

Keys, Money and Mobile Phone

Matthias Wagner

ESWC'09, Heraklion, June 2, 2009

Keys, Money and Mobile Phone*

- *Most essential objects to be carried around in everyday life
- Why considered essential?
- Adopted behavioral patterns?
- Consequences?



source: J. Chipchase et al., "Mobile Essentials: Field Study and Concepting", Nokia Research Center, Tokyo, 2005
<http://www.janchipchase.com> ("future perfect")

Next User Generations

- Increasing penetration of mobile phones amongst children
- To them, mobile phones become commodities used for day-to-day communication
- Starting age?
- Driving forces and correlated factors?



source: NTT DOCOMO Mobile Society Research Institute (MSRI) & GSMA, "Children's Use of Mobile Phones – An international comparison", Tokyo, 2009
<http://www.moba-ken.jp/english>

Evolution of the mobile phone

Evolution of the mobile service

Context Representation & Reasoning

Data mining & Profiling

Evolution of the mobile phone

Context Awareness

Semantic Platform Support

Service Personalization

Behavior Assistance

Life Logging

Smart NFC-based Services

User Guidance

Lifestyle Infrastructure

Evolution of the mobile service

User-centric Services

Life Assistance

Resources-driven Service Provisioning

Task Management

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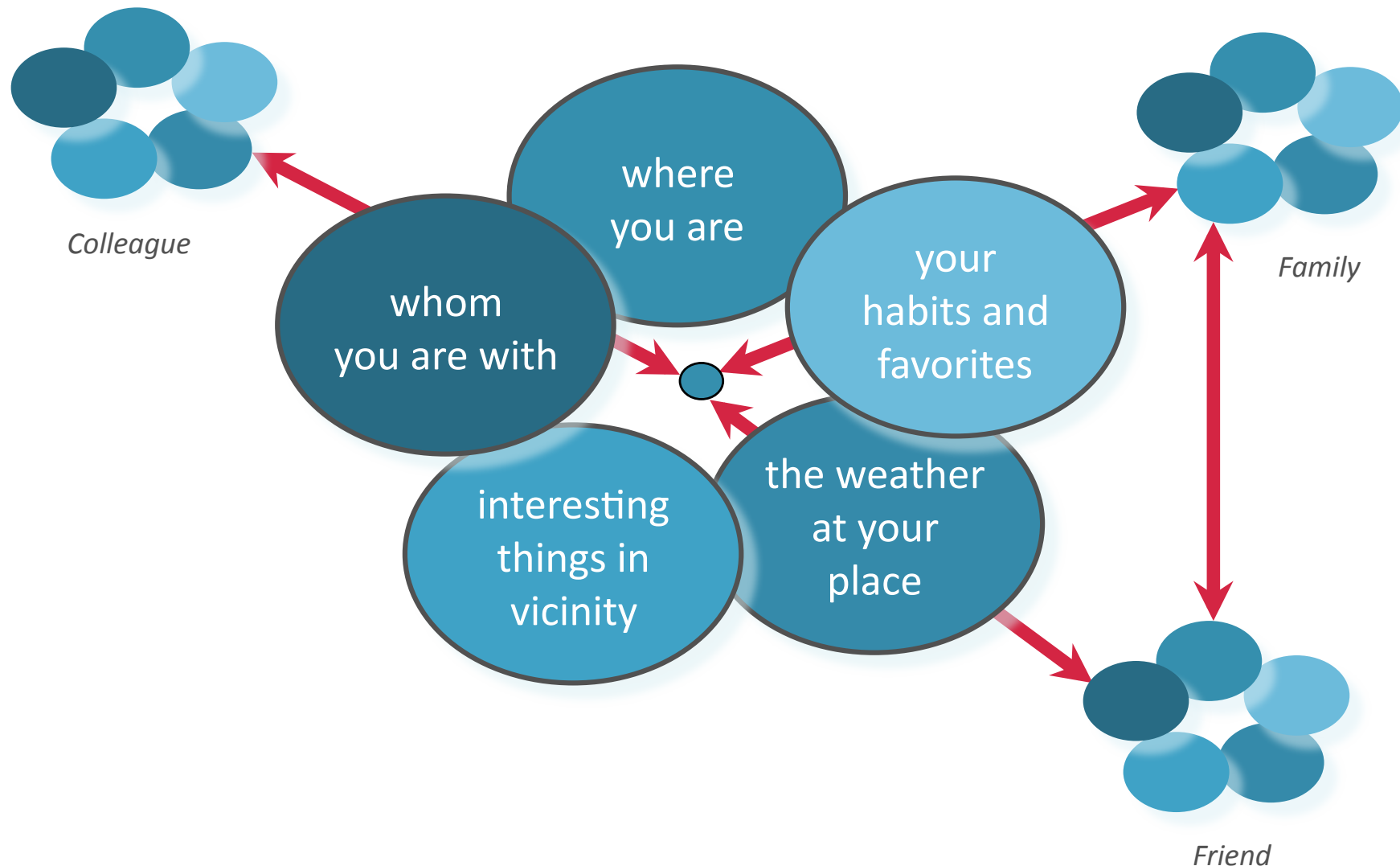
Evolution of the mobile service

Life Assistance

Resources-driven Service Provisioning

Task Management

Imagine your phone knows...



...what intertwines lives...

Context connects people

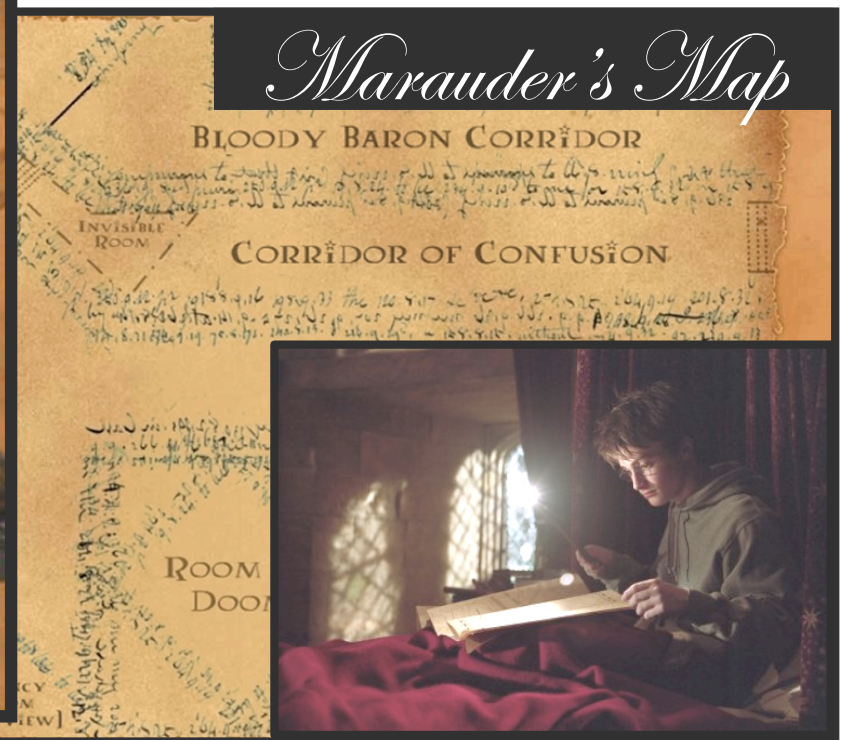
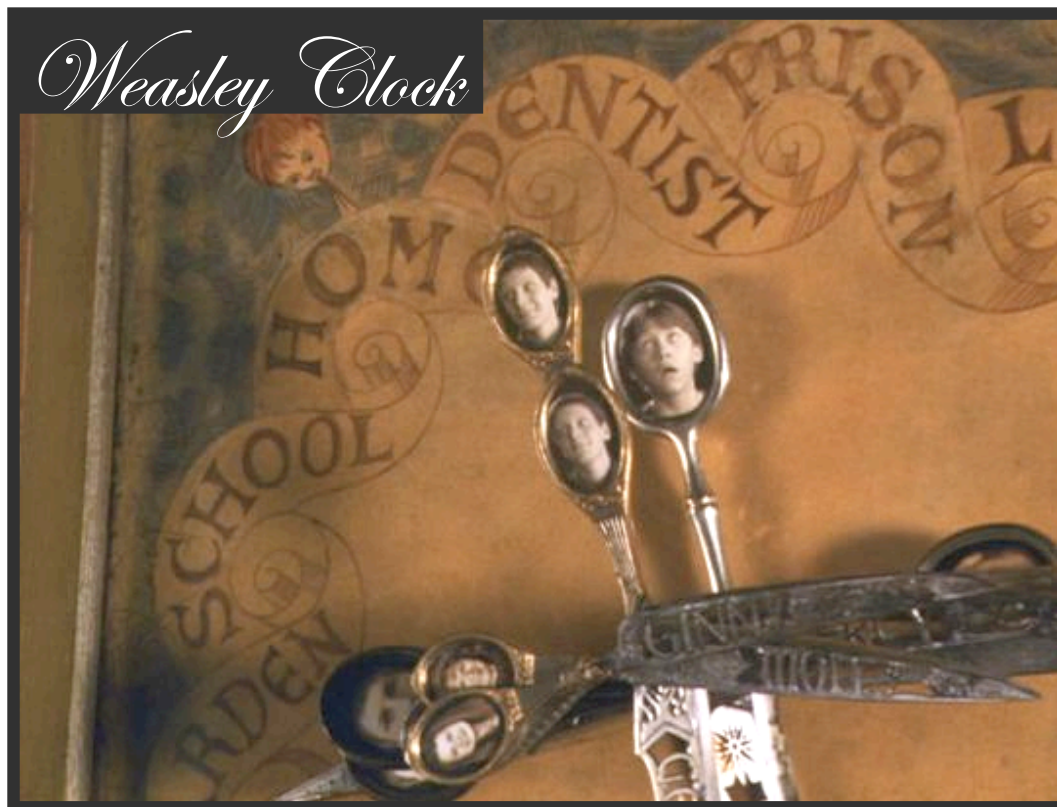
Waiting for same bus,
being with same friend

Family learns about your work
Colleagues learn about your life

Same favorite holiday destination,
hobbies or habits

...and tells you smartly!

- Often, contextual data is most useful when abstracted
- Context is perceived best at a qualitative level



IYOUIT

- A mobile community service
 - Prototype application to pioneer a digital lifestyle
 - Connected to emerging Web 2.0 services

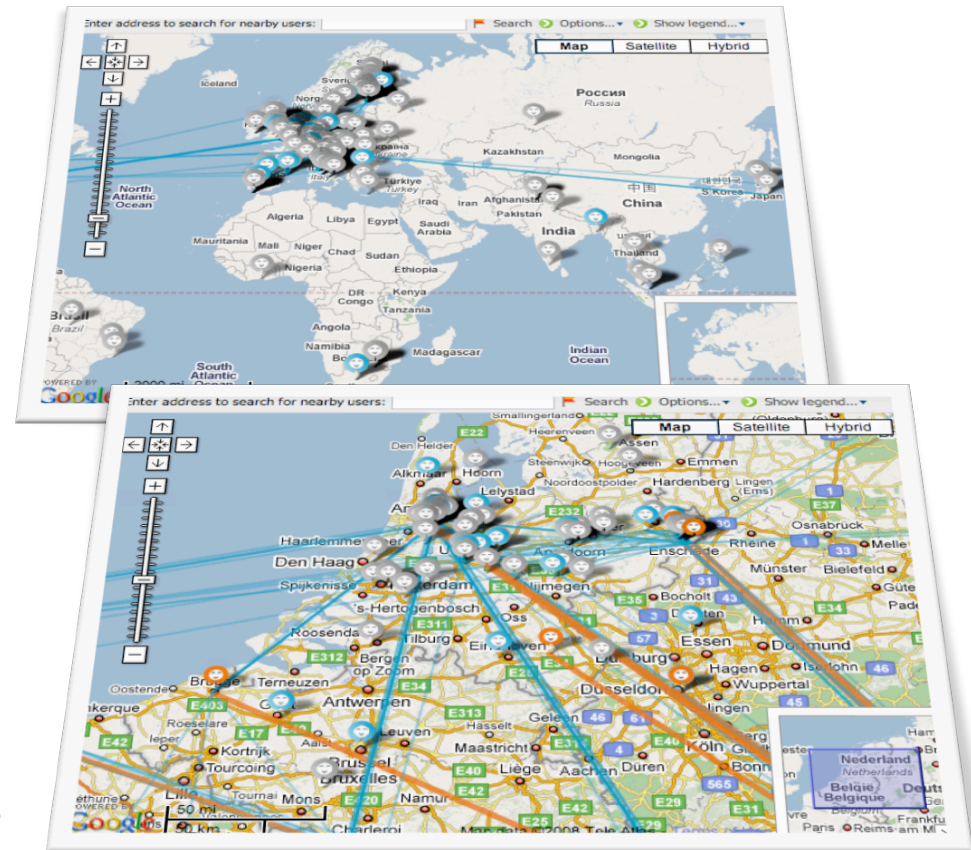
- Your digital life recorder
 - Facilitating context awareness on standard phones
 - Integration of key Semantic Web technologies



IYOUIT Community*



- 60+ visited countries
- 50+ phone models used
- 1.150+ users
- 10.000+ visited cities
- 1.500.000+ location measurements
- Developer connection active



*Since public release in June 2008

<http://www.iyouit.eu>

Use Cases

Real time context sharing

IYOUIT
Buddy Location

- MAKOMO's place**
16m ago: Fra's Casa
- MAKOMO's weather**
18m ago: Rain
- Lilia's location**
21m ago: København
- matiwi's weather**
31m ago: Rain
- Herma's weather**
40m ago: Rain
- Berty's map**
1h ago: München
- SEBABO's location**
3h ago: München
- SEBABO's place**
3h ago: DOCOMO Euro-Labs

IYOUIT
Buddy Location

- matiwi** (3m ago)
in Hengelo
- Berty** (7m ago)
in DOCOMO Euro-Labs together with Matti
- Me** (8m ago)
in Telematica Instituut
- MAKOMO** (18m ago)
in Fra's Casa
- Lilia** (23m ago)
in København

Options Me

Life blogging and widgets



Automatic photo & video tagging

Good morning in München in a happy mood



This picture was taken in München in subdivision Bayern It was cloudy when I made this photo. The prognosis is cold with periods of rain. This photo is taken on Münchenstr. April 14 2008 7:08:12 AM and contains location data with IYOUIT

