

Multimodal Access to Context-Aware Navigation Services

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- Multimodality and sensor fusion
- Access to rich information resources on the Web
- Context-aware services
- Resource limitations
- Hybrid approaches for outdoor and indoor navigation

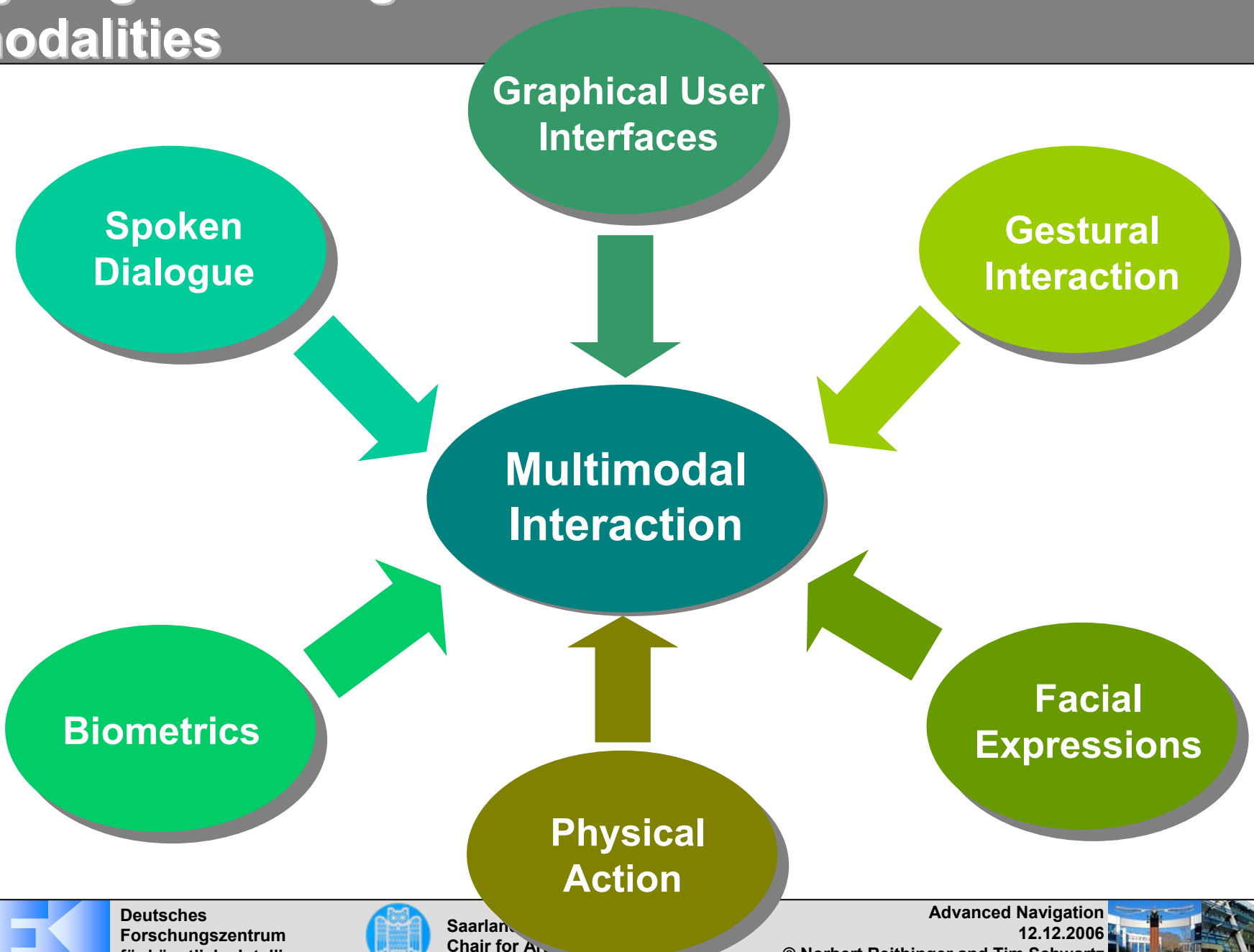
Why Multimodal Interaction? – An Example from SmartKom Mobile



Video download: www.smartkom.org



Synergies through fusion and fission of modalities



Why Multimodal Interaction?

- Use of modalities depends on **context** and **user preferences**
 - In the car: **acoustic** vs. visual
 - In public spaces: acoustic vs. **visual**
- Combination of modalities improves
 - Recognition accuracy
 - Mutual disambiguation
 - Interaction efficiency

“I believe that voice interfaces hold their greatest promise as an additional component to a multi-modal dialogue, rather than as the only interface channel.”

(Jacob Nielsen)

