Assistive Systems

Sensors

Human Computer Interaction Group (HCI)

Institute of Visual Computing & Human-Centered Technology,
TU Wien

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Content

Introduction – Sequence of Course

I. Demarcation and Definitions

- Umbrella term AAL
- Technical Aids vs. Assistive Systems

II. Active User Interface (HCI)

- Active Support

III. Assistive Robots – Movement

- Human Robot Interaction (HRI)

IV. Sensors – are entering the living area

- **Safety and Support**

V. Ethics, Law and Economics

VI. Requirements Analyse and Evaluation

IV. Assistive Systems: Sensors

- Topic: Sensors, Context Awareness
- Context: The meaning and necessity resp. urgency of actions changes with background information
- “Intelligent environment”- Ambient Intelligence
- Building automation, Smart Home
- Goal: avoidance of unnecessary actions and delays, increased comfort and safety, recognition of situations etc.

Goals

- Get to know concepts of Ambient Intelligence (AmI)
- Learn about technology and trends of building automation, Smart Home and Smart Metering
- Understand application in AAL and as Assistive System

Background

„Ambient Intelligence“

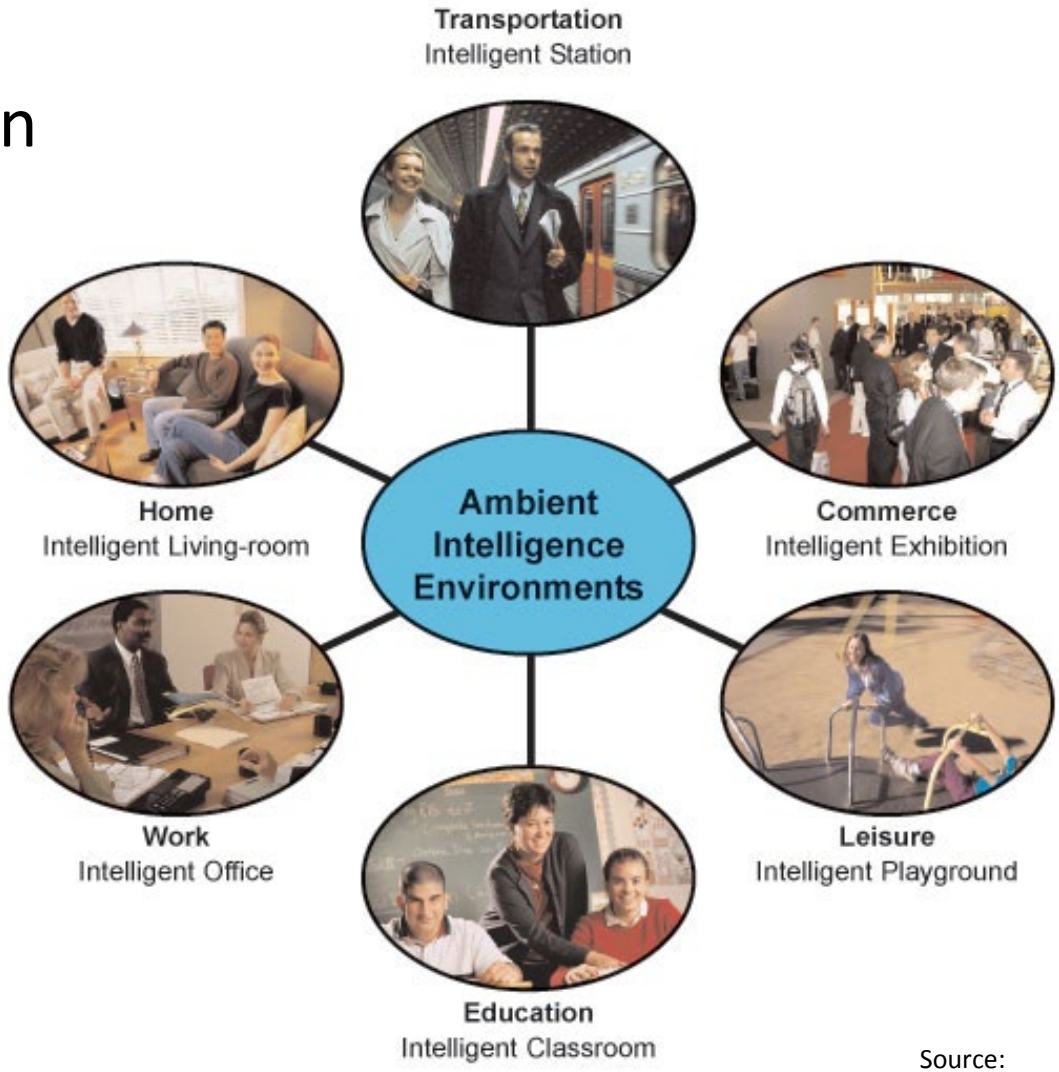
Ambient Intelligence (AmI) („Environmental intelligence“) Paradigm: (simple) interaction between users and environments of networked IT-Systems

Starting point: Miniaturisation, pervasive technology, networks, „Internet of things“

Subarea of AAL: application of AmI-environments for an autonomous and active way of living

AmI: Typical application areas

AmI goals:
Automatic recognition of user intentions
Automatic adaption and reaction to user



Source:
Forth ICS

AmI: Ways of interaction

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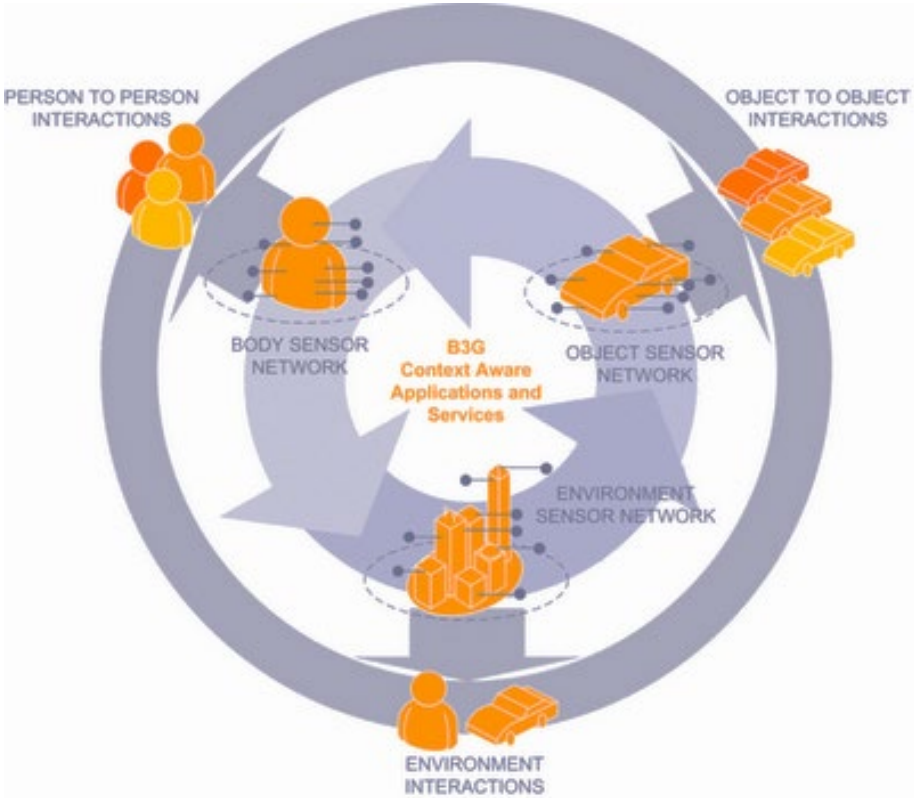
Technically supported „intelligent“ interaction

- Between persons
- Between persons and environment
- Between objects (devices) in the environment



AmI: implicit vs. explicit interaction

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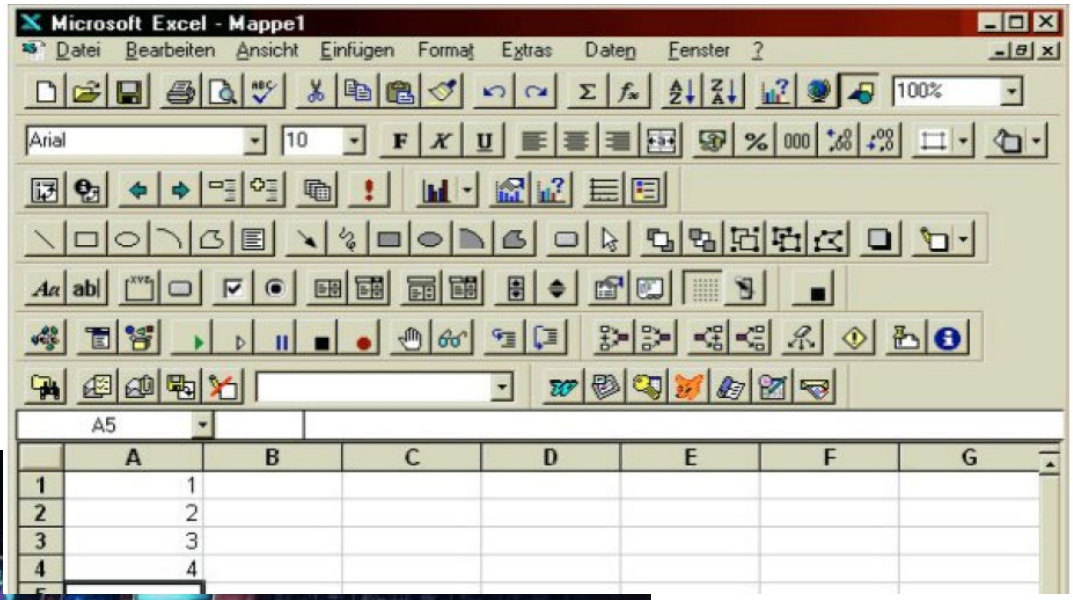

AmI: implicit vs. explicit interaction

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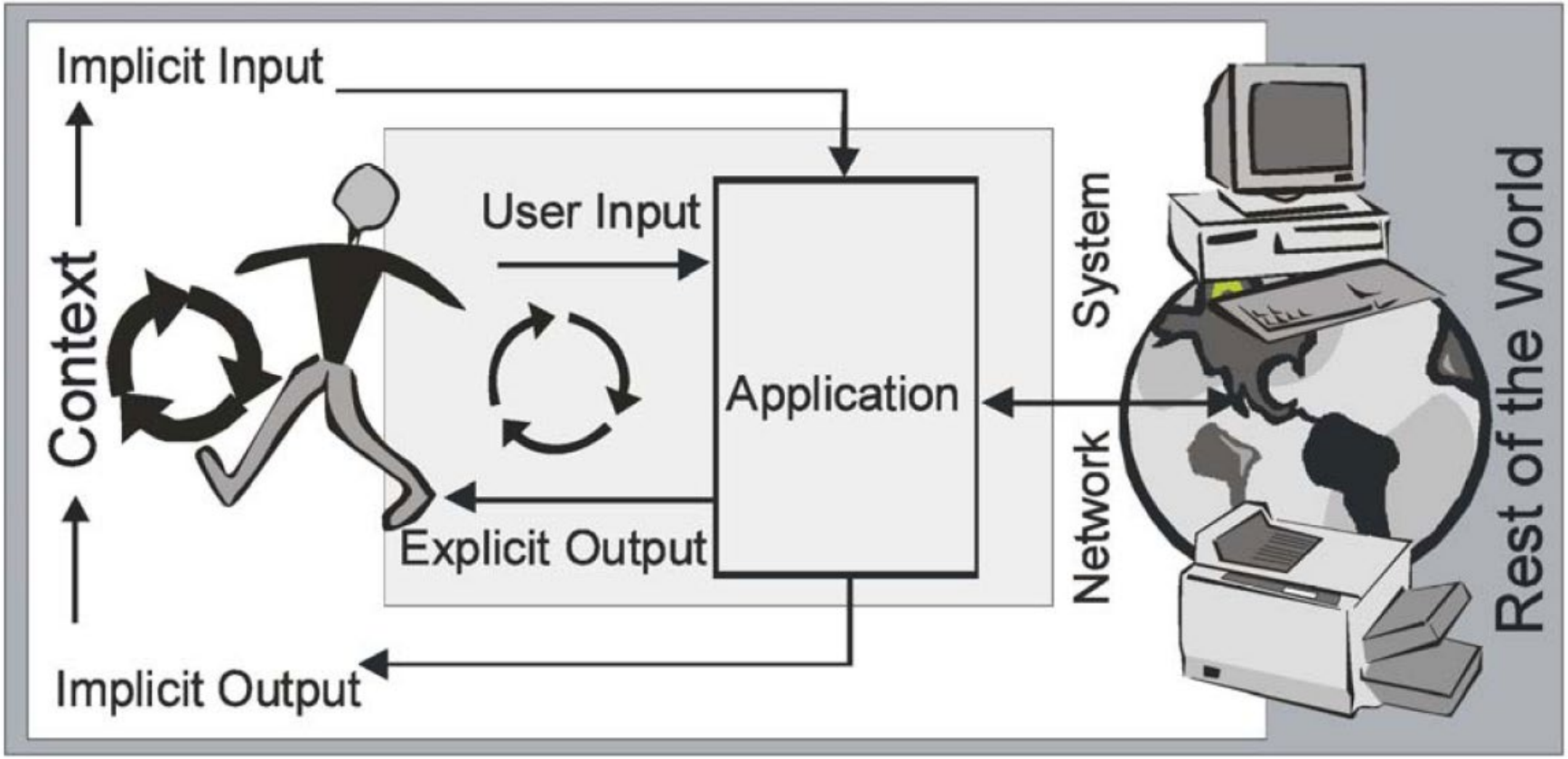
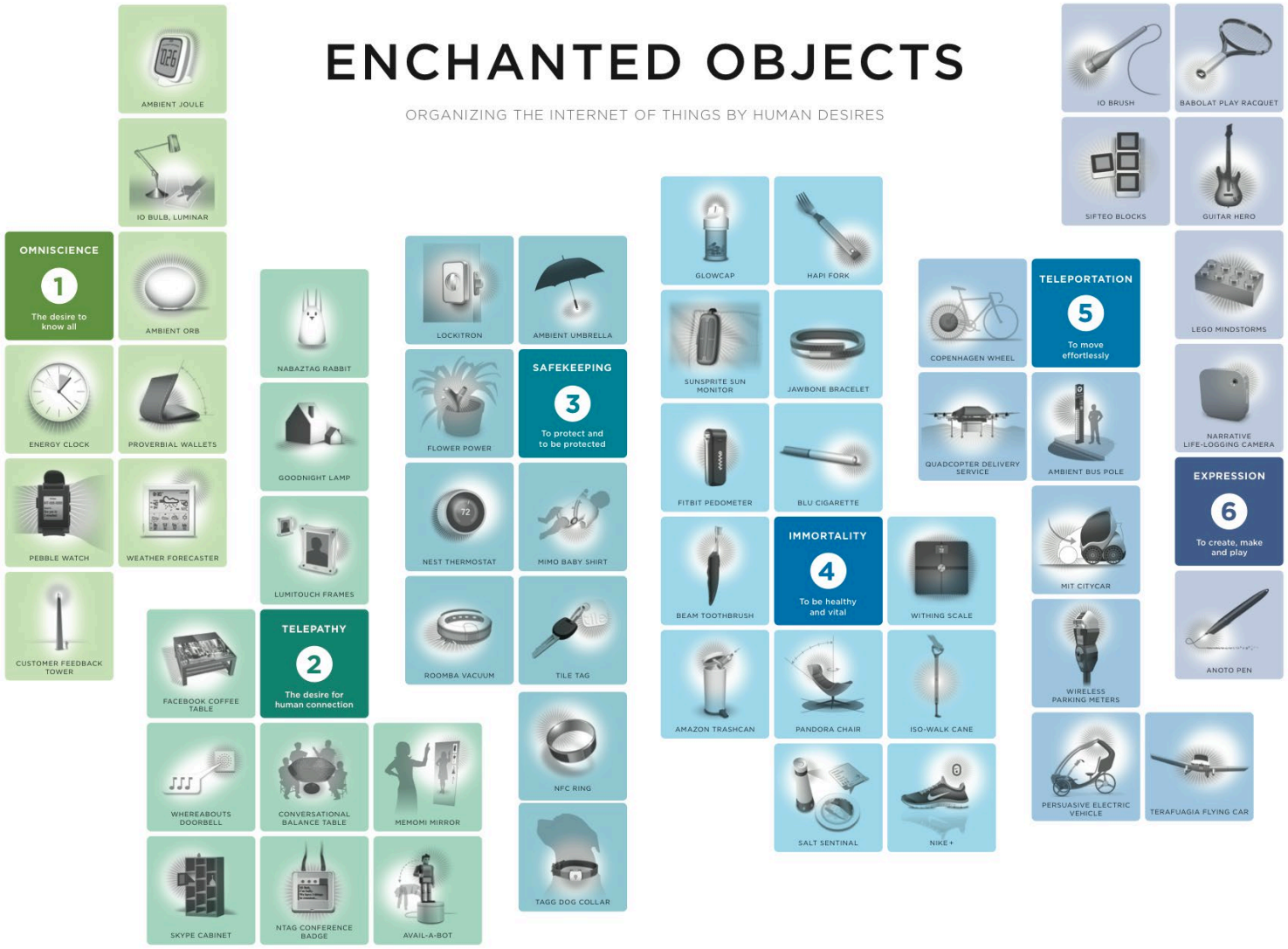


New interaction technologies: Object interaction



Source:

David Rose, MIT

AmI: implicit output (examples)

Source: Philips

Source: Ambient Devices

AmI: implicit sensors/output (example)

