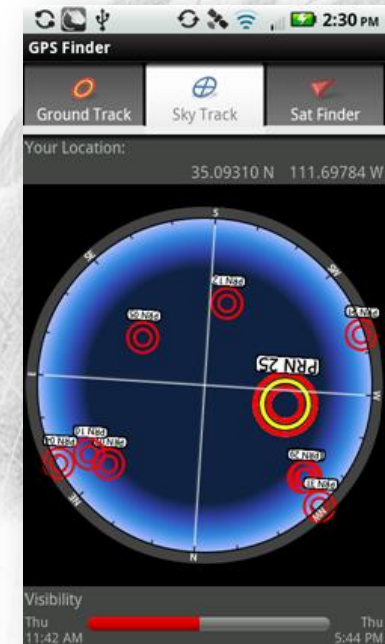
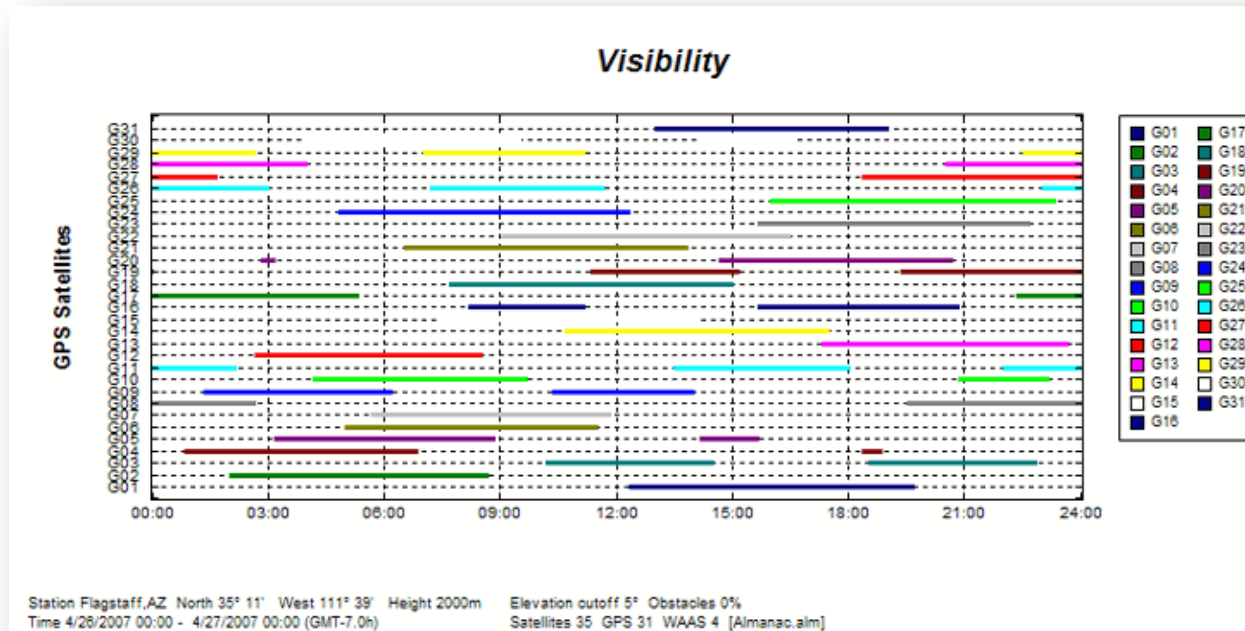
# Genauigkeit von GPS

- Empfängeruhr
- Messung der Ankunftszeit des Signals
- Atmosphärische Effekte
- Ephemeris (Orbit)
- Satellitenzeit
- Multipath
- Natürliche und künstliche Interferenz
- Sichtbarkeit von Satelliten
- ...



Source of error	Percent
Multipath	30-50%
Atmospheric / Ionospheric	25-30%
Receiver error	10-25%
Satellite clock error	5-10%
Ephemeris error	5-10%