Tags

- Bayern [x]
- Germany [x]
- München [x]
- contextwatcher [x]
- iyouit [x]
- Good morning [x]
- bluetagged [x]
- bt=00:12:d1:09:eb:e5 [x]
- bt=51:c3:b7:84:66:01 [x]
- bt=00:1a:2a:8b:fb:77 [x]
- bt=00:40:96:32:ae:55 [x]
- bt=00:1b:59:56:af:0f [x]
- bt=00:1c:df:3e:0a:67 [x]
- bt=00:40:96:42:2b:05 [x]
- bt=00:17:e5:63:40:e2 [x]
- city=leisure [x]
- cur=9 [x]
- happy [x]
- day=4 [x]
- nchen [x]
- =Europe [x]
- Germany [x]
- ace=Munich [x]
- 30331 [x]

Photo Tagging & Sharing

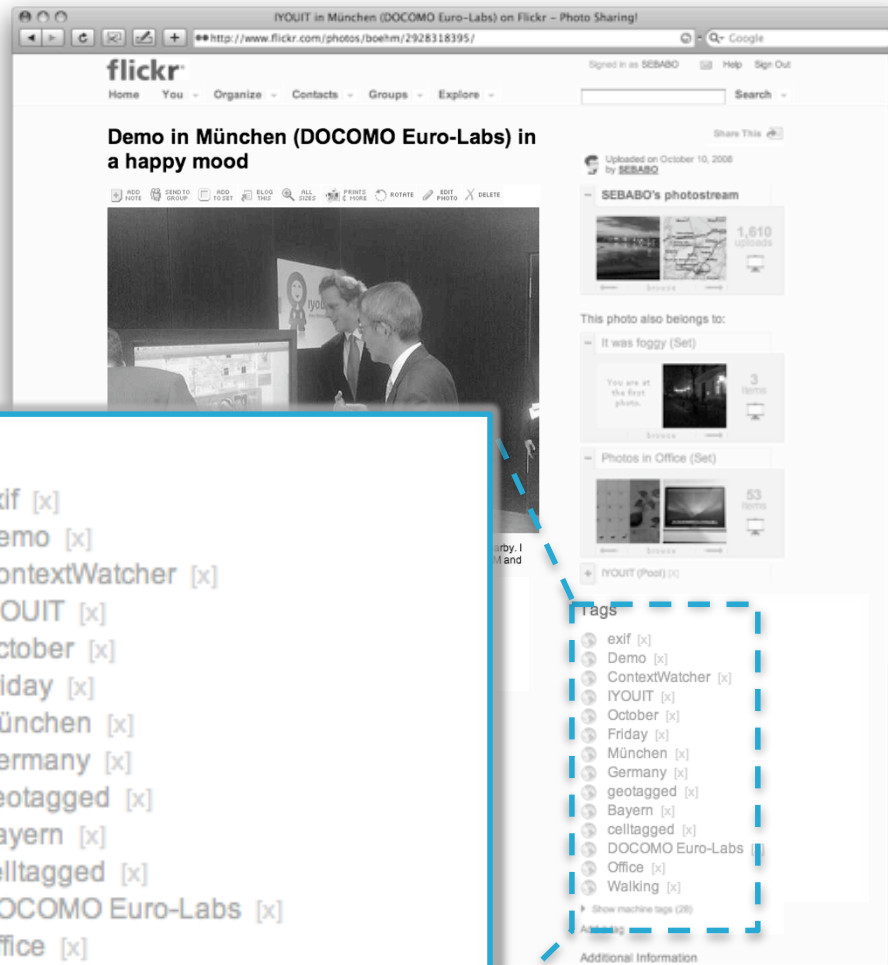


This screenshot shows a Flickr photo page. The main image shows two men in suits looking at a computer monitor. The page title is "Demo in München (DOCOMO Euro-Labs) in a happy mood". Below the image is a caption: "This photo was taken in München, in Bayern. SEBABO and Matti and Olsu were nearby. I was walking around. This photo was taken on Friday, October 17, 2008 11:13:00 AM and context-tagged with IYOUIT." To the right of the main image is a sidebar with "SEBABO's photostream" and "This photo also belongs to:" section containing "It was foggy (Set)", "You are at the first photo.", and "Photos in Office (Set)". Below that is a "Tags" section with a list of tags including "exif", "Demo", "ContextWatcher", "IYOUIT", "October", "Friday", "München", "Germany", "geotagged", "Bayern", "celtagged", "DOCOMO Euro-Labs", "Office", and "Walking". At the bottom of the sidebar is "Additional Information".

This screenshot shows a Flickr photostream page for user SEBABO. The page title is "Flickr: Your Photostream". The main content area displays a grid of photos with captions and metadata. The first photo is "Nitromaroder in München (DOCOMO Euro-Labs)". The second is "Sunset in Schondorf am Ammersee". The third is "Walking in Schondorf am Ammersee". The fourth is "Parking slot". The fifth is "Il Gusto". The sixth is "Photo Frame in München". To the right of the main grid is a vertical sidebar with a list of photo sets: "Photos in Education", "It was foggy", "I am relaxed", "Photos in Hotel", and "Photos in Eating_and_drin King".

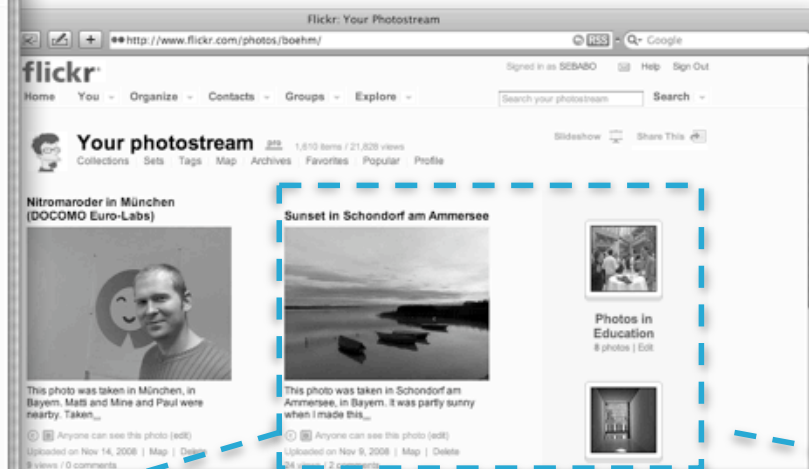


Photo Tagging & Sharing



- Tags**
- exif [x]
 - Demo [x]
 - ContextWatcher [x]
 - IYOUIT [x]
 - October [x]
 - Friday [x]
 - München [x]
 - Germany [x]
 - geotagged [x]
 - Bayern [x]
 - celltagged [x]
 - DOCOMO Euro-Labs [x]
 - Office [x]
 - Walking [x]

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- exif [x]
 - Demo [x]
 - ContextWatcher [x]
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 - October [x]
 - Friday [x]
 - München [x]
 - Germany [x]
 - geotagged [x]
 - Bayern [x]
 - celltagged [x]
 - DOCOMO Euro-Labs [x]
 - Office [x]
 - Walking [x]



Sunset in Schondorf am Ammersee

This photo was taken in Schondorf am Ammersee, in Bayern. It was partly sunny when I made this...

Anyone can see this photo (edit)
 Uploaded on Nov 9, 2008 | Map | Delete
 24 views / 2 comments

Photos in Education
8 photos | Edit

It was foggy
3 photos | Edit

IYOUIT Service Universe

facebook

twitter

flickr™

na
Baz
TAG by VIOLET



DOPPLR

*clearspring

You Tube



Context Representation & Reasoning

Data mining & Profiling

Evolution of the mobile phone

Context Awareness

Semantic Platform Support

Service Personalization

Behavior Assistance

Life Logging

Smart NFC-based Services

User Guidance

Lifestyle Infrastructure

User-centric Services

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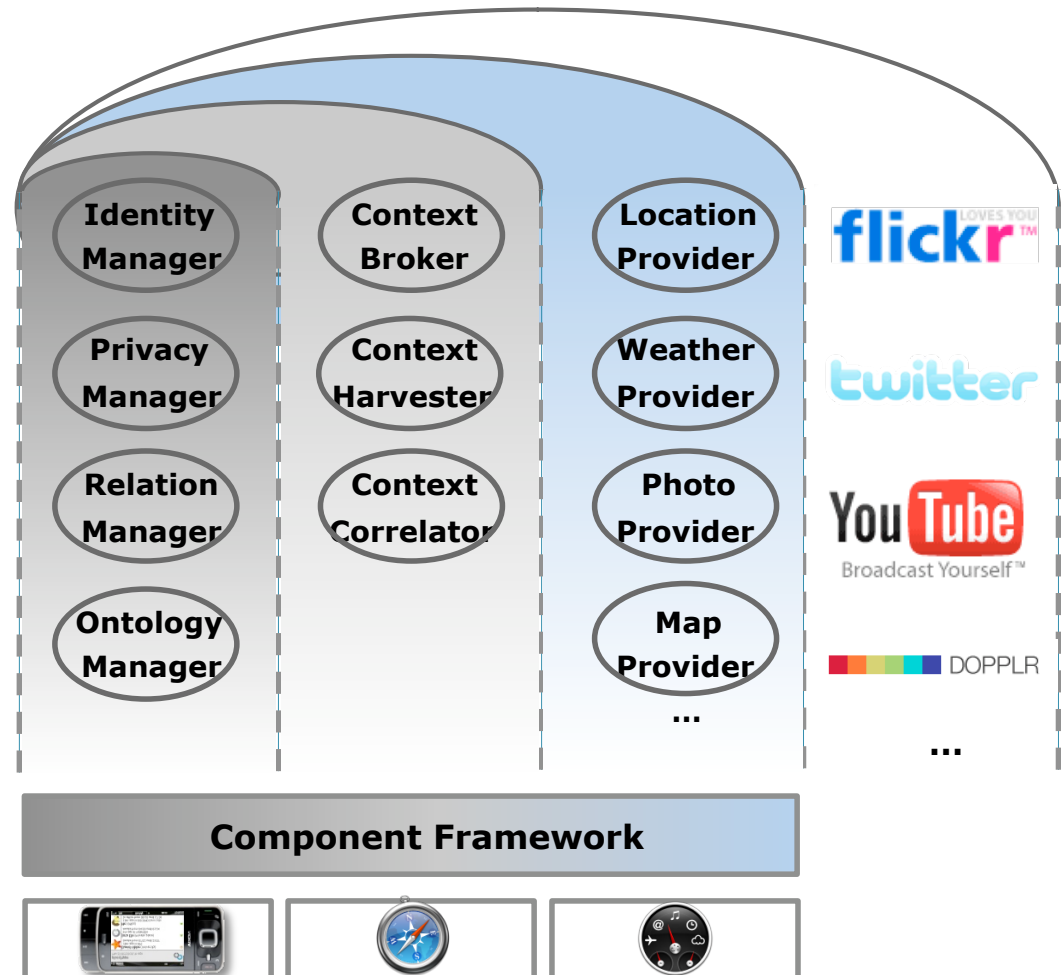
Resources-driven Service Provisioning

Task Management

Context Management Framework

A flexible component framework for IYOUIT and other mobile services

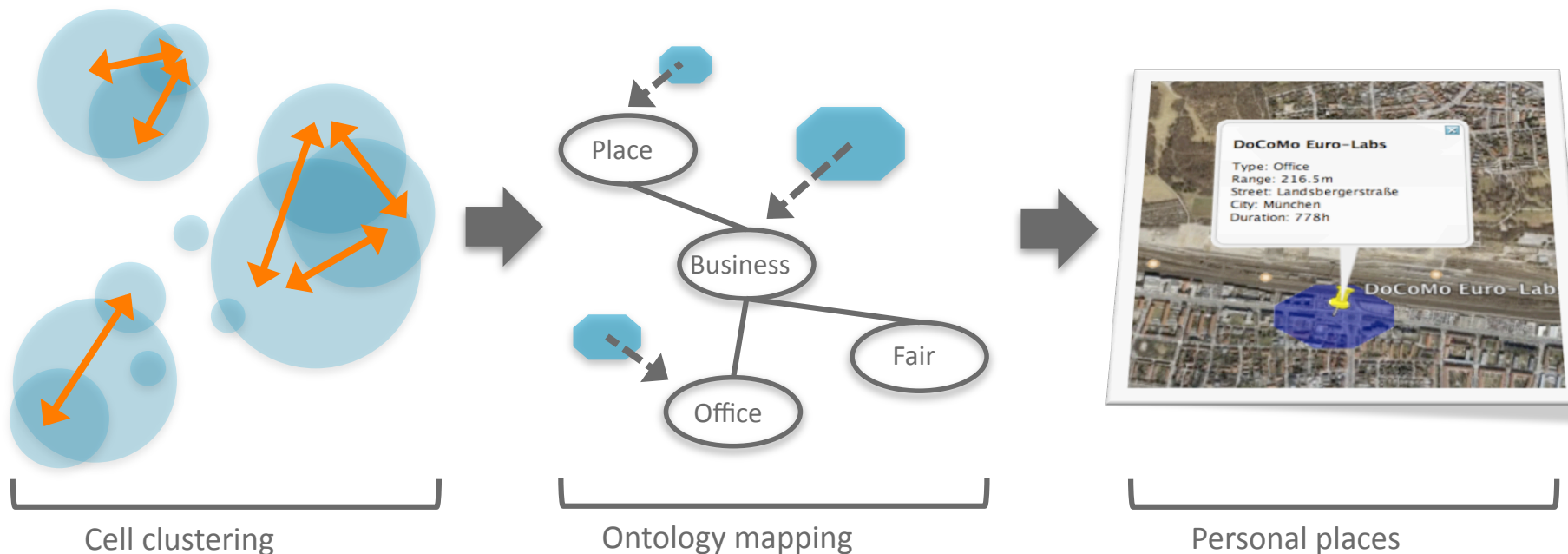
- Distributed service infrastructure
- Heterogeneous data sources
- Open API
- Qualitative context abstractions
- Embedded semantic mappings
- Access control & Privacy



Data Aggregation



- E.g., Place recognition
 - Positioning via GPS and cellular information
 - Data mining to determine places of frequent stay
 - Semantic ontology mapping