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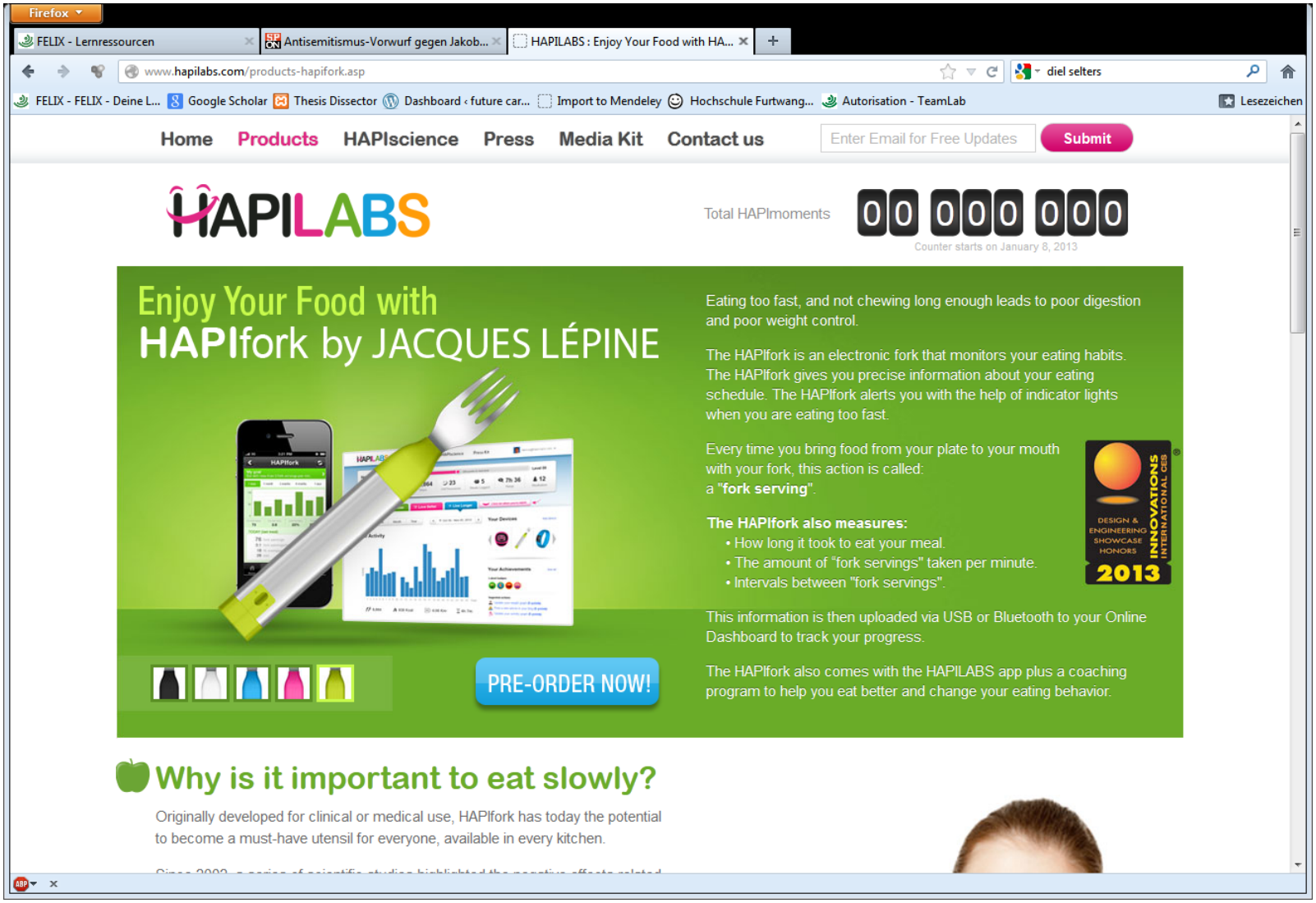
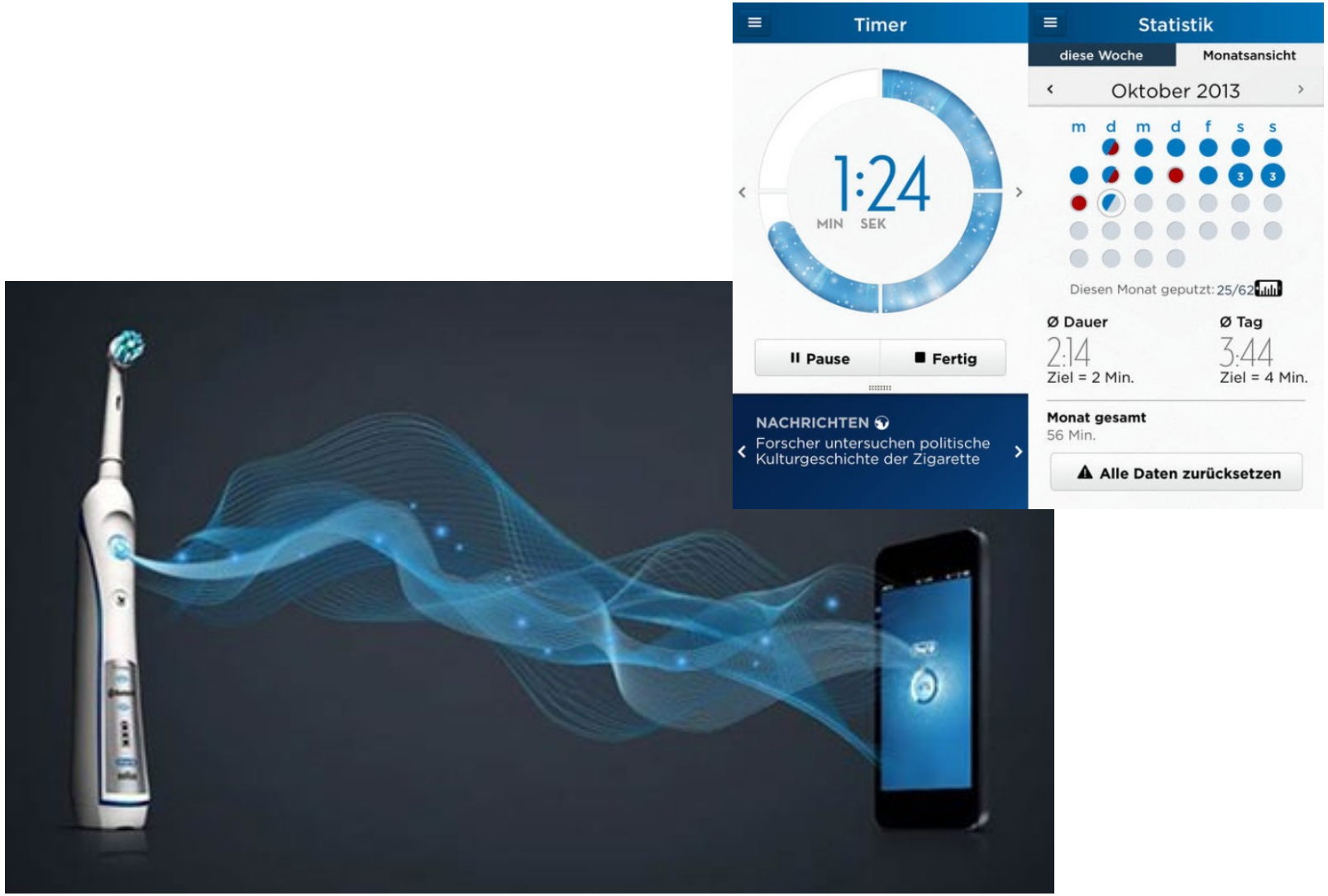


Fork vibrates if user is eating too fast

VO Assistive Systems

AmI: „Smart Objects“



AmI: Object interaction

GlowCap®

GlowPack™

Lights up/ vibrates, when medicine should be taken.

AmI: implicit interaction/output (example)

„Pillow Talk“

Source: http://www.littleriot.com

Wristband senses own heartbeat, which is output in pillow of other person

From great AmI visions to the base technologies relevant for Assistive Systems

Base technologies: Sensors, automation

Sensors are used for:

- Increasing comfort (Smart Home, building automation)
- Saving energy
- Detecting emergencies
  - Fall detection
  - (In-)activity analysis
- Determining presence and position of user
- Providing background knowledge (context) to functions
  - What is the user doing in this moment resp. what has he/she already done

Building automation, „Smart Home“

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- **Building automation** is the (classic) electronic control of buildings **(lights, heating, shading)** by central systems
- **„Smart Home“** denotes the **networking of building automation with further systems** in the house (household appliances, consumer electronics, …)

Quelle: Hager

Classic building automation

- Typical components: switching actuators, movement detectors, Reed contacts, motors, ...
- Typical control elements: Programmable switches, Touch displays, Remote controls
- Typical technologies: Home bus systems (EIB / KNX)

Quelle: Gira, RWE, Hager

Retrofittable building automation

RF networked systems enable simple retrofitting in existing homes.
Battery operated (lifetime: several years)
or
batteryless systems by *Energy Harvesting* (e.g. EnOcean)

RWE

Smart Home: Application example Typical bundles offered

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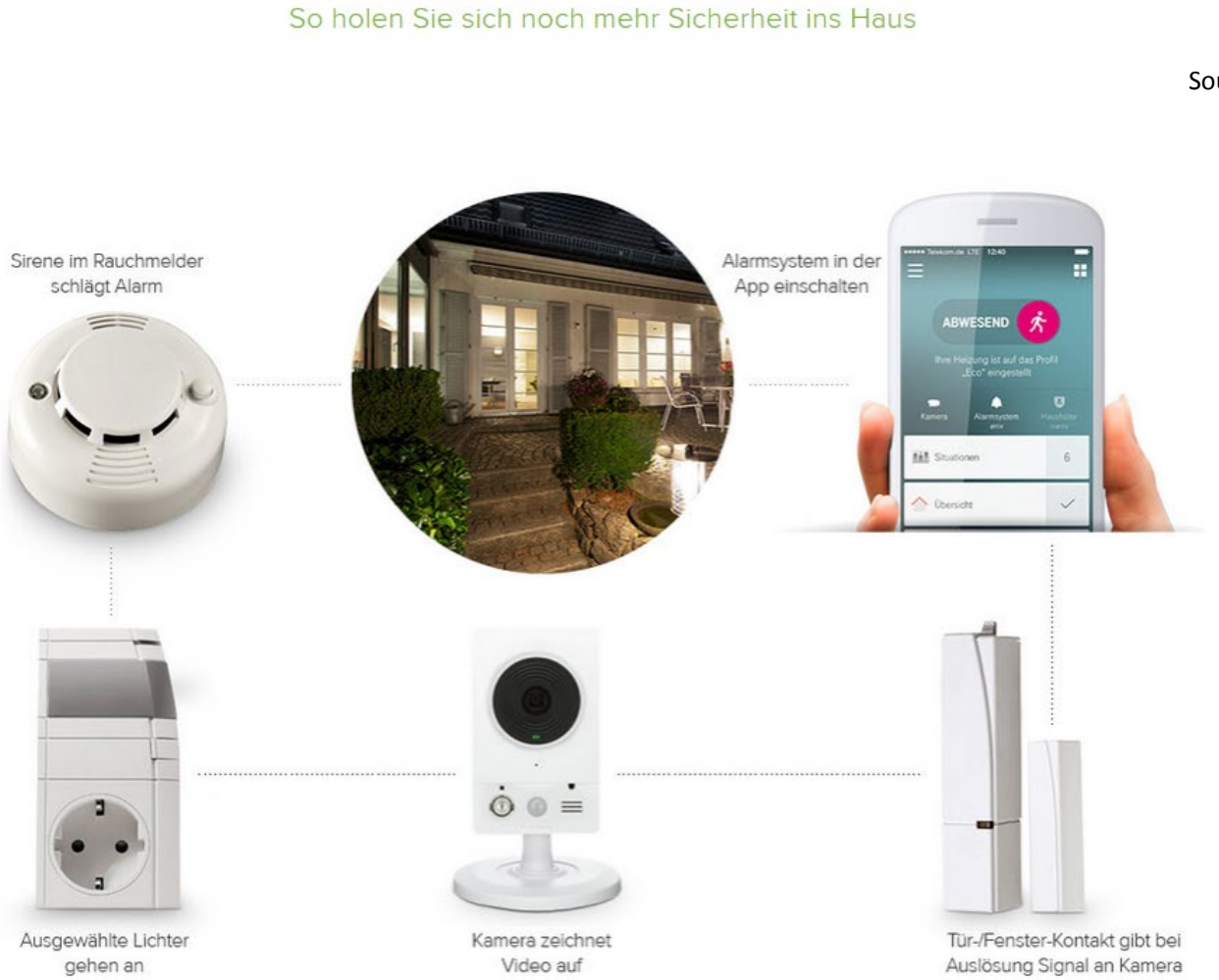
Alarm



Source: Qivicon

Smart Home: Application example Typical bundles offered

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Comfort and Energy Saving

Source: Qivicon

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Austria: A1 Smart Home Comfort or Safety Package

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A1 Gateway

Das A1 Smart Home Standard bzw. Premium Gateway übernimmt die gesamte Kommunikation zwischen Ihrem Smartphone und Ihren Smart Home Geräten – verschlüsselt und ausfallsicher!

Thermostat

Mit dem Thermostat in Kombination mit dem Multisensor können Sie Ihre Energiekosten senken. Die Temperatur wird Ihnen direkt am Gerät auf einer LCD-Anzeige dargestellt.

Tür-/Fenstersensor

Dank des Tür-/Fenstersensors wissen Sie immer, dass Türen und Fenster, aber auch das Garagentor oder die Haustierklappe, in Ihrem Zuhause geschlossen sind.

Multisensor

Der Multisensor misst Licht, Temperatur und informiert Sie aktiv bei Bewegungen. Durch das moderne Design und die optimale Größe lässt er sich gut in Ihre Einrichtung integrieren.

Steckdose

Die Steckdose kann zur manuellen oder automatischen Steuerung von Elektrogeräten oder Lichtanlagen genutzt werden.

Indoor Kamera

Sehen Sie immer was zuhause passiert. Live. Und in Videoaufzeichnungen, wenn die Sensoren Unerwartetes registrieren. Mit 115° Radius, HD und Private Mode.

Die App

Source: A1

Austria: T-Mobile Smart Home Comfort or Safety-Package

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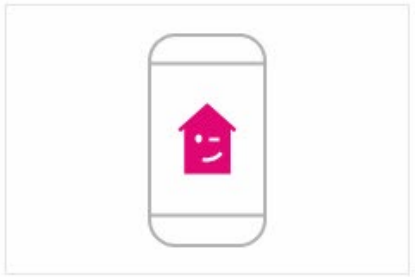
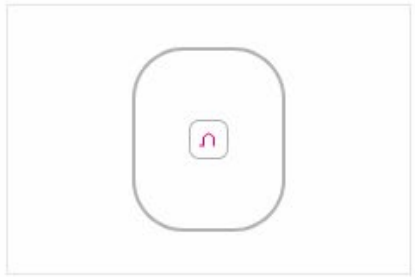
1. SmartHome-Lizenz



2. SmartHome-App



3. Home Base

4. Smarte Geräte

Home Base

In jedem Starterpaket inkludiert.

Source: T-Mobile

Austria: SMARTHOME-Austria Several Packages

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Source: smarthome-austria/Kelag

Austria: Medion Several Packages

Starterset - **Einsteiger**

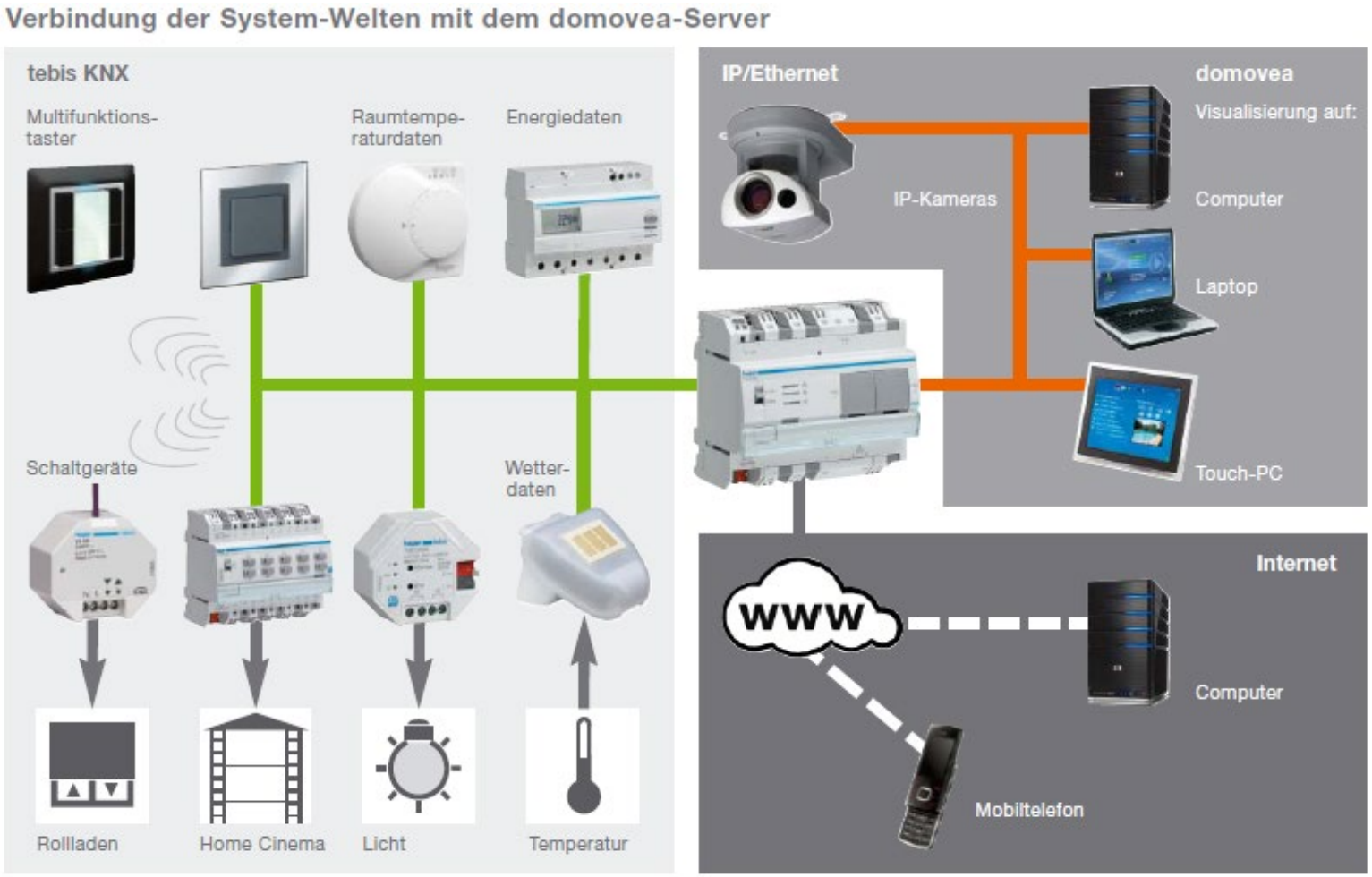
Mit unserem Smart Home Starter Set für Einsteiger bekommst Du alle notwendigen Komponenten, um Hab und Gut effektiv zu schützen. Der Clou dabei: Du kannst das System einfach selbst installieren. Zudem bietet das Starter Set ein unschlagbares Preis-/Leistungsverhältnis.

Starterset - **Fortgeschrittene**

In diesem MEDION Smart Home Starter Set für Fortgeschrittene befinden sich neben der MEDION Smart Home Zentrale vier Tür-/Fensterkontakte sowie ein Erschütterungssensor, ein Bewegungs- und ein Rauchmelder, ein Heizkörperthermostat, ein Zwischenstecker sowie eine IP-Kamera und eine Wetterstation.