SmartWeb: The Consortium

Project Duration: 2004-2008

Scientific Director:
Wolfgang Wahlster

DAIMLERCHRYSLER



BMW Group
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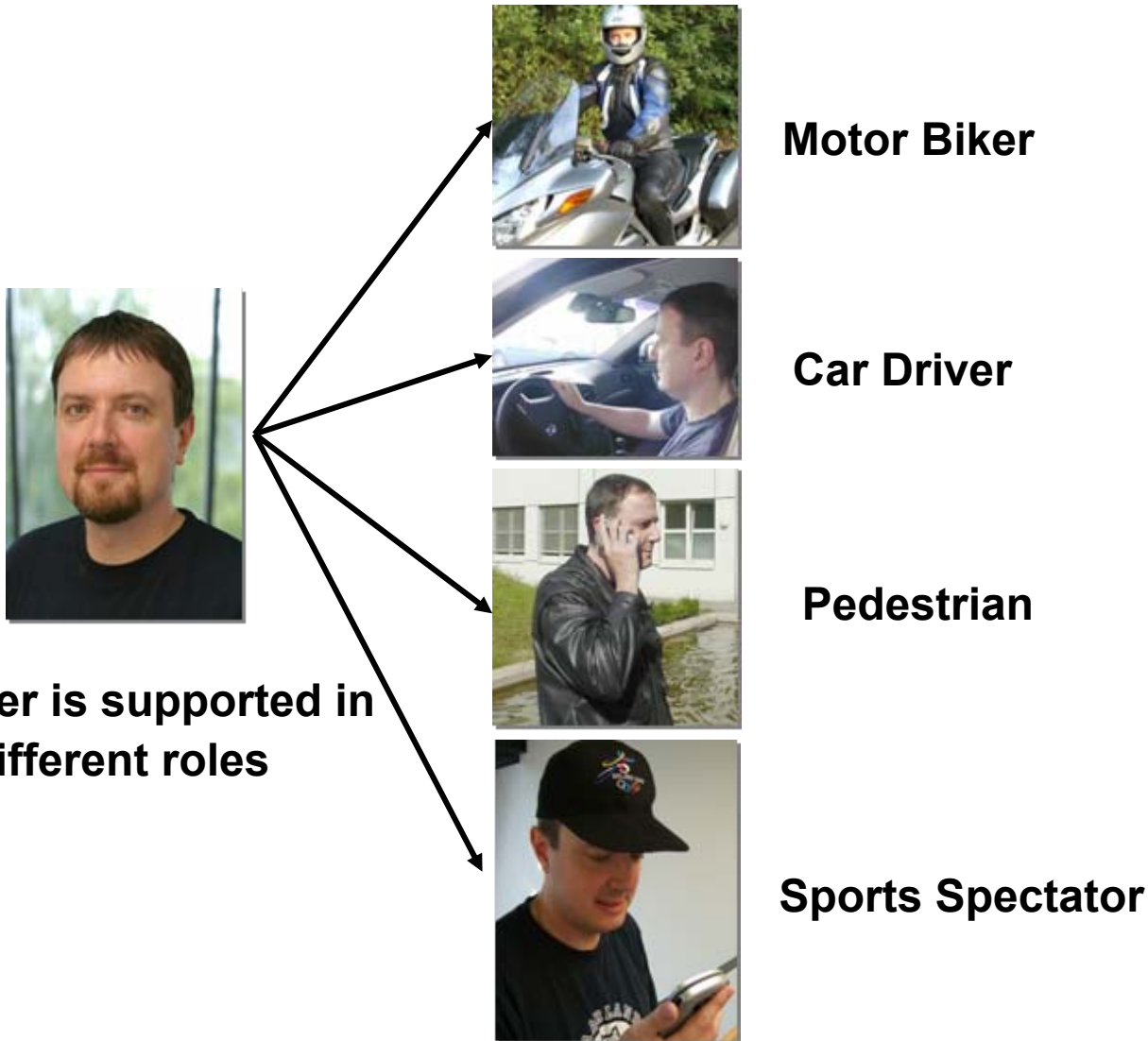
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SmartWeb provides a Context-Aware User Interface



SmartWeb: Getting Answers on the Go

Who won the
World Football
Championship
in 2006?



SmartWeb: Getting Answers on the Go



SmartWeb: Navigating in the Results



SmartWeb: Navigating in the Results



SmartWeb-Car: Mobile Web Access in a Mercedes (A Class and R Class)



Who has scored most goals at the FIFA World Cup?

Where do I get the lowest gas price?

Where are speed traps today?



SmartWeb: Mobile and Multimodal Internet Access on a BMW K 1200



Spoken question of the motor biker:
How's the weather today?