# Genauigkeit von GPS



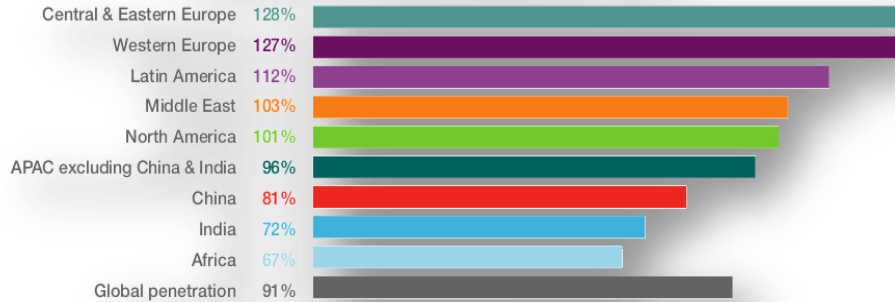


# Mobile Systeme

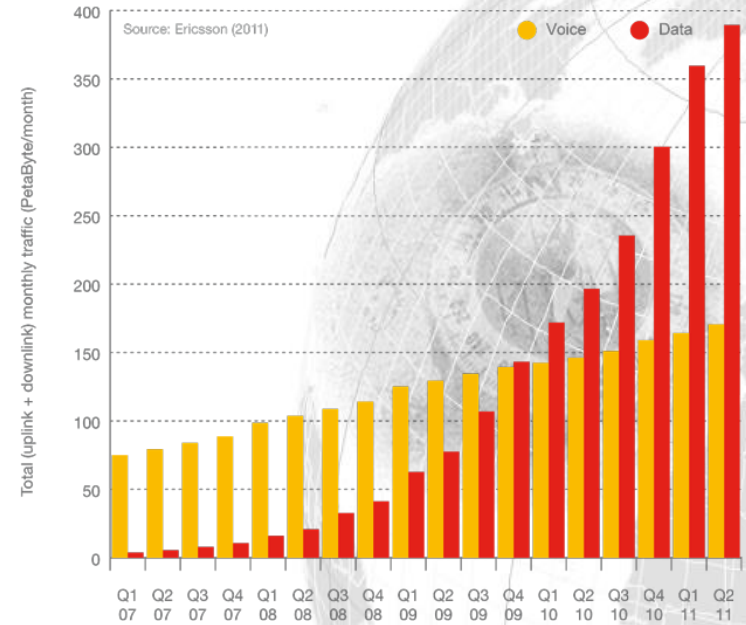


# Mobile Systeme ::: Motivation

## Penetration Percentage Q3 2012

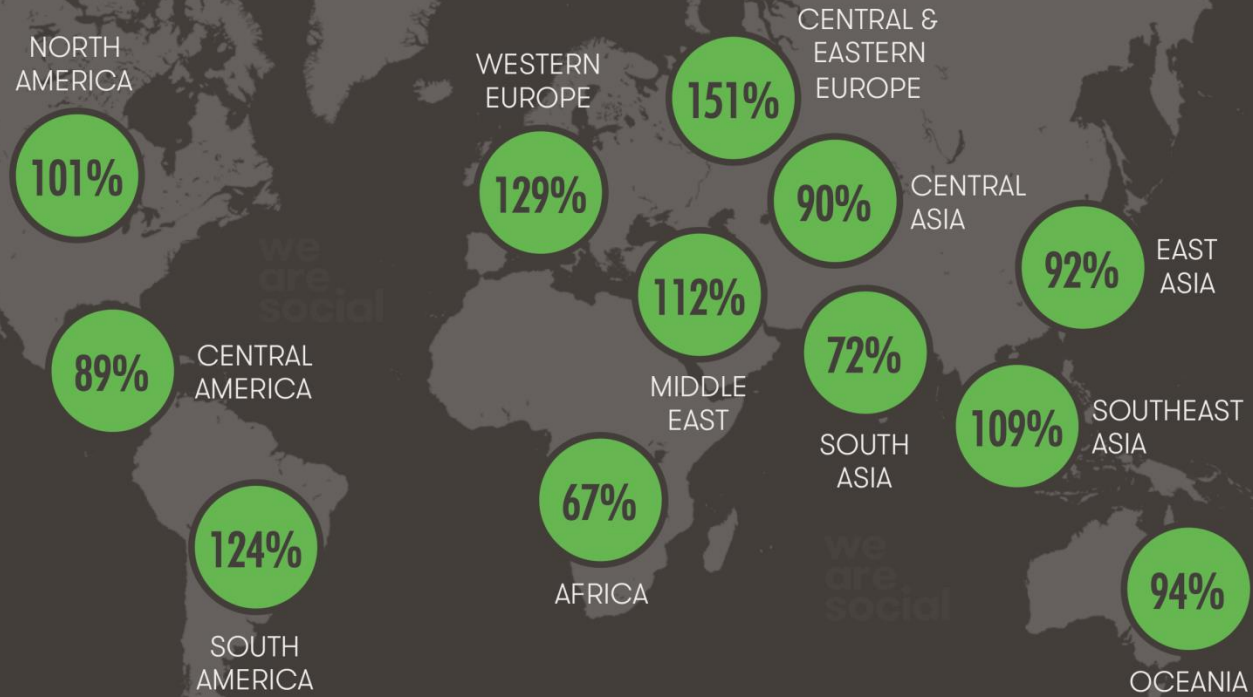


Source: Ericsson (November 2012)