Source: Medion

Smart Home – typical System architecture



Source: Hager

Installation and cabling needed

Smart Home - Status

Up to now mainly as individual installations in luxury segment (< 1%) or in research projects

Missing standardisation – „isolated application“
Integration made difficult by largely different product lifecycles

Trends: price decline, increasing choice of products for retrofitting, energy saving as driving force, wireless

Smart Home - Protocols

- Infrastructure (e.g.: 6LowPAN, IPv4/IPv6, RPL)
- Identification (e.g.: EPC, uCode, IPv6, URIs)
- Comms / Transport (ex: Wifi, Bluetooth, LPWAN)
- Discovery (e.g.: mDNS, DNS-SD)
- Data Protocols (e.g.: MQTT, CoAP, AMQP, Websocket, Node)
- Device Management (e.g.: TR-069, OMA-DM)
- Semantic (e.g.: JSON-LD, Web Thing Model)
- Multi-layer Frameworks (e.g.: Alljoyn, IoTivity, Weave, Homekit)

Example of Platforms spanning several manufacturers

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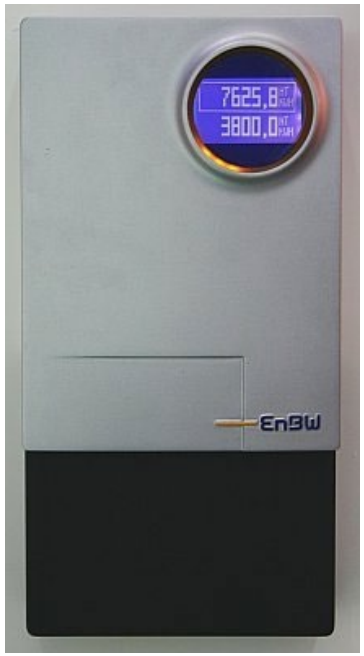
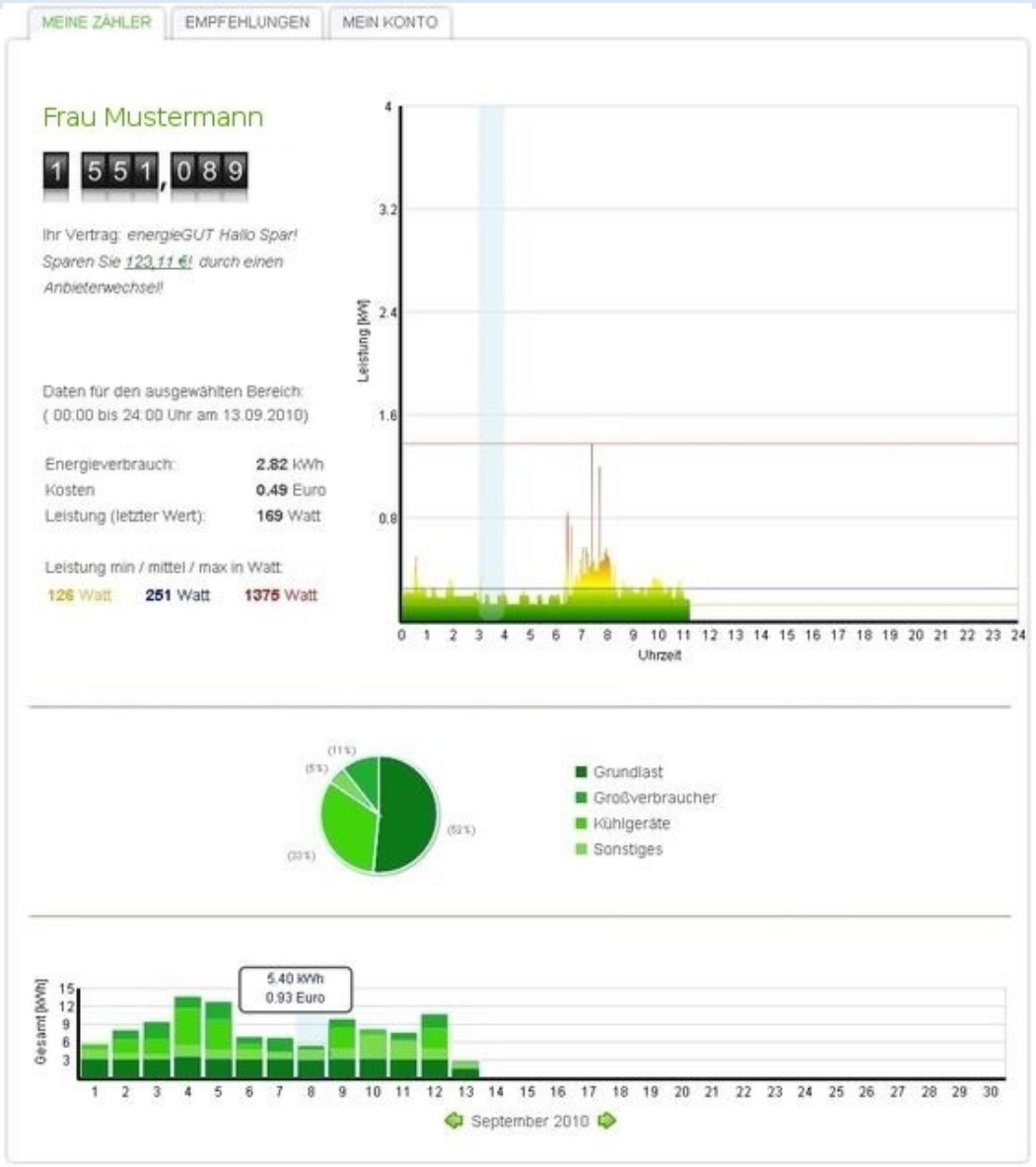
Telekom

Qivicon

Smart Metering as Sensor





Sources: EnBW, discovergy

Demo: https://my.discovergy.com

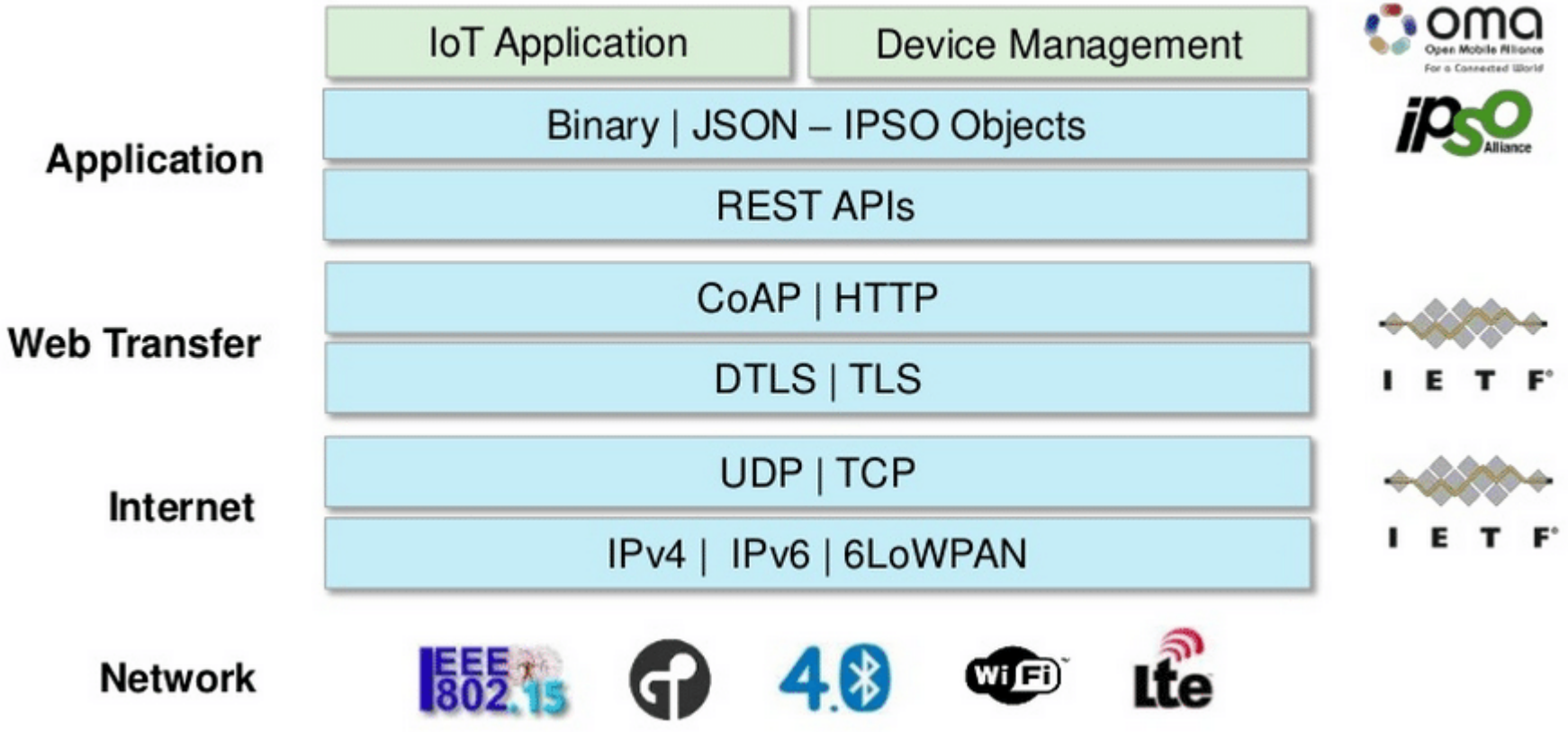
Smart Home: Applications in the AAL environment

- Support/orientation (e.g. automatic lighting)
- Automatic building control for disabled persons
- Usage of building sensors and Smart-Metering for monitoring and detection of emergencies
- Usage of building sensors as context information (e.g. localisation of user)
- In open environment nowadays with Narrowband IOT/LTE increasingly but not everywhere available

From Smart Home to Assistive System

- **Smart Home** allows users to interact actively with their living environment and to control it (also from afar). Smart Home optimises and monitors the living environment.
- An **Assistive System** additionally monitors the activities and the wellbeing of (single) users, without need for the person to actively do something.
- **IOT** is the network of physical devices, vehicles, home appliances, sensors, actuators, … to connect, collect and exchange data.

IOT Stack – Physical to Application Layer



Source: Simon Ford - Director of IoT Platforms ARM

Creating interoperability

- One platform offers the **coherent system environment** for applications. Often needed services are provided centrally. Different components can be attached via defined interfaces

or

- Middleware: An intermediate layer mediates between applications and infrastructure and hides the complexity of systems

Example of cross-manufacturer open platforms

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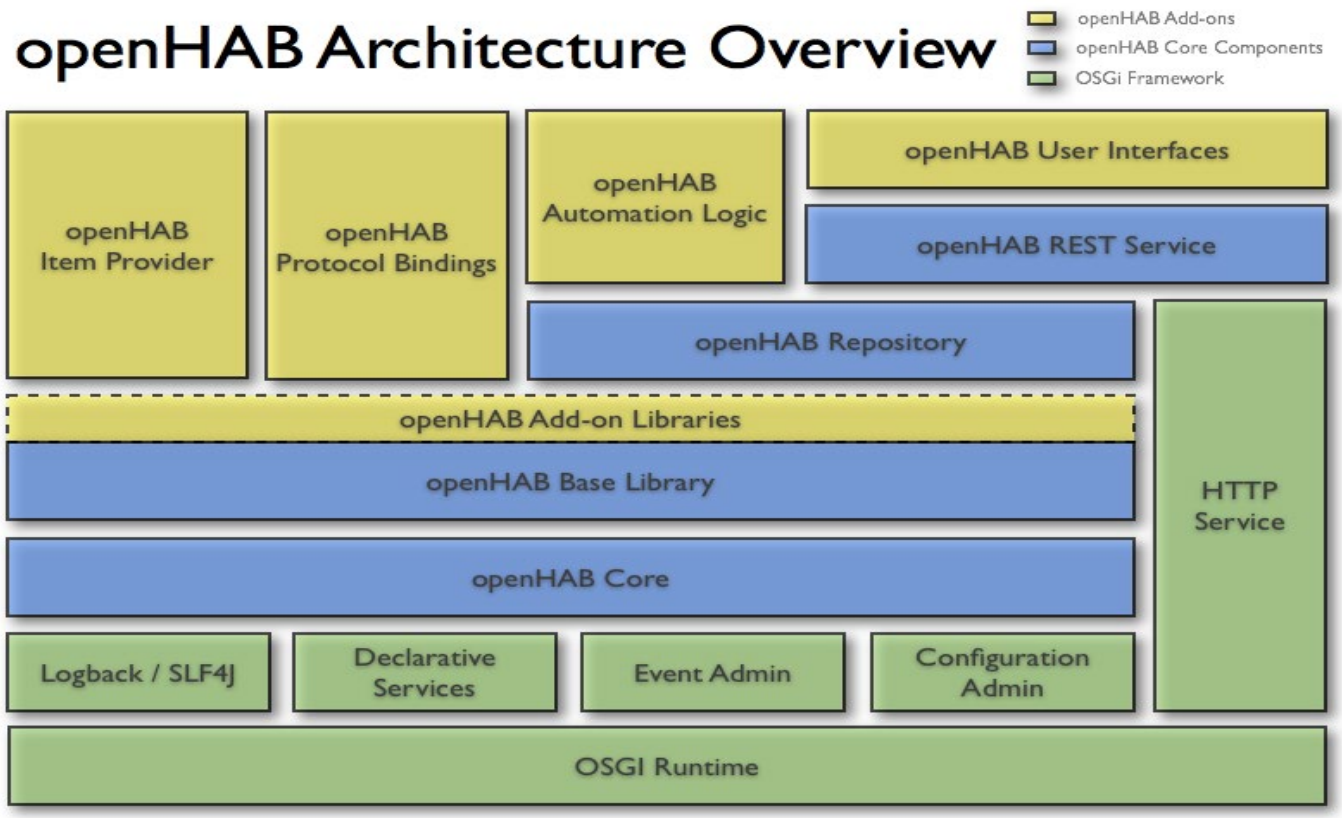
Open Home Automation Bus (openHAB) ->
Since 2013 „Eclipse SmartHome“

Open Source
JAVA, OSGI

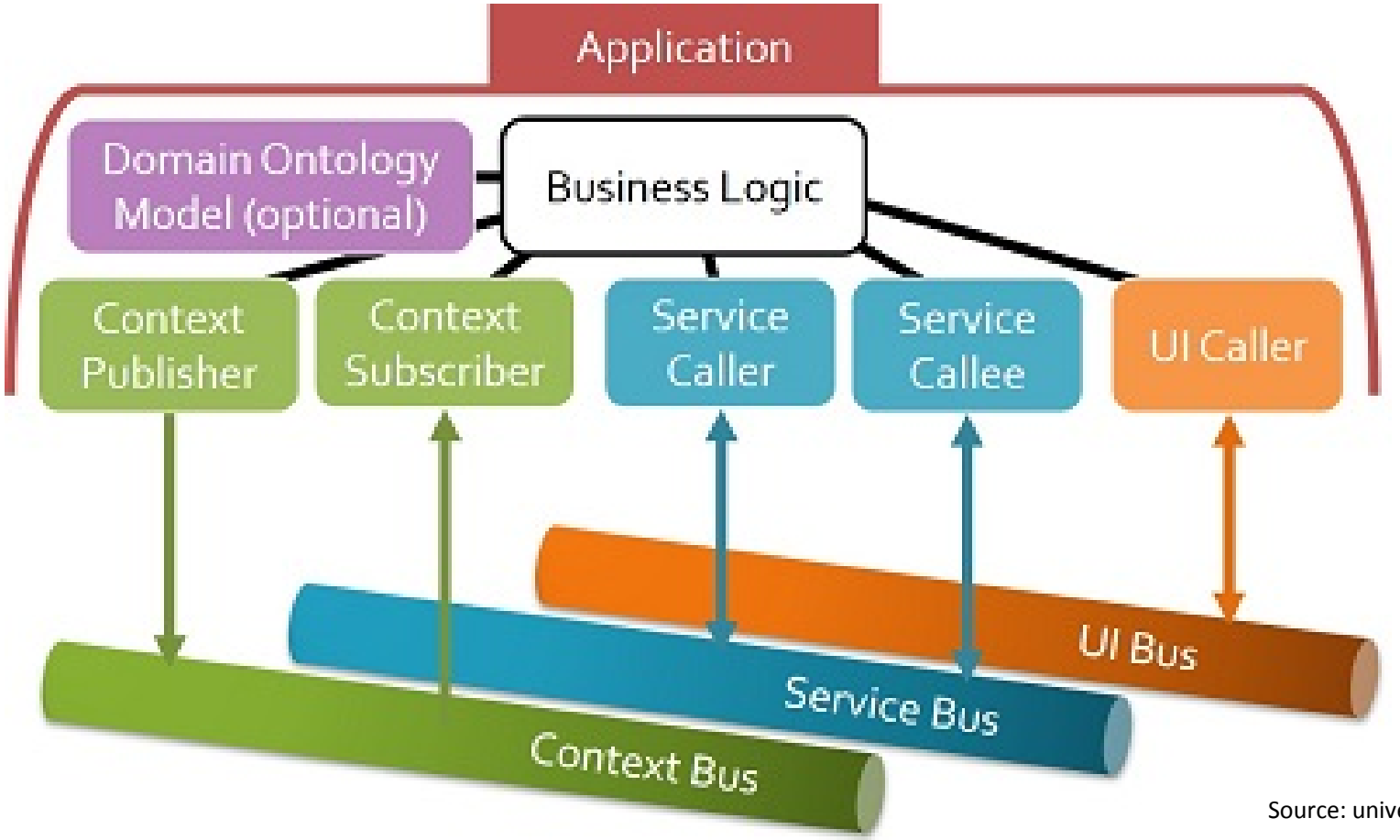
„Bundles“
Implement protocols and functions

Rules,
graphical user interface
Can be extended



Example of middleware: universAAL

Middleware supporting assistive applications



Source: universAAL

Ontologies: „common understanding“ of data from different services

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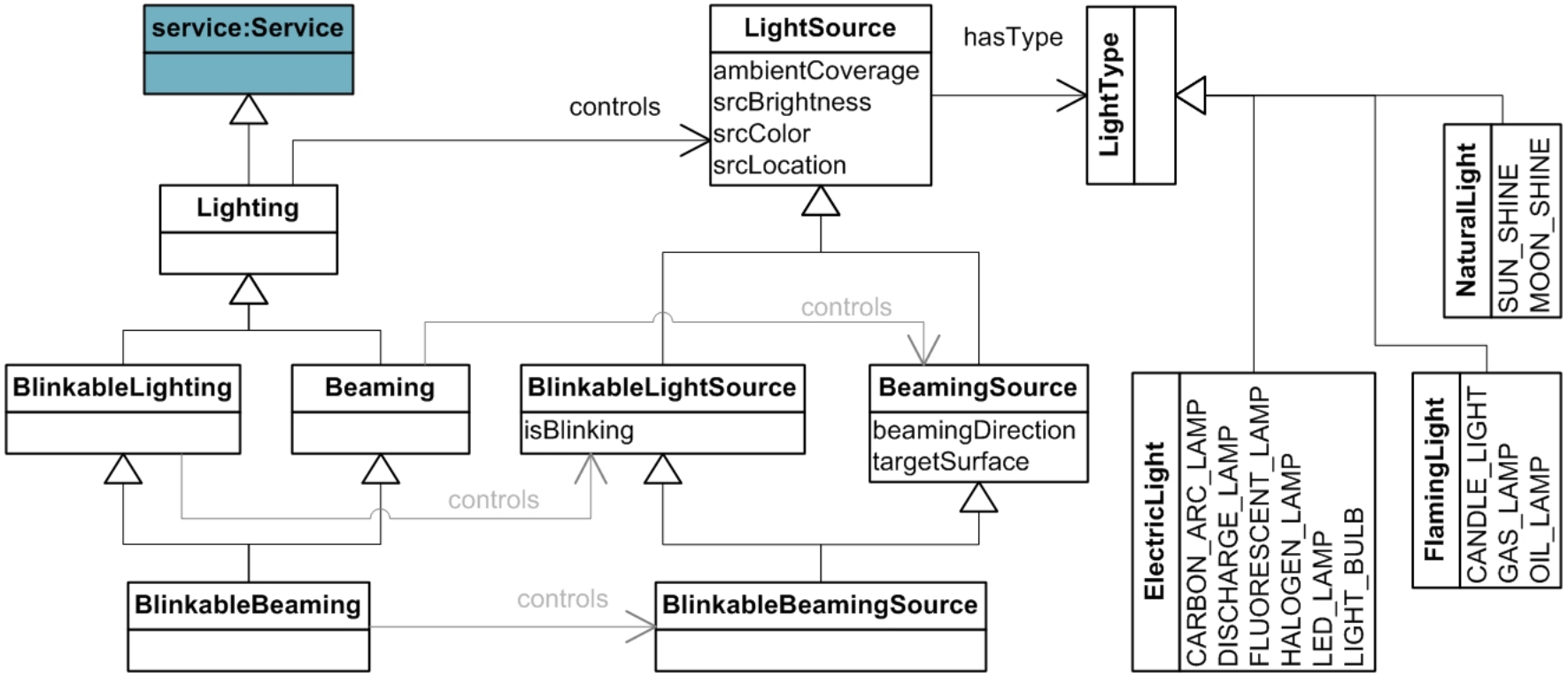
Example ontology: Activity Hub model (ISO 11073-10471) example “Lighting”



Source: universAAL

VO Assistive Systems

AAL relevant standards (examples)

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Bereich	Standard
Vital data sensors	Continua Health Alliance
Smartphone for apps	OS: Android, iOS
Sensors, building	Busses: KNX (EIB), Loxone…
Sensors, wireless	EnOcean, ZWave…
Household appliances	Miele@Home, Samsung, Bosch…
Health records	HL7…
User interface	(universal remote console)
Consumer electronics	Bluetooth, IR
Network	IPv4/v6, SSL, OpenID…

Also relevant ISO standards

ISO/IEC 29341 Information technology -- UPnP Device Architecture

Many parts e.g. part 30-1: IoT management and control device control protocol

ISO/IEC 30141:2018 Internet of Things (IoT) -- Reference Architecture

- Characteristics of IoT systems
  - trustworthiness characteristics
  - architecture characteristics
  - functional characteristics
- …

Current situation

- Many protocols, a wide range of available sensors, devices, related applications/ commercial systems => theoretically good starting point
- Manufacturers follow own „standards“ instead of complex public standards. Vendors are small companies or come from related business areas. Concepts for maintenance are rare.
- Little to no overview, consulting, financing
- Recently, attempt to establish safety and update standards.