SmartWeb combines five Input Modalities

Speech over
Bluetooth Headset
or built-in
microphone



Gestures
based on Pen Input



Haptic
Feedback for
Handlebars
on BMW bike



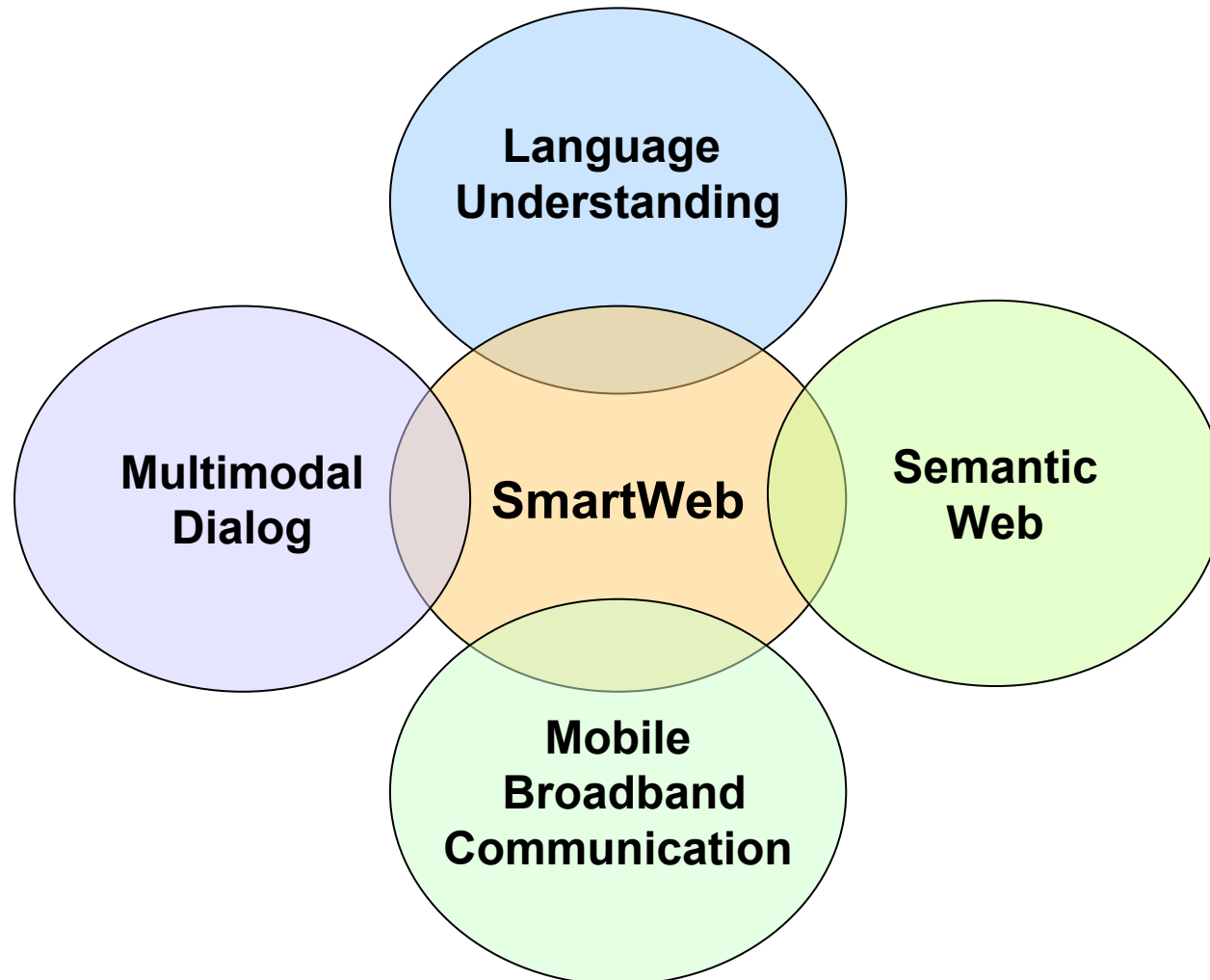
Face
Camera
Experimental



Bio Signals

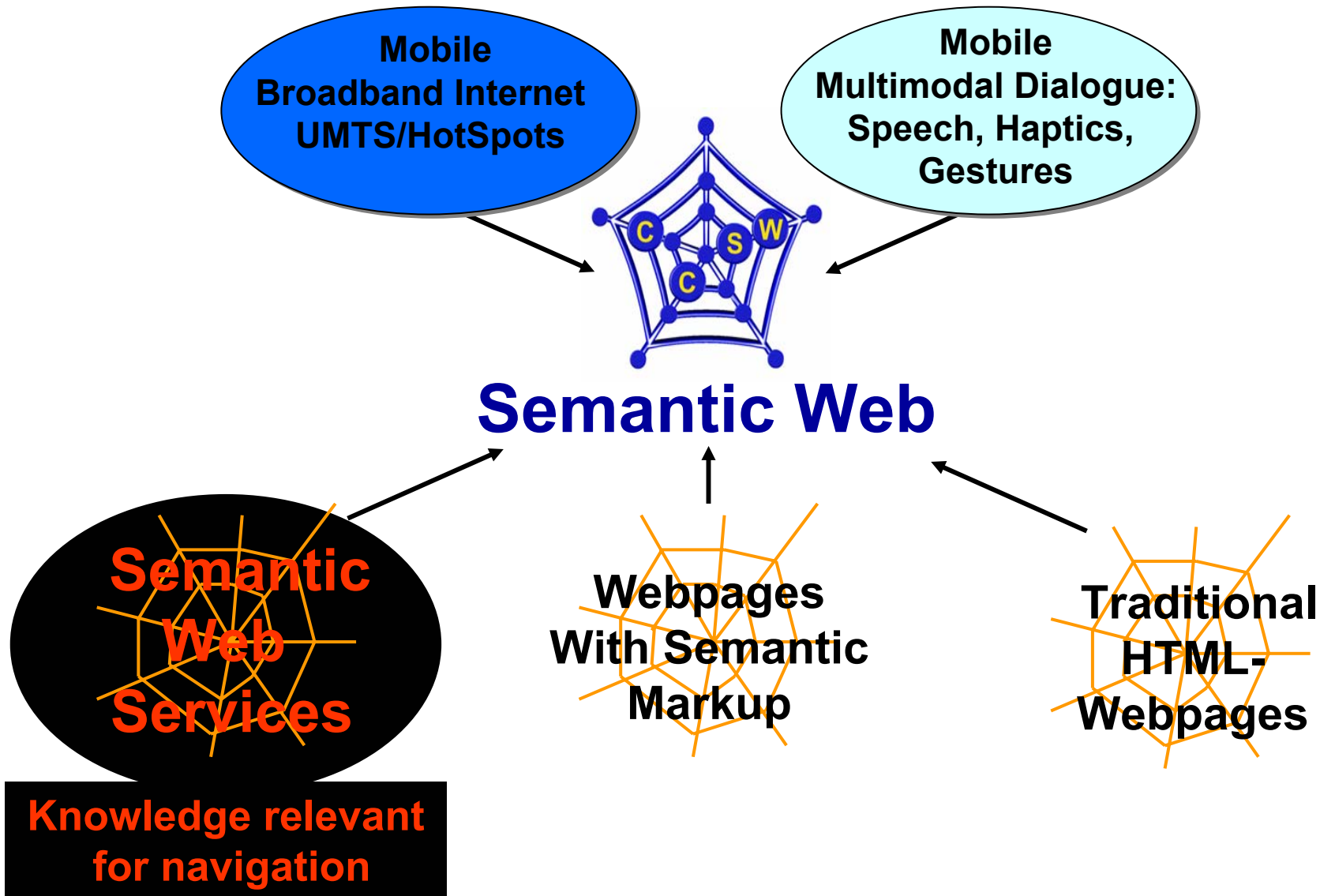


SmartWeb Integrates four Important Research Areas

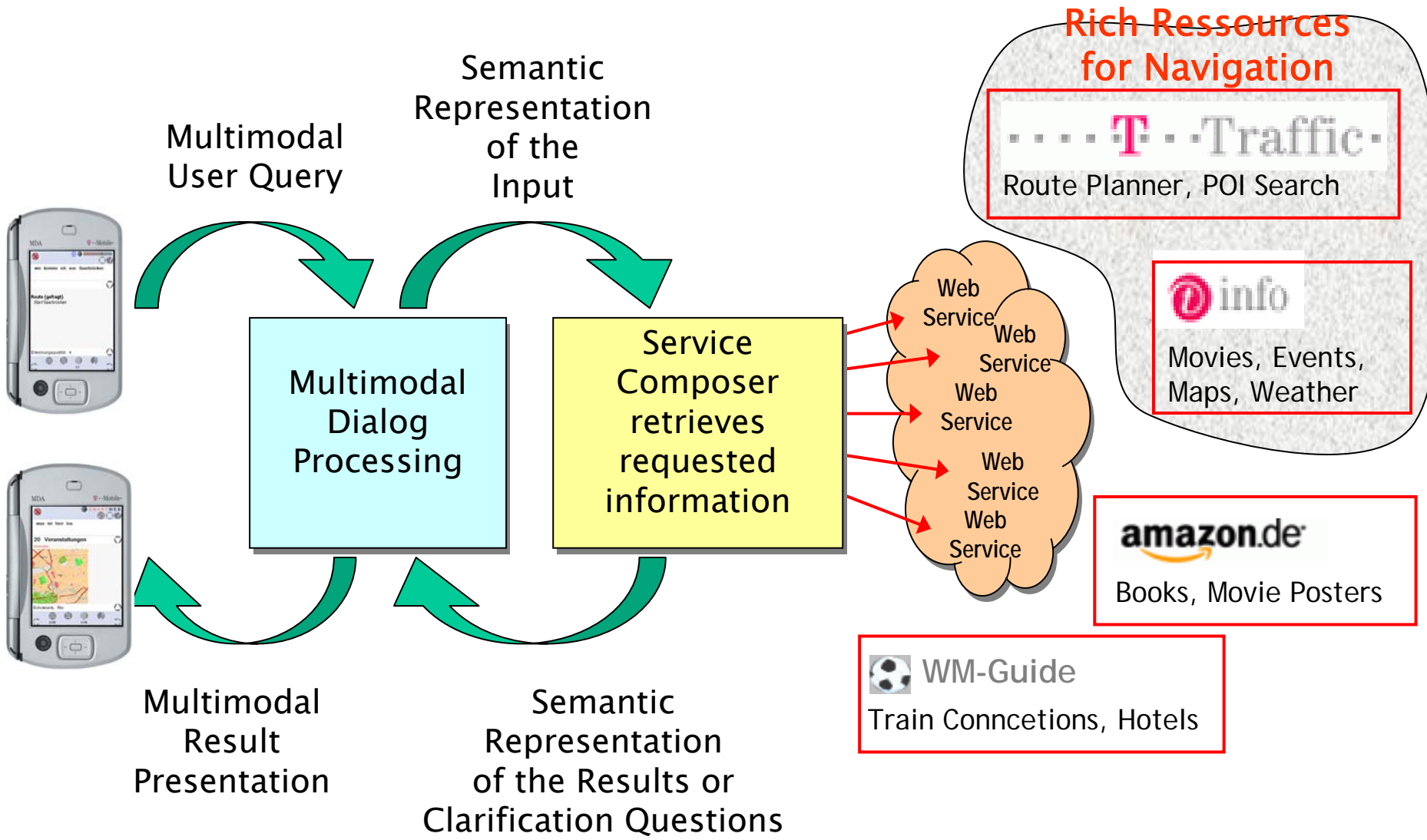


SmartWeb: Open-Domain Question Answering