Data Aggregation

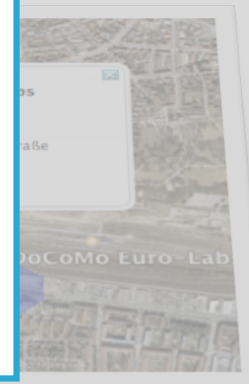


- For instance, Place recognition

Context Representation

```

<contextElement>
  <contextProviderAdvertisement id="1092"/>
  <entity id="1079" name="MaKoMo"/>
  <observer id="1083" name="Basti"/>
  <param name="weather" time="2008-01-20T14:37">
    <param name="temp" ontRef="#very_warm">
      <param name="tmin" value="3" accuracy="90"/>
      <param name="tmax" value="9" accuracy="90"/>
    </param>
    <param name="location" id="4468">
      <param name="city" value="Munich"/>
      <param name="country" value="Germany"/>
    </param>
  </param>
</contextElement>
  
```



Office

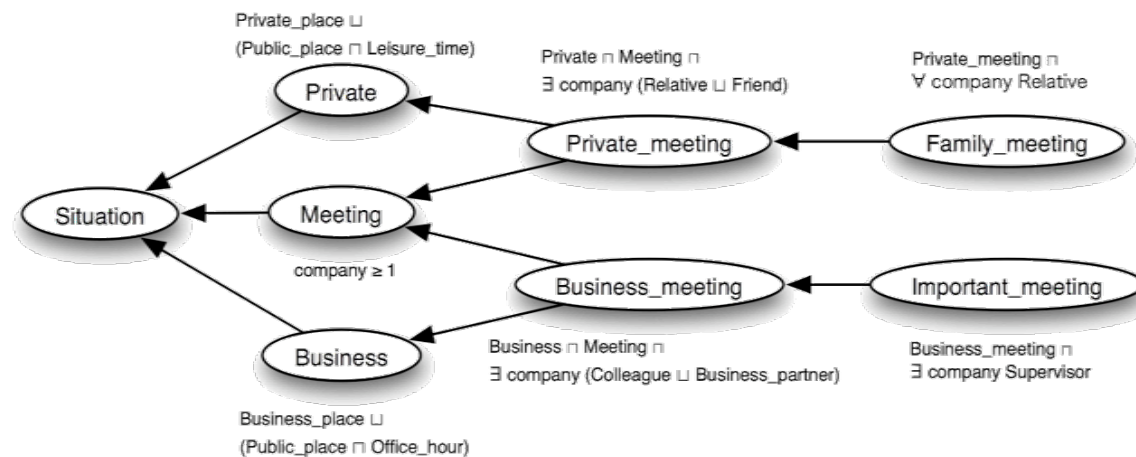
Cell clustering

Ontology mapping

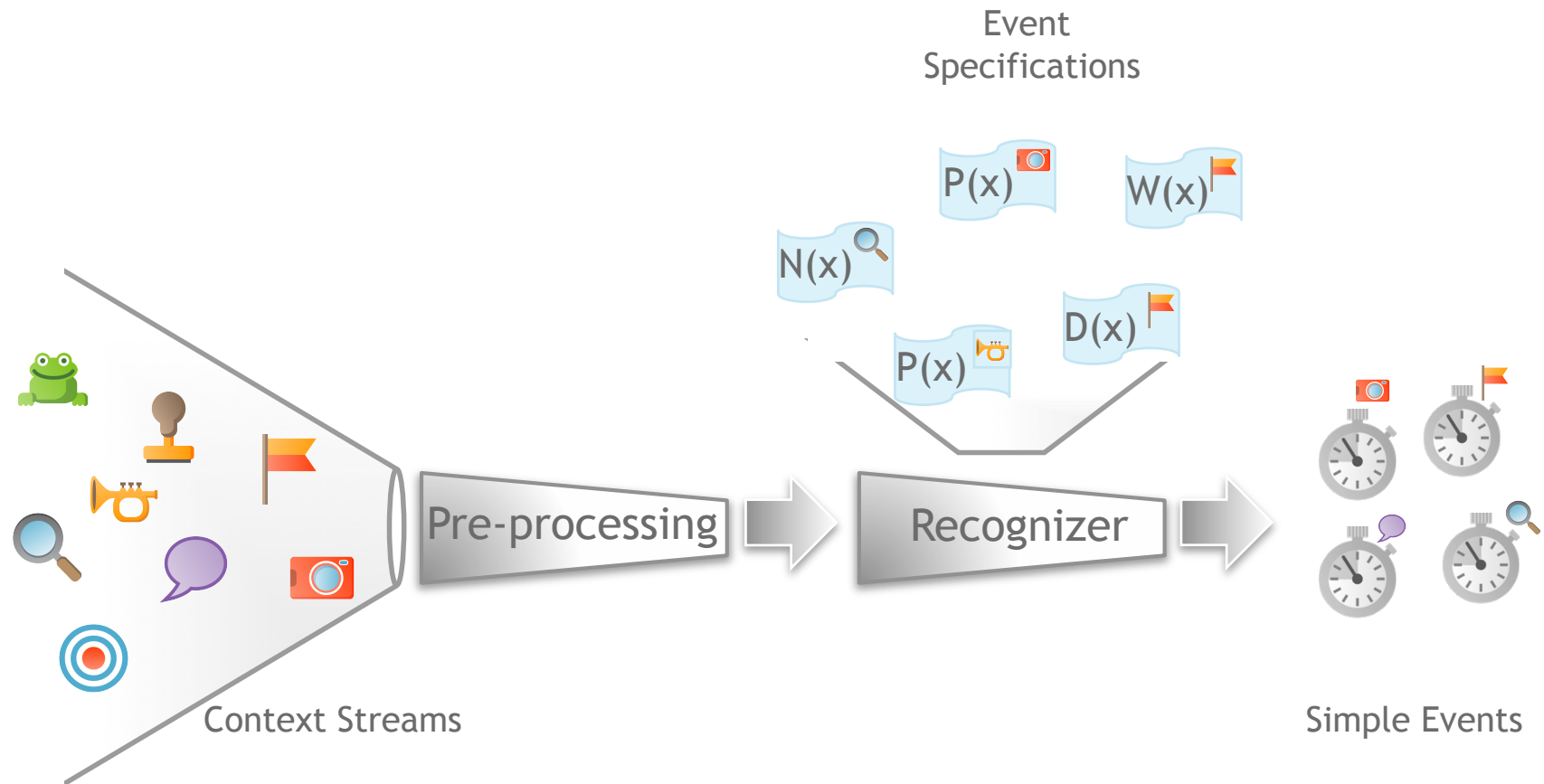
Personal places

Context Ontologies & Reasoning

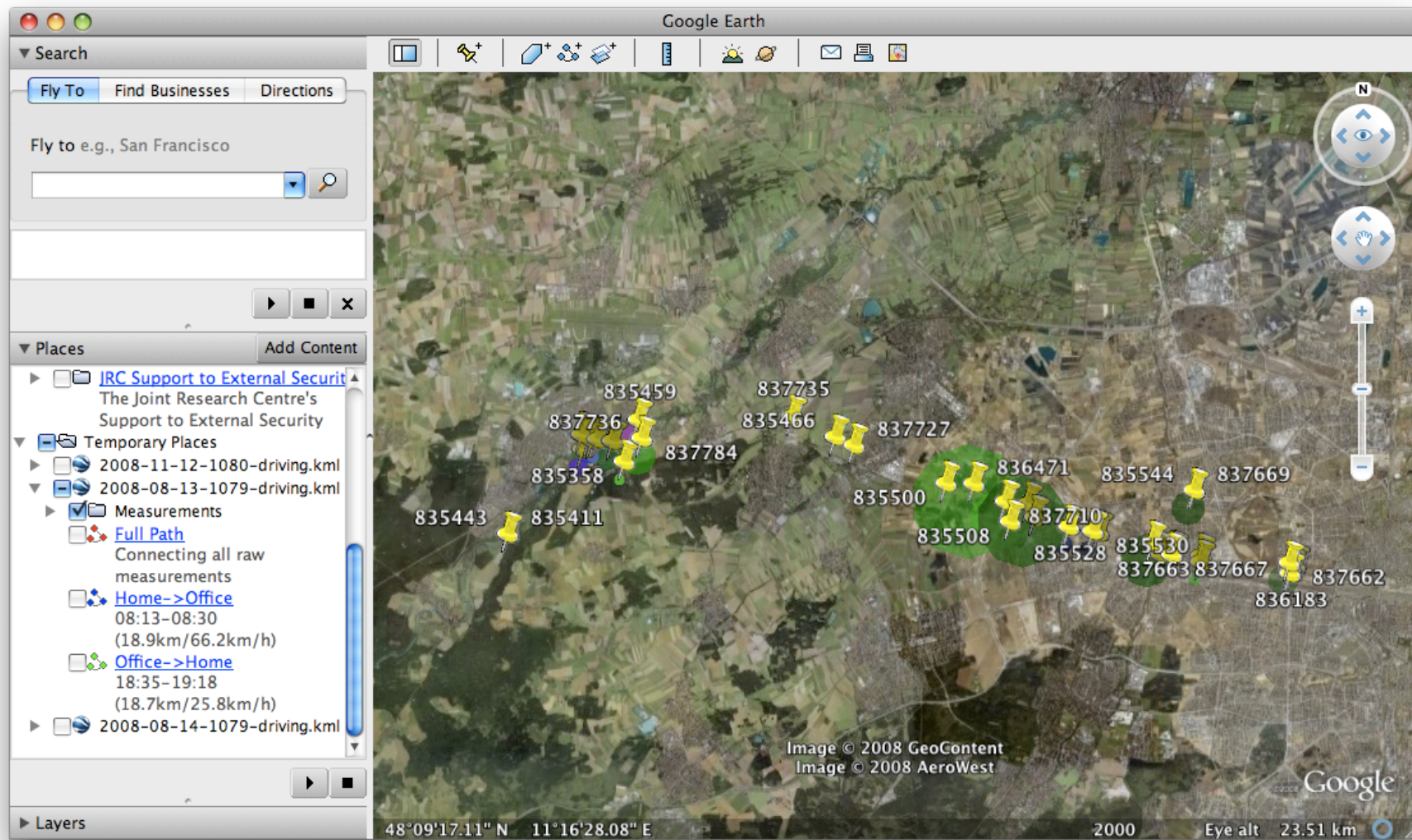
- Context Ontologies
 - Representation of high-level qualitative context
 - Decidable fragments of OWL
- Contextual Reasoning
 - DL-reasoners (Pellet, FaCT++,RacerPro)