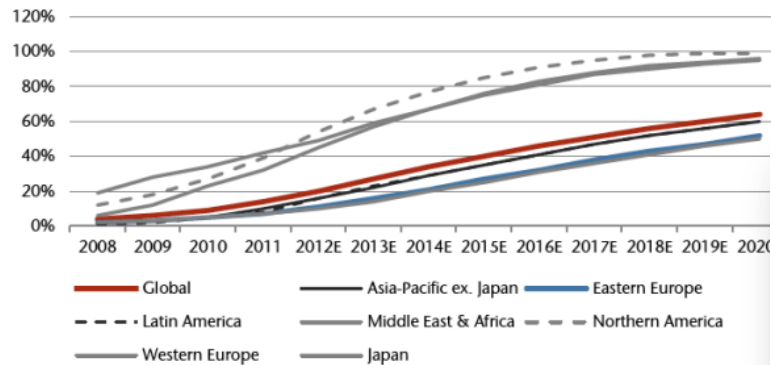
JAN  
2014

# MOBILE PENETRATION BY REGION

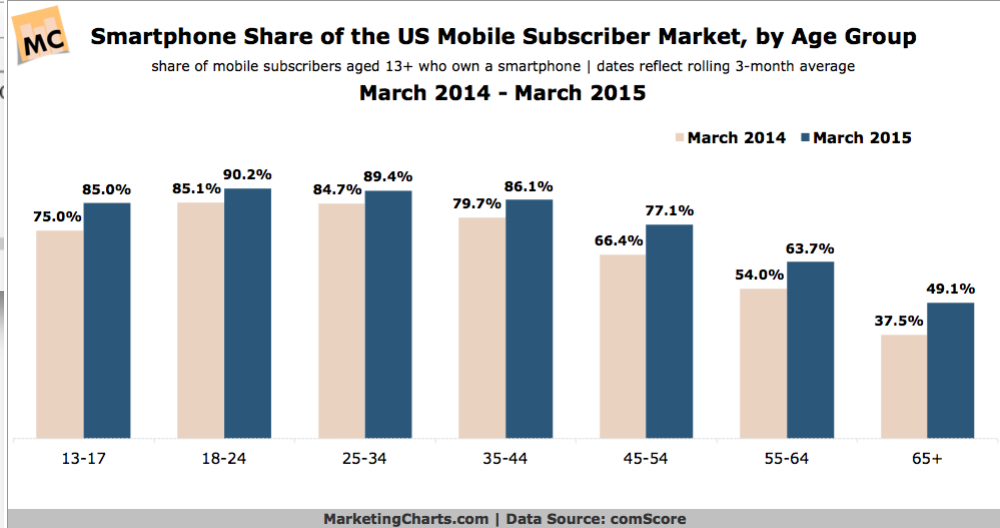


# Mobile Systeme ::: Motivation

**Exhibit 1: Smartphone Penetration Estimates**



Source: Gartner historical, Jefferies & Company, Inc. estimates



# Mobile Systeme ::: Motivation

And mobile audience growth is being driven more by mobile web properties, which are actually bigger and growing faster than apps.

Average Monthly Audience: Top 1000 Mobile Apps vs. Top 1000 Mobile Web Properties

Source: comScore Mobile Metrix, U.S., Age 18+



COMSCORE

insight

A comparison of the Top 1000 Apps vs. the Top 1000 Mobile Web Properties shows a surprising result. Not only do mobile web properties have audiences that are more than 2.5x the size, but these audiences are also growing twice as fast.

© comScore Inc. Proprietary

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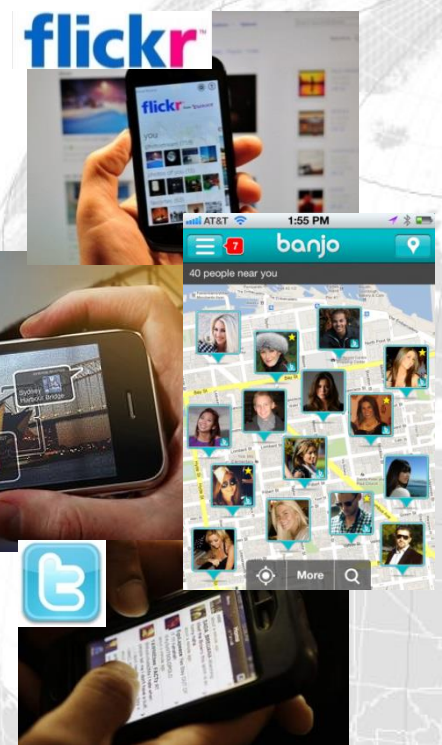


# Mobile Systeme | GIS | Apps ::: Definition

- **Mobiles System:** autarkes, nicht-stationäres Gerät in einer verteilten (drahtlosen) Kommunikationsumgebung
- **Mobile App:** Anwendungssoftware für kleine, ressourcenbegrenzte Handheld-Geräte wie Smartphones, Tablets, etc.
- **Mobiles GIS:** Diverse Daten, Analysealgorithmen, Nutzer und Visualisierungstechnologien, die auf einem mobilen Gerät laufen bzw. gespeichert sein können.