– Beyond Google

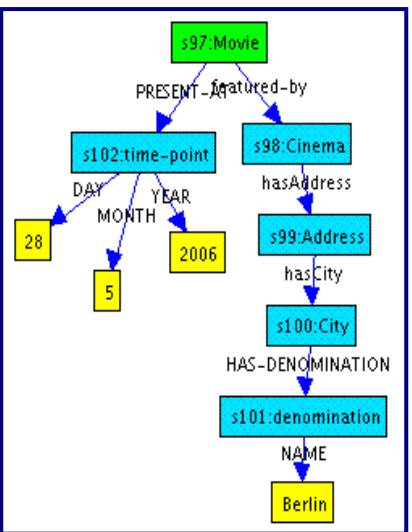


Generic Composition of Web Services in SmartWeb

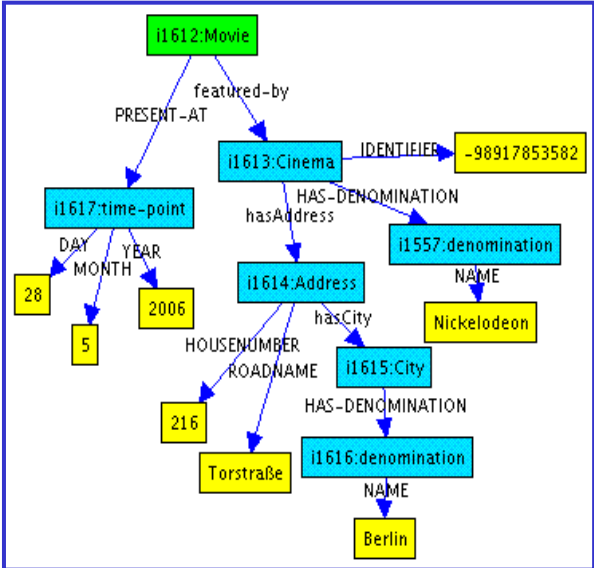


ServiceComposer: Composition of four Web Services to Answer a Single Question

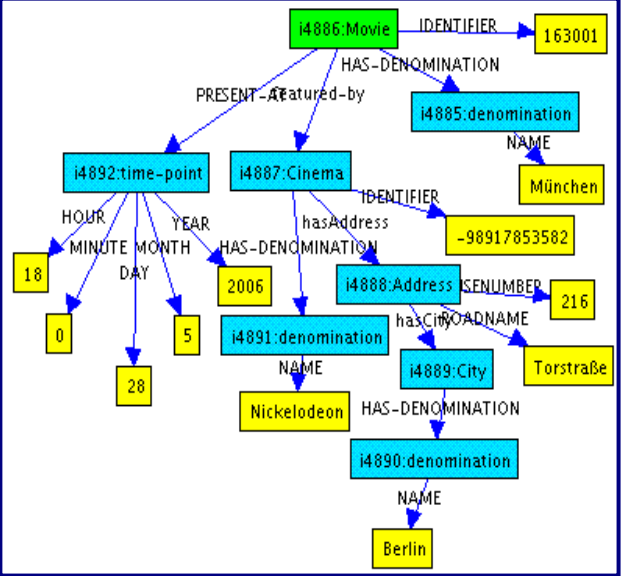
Query: „ What’s in the movies today?“



SearchCinemasAround



SearchPlayTimes
SearchMovieDescription



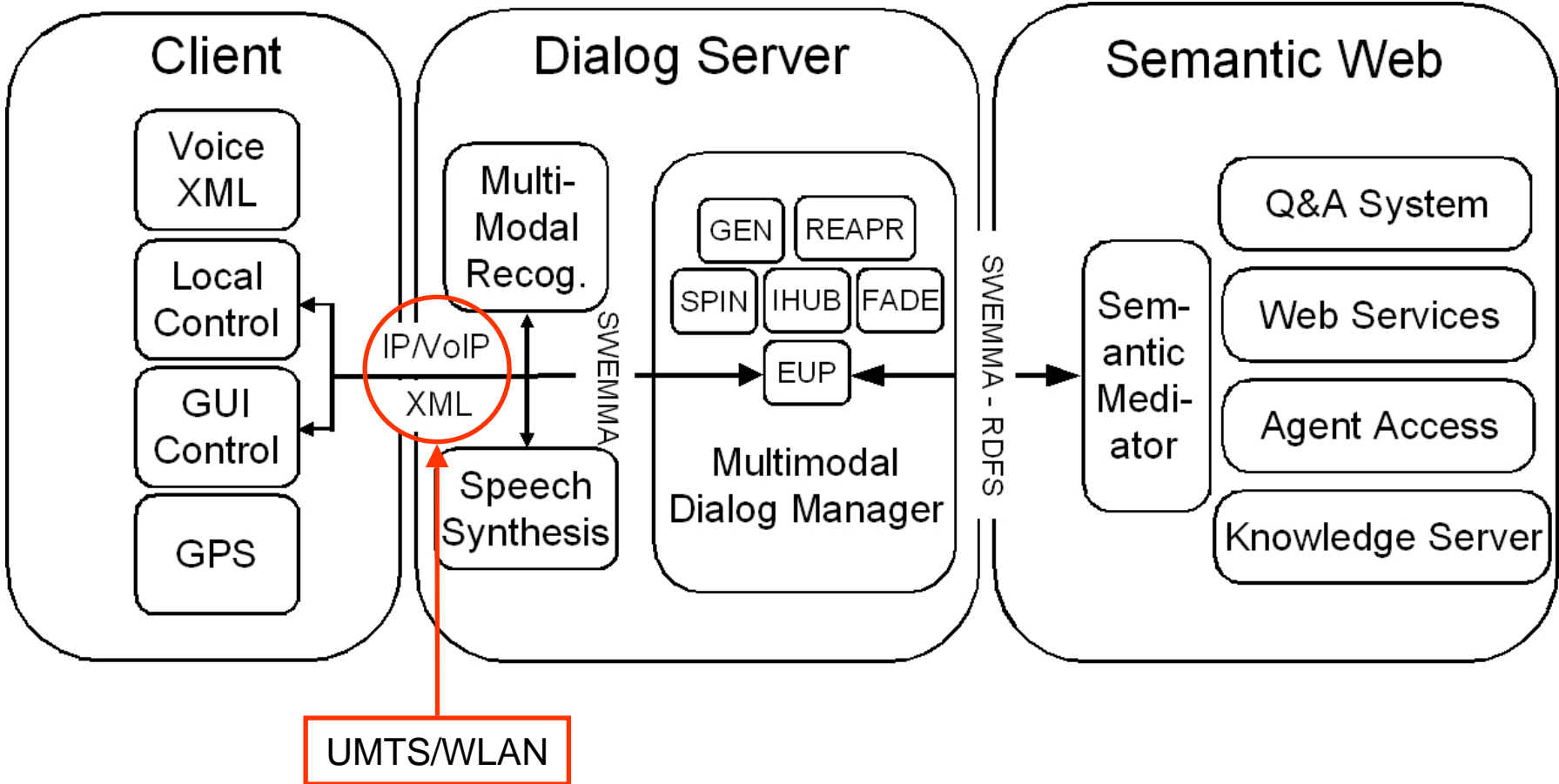
Movie Poster annotated with MPEG-7 metadata



Comprehensive user information = Location based + up-to date context + long-term background



SmartWeb – Distributed Architecture



Movie and Cinema Information



Location-based Information Services



Was ist *hier* los? = What's going on *in Berlin*?



Ressource Adaptive Navigation

Transfer Unit „Cognitive Technologies for Real-Life Applications“
funded by the German Research Foundation (DFG)