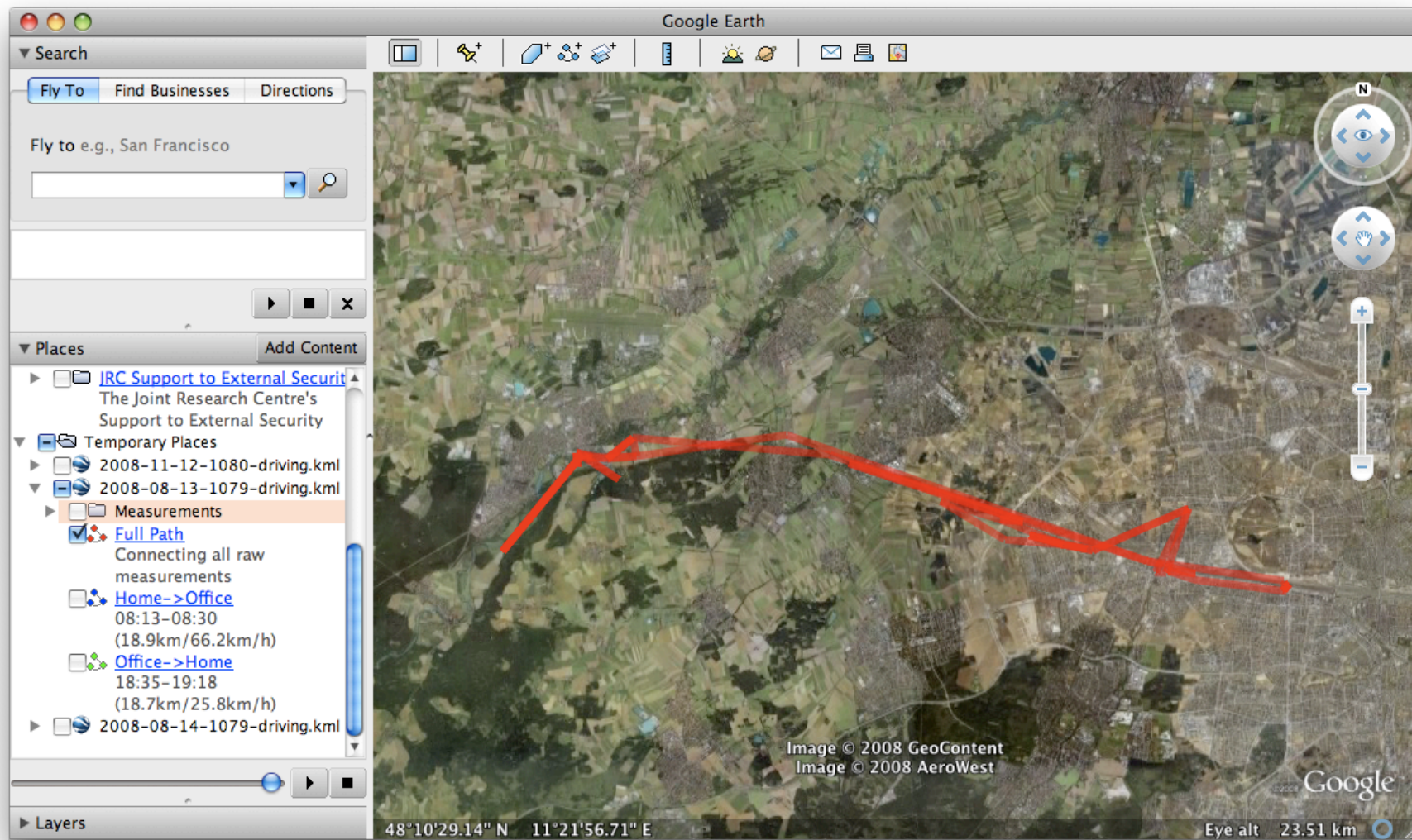
Recognizing Simple Events



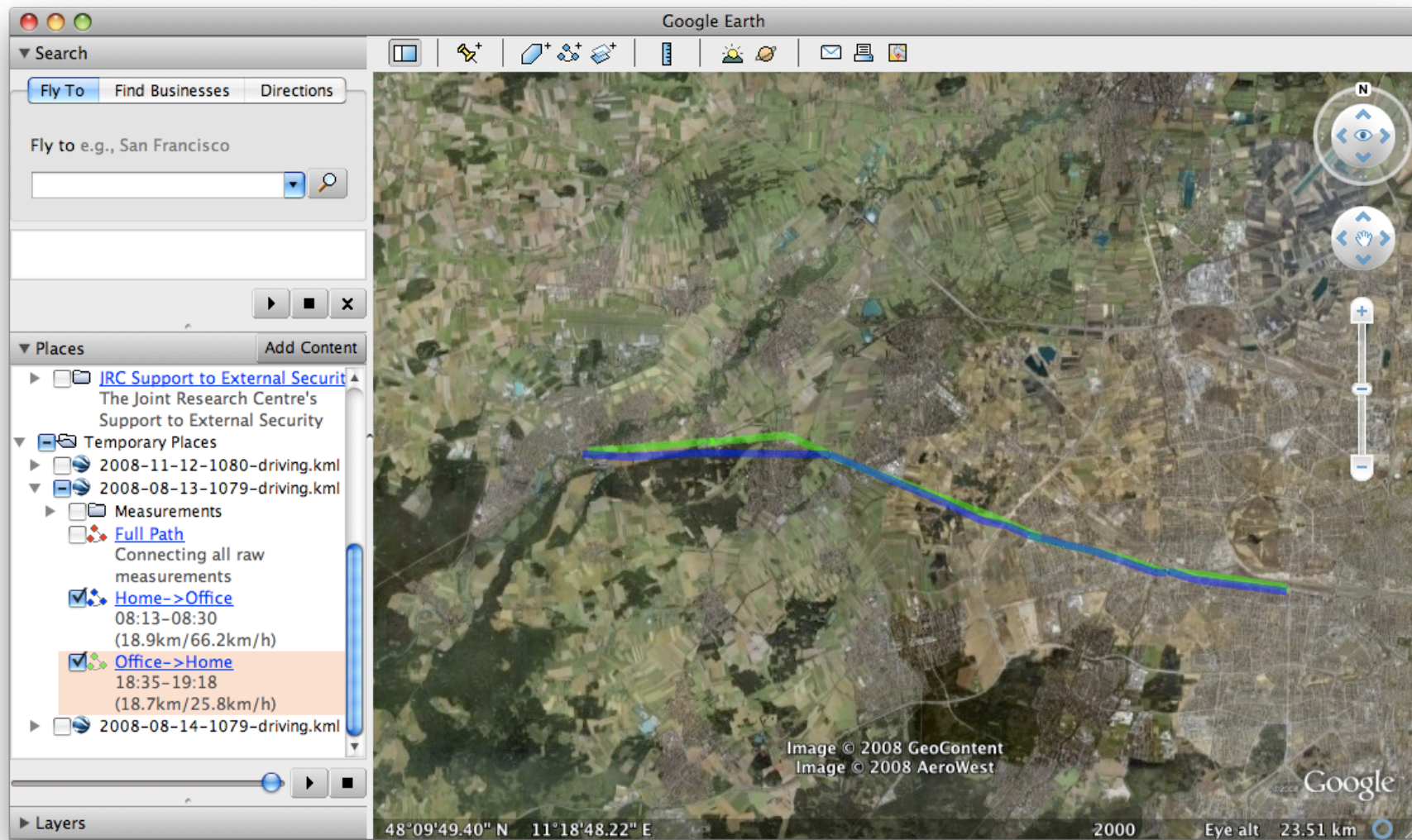
Preprocessing



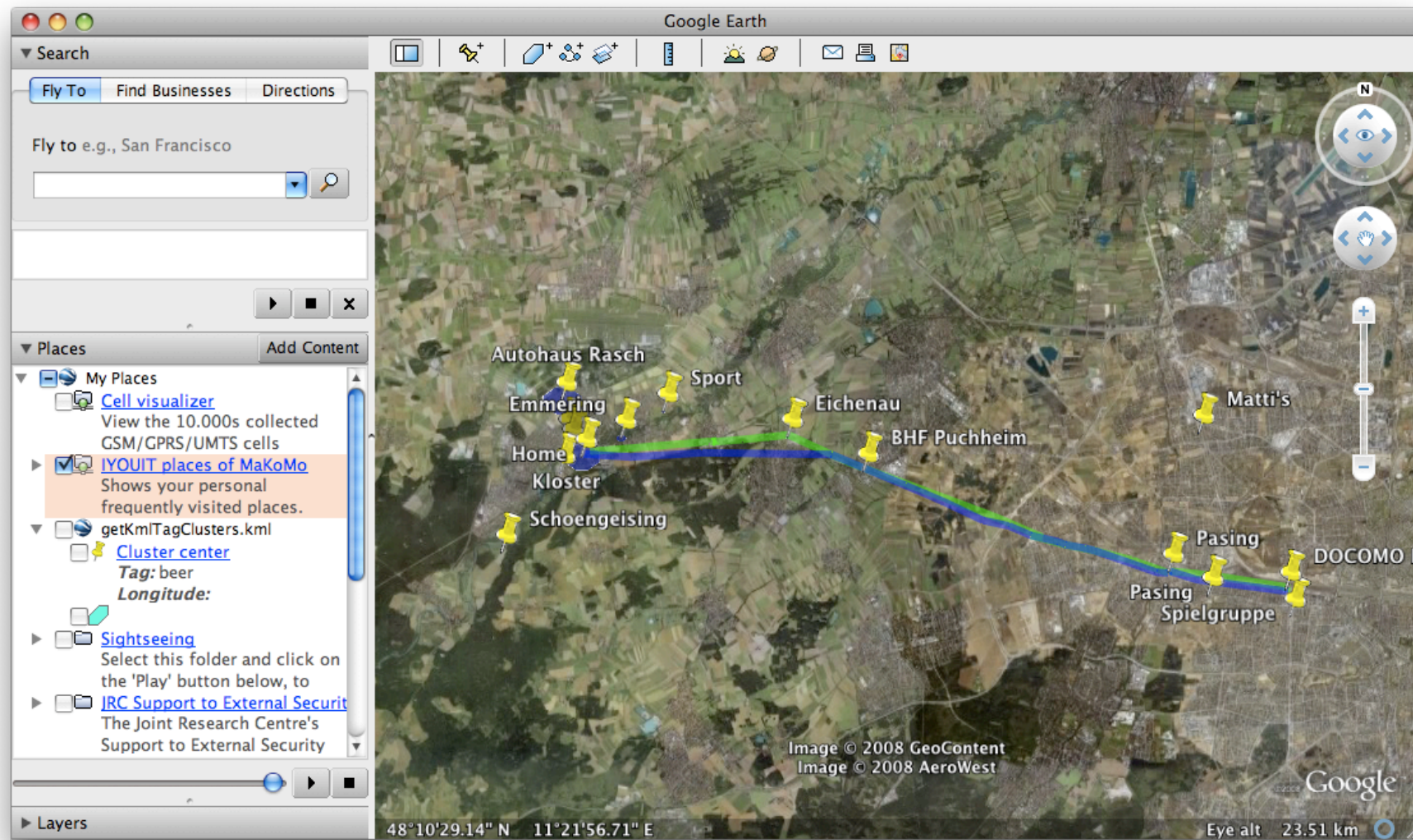
Preprocessing



Preprocessing



“Driving Home-Work”



Example of Simple Events

Analyzing 102 records delivered

6 Place Events:

```
[06:56-08:13, Home, Space.owl#Home]
[08:14-08:15, Way to S-Bahn, Space.owl#Travel_point]
[08:32-18:35, DOCOMO Euro-Labs, Space.owl#Office]
[19:04-19:05, Eichenau, Space.owl#Railway_station]
[19:06-19:09, Way to S-Bahn, Space.owl#Travel_point]
[19:12-00:00, Home, Space.owl#Home]
```

4 Walking Events:

```
[07:26-07:56, walking, 1008 steps]
[08:32-08:35, strolling, 64 steps]
[18:26-18:34, walking, 277 steps]
[19:06-19:18, walking, 443 steps]
```

2 Driving Events:

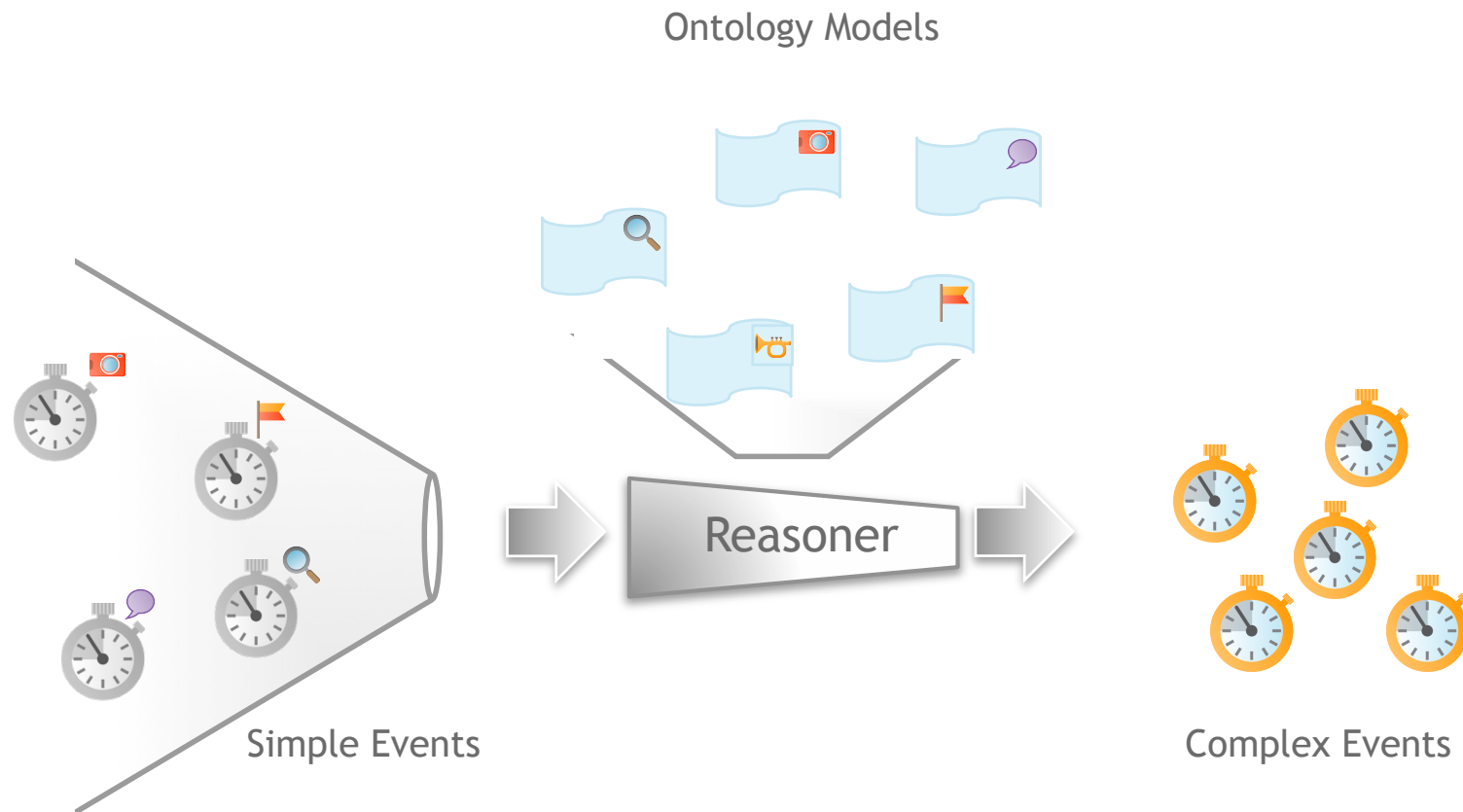
```
[08:13-08:30, driving 18.9km distance, 66.2km/h]
[18:35-19:06, driving 15.5km distance, 29.2km/h]
```

3 Nearby Events:

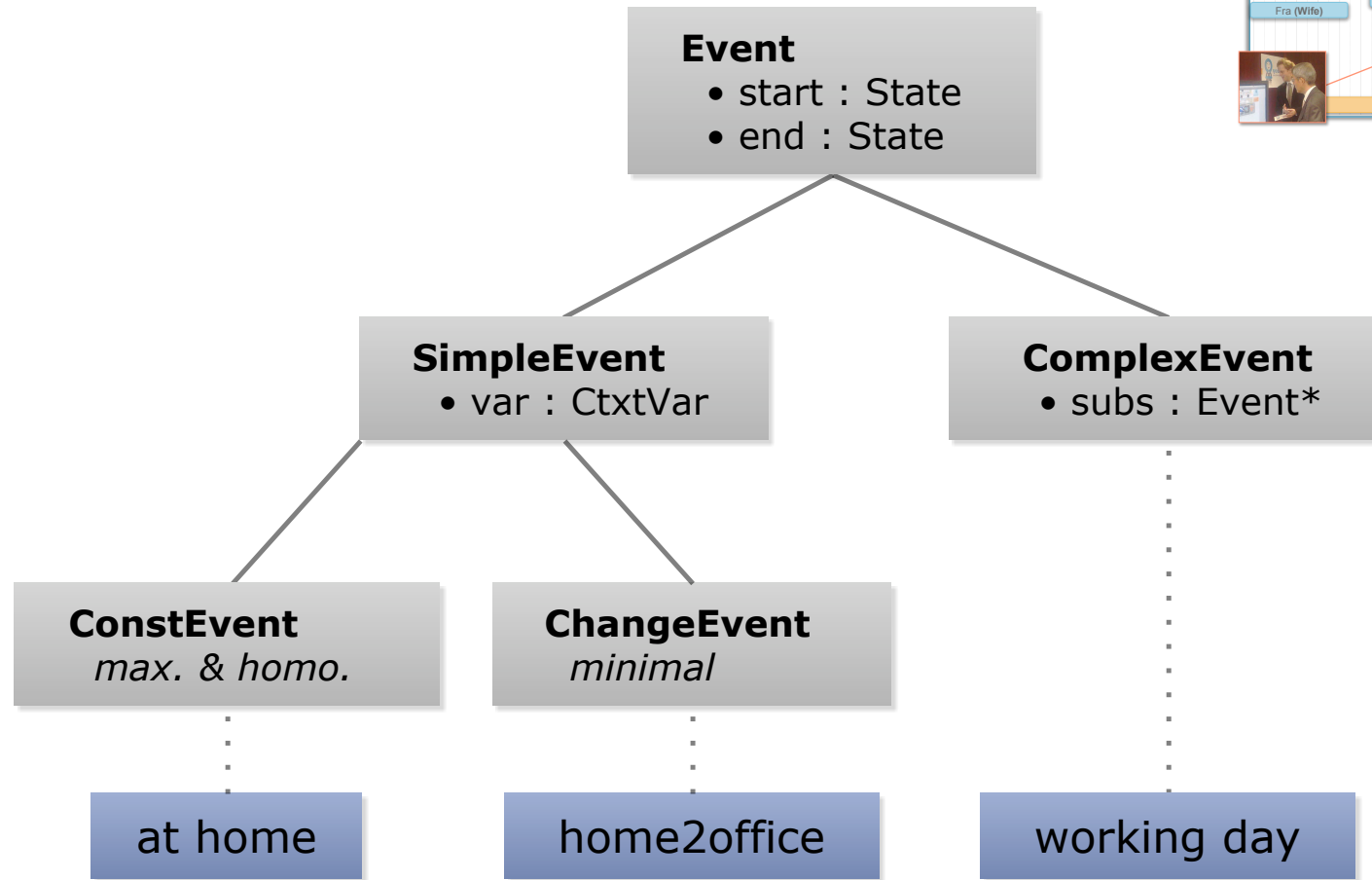
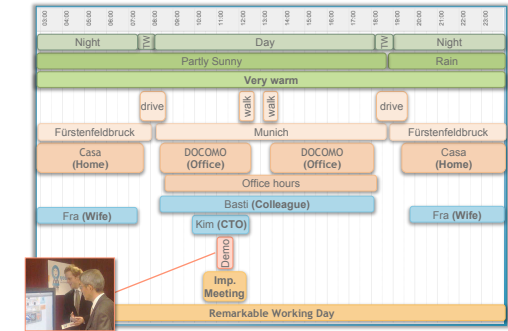
```
[08:27-18:53, nearby 1089]
[08:32-17:49, nearby 1126]
[09:05-18:35, nearby 1086]
```