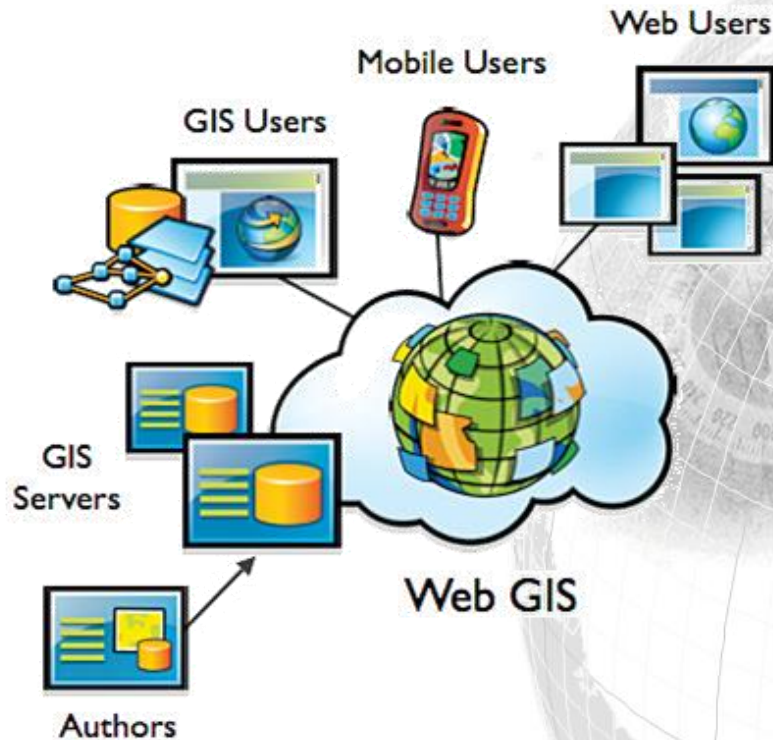
# Mobile Geo-Apps ::: Hintergrund

- 2010s: Mobile Apps und Maps



# Mobile Systeme ::: ...und GIS

- Daten
- Services
- Algorithmen
- Plattformen
- Providers/Autoren
- Users (!)
- ➔ Interfaces



Source: <http://www.esri.com>

# Mobilität ::: Definition?

- *Gerätemobilität*
  - Bewegung im physischen Raum, unabhängig vom Netzwerk
- *Nutzermobilität*
  - Bewegung im physischen Raum (mobil oder stationär)
- *Anwendungsmobilität*
  - Zugriff auf Anwendungen und Services von dem Ort aus

Sources: Cooper (2001), Roth (2005) and Chan et al. (2000)

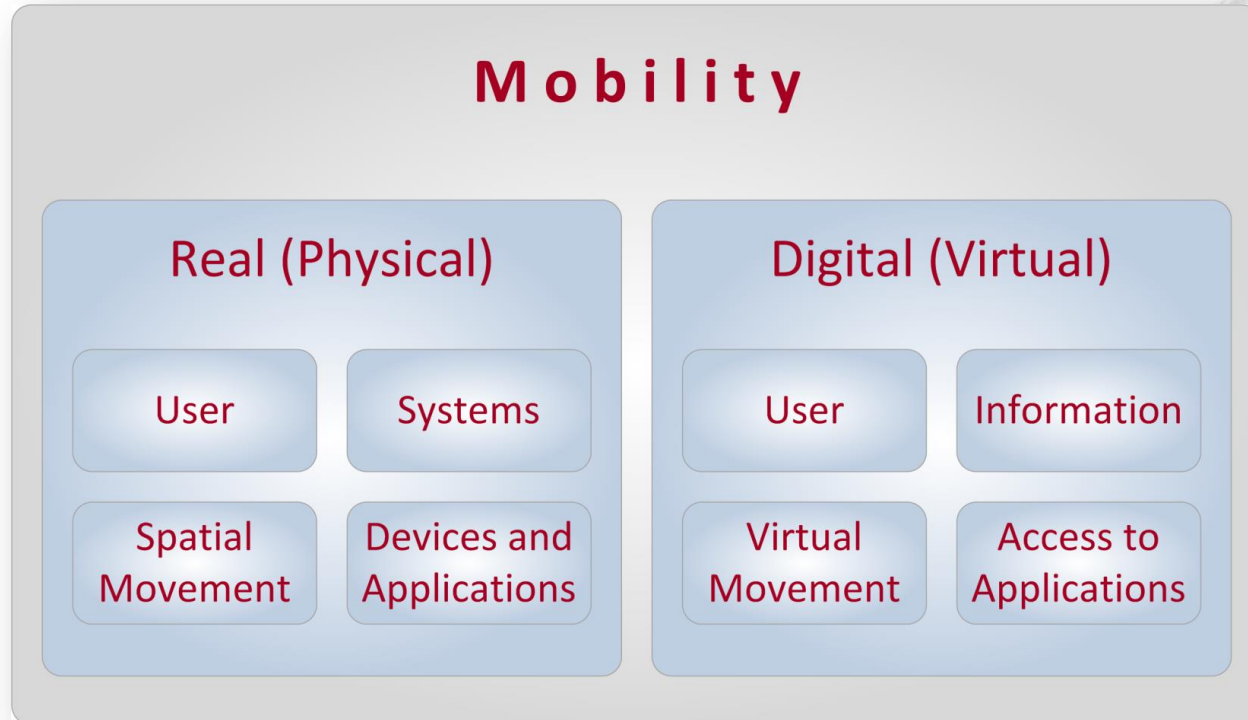
# Mobilität ::: Definition?