Beyond Smart Home – Sensors, activity and context

Safety technology: Classic sensors

Movement detector on infrared (IR) basis (PIR = Passive Infra Red) needs change (movement)

Reed-magnet contact
Detects opening of doors and drawers, (or toilet flush)

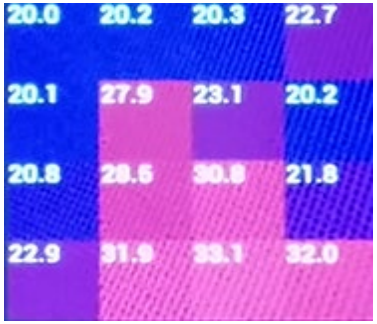
Switch/Measurement adapters
Measures current, switches load

Special sensors

Presence detectors on IR basis

Do not need movement for triggering (different to PIRs)

Deliver a coarse IR pixel image (temperature)



Detect presence of non-moving persons

Special sensors

Bed sensors recognize if a person is in bed:

AirSkin sensor: air(pressure)

Emfit mattress sensor

Bed foot sensor (weight)

Safety technology: Special sensors

- Current in cable without adapter (to plug in) and cutting cable (by stray field)
- Waterflow in pipe without measurement device to plug in between (by detection of temperature change, noise, vibration…)
- Temperature monitoring for stove (on IR basis)

Safety technology
Detection of hazards

Smoke detector
Stove switchoff
Water leakage alarm
Devices with automatic switchoff (flatiron, etc.)

Water leakage alarm

Smoke detector

Stove monitoring

Gas detector

Special sensors

Current:

Fitness tracker or Smartwatch (mostly via cloud)

Record movement, sleep phases, pulse

Bluetooth LE interface to Smartphone to cloud

Often proprietary encrypted data, only available via server from internet

Perils – e.g. falls at old age

Significance

- More than 15 Mio. people >65 years in D
- 30% of them fall at least once per year
- In care homes even two times per year

Results:

- 10-20% have to be treated by doctors
- 1-2% hip fractures
  - 70% likely death within a year for persons > 75 years

(Source: Wildner 2001, Hoffmann 2006, Gillespie 2003)

Sensors for fall detection

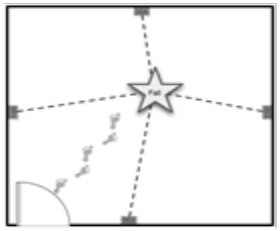
Users often not able to call help on their own, do not want to “annoy” or forget to make use.

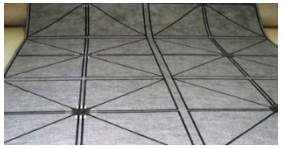
Body worn

- Movement, vibration
  Hip or wrist

On the floor

- Vibration, flooring





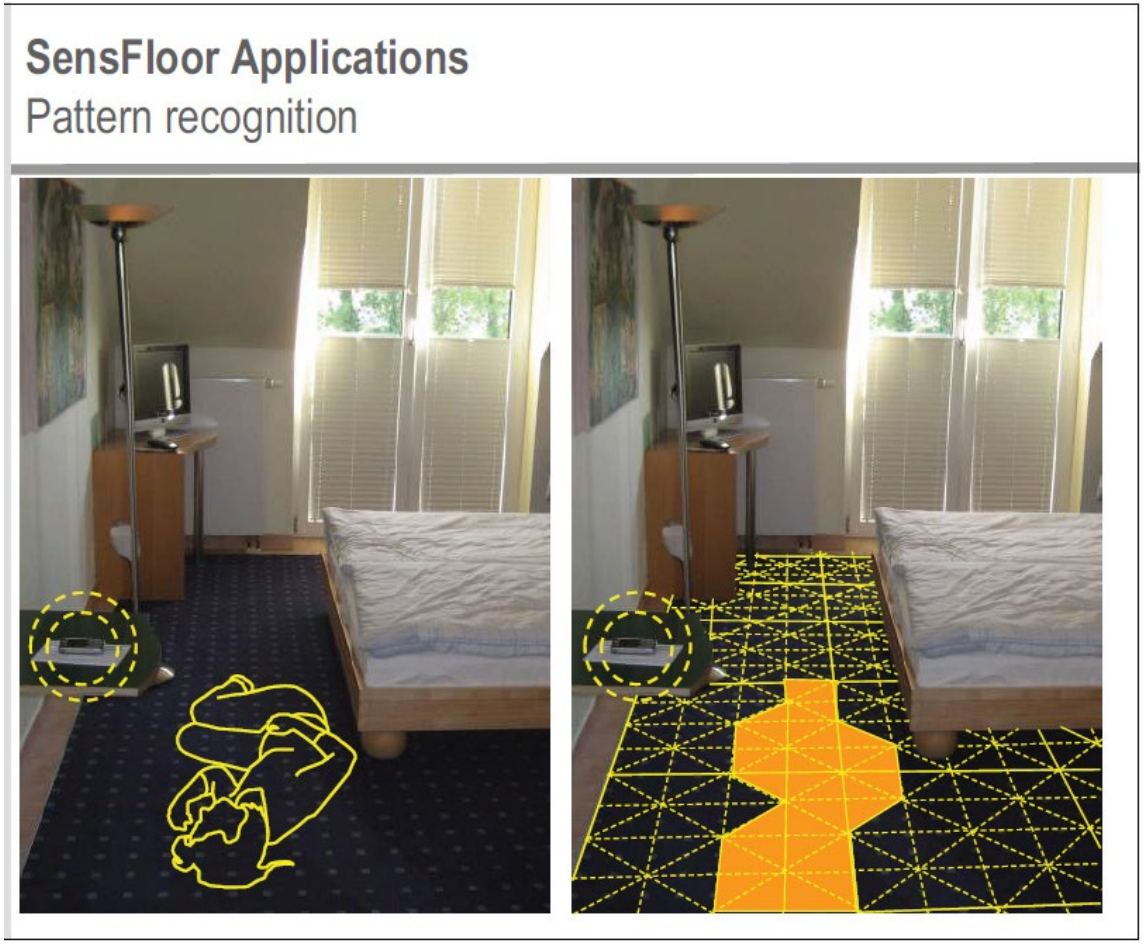
In the room

- 3D camera

Indirectly

- Inactivity

Fall detection: special sensors



Source:
FutureShape, 2010

Fall detection – fall prevention/mitigation

Are detection systems the only solution?

Even better:

- Fall prevention
  Better lighting
  Realisation, training
  Removal of trip hazards (carpets)
- Protection against fall consequences: cushions

Fall prevention - illumination

Battery operated orientation light with movement detector

Classic Senior alarms

Water detector /
Smoke detector

Wireless button

Central (PSTN)
alarm unit

Fall sensor

Classic and future alarm systems

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Problems today

- Low acceptance (pendant, sensors on body)
- High number of false alarms
- High rate of non users (obliviscence)
- Low diffusion (in D)

Solution attempts

- Ambient sensors instead of body worn
- Passive alarms (inactivity, no action needed)
- Flexible use (not only for emergencies)

House alarm, pendant and AmbiACT

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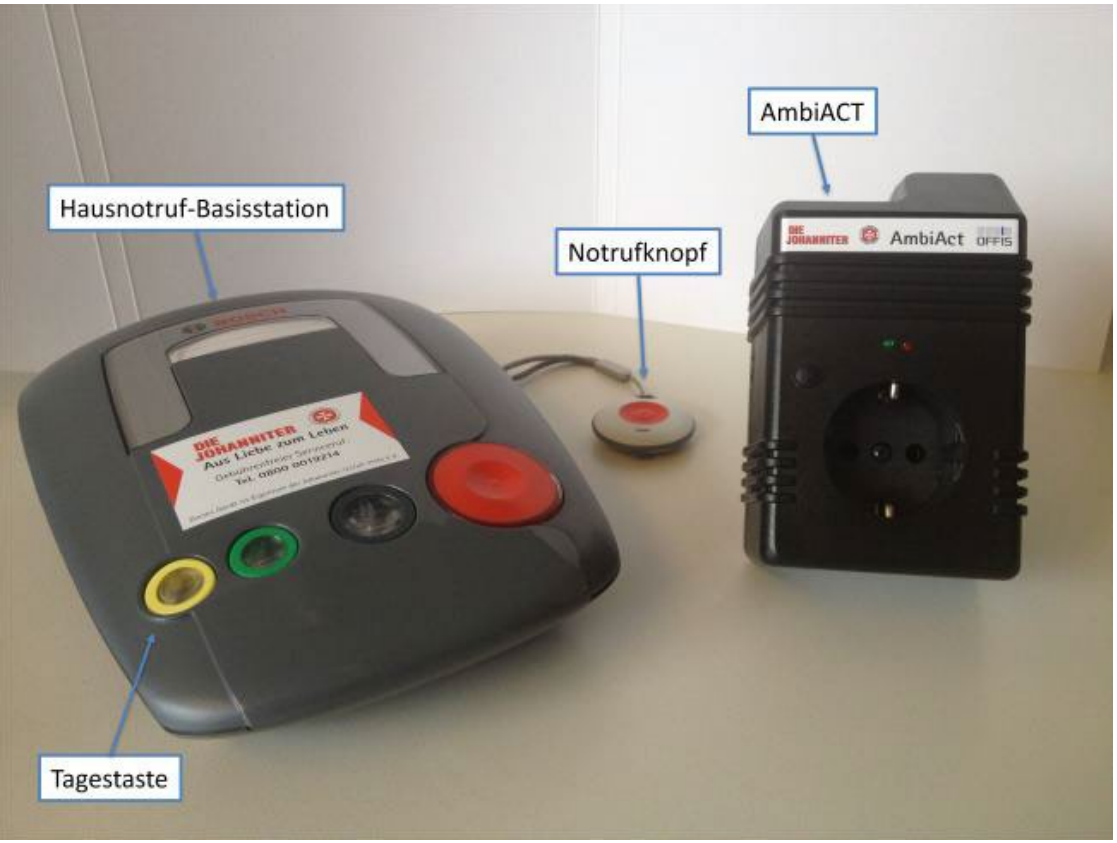
Simple combination



Source: Eckert et al., 2014

The AmbiACT-current sensor automates the reset of the so-called passive house alarm with every usage of an electrically powered device associated with activities of daily living

Example:
The AmbiACT current sensor is connected to a normally used daily electrical device (e.g. kettle, coffee machine).

The manual switching on / off of this device by the user is registered by the current sensor and leads to the reset of the "safety clock".

House alarm: current problems

- Based on classic telephone (PSTN) with power supply over telephone wires from automatic exchange
  -> telephone and alarm also worked in case of power loss in the house

- Nowadays often replaced by VOIP technology or mobile phone, -> no defined power outage bridge time.

(Costs ca. 25-30 € per month rent, optional add-on services)

Localisation systems
special localisation systems

Within buildings by transponders

Outside via GPS

Also in combination

Geofencing or localisation

Example:

Martin Elektrotechnik

„Schutzengelsysteme“

Raphael-Armbanduhr
mit eingebautem Transponder für Radiofrequenz-Identifikation, spritzwassergeschützt.

Uhrendummy mit Patentverschluss
als Armband oder Fußband. Offen frei verstellbar, geschlossen fest und sicher.

Raphael-Schlüssel
für den Patentverschluss. Durch Magnettechnik einfache Handhabung und große Zuverlässigkeit.

Raphael-Melder
einfach installieren und in Betrieb nehmen. Die Erfassungsreichweite beträgt 0,5 m - 7 m. Meldet auf beliebige elektronische Benachrichtigungssysteme.

Localisation systems: Special mobile phones

E.g.: SmartLinq

E.g.: Emporia

E.g.: sazo GPS

Activities of daily living (ADL)

Activities of daily living (ADLs or ADL) is used in healthcare sector to refer to older persons' daily self care activities.
3 classes of ADL are important for Assistive Systems:

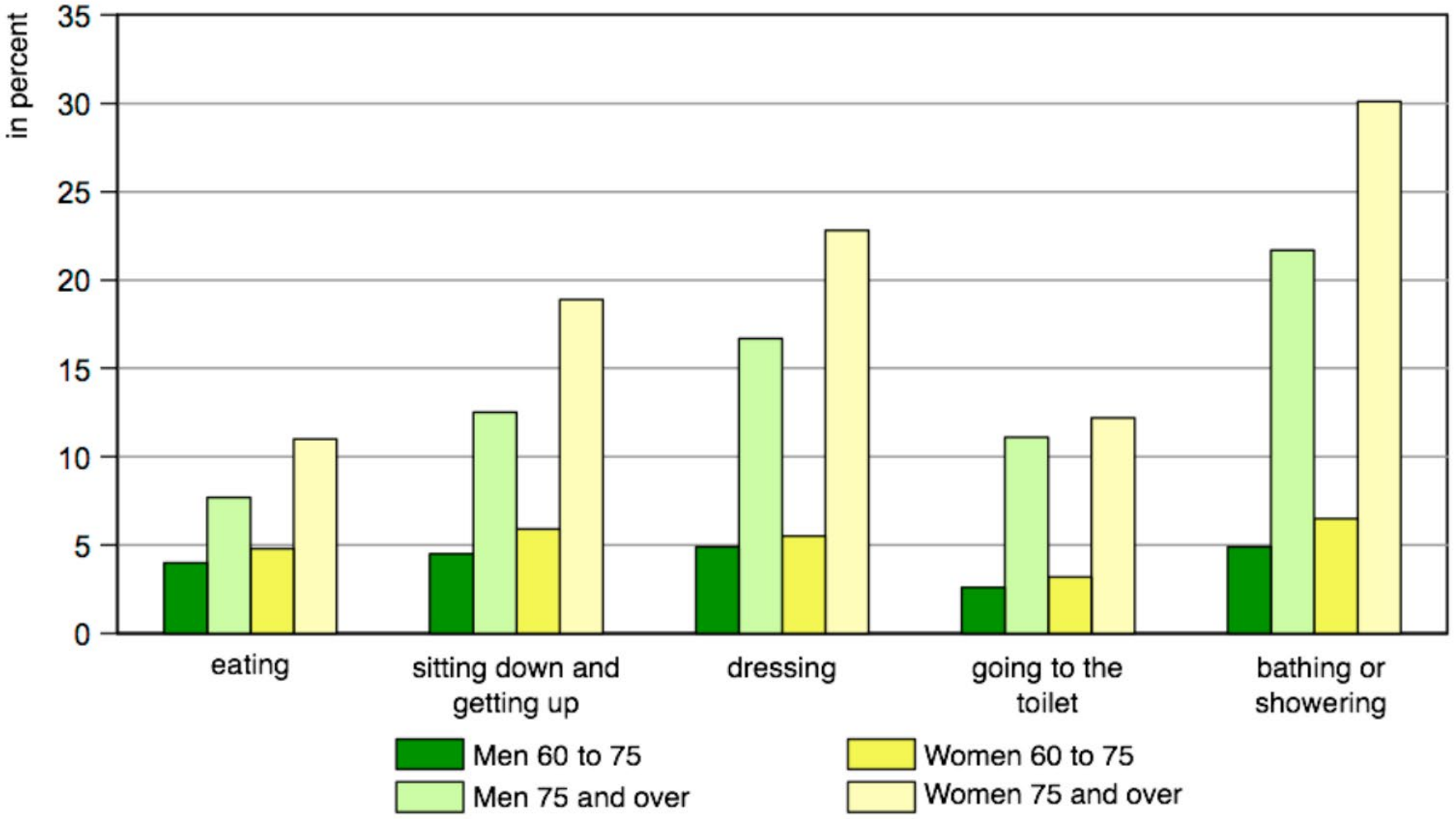
(basic) ADL = Activities of daily living. They include the ability to toilet, feed, dress, groom, bathe, and ambulate.

iADL = Instrumental ADL. They include the ability to successfully use the telephone, shop, prepare food, do the housekeeping and laundry, manage medications and finances, and use transportation

eADL = Enhanced ADL include participation in social and enriching activities, such as learning new skills and engaging in hobbies.

Source: potenziAAL, benefit, 2015

Older people's difficulties with ADLs



Source: Statistik Austria, Österreichische Gesundheitsbefragung 2006/2007, nach potenziAAL, benefit, 2015

Sensors and data

Types and quality

Sensors, aspects

- Power supply
  - Mains, battery
  - Energy Harvesting
- Networking
  - Cable
  - RF wireless
- Mounting
  - Size
  - Conspicuousness
  - Obstructiveness e.g. at cleaning
  - Removability (mounting holes)
  - Stability

Sensors, types

- Fall
  - Vibration, distress sounds
- Position
  - Movement
  - Presence
- Activity
  - Movement
  - Opening doors
  - Usage of (electric) devices
- Environmental conditions
  - Light, temperature
- Presence (indirectly)

Sensors, data

There are different kinds of data:

- Direct „analog“ readings e.g. temperature as indicator for situation, battery monitoring

- Single „events“ e.g. alarms

- Indicative events as local indicators of incidents e.g. movement sensors

Data mostly occurs in form of time series, the order and synchronisation with time is important, especially with networking

Sensors, purpose

- Presence (mostly indirectly)
- activity – context, instructions
- Position – contacting user
- Environmental conditions – emergencies
- Activity - and inactivity patterns
  - Comparison with typical patterns
  - Emergency detection
  - Daily patterns e.g. light at evenings, visiting WC, bed
  - Statistical adaption to frequency of certain events

But: collect only necessary data

Sensors, experience

Technology not always is popular and accepted, the users are no typical consumers, which themselves choose the systems.
Sensors and modules should be as invisible as possible. Many older people find technology as not fitting to furniture and intrusive, even when it is not at all in their way. Blinking lights or noises are found to be extremely disturbing and there are frequently doubts regarding radiation (possible sleeping disorders) and power consumption (always on).
But: users have a right to know about sensors

Sensors, perils

- Additional cabling can increase tripping hazard -> carefulness with installation
- Wireless data transmission can be captured by unauthorised persons -> encryption
- Collected data can be stolen by unauthorised persons -> authenticated access, protocols, data economy and preferably no transmission over Internet, if at all only encrypted and secured
- Deceptive safety -> sensors should never be seen as sole guarantor of safety

Are basic sensors from building technology useful also for more complex detection?