Recognizing Complex Events



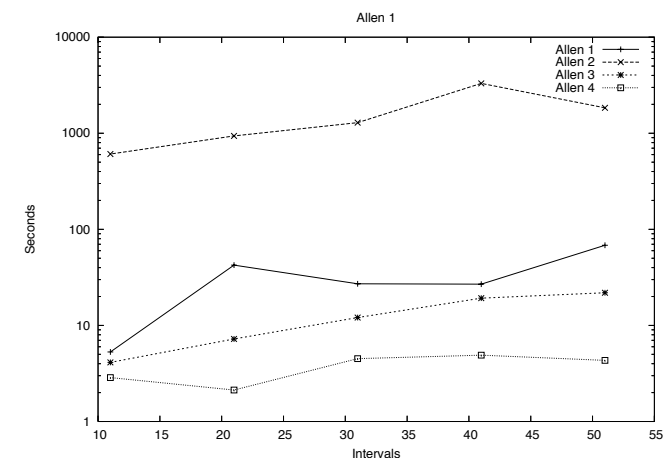
Event Modeling



Recognizing Complex Events

- Case study engineered together with Racer Systems
- Allen relations as define NRQL queries [CONTEXT'07]
 - Explicit next-relation between states
 - Bad performance due to recompilations and unfolding: 1.8 ARPS*
- Allen relations materialized via rules (large Aboxes!)
 - CD atom "<": 66 ARPS
 - Data substrate "<": 170 ARPS
- Via imperative MINILisp: 600 ARPS

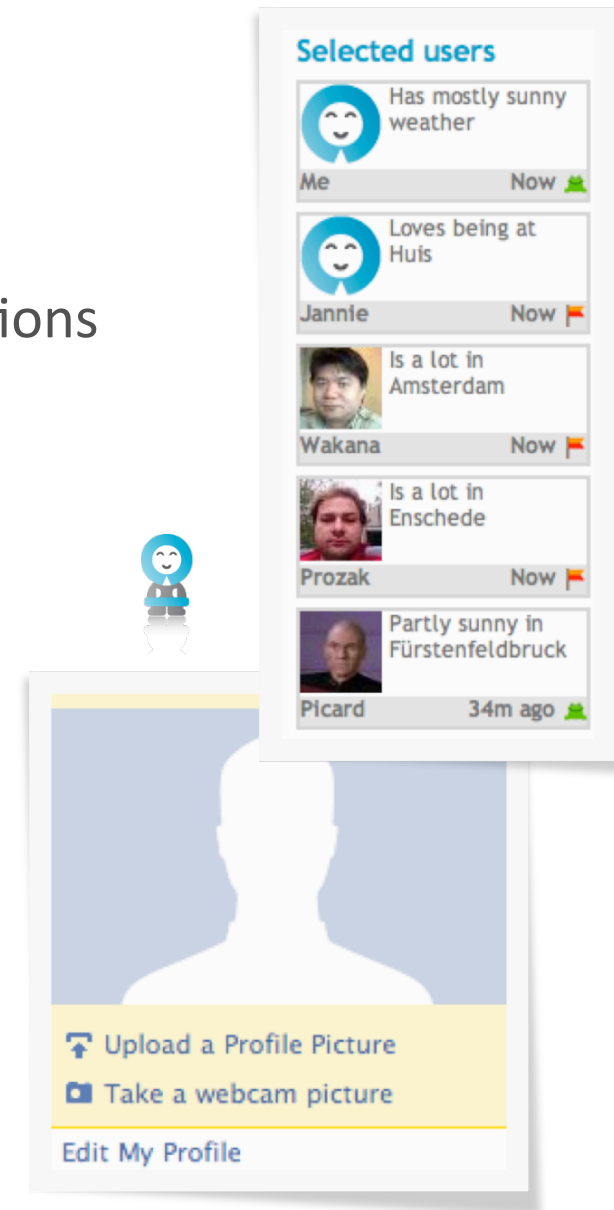
Allen's Interval Algebra



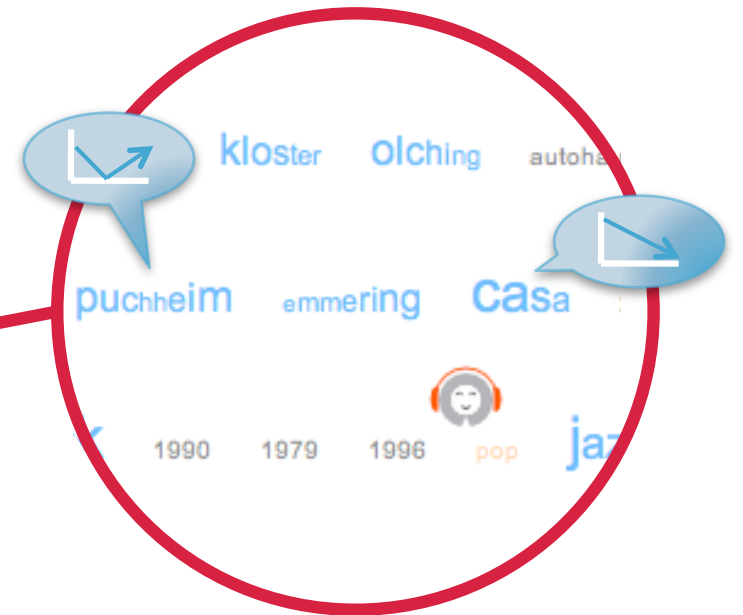
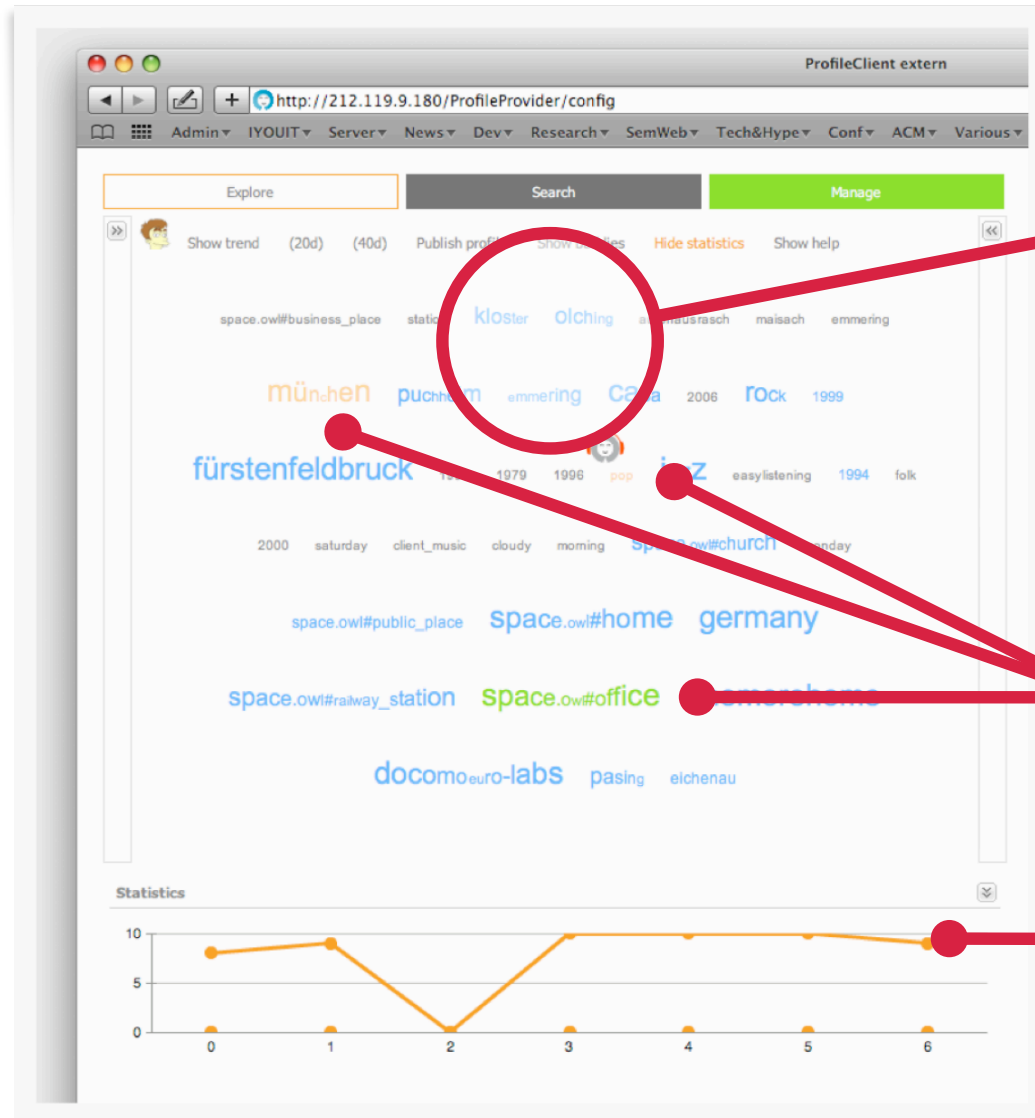
*50 Simple Events; ARP = Allen relations per second

Data Mining & Profiling

- Data Mining
 - Identification of significant context correlations
 - Analysis of contextual evolution over time
 - Association rules to capture strong associations between context streams
- User profiling
 - Aggregated & deduced context to build dynamic profiles
 - Matchmaking with the “familiar stranger”