- *Mobile Individuen*
- *Mobiles Setting*
  - Bewegung durch die Nutzung eines Objektes
- *Mobile Technologie*
  - Endgerät – tragbar und mobil
- *Mobile Information*
  - Ubiquitärer Zugriff auf Information

Sources: Weilenmann and Larsson (2003)



# Mobilität ::: Definition



Source: Adapted from Krannich (2010)

# Mobilität ::: Definition?

- Definition schwierig, weil der Begriff...
  - ◆ ...in verschiedenen Disziplinen genutzt und geprägt wird
  - ◆ ...oft undifferenziert verwendet wird
  - ◆ ...zu generisch ist, um eine konsistente Definition zu finden
  - ◆ ...kontextabhängig ist
- ➔ *"Mobility is one of those words that are virtually impossible to define in a meaningful way. You either come up with a definition that excludes obvious instances, or your def. is too vague; it fails to shed light on important aspects."*

Source: Krannich (2010)

# Mobilität ::: Definition?

- Funktionalität
- Zweck
- Form und Interaktionsmöglichkeiten
- Fähigkeiten
- Persönliche Mobilität
- “Computation paradigm”
- ...?



# Mobilität ::: Definition

- “Mobil”
  - ◆ Gerät ist tragbar oder transportierbar
  - ◆ Nicht das Gerät ermöglicht Mobilität, sondern es kann unabhängig von der physischen Position für Kommunikation genutzt werden
  - ◆ Der Nutzer ist mobil, nicht das Gerät

# Mobilität ::: Definition

- “Mobiles Gerät”
  - ◆ Drahtlos (batteriebetrieben)
  - ◆ Kann während des Transports benutzt werden
  - ◆ Integrierte I/O
- “Mobiles System”
  - ◆ Mobiles Gerät + OS + Anwendung