BMW Group



Saarland University
Chair for Artificial
Intelligence



Cognitive Resources

- Time restrictions (time pressure)
- Familiarity with information presentation

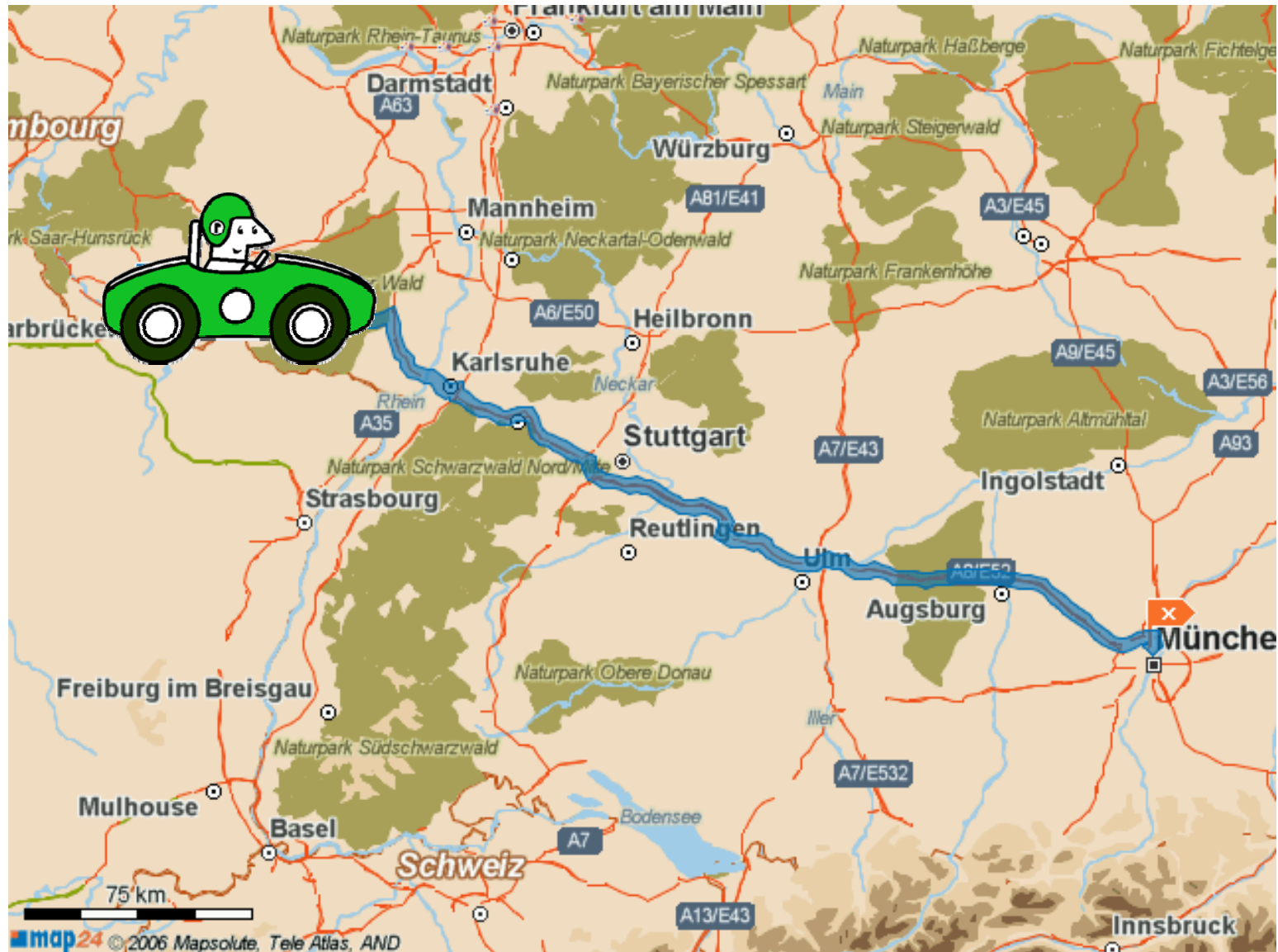
Restrictions on available localization techniques

Technical Resources

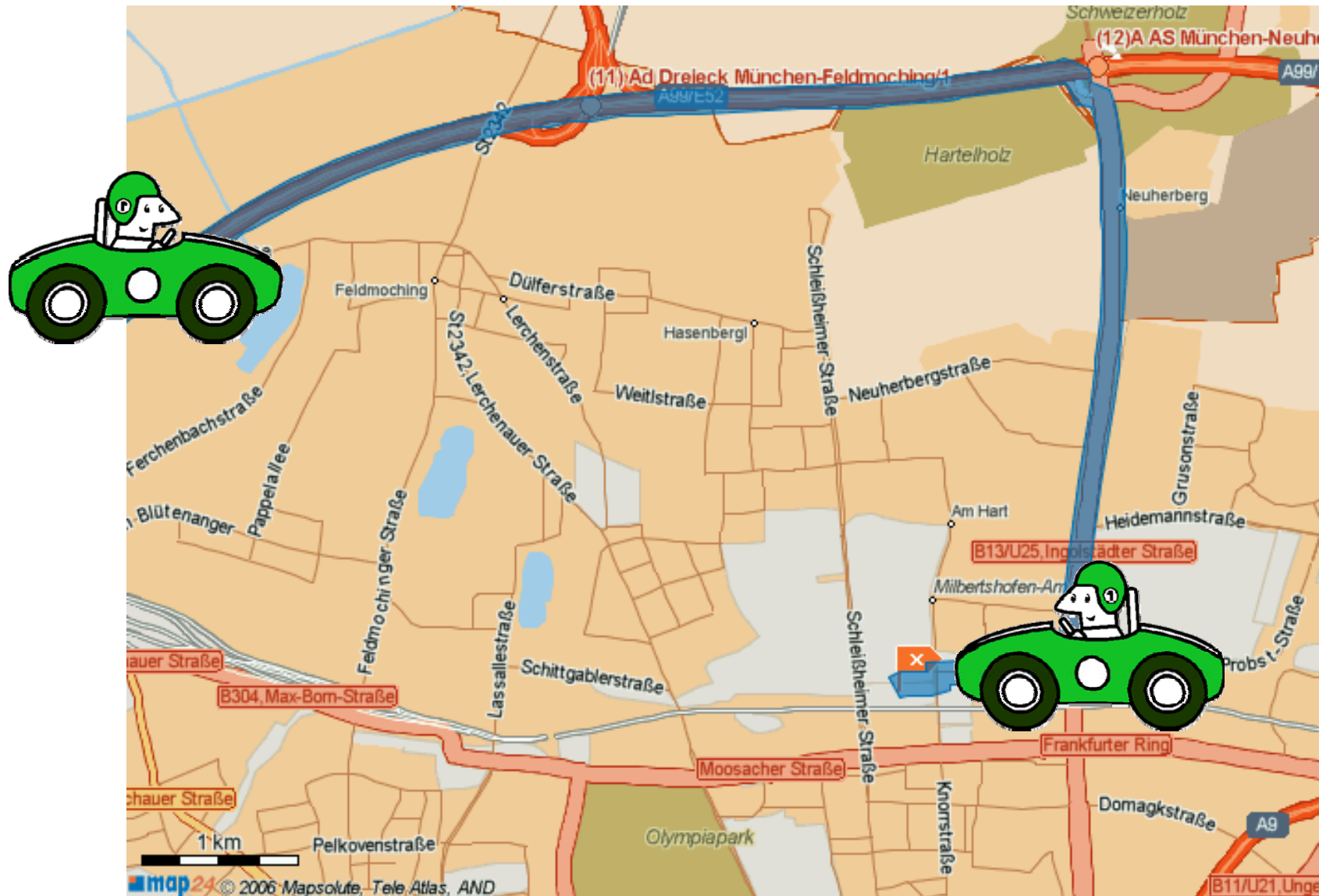
- Restrictions on the production process
- Restrictions on the output device
- Restrictions on the available localization techniques