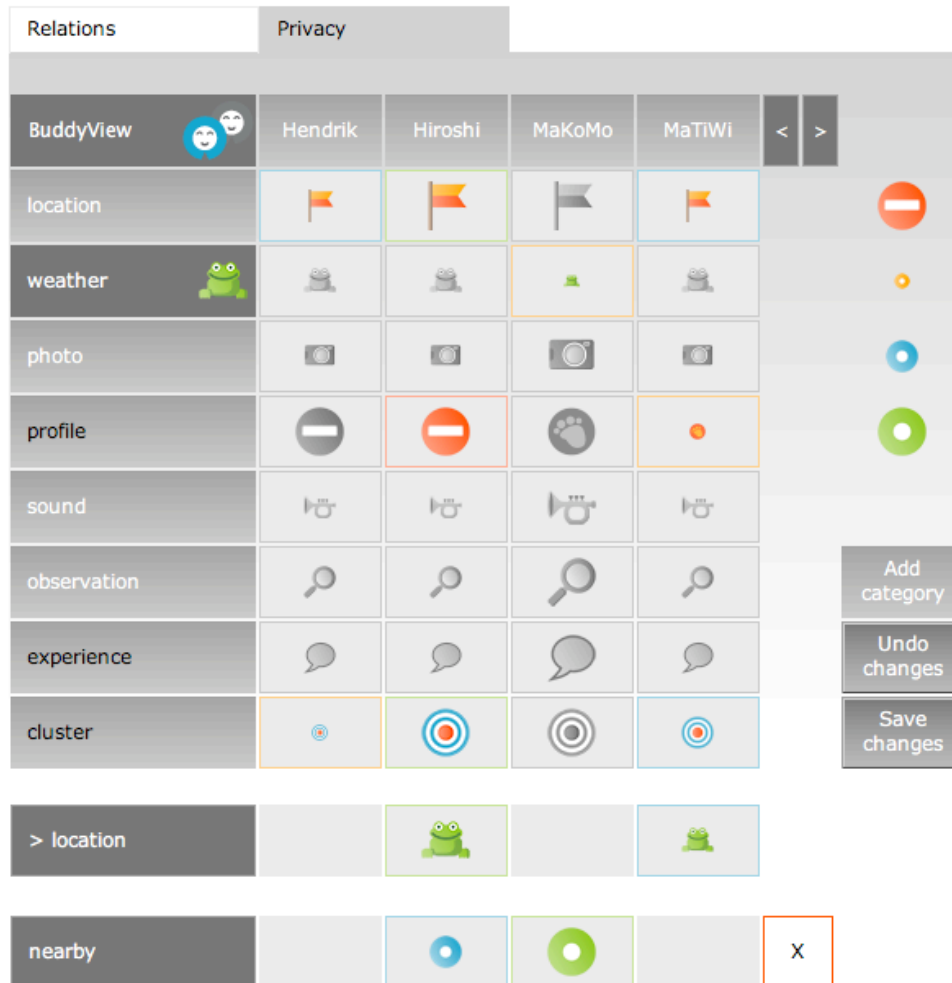
Profile Browser



• Rule visualization

• Statistical data and trend computation

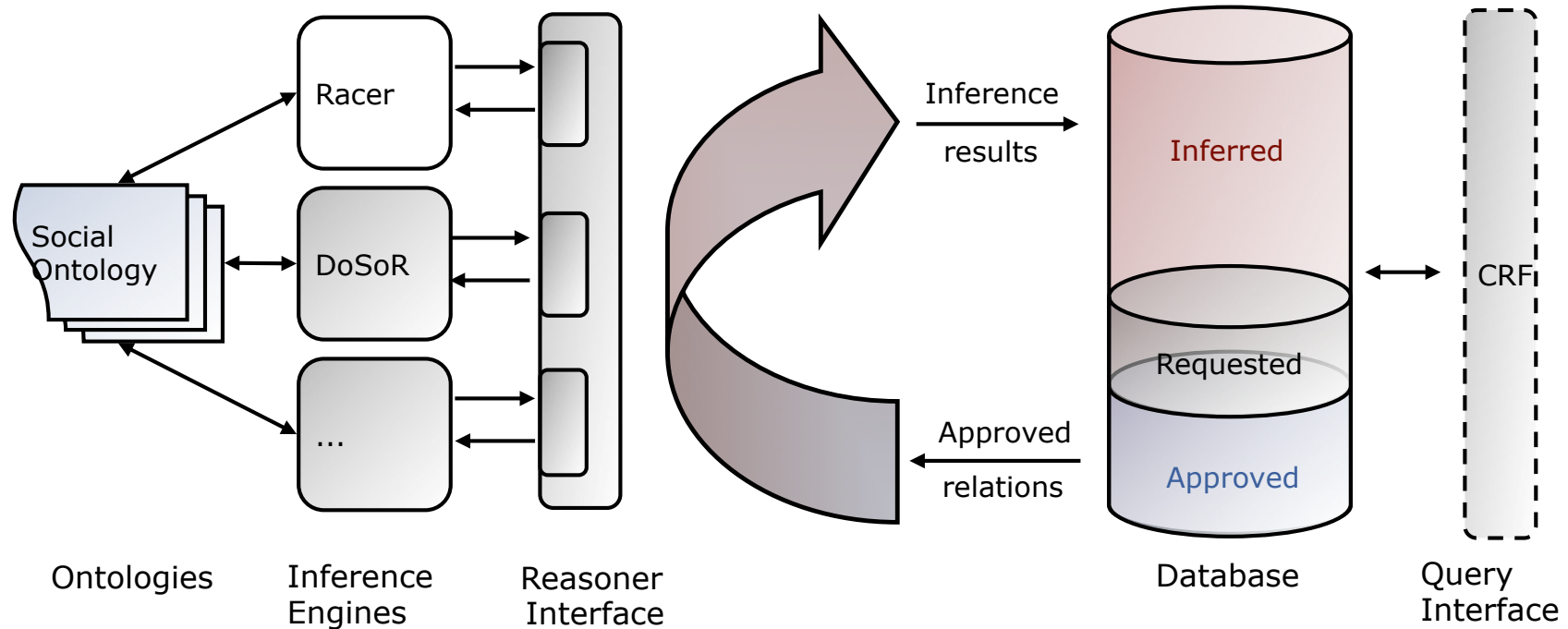
Privacy Management



- Access control for personal data
- Group directives based on social relationships
- Buddy-specific definitions overwrite group directives

Social Networking & Privacy

- Privacy policy activation through ontology-based reasoning
- Context-sensitive social networking



OWLlink

www.owlLink.org



OWLlink in Karlsruhe



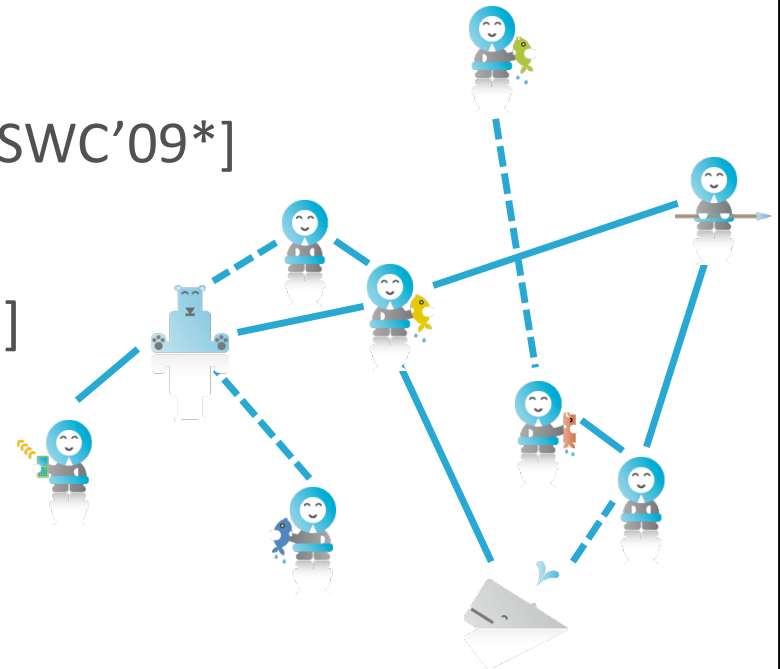
This photo was taken in Karlsruhe, in Baden-Württemberg. [SEBADO](#) was nearby. It was sunny when I made this photo. The prognosis was mild with sun and clouds. Taken on Sunday, October 26, 2008 11:31:30 AM and context-tagged with [VCSUIT](#)

- Extensible Protocol for accessing OWL reasoning services
 - Successor to DIG2.0 [“DIG for OWL 2”, OWLED’08]
 - Extension mechanism (incl. axiom retraction)
 - Joined work with Ulm University
 - First implementation in RacerPro
- Supported by DOCOMO and highly anticipated for
 - Platform independence and extensibility, e.g. Axiom Retraction



Summary of Applied Semantic Technology

- OWL-based ontologies and Semantic Middleware
 - Decidable fragments of OWL
 - DL-reasoners (Pellet, FaCT++, RacerPro)
 - Interfacing (OWLAPI, OWLink [OWLED'08])
- Extensions and framework aspects
 - Performance evaluations [SSWS'06, ESWC'09*]
 - Event recognition [CONTEXT'07]
 - Qualified social networking [ESWC'07]
 - Situational reasoning [KER'08]



*Talk on Wednesday: "Who the heck is the father of Bob?"

Mobile Adventure

Context Representation & Reasoning

Data mining & Profiling

Evolution of the mobile phone

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Task Management

1 pm - Cafe
Retrieve information
from sales tag

CAFÉ Barcelona
One Free Drink Ticket

Buy 1 Lunch Special and we'll give you one free drink.
M-F 10am. to 2pm.
*lunch-time use only
*only 1 coupon per person

Special Sandwich

INGREDIENTS:
TOMATO, LETTUCE,
PARMA HAM, EGG,
EDAM CHEESE

Vitamin A	4%	Vitamin C	12%
Calcium	0%	Iron	2%
Vitamin D	2%	Thiamin	1%
Riboflavin	10%	Niacin	10%

Total Fat 2.5g



DCMX RECEIPT

Date: February 16, 2009

Coffee	€ 2.0 × 1	€ 2.0
Sandwich	€ 5.0 × 2	€ 10.0
French fries	€ 2.5 × 1	€ 2.5

Use this Coupon
One Free Drink Ticket

Total Amount: € 12.5



2 pm - Cafe
Pay with e-money

**NTT DOCOMO's
Customer-oriented
Service Model**

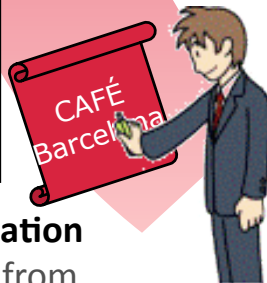
12 pm - Office
Receive by e-mail

CAFÉ Barcelona

ABC Bank
5th Avenue
East Street
DoComO Inc

We are HERE!

Address: 3-2 5th Ave. E. Street
Phone: 012-345-678
Lunch: M-F 10am. to 2pm.
Dinner: M-F 6pm. to 11pm.



10 am - Train Station
Receive a map from
Smart-Poster

Service Selection

- Transport for London
- DCMX
- COUPON LIST

CAFÉ Barcelona
One Free Drink Ticket **Get free French fries**

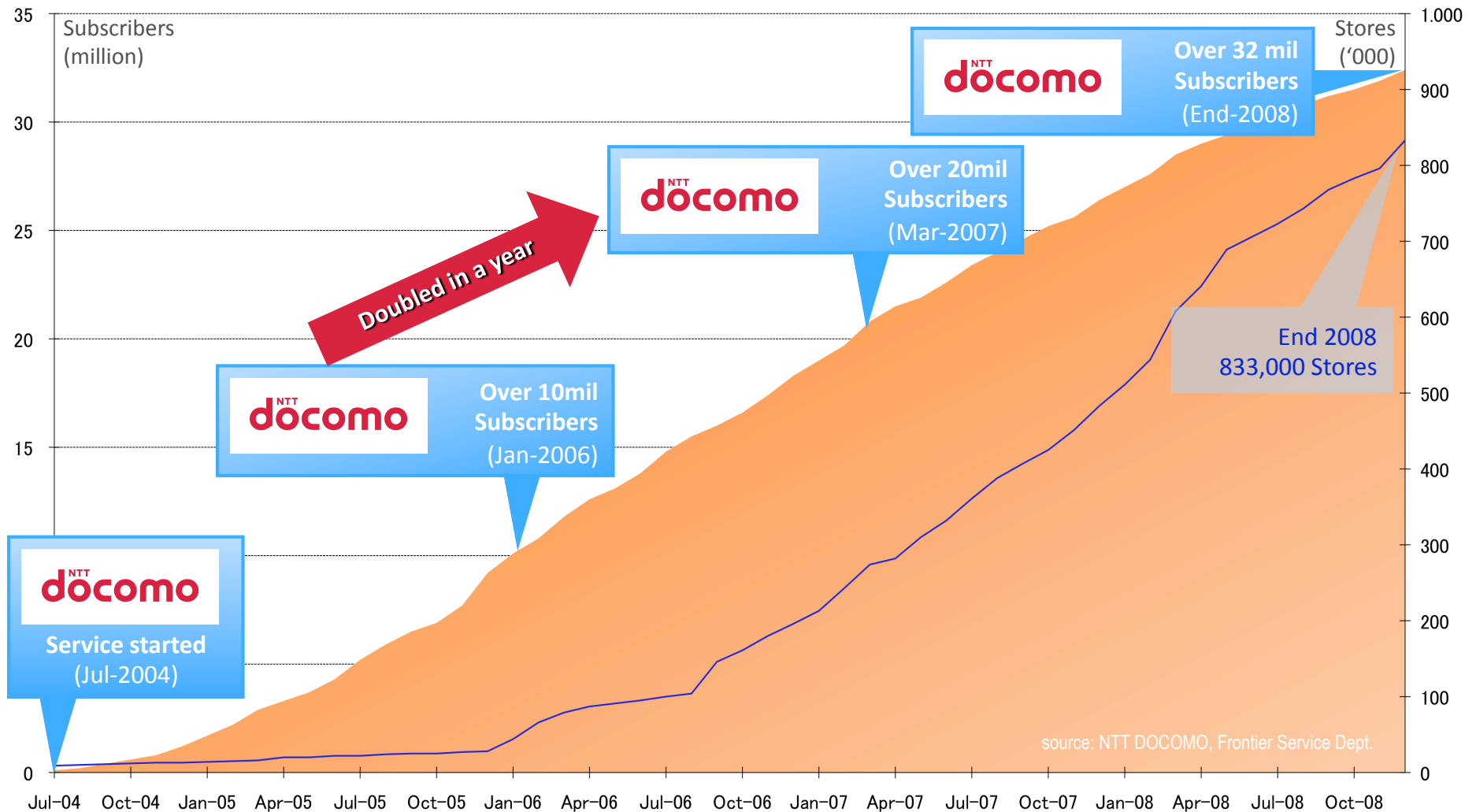
Buy 1 Lunch Special and we'll give you one free drink and french fries.
M-F 10am. to 2pm.
*lunch-time use only
*only 1 coupon per person



7 pm - Home
Exchange coupons

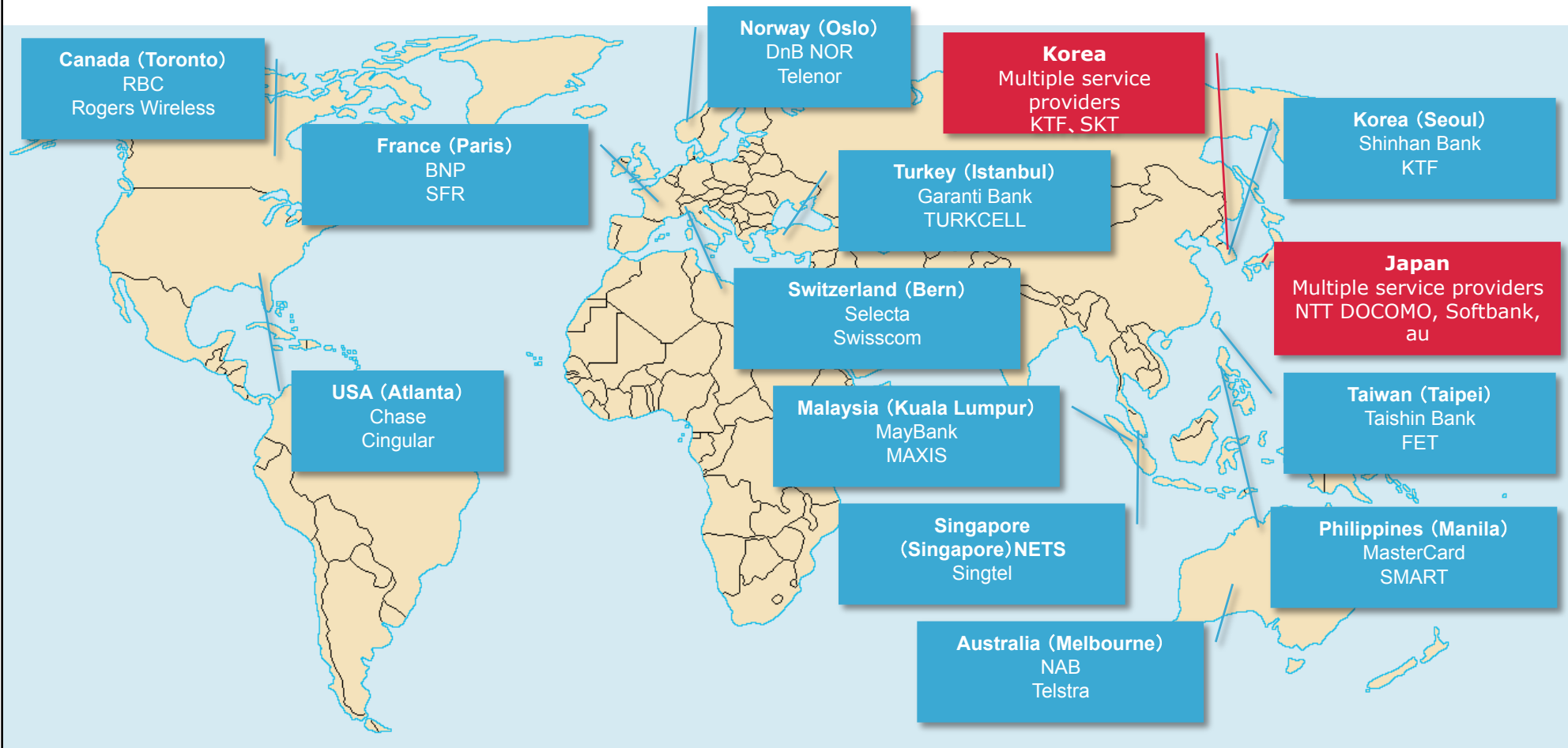
source: NTT DOCOMO, Frontier Service Dept.