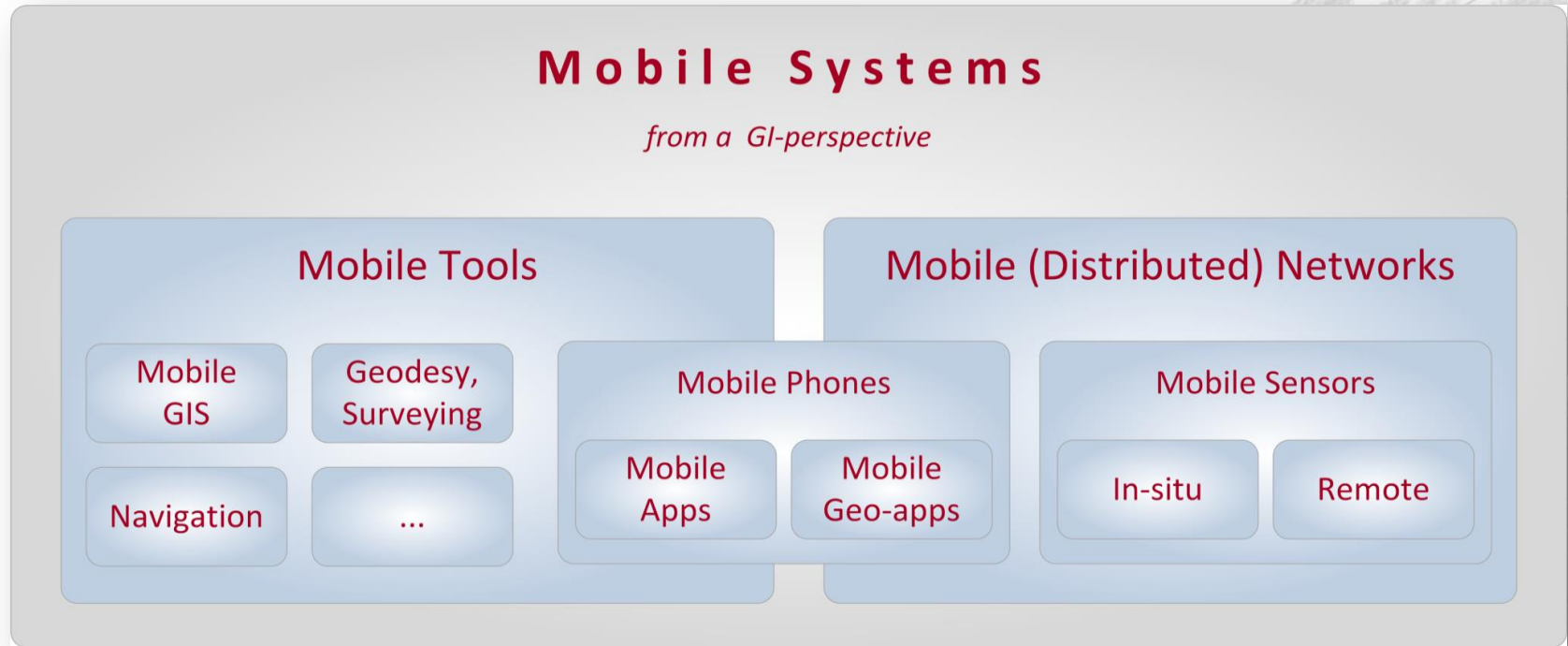


# Mobile Systeme ::: Definition

- ...vs. desktop-oriented applications
  - ◆ Design and information presentation
  - ◆ Motivation of usage
  - ◆ Context
  - ◆ I/O
  - ◆ Interaction



# Mobile Systeme ::: GI Definition



# Mobile Systeme ::: Mobilitätskriterien

- Portabilität
  - ◆ Gewicht
  - ◆ Form
  - ◆ Komponenten
- Platzbedarf
- Konnektivität



# Mobile Systeme ::: Mobilitätsgrad

## Anforderungen

- Klein
- Leicht
- Komfortabel zu tragen
- Freihändige Interaktion
- Visuelle Ausgabe
- Nicht-visuelle Ausgabe
- Händische Interaktion