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Movement/presence detectors

Presence of a person in a room, movement

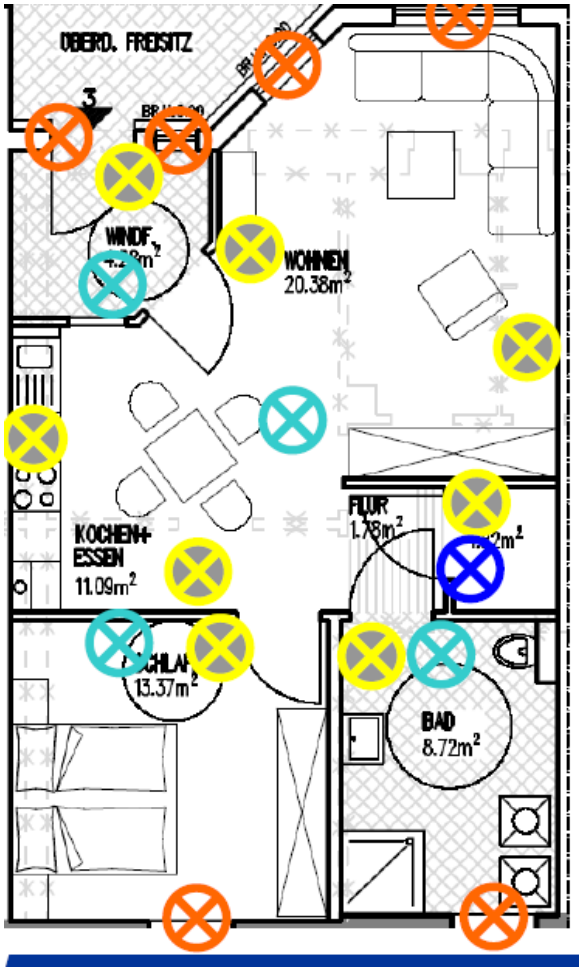
Window/door contacts

Open/close

Digital/smart meters

Usage of electric devices, lights

AAL approach: detect Situation from (Smart) Building Technology indirectly



- **Tür- bzw. Fenstersensor inkl. elektrischem, mit PAUL bedienbaren Rollladen**
  Door, window
- **Bewegungsmelder**
  Movement
- **Lichtschalter, auch mit PAUL bedienbar**
  Light
- **Wasserflusssensor**
  Water

Source:
TU Kaiserslautern

Sensors for selected ADLs - indirect sensing

ADL	Type	Place
Washing and clothing	Humidity Movement	Bathroom Bathroom
Washing and clothing	Contact Temperature Movement	Wardrobe Bedroom Bedroom
Defecation	Movement Contact	Toilet room Flushing
Activity	Movement Contact	All rooms Entrance
Eating and drinking	Contact Contact Movement	Cupboard Fridge Kitchen

Source: Chiriac 2012

Sensors – periodic check

Sensor	*Frequenz*	*Lebensdauer*
Bewegung und Helligkeit	15s (bei Bewegung)	> 1 Jahr
	2-6 min (ohne Bewegung)	
Temperatur und Luftfeuchte	2-3 min	< 3 Jahre
Kontakt	1x pro Tag (Alive-Message)	> 2 Jahre

Source: Chiriac 2012

Sensors emit messages in intervals according to configuration → allows function check.
If e.g. a contact sensor does not send a message at least once per day, it can be concluded that there is a problem (possible low battery, broken)

Activity monitoring in real applications

VC&HCT





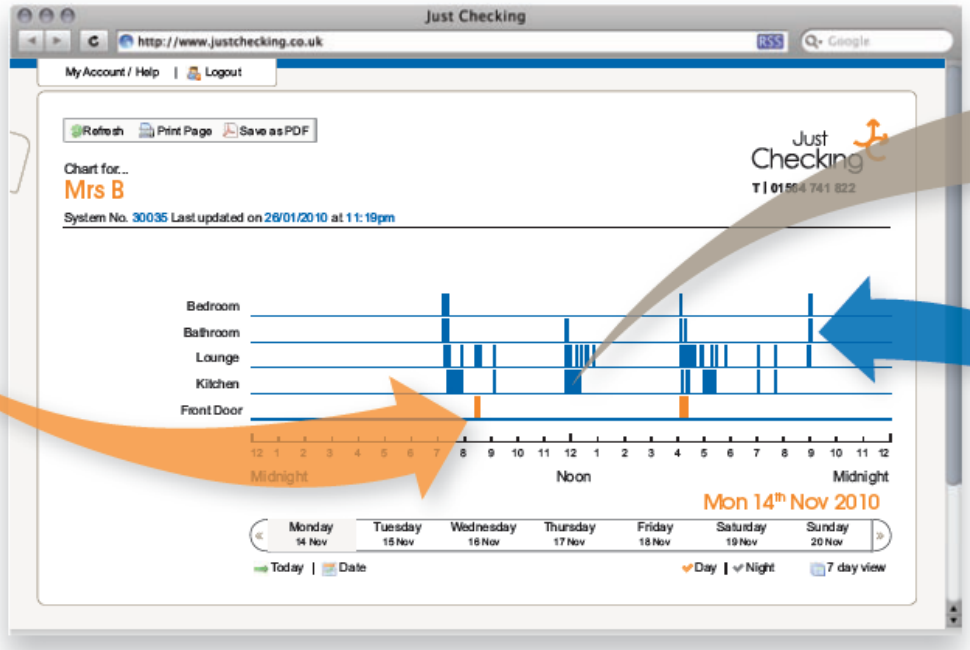

Sensors and data

Evaluation and visualisation

Detection and decision

Example: Activity diagrams

VC&HCT



Front Door:
Homecare visits...

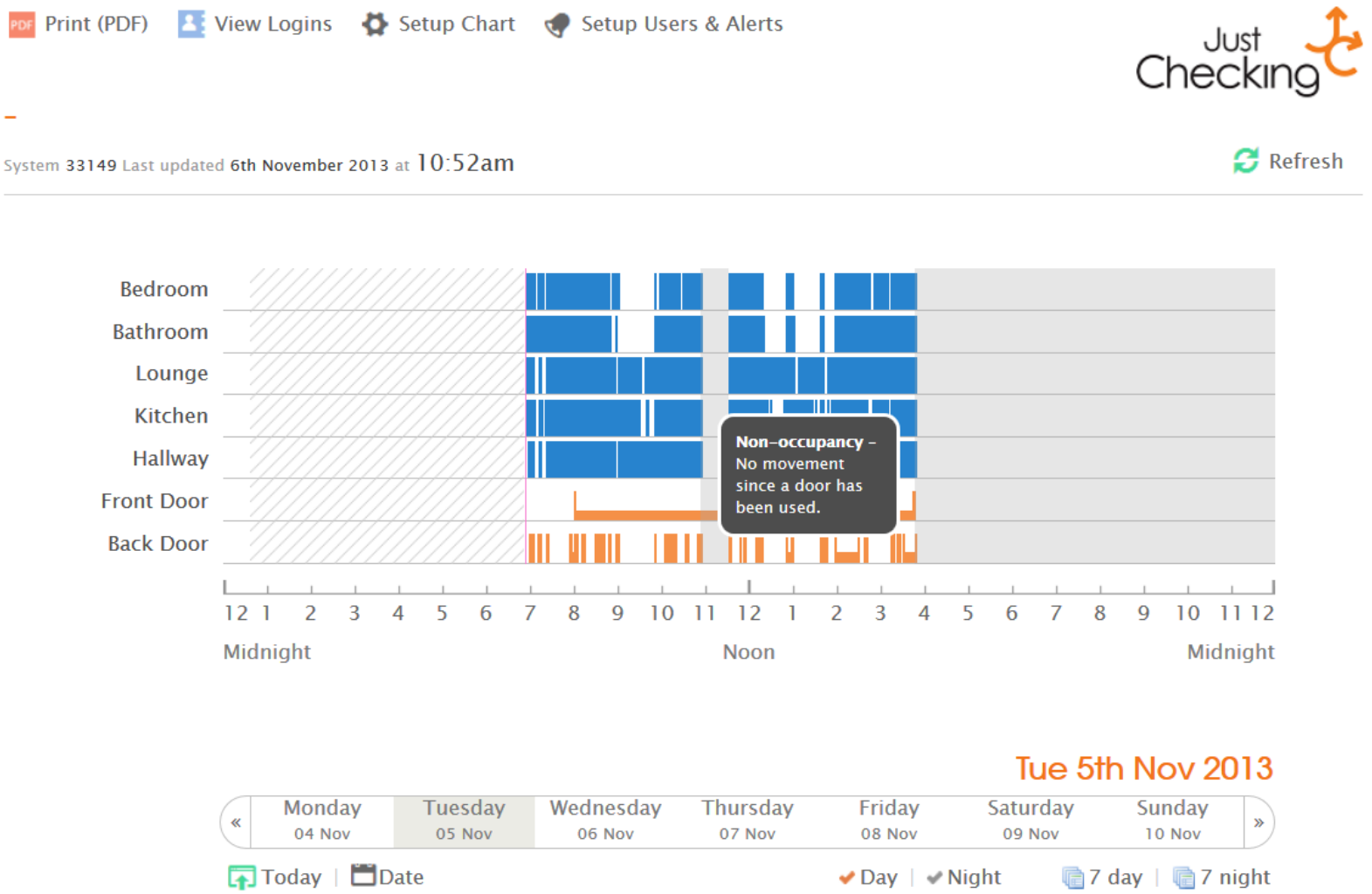
Kitchen:
Meal Preparation...

Bathroom:
Regular visits...