NFC Mobile Services in JP [Osai-fu-Keitai™]



source: NTT DOCOMO, Frontier Service Dept.

Worldwide NFC Mobile Business & Pilots



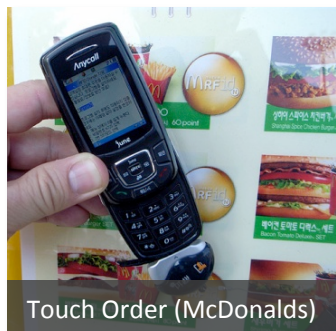
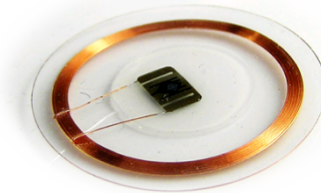
TRIAL, Country (City)
Service Provider (Service)
Mobile Network Operator

EXISTING, Country
Mobile Network Operator

source: NTT DOCOMO, Frontier Service Dept.

Smart NFC-based Services

- Building on the commercial success of NFC
- Multi-tagged to move beyond “Touch-and-Go”
 - Augmenting objects with many NFC tags
 - UI = mobile phone & tags
 - Overcome limited I/O capabilities of mobile devices



Touch Order (McDonalds)



InfoTags (City of Oulu)



Octopus (PitTouch)



Pupil Posters (VTT)

PERCI (Pervasive Service Interaction)

PERCI Movie Tickets

Please follow the steps below in order to use this poster. To select an action or an option , take a picture of its visual marker , type its number identifier or touch its NFC-symbol  with your NFC-enabled mobile phone.

- 1) Open the PERCI client on your mobile phone.
- 2) On the poster, select the action you want to accomplish.
- 3) Follow the instructions on your mobile phone.
- 4) Select the options on the poster that are appropriate for your action.

Select an Action

Order Movie Ticket

View Movie Details

Select a Movie

13.00

15.00



17.00

20.00

23.00



PERCI Transportation Tickets

Please follow the steps below in order to use this poster. To select an action or an option , take a picture of its visual marker , type its number identifier or touch its NFC-symbol  with your NFC-enabled mobile phone.

- 1) Open the PERCI client on your mobile phone.
- 2) On the poster, select the action you want to accomplish.
- 3) Follow the instructions on your mobile phone.
- 4) Select the options on the poster that are appropriate for your action.

Select the Duration of your Journey

1 Hour

3 Hours

4 Hours

1 Day

1 Week

1 Month

Select the Number of Passengers


1

2..5

Child

Bicycle

Select the Origin and Destination of your Journey by selecting the Areas, in which the appropriate Stations are:



Select the Type of your Ticket

Select Ticket directly

Single Ticket

Single Return Ticket

Round Trip Ticket

Multiple Ticket 1

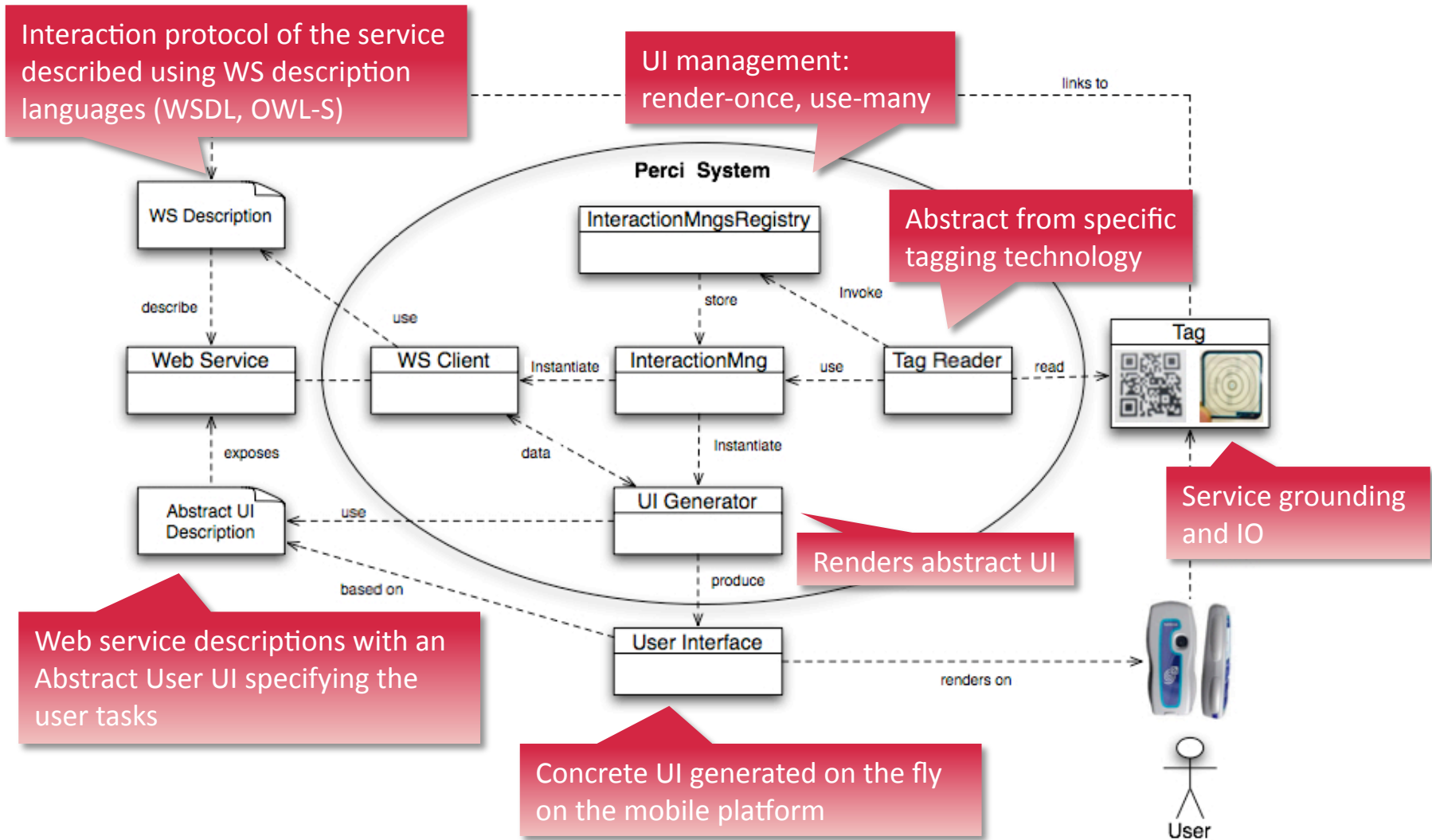
Multiple Ticket 2

Multiple Ticket 3

Multiple Ticket 4

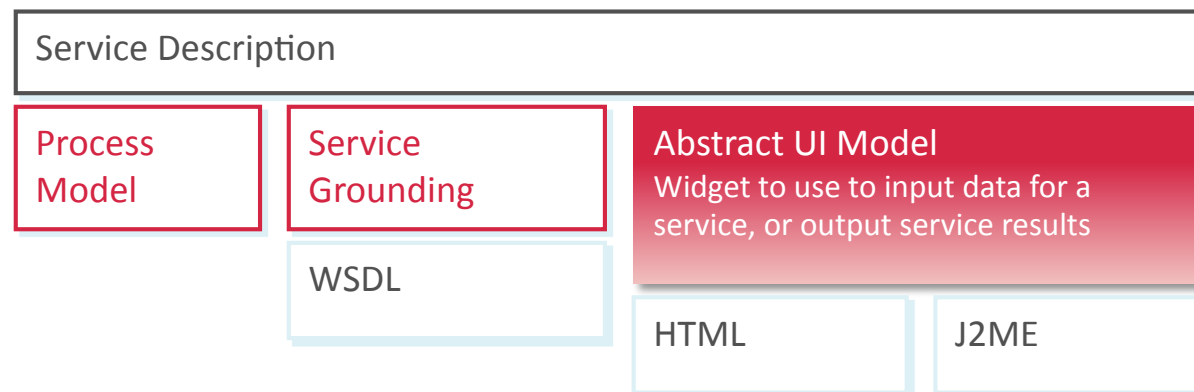
Multiple Ticket 5

PERCI Implementation

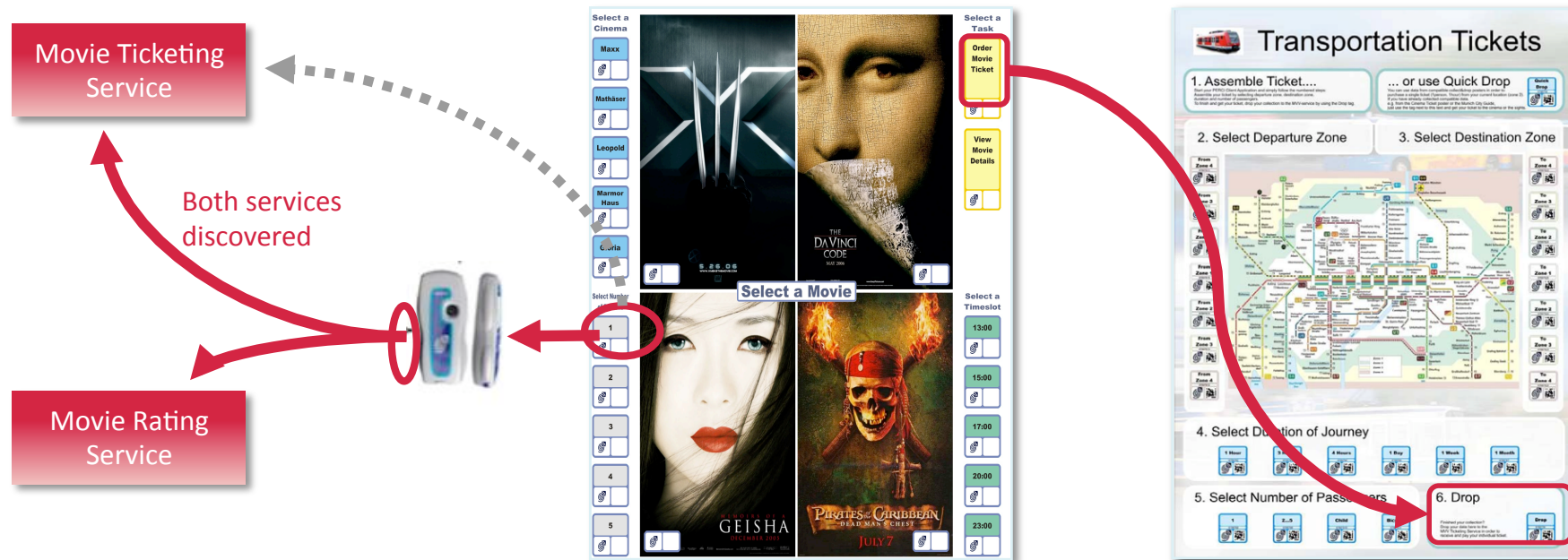


Managing Service Interaction

- WS technology provides declarative description of services
- WSDL
 - Operations performed by the service: required/generated IO
 - Message format, network protocol and service port
- OWL-S
 - Execution order and mapping to service semantics
 - OWL-S extension: abstract UI to specify the user actions
 - Close relation between the abstract UI and OWL-S process model
 - I/O of atomic processes to be passed to abstract UI



Semantic Interoperability



- Collect & Drop
 - Data across smart posters: usage history for posters and tags
 - Intelligent mapping of tags across posters & applications
- Proactive Service Discovery
 - Dynamic binding of multiple services to tags / objects
 - Recommendation of additional services

NFC-based Interaction with different Displays



- NFC-based services deployed on generic tag infrastructure
 - Similar services on different dynamic displays and static posters
 - Same look, feel and ease of use
 - Maximized usability, optimized development and deployment
- NFC Forum Global Competition '08 (Winner Research Track) & Mobile World Congress '09



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Behavior Assistance

Life Logging

Smart NFC-based Services

User Guidance

Lifestyle Infrastructure

User-centric Services

Evolution of the mobile service

Life Assistance

Resources-driven Service Provisioning

Task Management

Context Representation & Reasoning

Data mining & Profiling

Evolution of the mobile phone

Context Awareness

Semantic Platform Support

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Cross-Industry Services [NFC Multi Service]

Area	STATION AIRPORT	VEHICLE	OFFICE	STORE RESTAURANT	THEATER STADIUM	ANYWHERE
Usage of NFC Mobile Phone	Pass gate Get information from smart poster Get information from information kiosk Pay bus/taxi fare	Personalize seat position Use to represent driver's license Pay parking fee	Enter/exit office Exchange business cards Log in to PC; Print using copier machine	Pay by credit card Get loyalty points Get and use coupon Share information and coupon among users	Pass entrance Get event information	Download and personalize application Check usage history Download ticket Lock phone remotely
Service Industries	Mass and Public Transport Advertising	Drivers and Vehicle Services	Security	Banking Retail Credit Card	Entertainment	Any