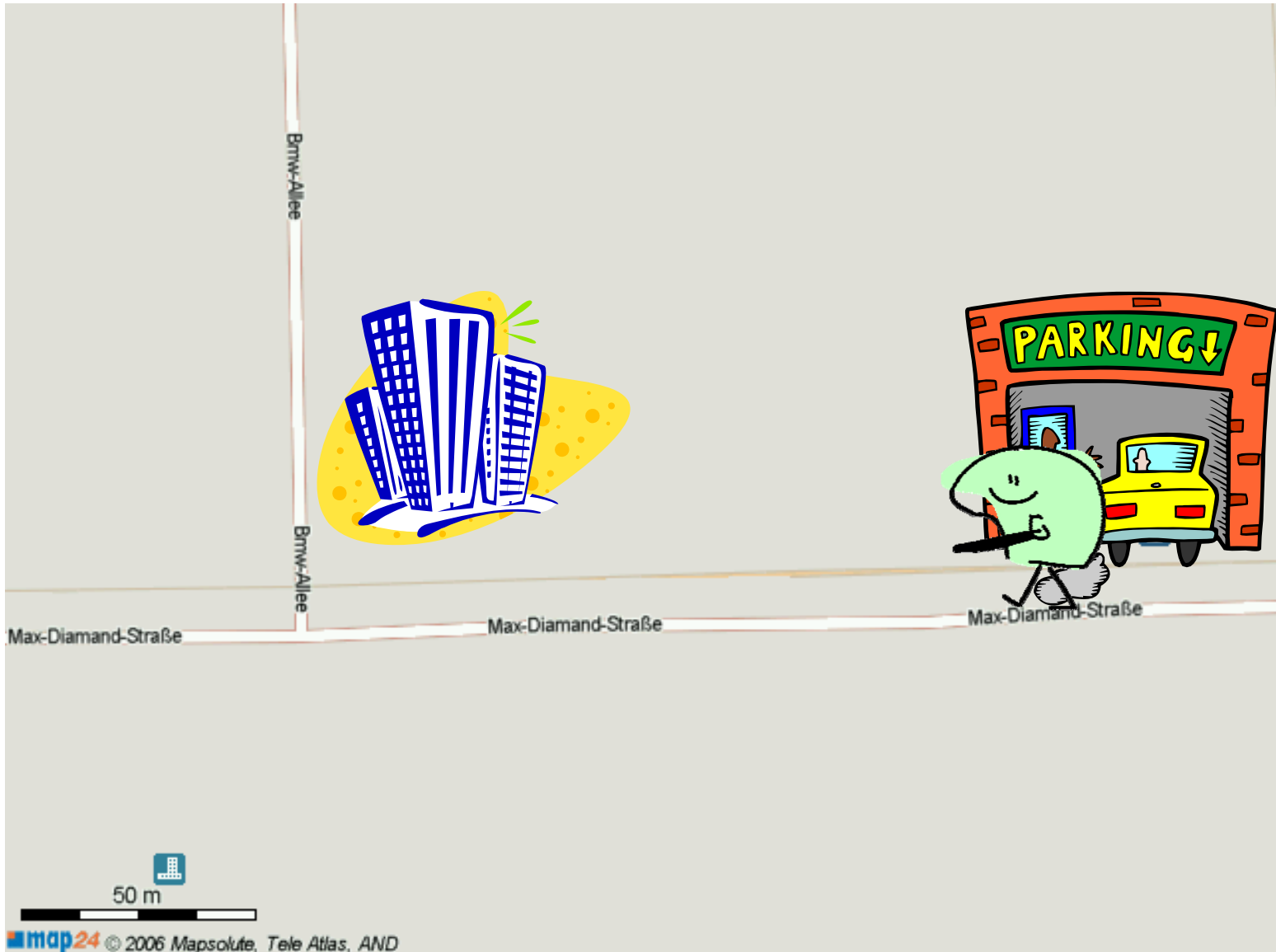
Hybrid Navigation – GPS Overland



Car Navigation – GPS to Multi-Story Car Park



Multi-Story Car Park and Pedestrian Navigation



Indoor Navigation – No GPS Signal!



Hybrid Navigation



Car Navigation **GPS**

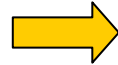


Pedestrian Navigation **GPS**



Indoor Navigation ???

Pedestrian Navigation **GPS**



Car Park Navigation ???