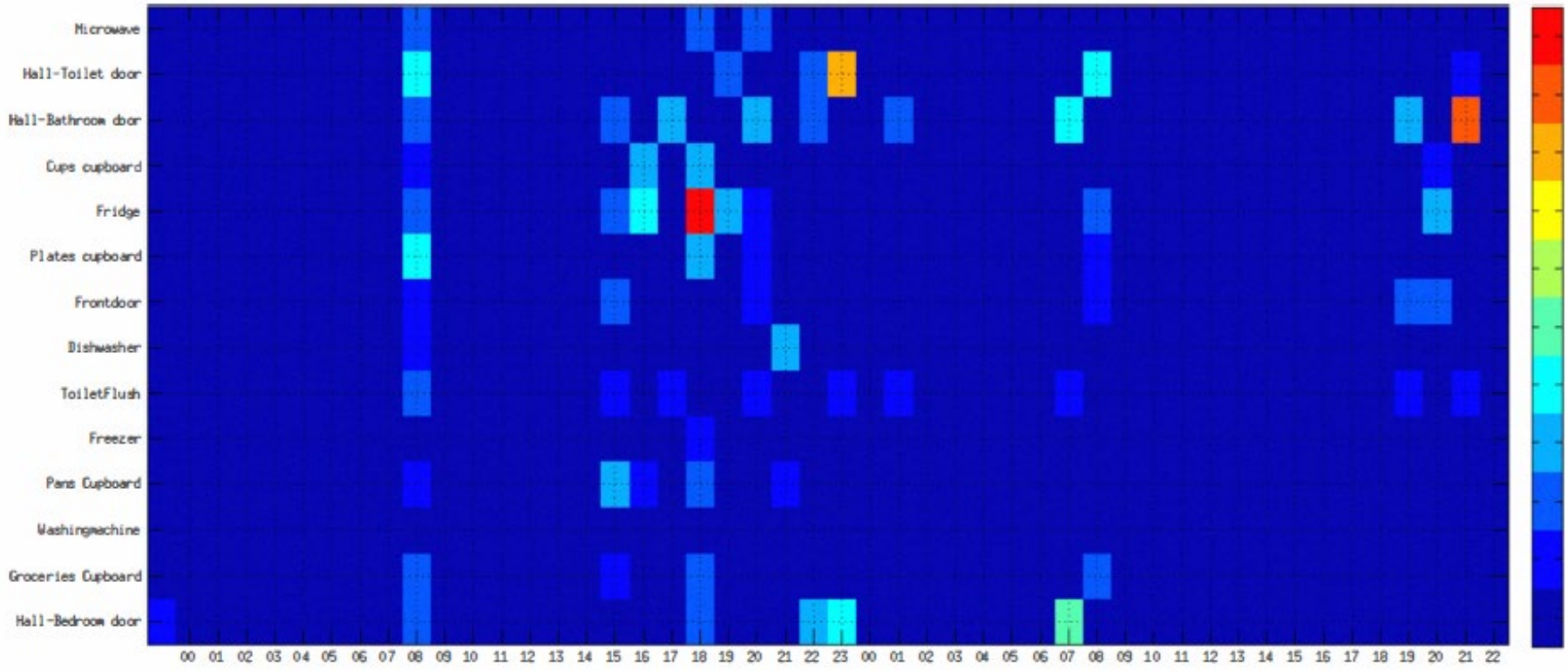
Source:
www.justchecking.com

VO Assistive Systems

Example: Activity diagrams



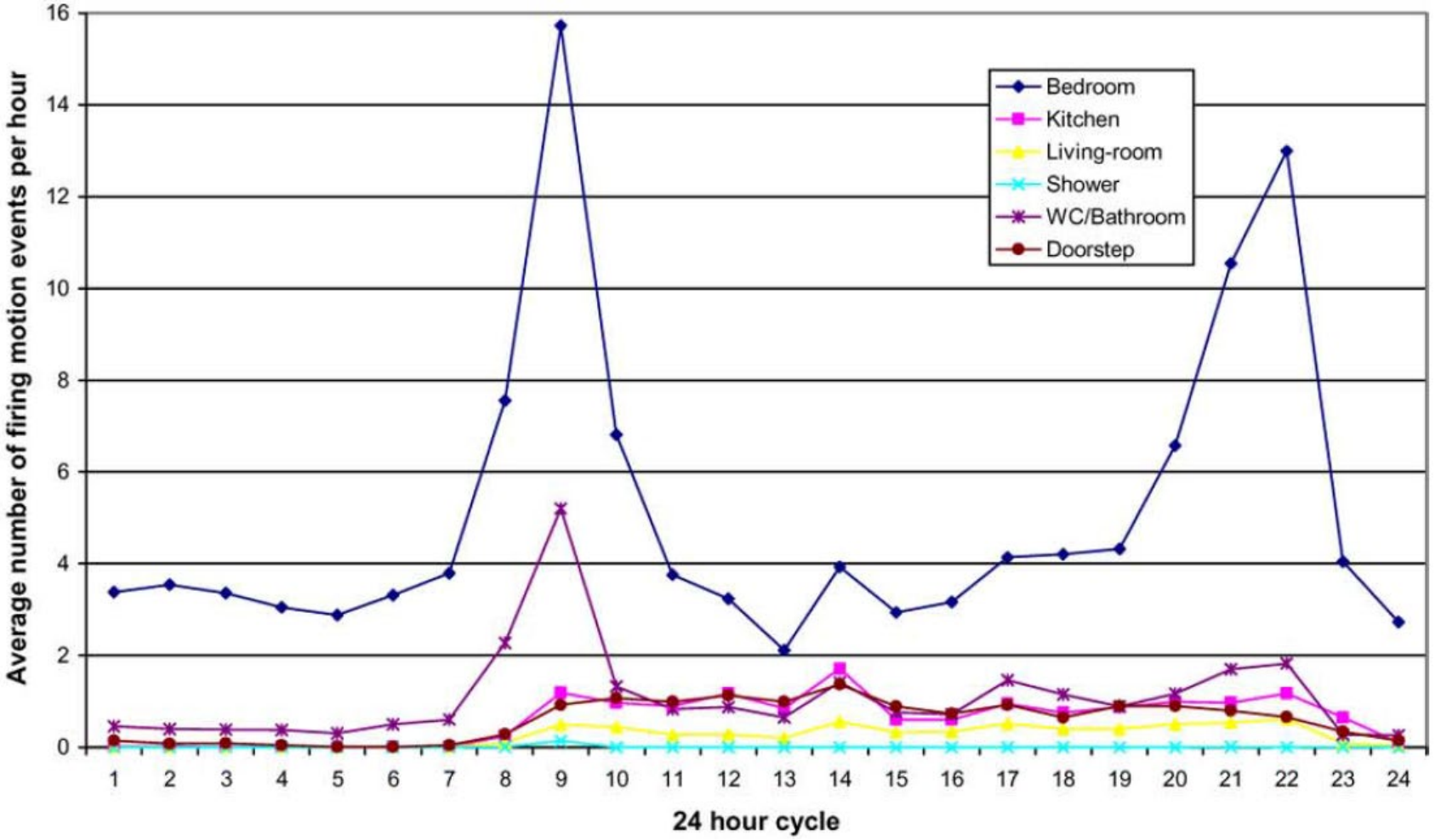
Example: Activity as heatmap



„Heatmap“: the „hotter“ the more activity

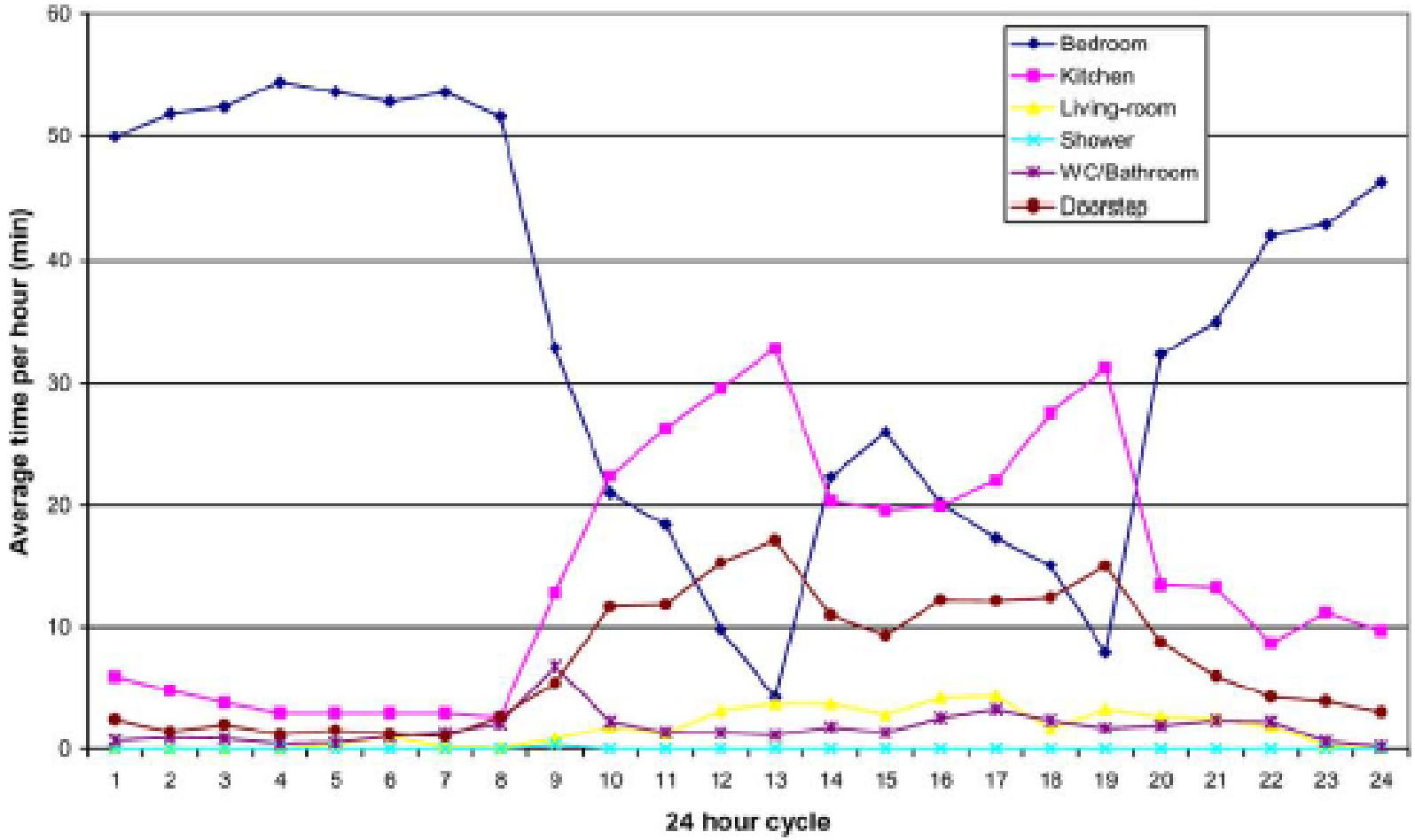
Source: Kropf et al. 2012

Example: activity per room



Virone et al. 2008

Example: presence per room

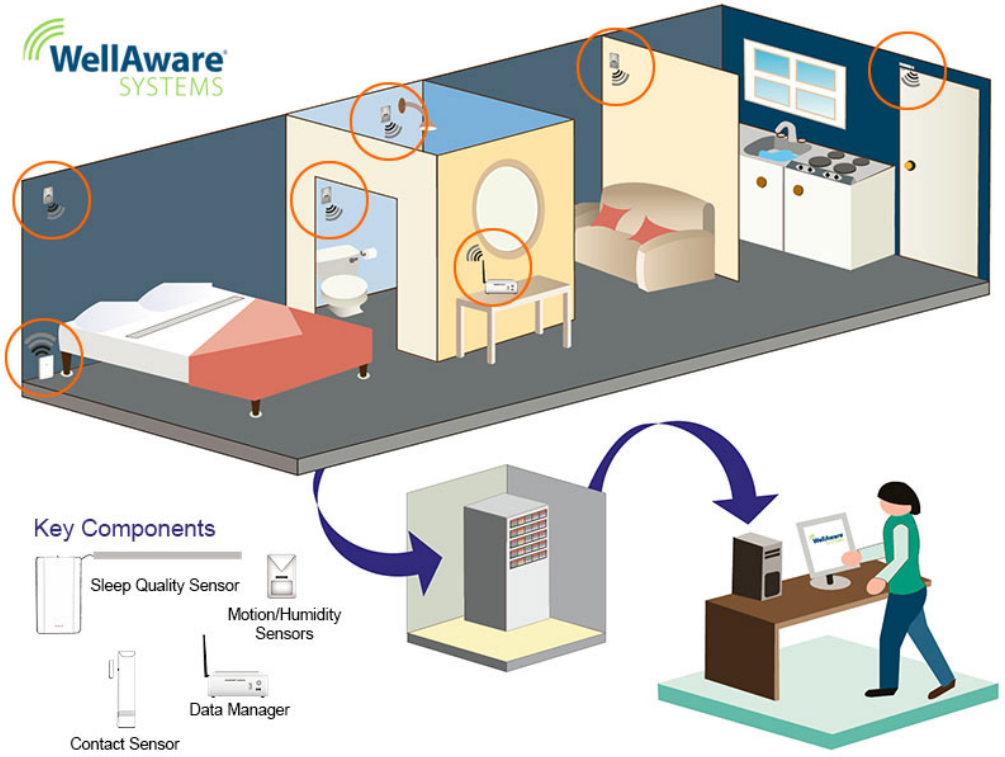


Virone et al. 2008

Overview: vendors today

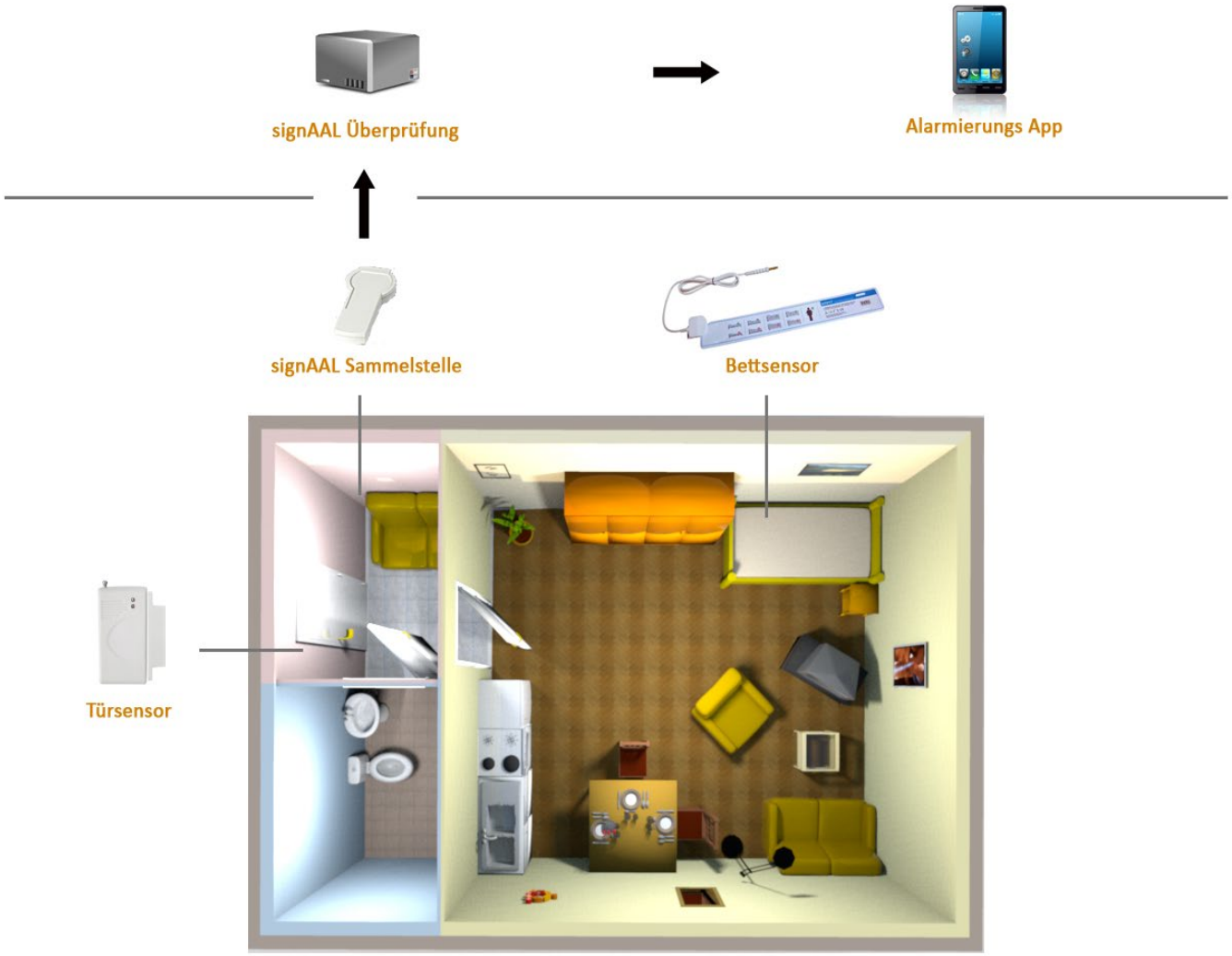
Also in D:
Tunstall Adlife
Locate Solutions
easierLife

Only in USA / GB:
BeClose
Just Checking
QuietCare
WellAware
Simply Home
GrandCare Systems



Example signAAL project

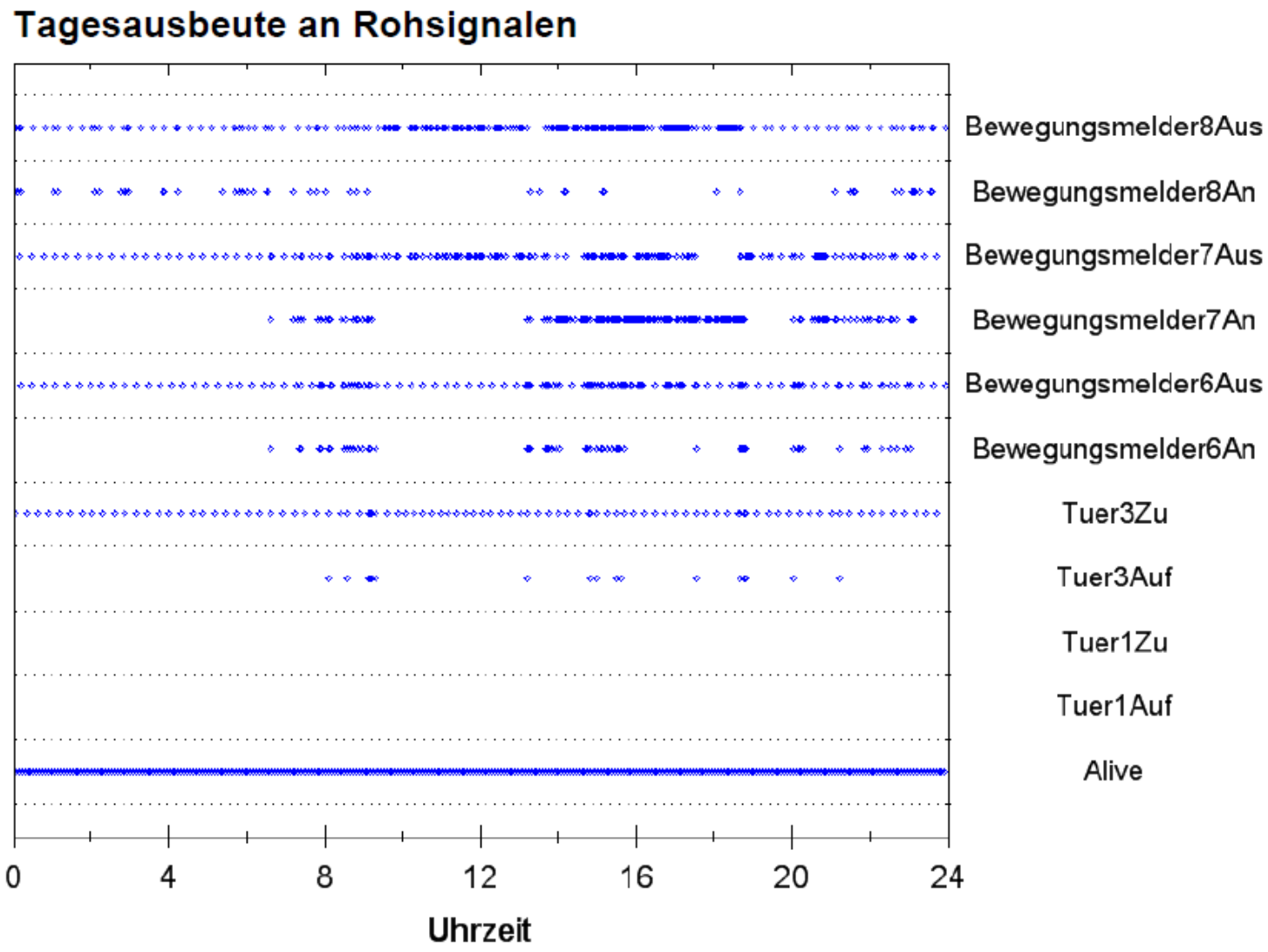
System for detection of unusual nightly activity and support for care staff



Source: www.aat.tuwien.ac.at/signaal/

Situation recognition in AAL systems: Starting point: sensor data time series

VC&HCT

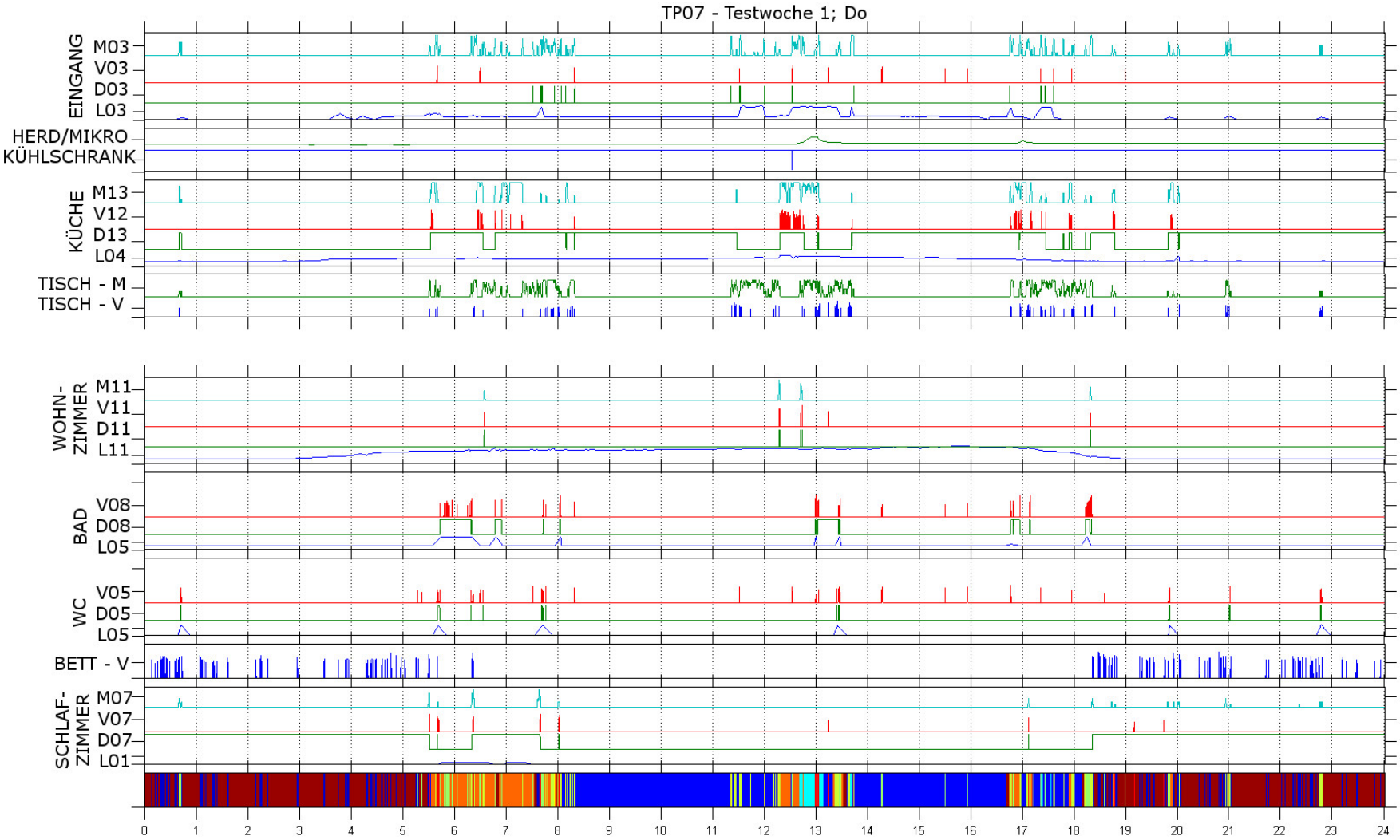


Source:
Tu Kaiserslautern

VO Assistive Systems

Situation recognition in AAL systems: Starting point: sensor data time series

VC&HCT



Patterns of classes of actions from raw data (eHome project)

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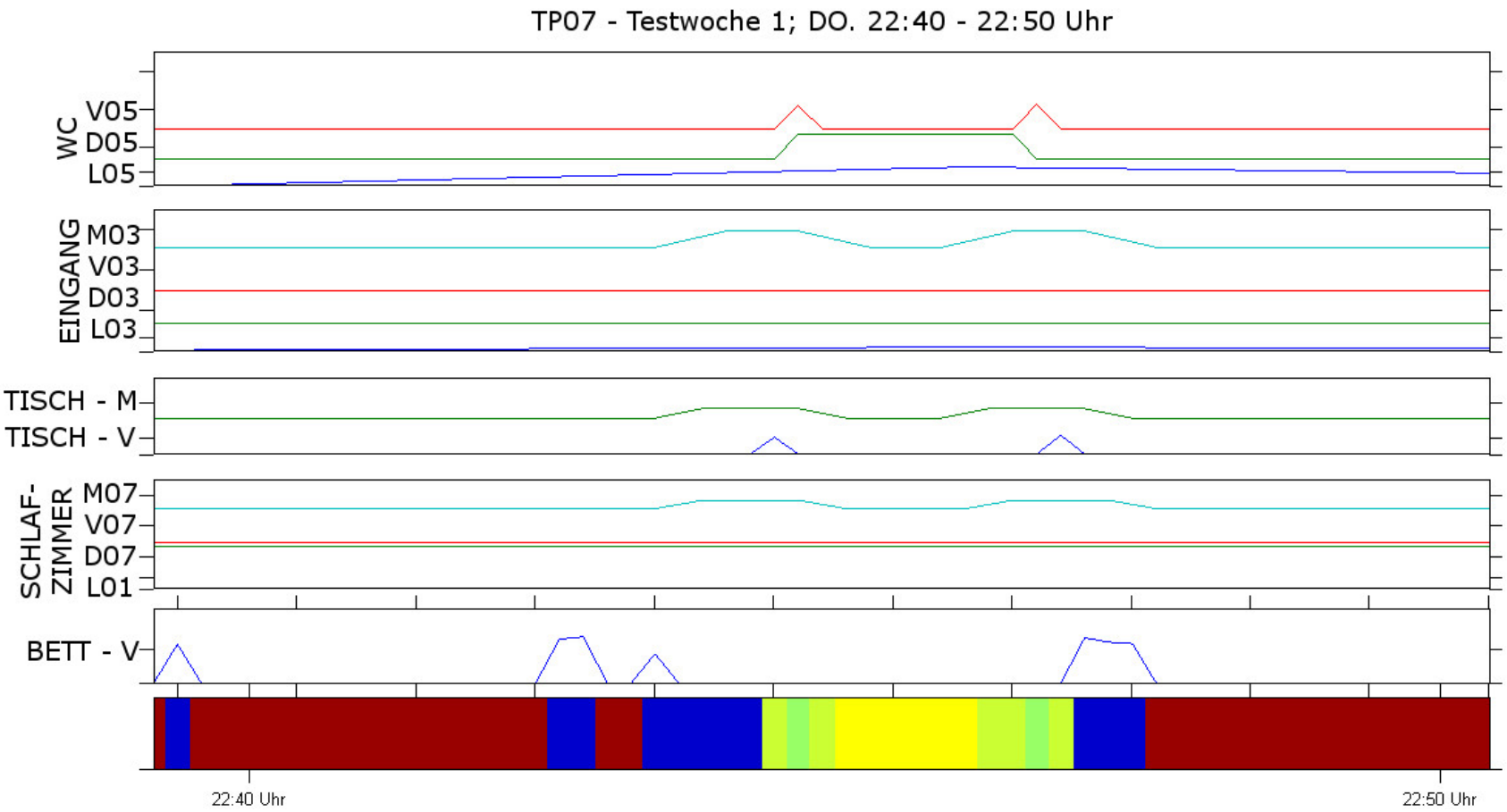
Situation recognition in AAL systems: Detail: nightly visit of toilet