highly mobile  
↑  
Degree of Mobility  
stationary

### Wearable



### Mobile



### Portable



### Stationary

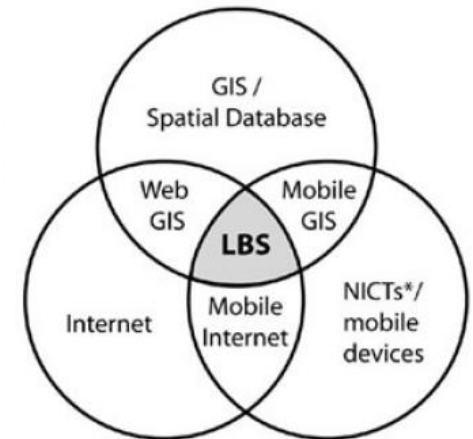


# Location-based Services



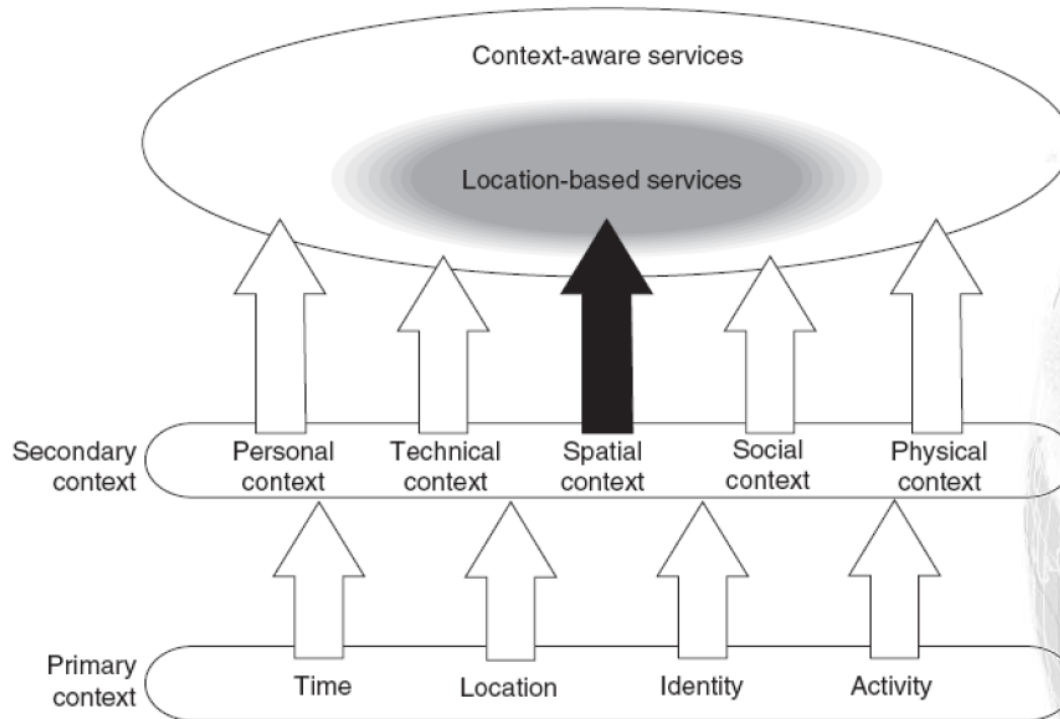
# LBS ::: Begriffsklärung

- **Location Awareness:** “the ability of people, or machines, to make decisions based on the awareness of their location and/or of the objects that have influence on the decision.”
- **Location-based Service:** service to retrieve information based on the user’s current location
- *Location Service:* service using a technology to locate a (mobile) device
- ➔ Begriffe LS und LBS verschmelzen bzw. LS verschwindet zunehmend





# LBS ::: Context Awareness

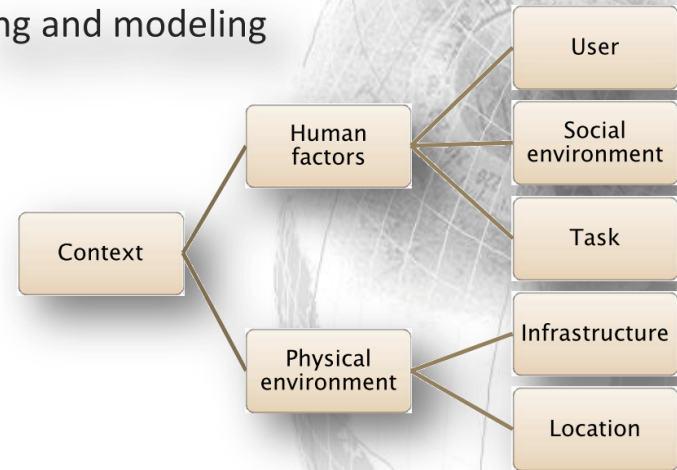


Source: Küpper (2005)

# LBS ::: ...aus GIS-Perspektive






- Kontextmodellierung und -adaptierung
  - ◆ “locations and the identity of nearby people and objects”
- Fokussierung auf den Nutzer
  - ◆ Anforderungen, Verhalten, Profil
- Prozessierung und Modellierung von räumlichen Daten
- Modellierung von Orten