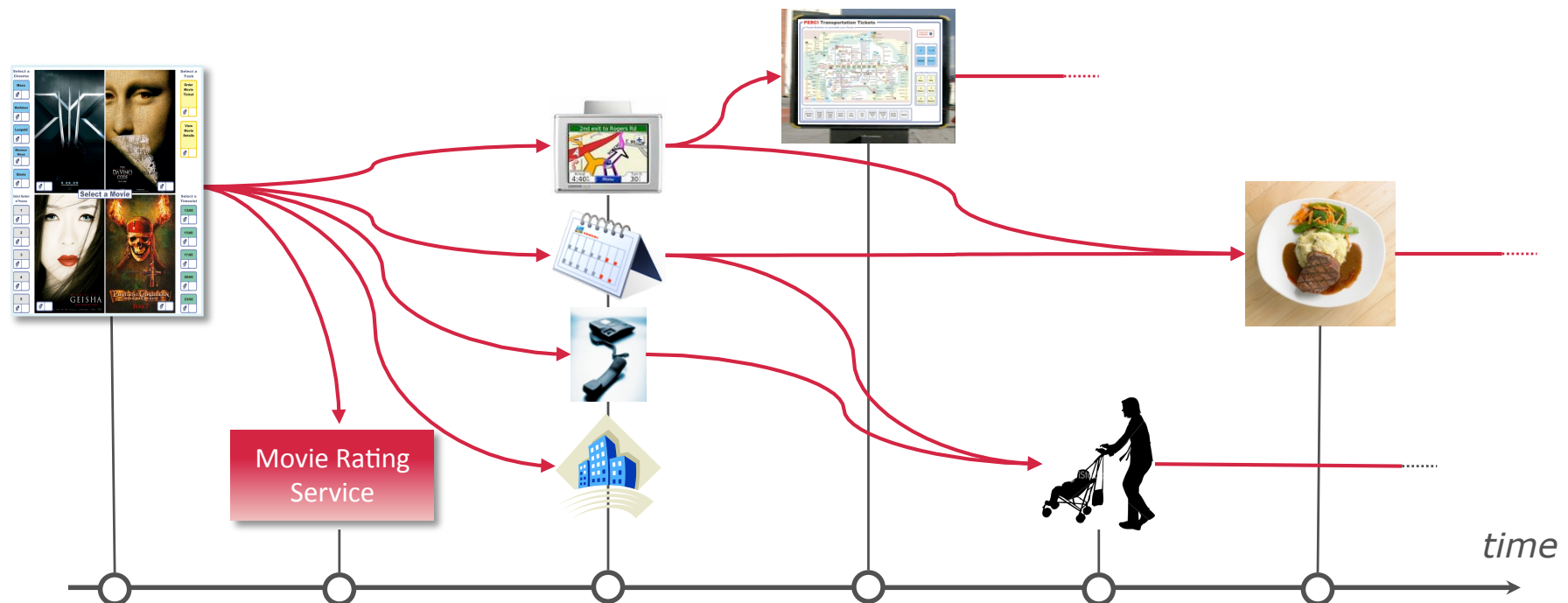
source: NFC Forum

The Service Heterogeneity Problem

- Service heterogeneity
 - Many different services addressing very different needs
- Data heterogeneity
 - Each service provider represents information in a proprietary ways
 - Virtually no standards (and very difficult to make them)
- Providers heterogeneity
 - Different organizations hold key pieces of information
 - It is (almost) an open market, anybody can enter
- Protocol heterogeneity
 - Many different protocols are used to provide the services

User-Centric Service Composition

- Implicit workflow of services which is driven by (and tailored to) the activities of the user
- The mobile phone helps the user to fit all activities together and to manage consequences when something goes wrong

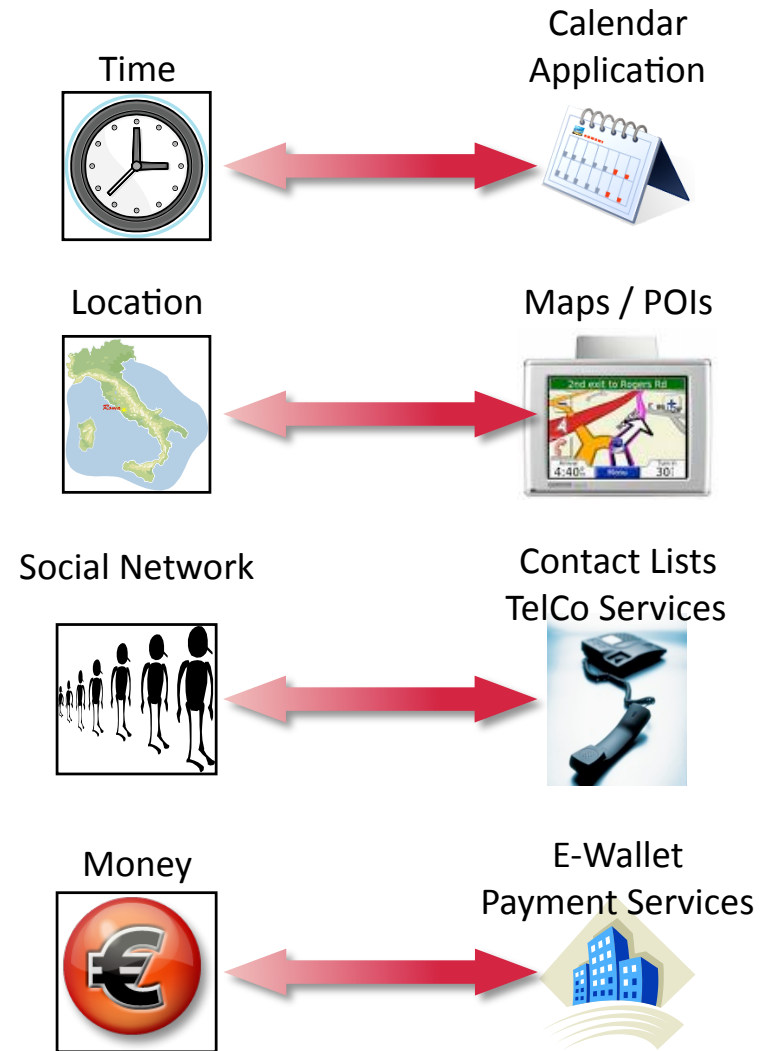


User-Centric Service Composition

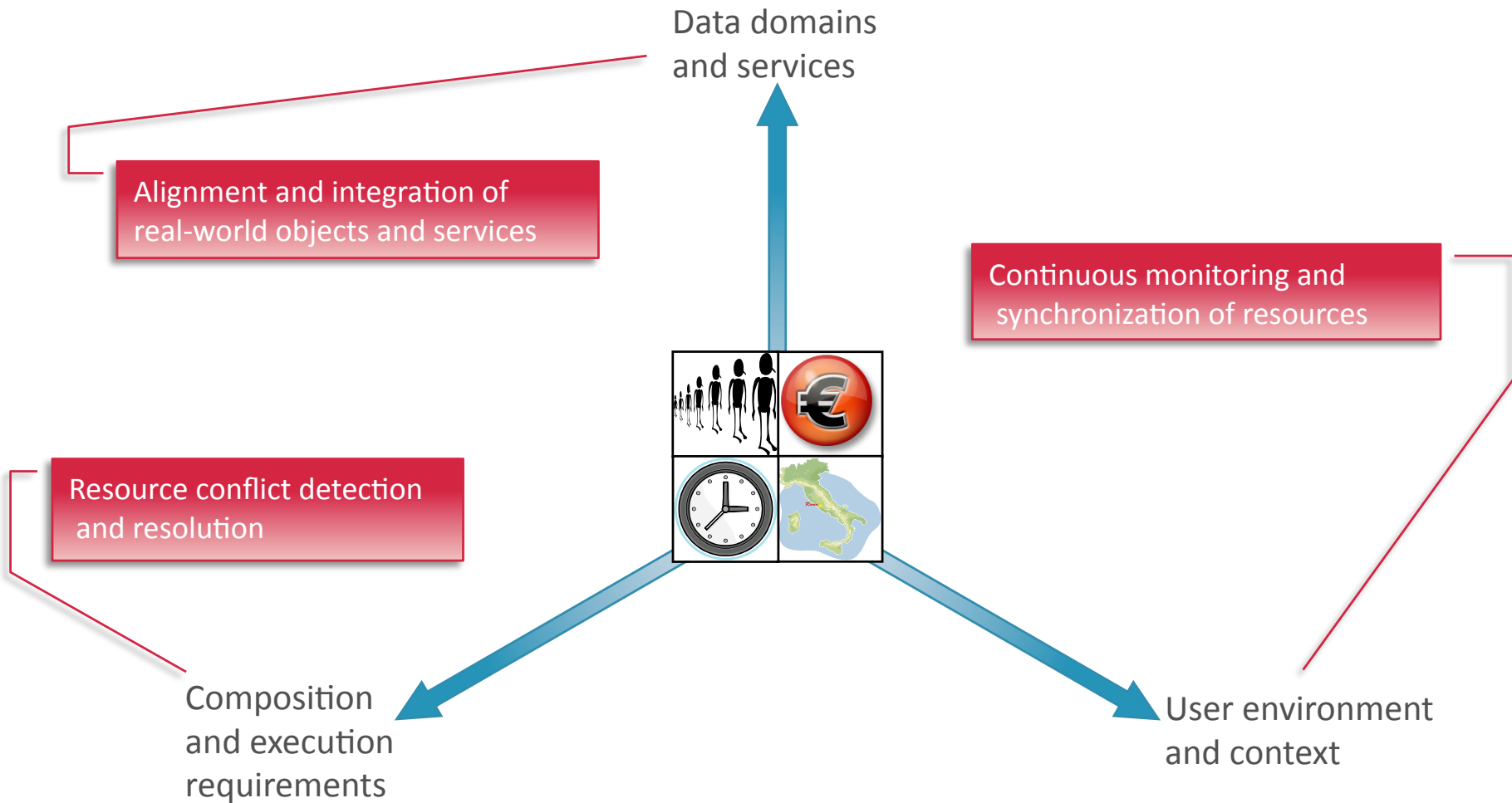
- To open up the full advantage of the ever growing number of available services to the mobile user
- Challenges:
 - User has to be in control: identify the right concepts (interaction means) for interacting with the services
 - Service heterogeneity: Identify the right concepts (semantic annotations) for describing the services
- Core idea:
 - Interaction means and semantic annotations are both based on a small set of “core resources” (most prominent context)

Core Resources

- User centricity requires the organization of services and applications around “the life of the user”
- Services are organized along four core assets of the user
 - **Time** representing the temporal relation of user activities
 - **Location** representing the spatial relation
 - **Social** representing other parties involved in those activities
 - **Money** representing costs of activities
- Well know applications (calendars, maps, contact lists, e-wallets) are used to expose services to the user

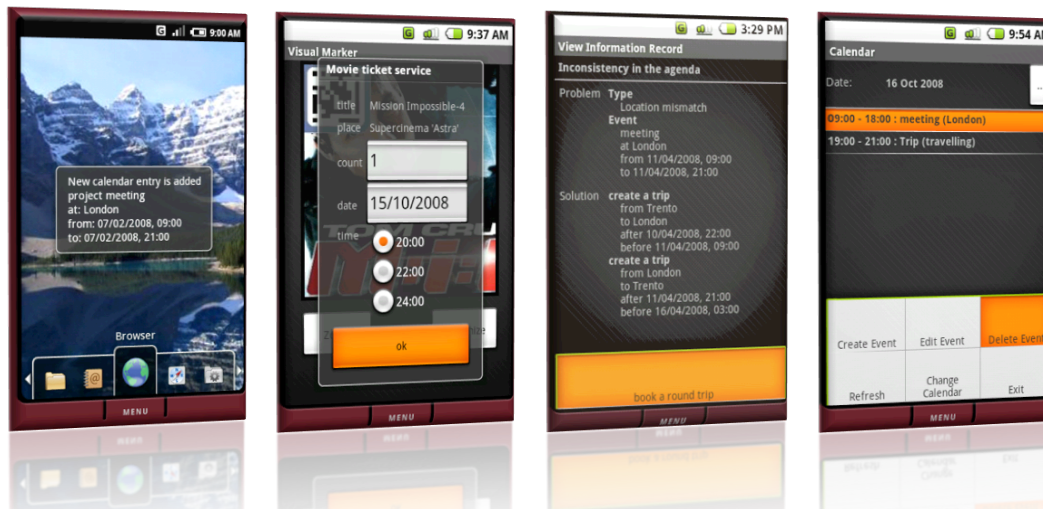
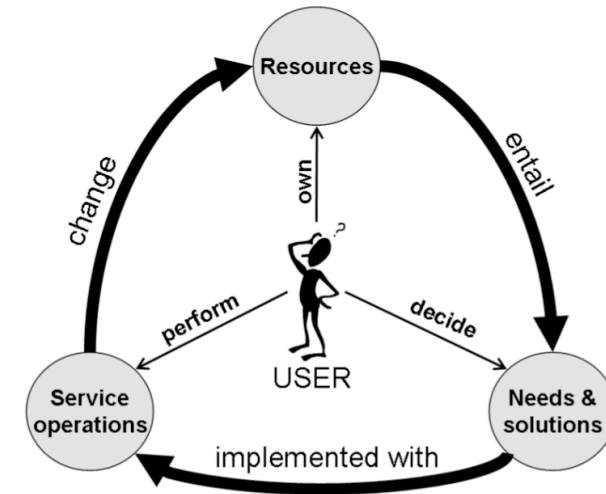


Using the Resource-driven approach



YourWay!

- “Have services your way!”
 - User-centric composition & personalization of mobile services
 - Seamless integration of real-world Web services
 - Grounding in user context & resources



Early prototype (Android-based):

- Travel & scheduling support
- Personal and business tasks
- Support of transactions & re-scheduling

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Summary & Conclusion

- “Keys, Money and Mobile Phone”
- Evolution of the mobile phone and the mobile service
- Semantic Technologies as key enablers
 - Context Awareness & Life Logging
 - Context representation & reasoning
 - Semantic platform support
 - Lifestyle infrastructure & smart NFC



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