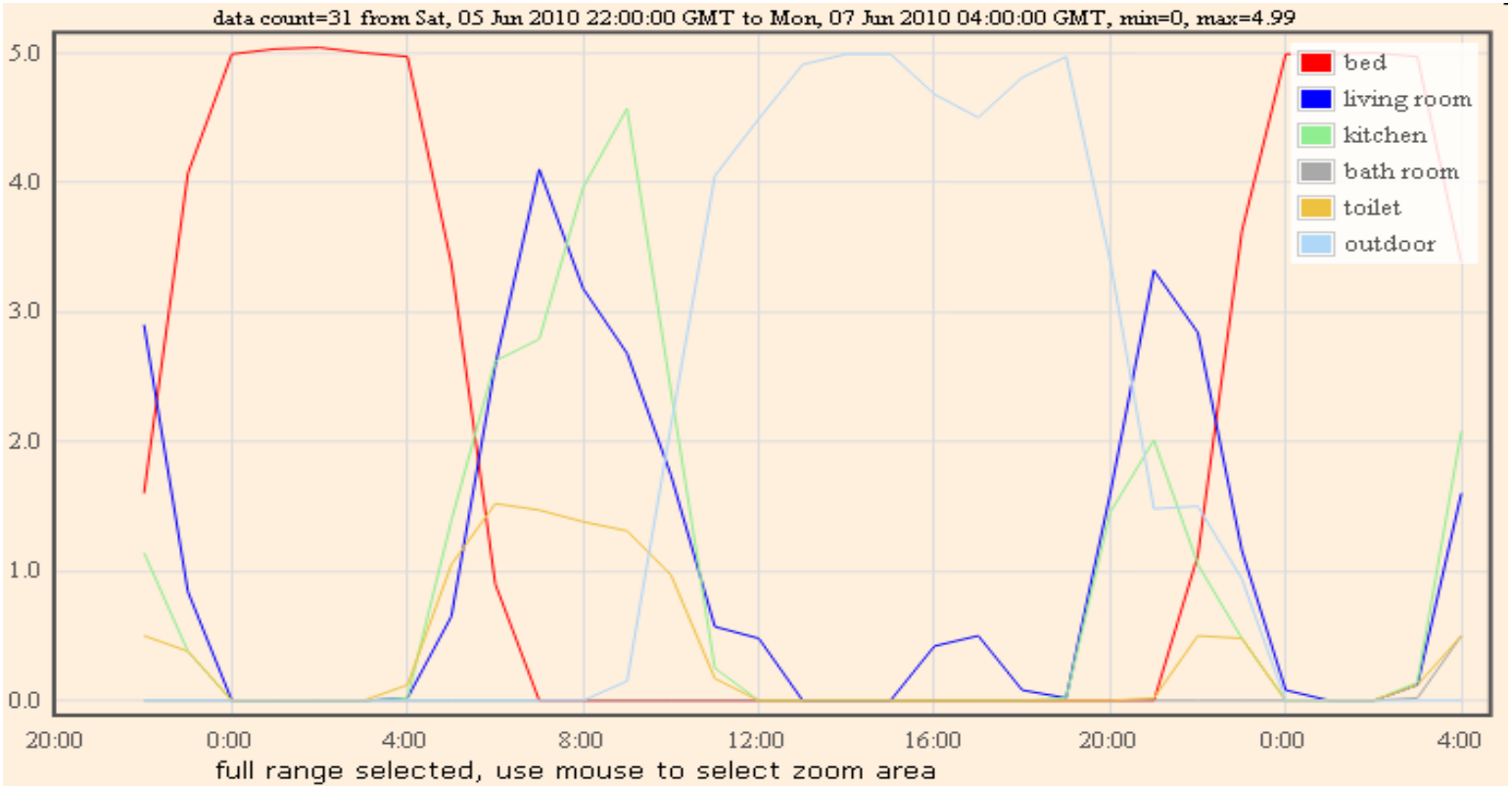
VC&HCT



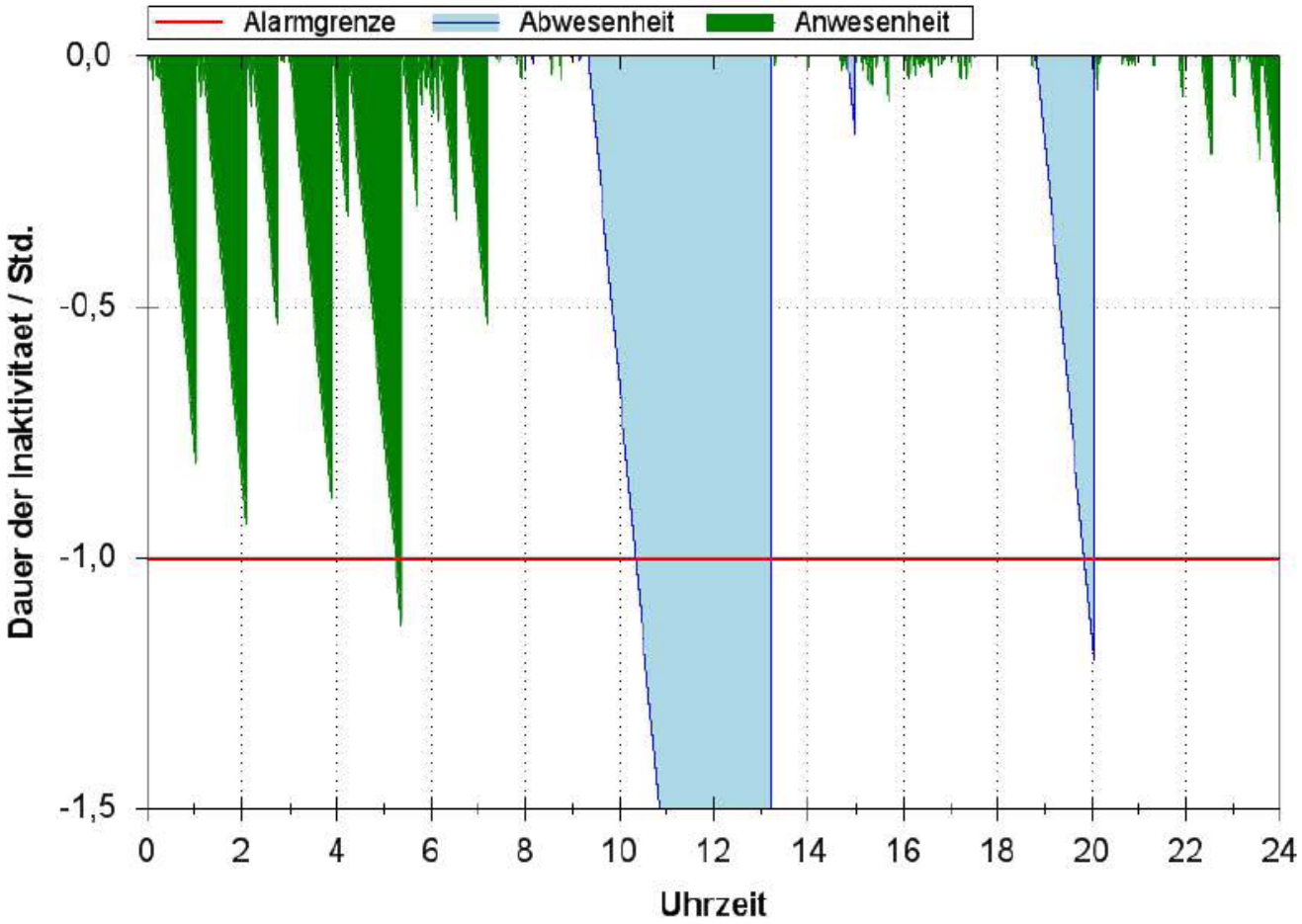
Patterns of classes of actions from raw data (eHome project)

Simple situation recognition: Statistics – comparison with past

VC&HCT



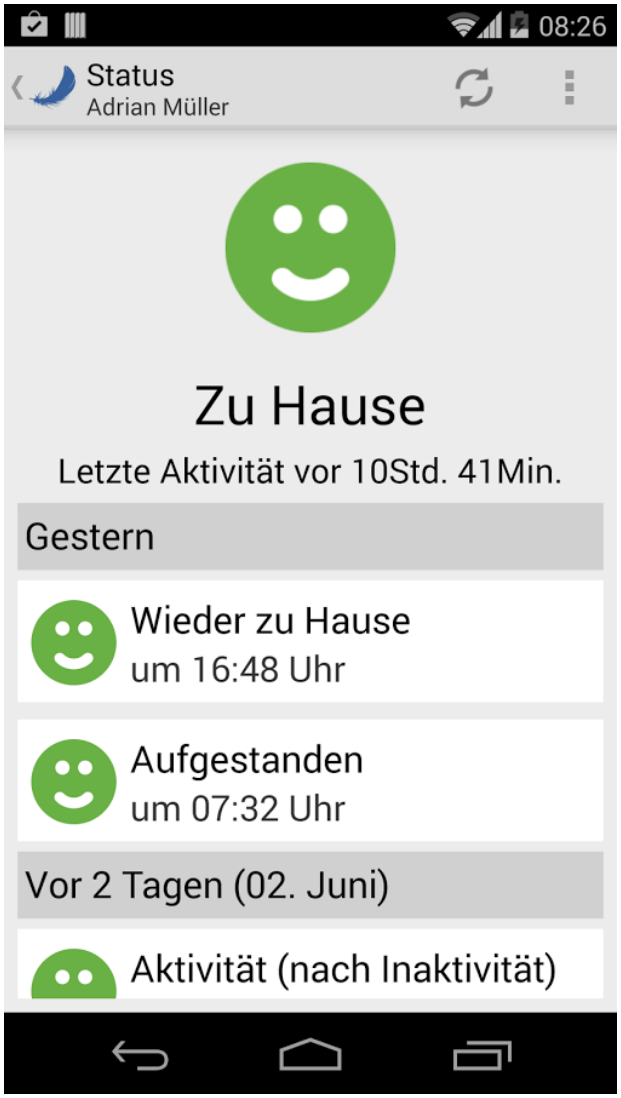
Simple detection of situation: Inactivity – what is „normal“?

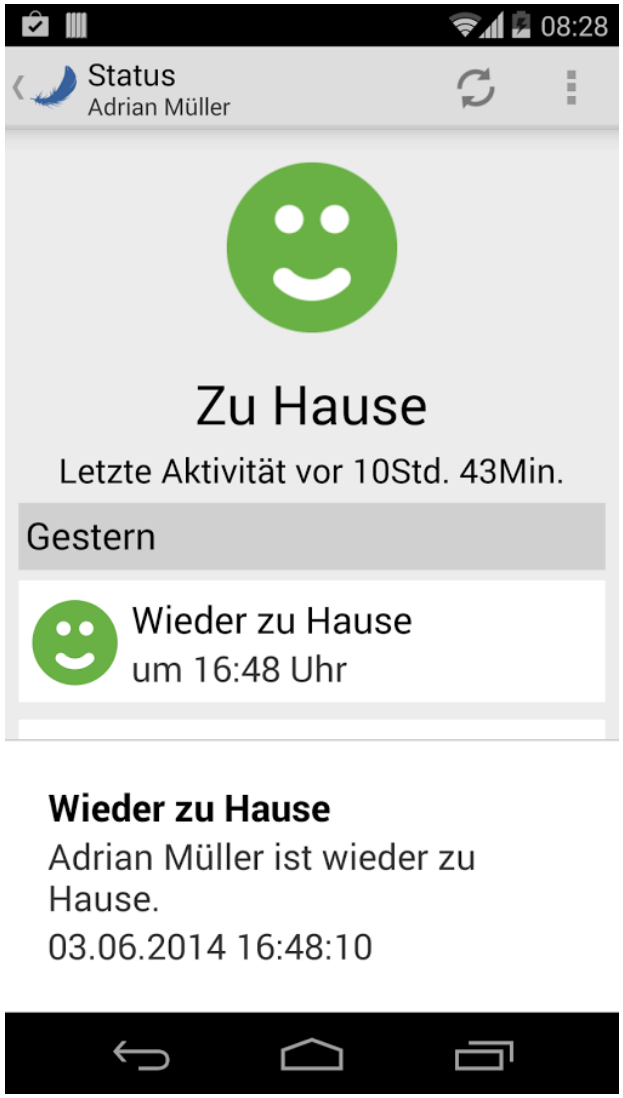


Quelle:

Tu Kaiserslautern

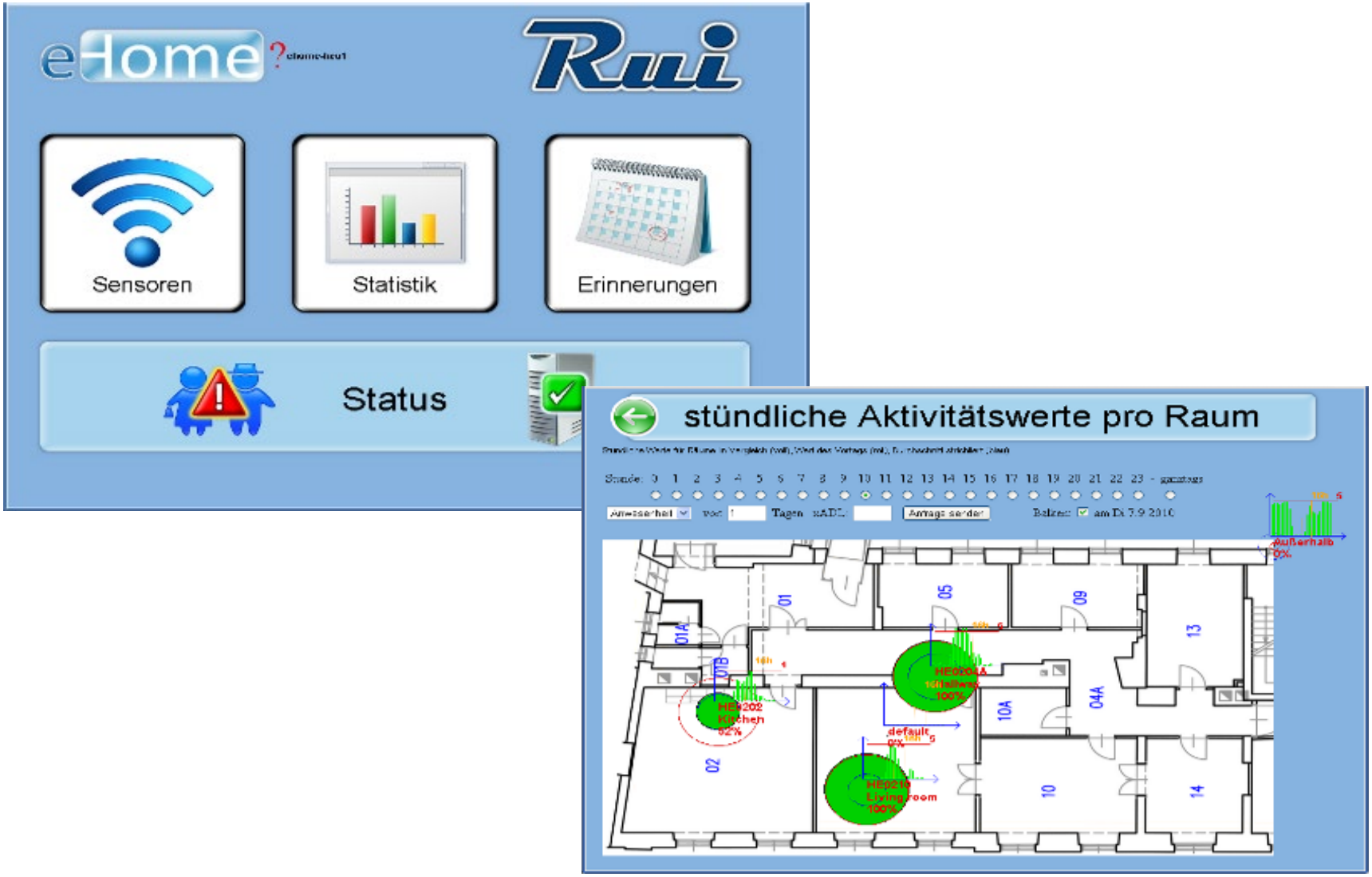
Example: automatic evaluation and visualisation (App)





Source: easierLife

Example: automatic evaluation and visualisation (remote interface)



Methods for situation recognition What is unusual?

Rule based (specification based)

e.g. logical rules, semantic models (Ontologies)

Needs rules which implement ***Domain knowledge***
e.g. from experts, immediately useable, parameters

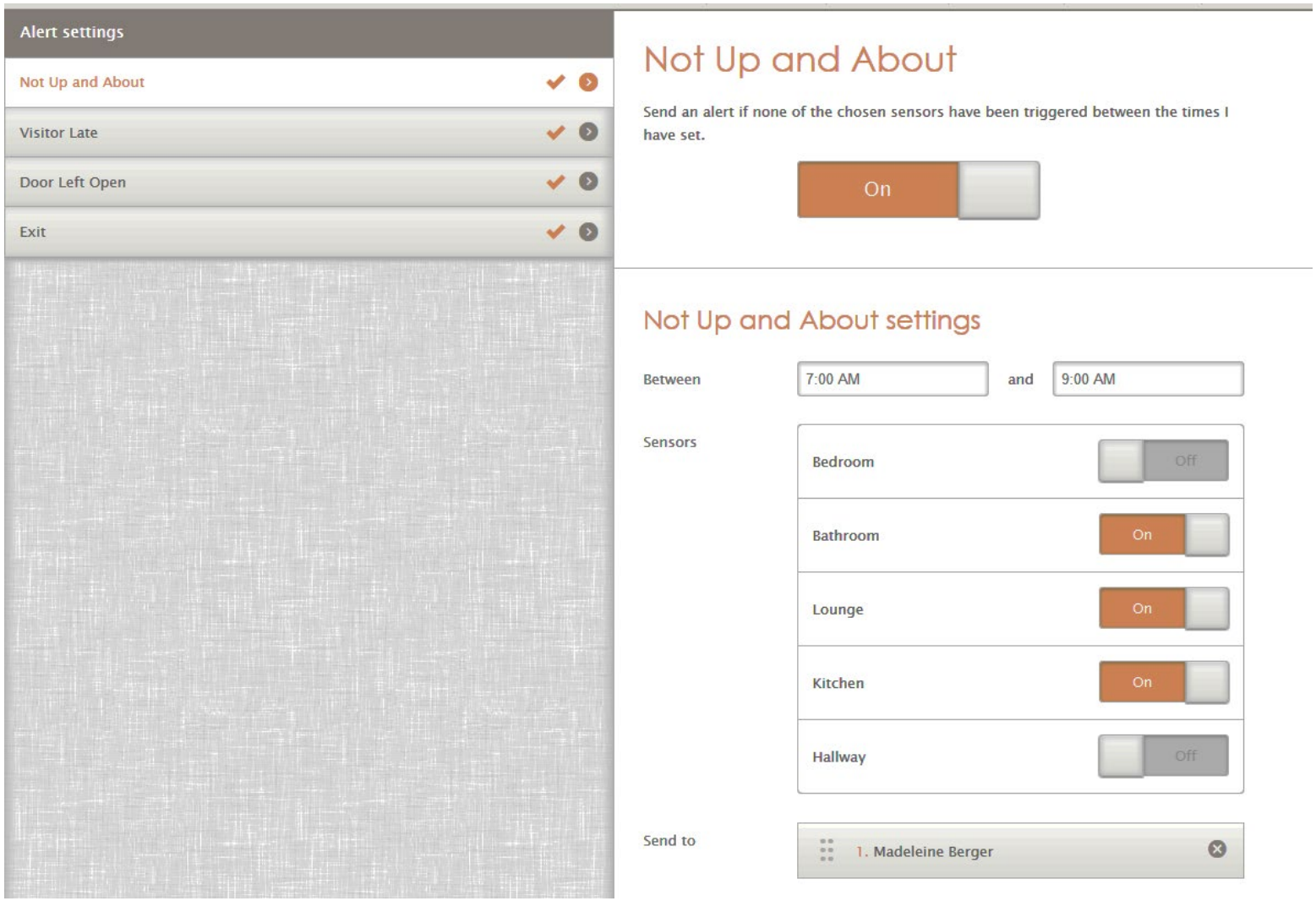
By learning (learning based, KI)

e.g. Neural nets, Decision trees

Need plenty of ***training data***, *time to learn*

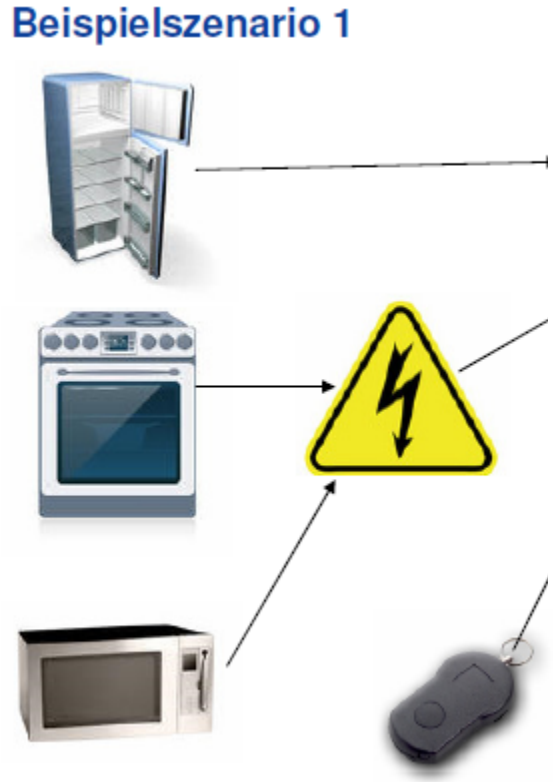
No direct parameters

Rule based situation detection



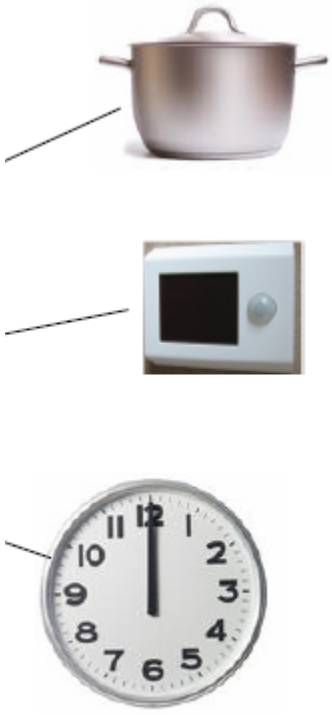
Example scenario: Recognition of “prepare lunch”

„Preparation of lunch“



Lunch

Fridge door
Cupboard door
Power consumption (oven)
Movement detector in kitchen
Time of day
Localisation