ing and modeling



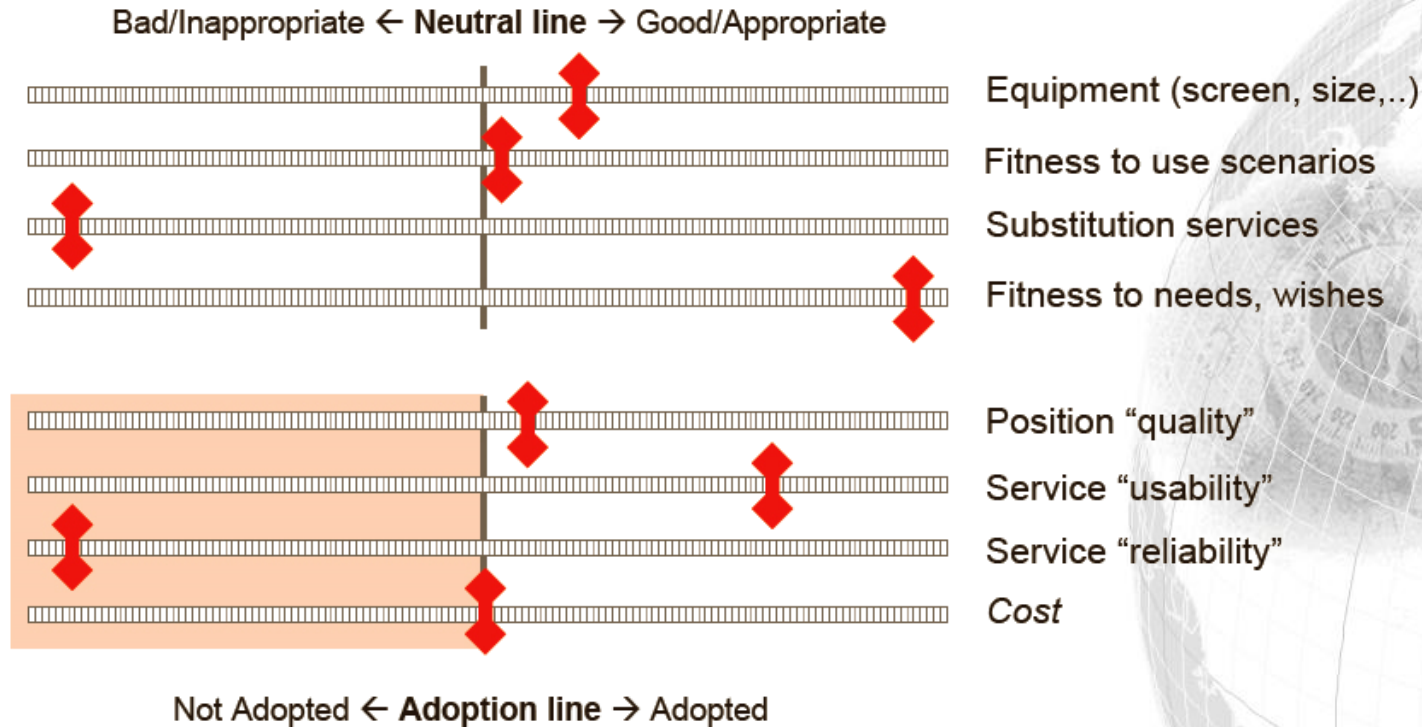
Source: Jiang and Jao 2006

# LBS ::

	Action	Questions	Operations
	<b>orientation &amp; localisation</b> locating	where am I? where is {person object}?	positioning, geocoding, geodecoding
	<b>navigation</b> navigating through space, planning a route	how do I get to {place name  address  xy}?	positioning, geocoding, geodecoding routing
	<b>search</b> searching for people and objects	where is the {nearest   most relevant   & } {person   object}?	positioning, geocoding, calculating distance and area, finding relationships
	<b>identification</b> identifying and recognis- ing persons or objects	{what   who   how much } is {here   there}?	directory, selection, the- matic/ spatial, search
	<b>event check</b> checking for events; de- termining the state of objects	what happens {here   there}?	

Source: Beinat et al. (2007)

# LBS ::: Erfolgsfaktoren



Source: Beinat (2006)

# LBS ::: (Google) Ingress

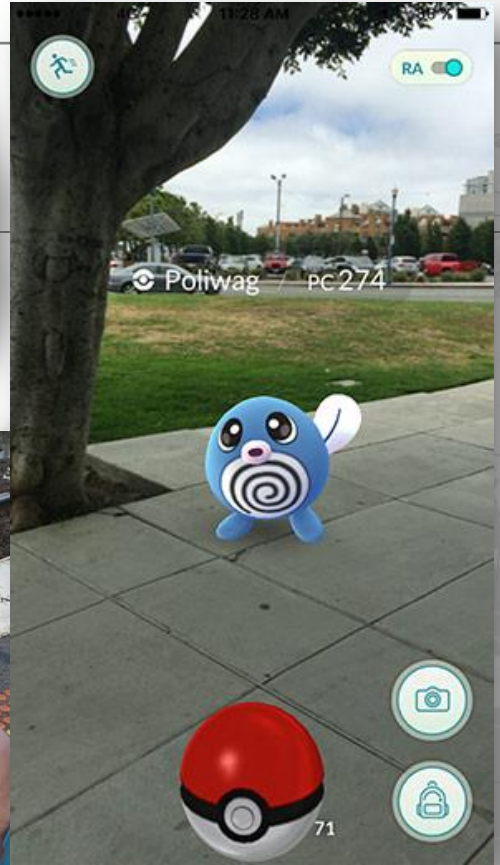
- Location-based gaming
- Verbunden mit der "wirklichen" Welt
- AR-basierte Nutzerinteraktion



Source: <http://www.ingress.com>



# LBS ::: Pokémon Go





## Biomedicine

## Pokemon Go Increased U.S. Activity Levels by 144 Billion Steps in Just 30 Days

The latest gaming craze increases activity levels for players, regardless of their age, sex, or weight.

by Emerging Technology from the arXiv    October 21, 2016



**Robert Butler, the founding director of the National Institute on Aging,** once said: “If exercise could be purchased in a pill, it would be the single most widely prescribed and beneficial medicine in the nation.”

<https://arxiv.org/abs/1610.02085>

# Literatur

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