Car Navigation **GPS**



Indoor Navigation – Bridging the Gap

- GPS does not work in buildings
- Need for other technologies:
 - WiFi-Access-Points
 - Mobile Phone Cells

Restrictions on available localization techniques

- Infrared Beacons
- RFID Tags
- ... (to be continued)
- Technologies differ in precision, privacy and cost (cost for hardware & cost for deployment & cost for maintenance)



Always Best Positioned (ABP)

- Somewhat similar to Always Best Connected (ABC)
 - ABC chooses the best connection technology available at current location
- Always Best Positioned combines all available positioning-technologies to achieve a better precision
- Limited Resources:
 - Different senders need different sensors
 - Not every device is equipped with all sensors or senders
 - Not every positioning-technology that can be used by device is available everywhere

→ Resource-adaptation through **Sensor Fusion**

LORIoT: Used Senders

(Localization and ORientation for Indoor and Outdoor environmenTs)



Infrared beacons:

- Sending characteristic: conical (light ray)
- Receiving signal → user stands in light ray
- Measurement relatively exact
- Sends 16 bit wide ID
- Costs: ~100€/beacon



Active RFID-tags:

- Sending characteristic: radial (radio waves)
- Receiving signal → user stands near tag
- Measurement inaccurate
- Coordinates stores in internal memory
- Costs: ~20€/beacon



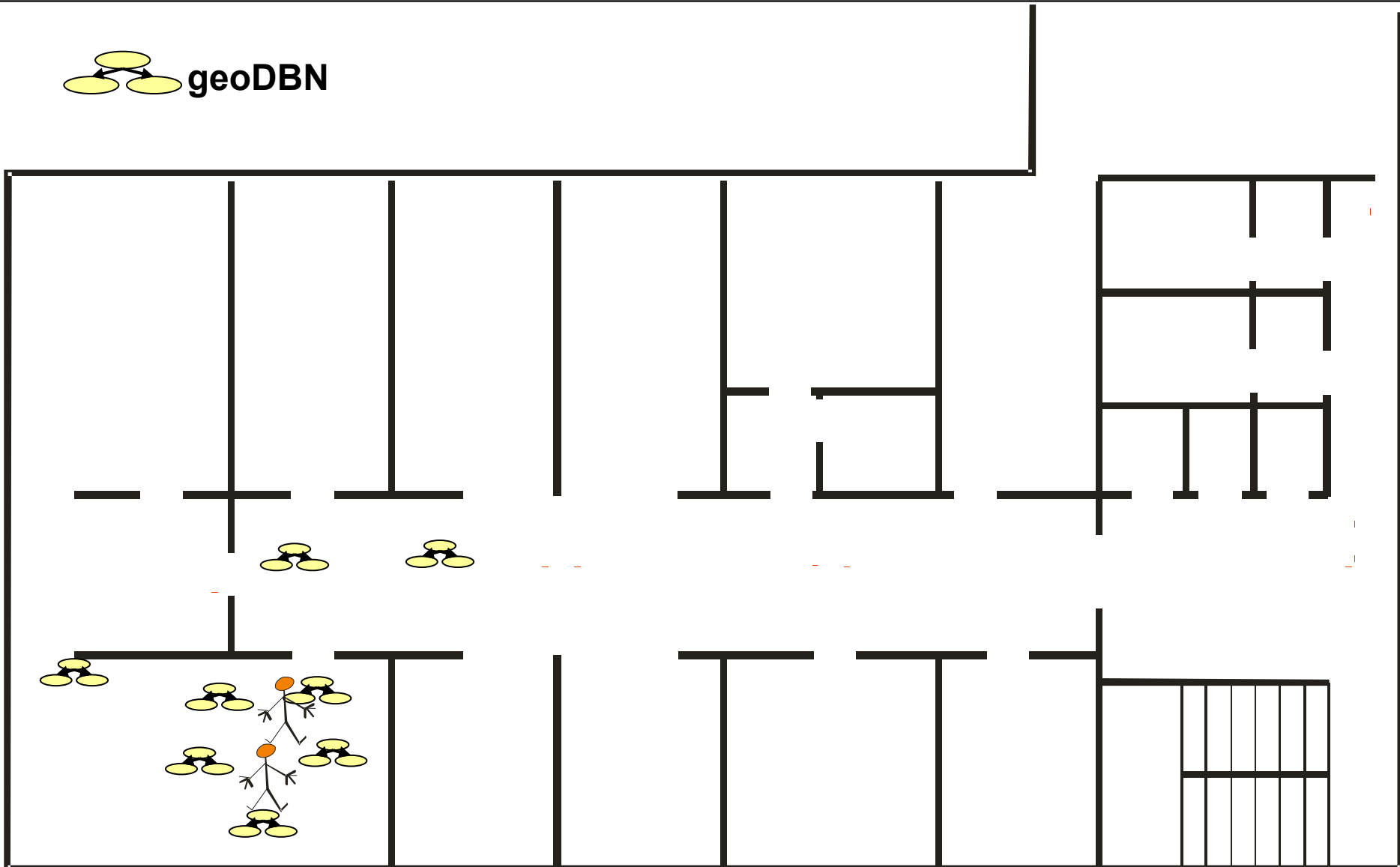
LORIOT: Used Sensors



- Infrared signals through built-in infrared port
- Active RFID tags through PCMCIA RFID reader card
- Calculation and visualization of user position on a PDA
- Uses Geo Referenced Dynamic Bayesian Networks (geoDBNs) for sensor fusion
- Can use infrared only, RFID only or combine both for better accuracy
- Self-localization protects privacy of the user (no tracking)



Clouds of geoDBNs



Summary

- Multimodality and sensor fusion support navigation
- Rich information resources on the Web add value for information seeking users
- Context-awareness enables new services
- Resource limitations ask for innovative solutions
- Hybrid approaches for outdoor and indoor navigation enable seamless navigation



Thank You Very Much for Your Attention!

Please find more information including papers and links to additional projects at

www.dfki.de/~bert

www.smartweb-project.org

w5.cs.uni-sb.de/~schwartz

w5.cs.uni-sb.de/rena