Source: Fraunhofer IMS

Detection Rule: Nightly Visits of Toilet

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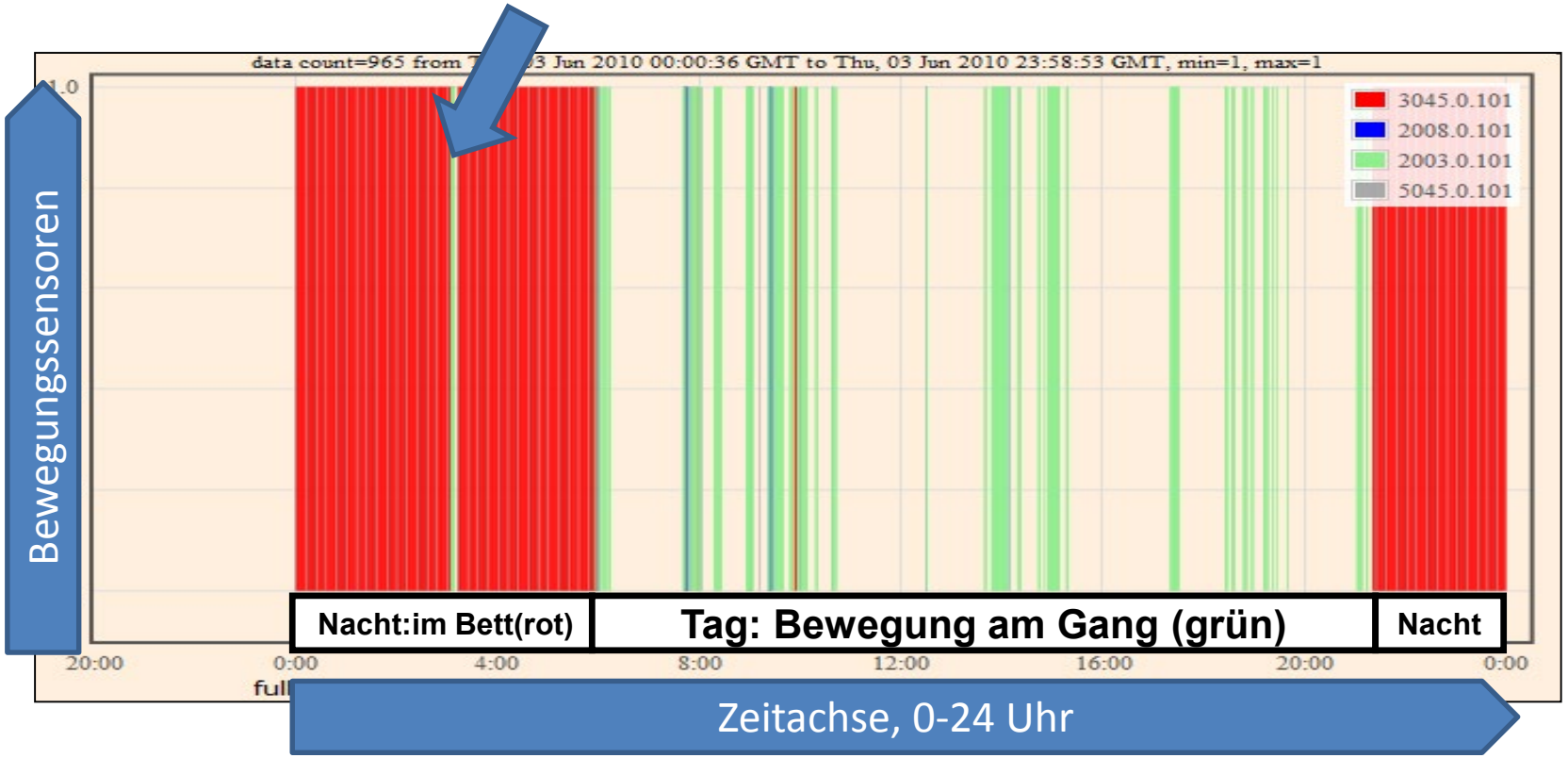
A nightly visit of the WC and return to sleeping room are well detectable



Stove Alarm Rule

Alarm if

- Kitchen not used for long time (presence, activity)
- Leaving apartment while stove still hot

First alarm via screen, then SMS to own mobile

Auto-switch off needs electrical installation

Stove Alarm Rule: sensor data

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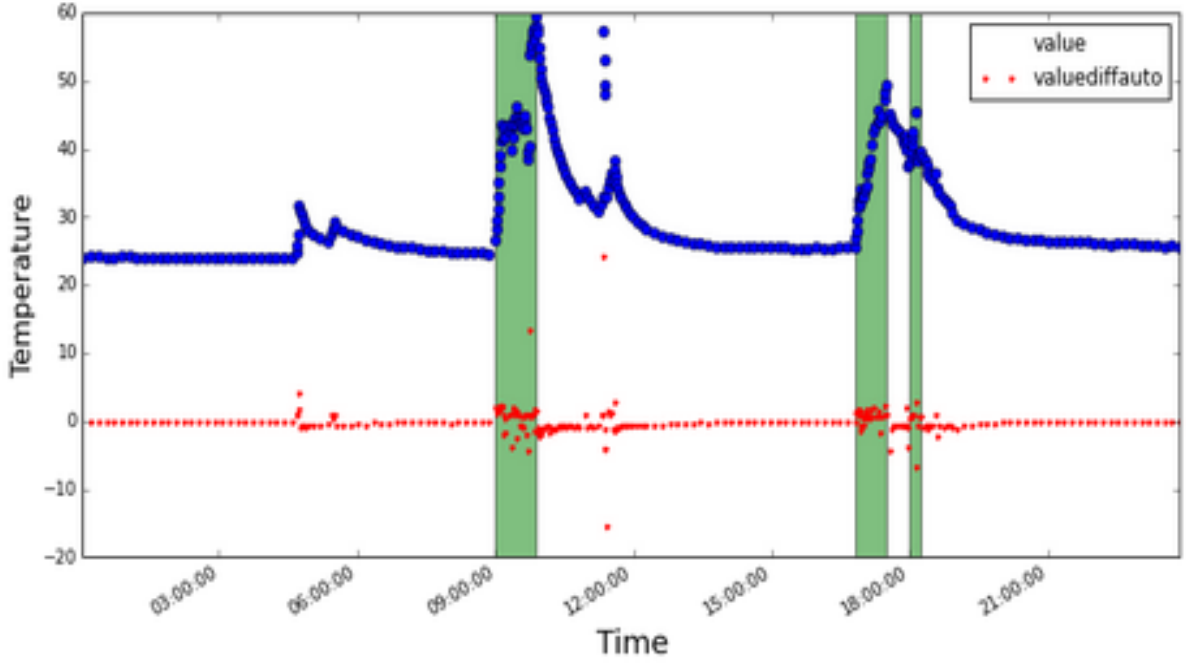
Typical rise in temperature, slow decrease

Cooking – warm over

Relatively to environment temperature



Coffee machine alarm rule

- Special power socket (reads power)
- First alarm on screen (GUI), then SMS to relatives

Recognition of usage time

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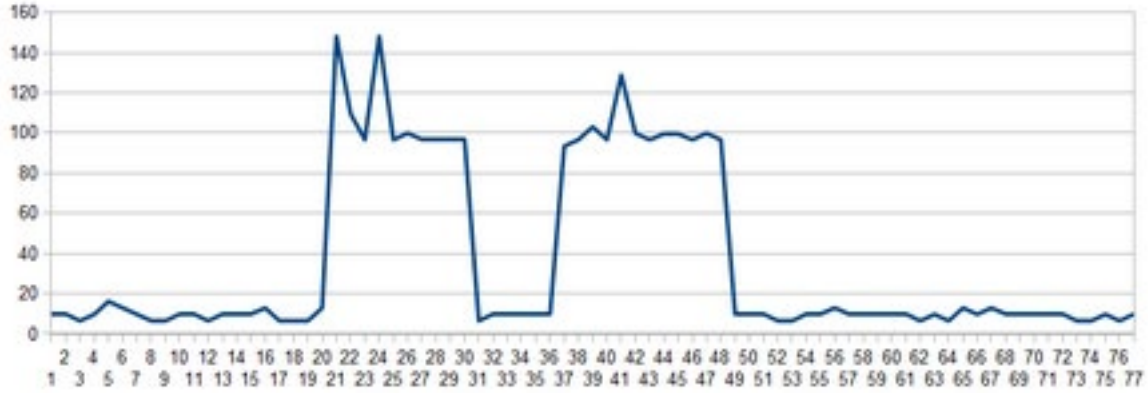
- Plug-in adapter
  or sensor on cable (for one device)
- Smart Meter identifies single loads
- Typical power consumption trends



Times for getting out of bed / to sleep
Learned behaviour

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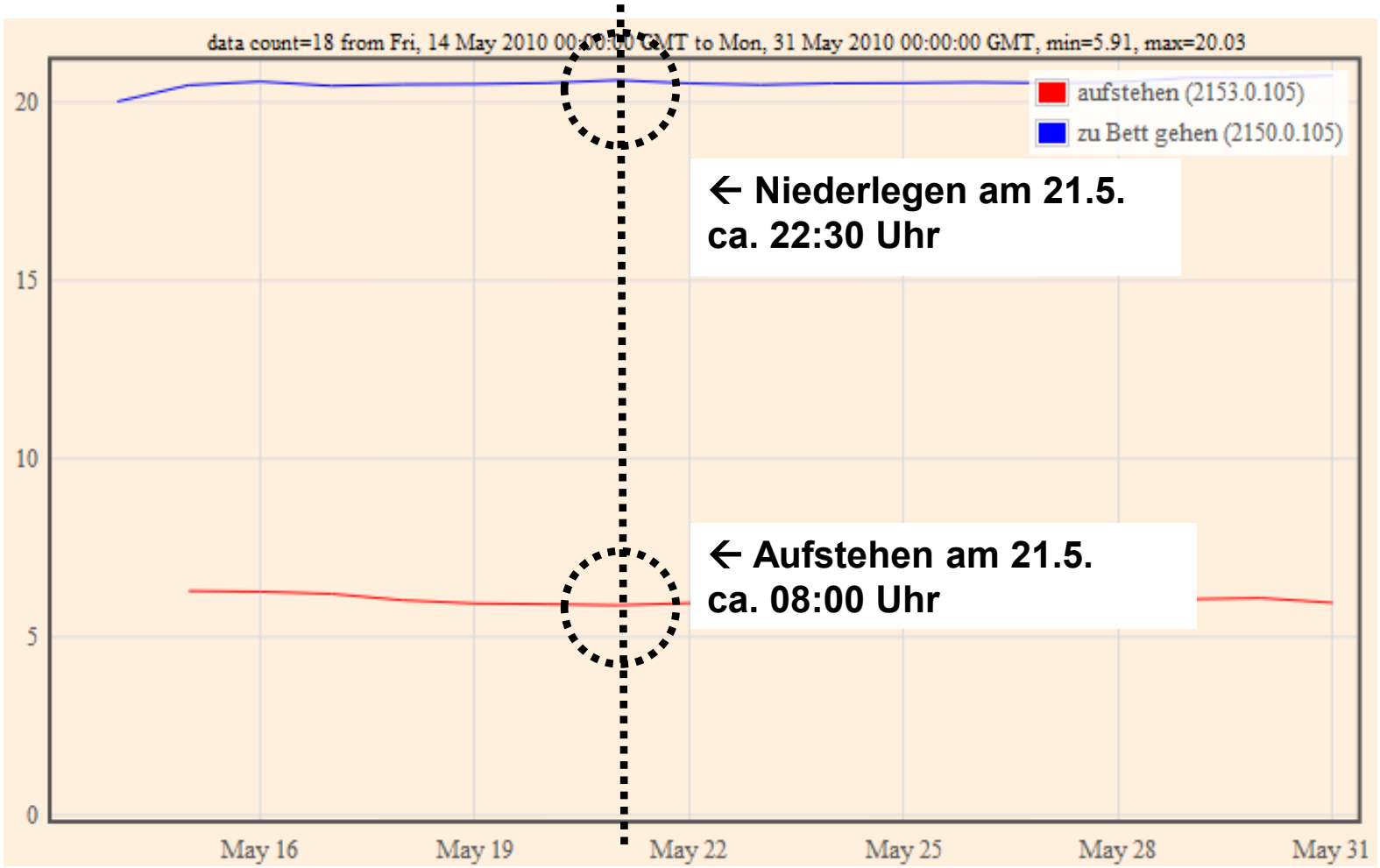
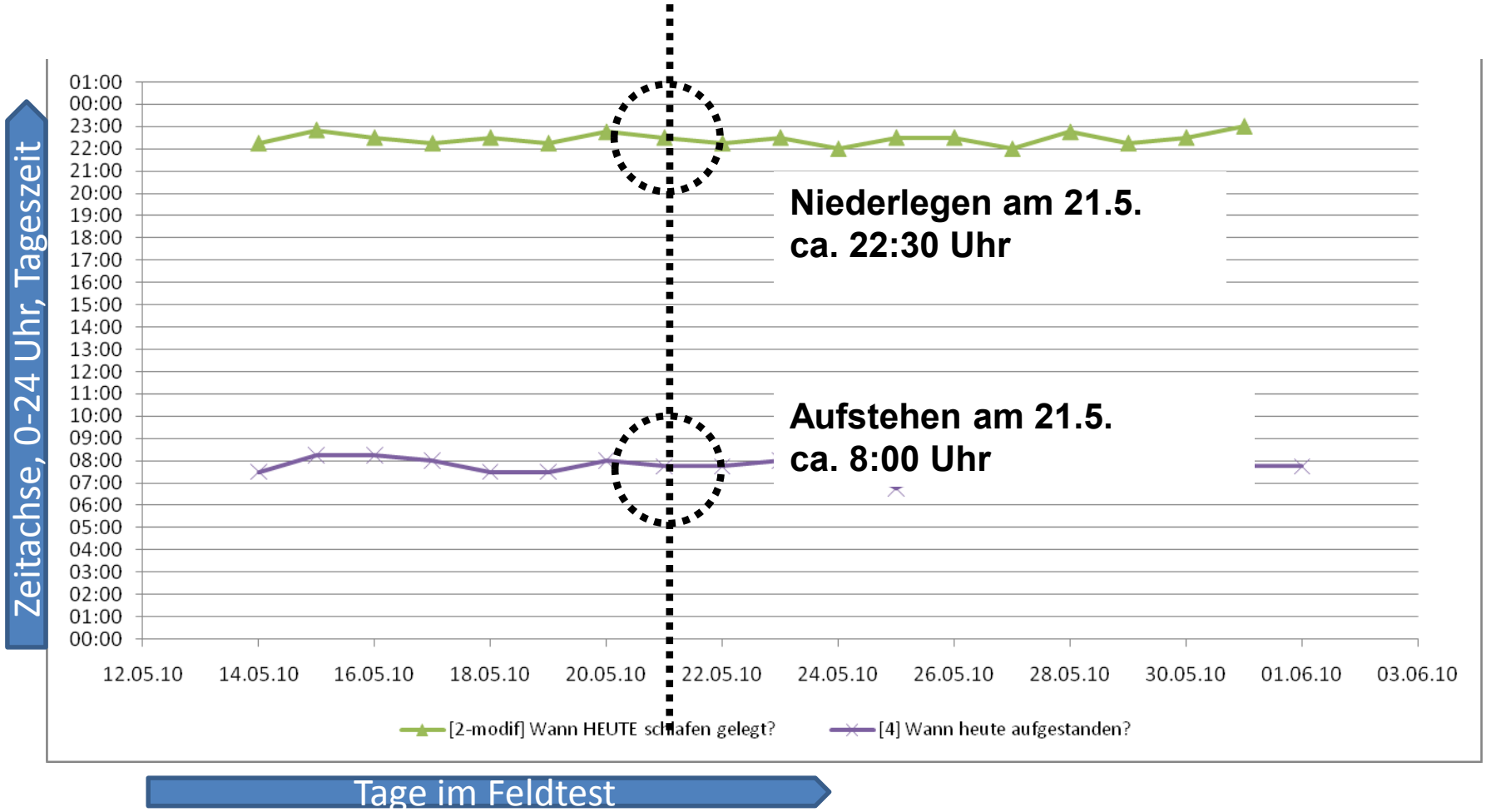
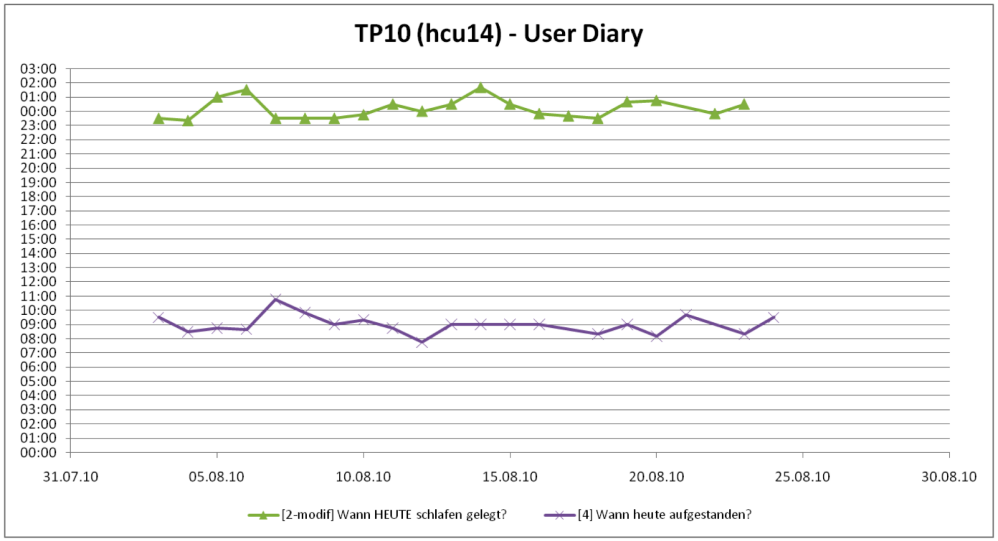
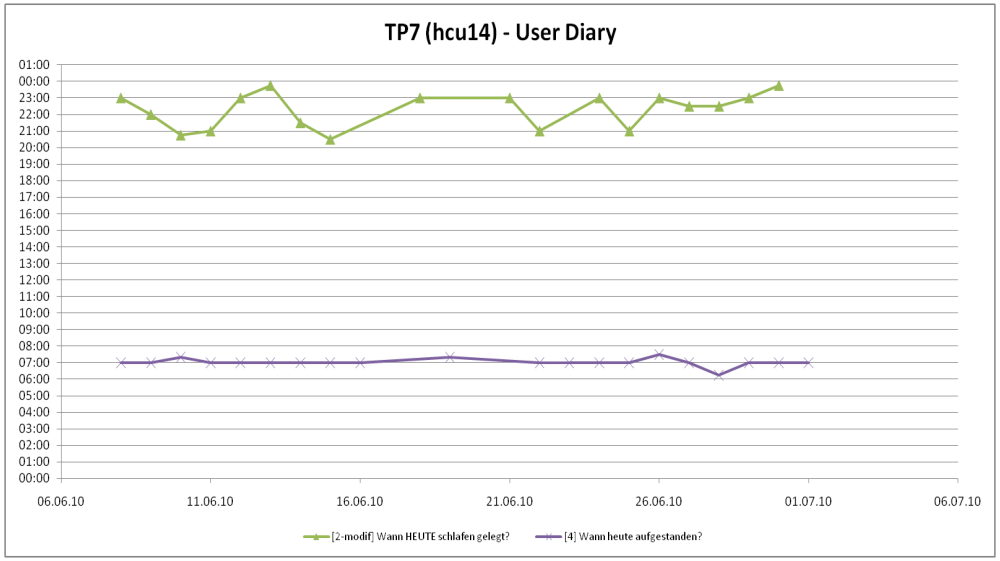


Comparison with hand written diary of test person



Differences among test persons



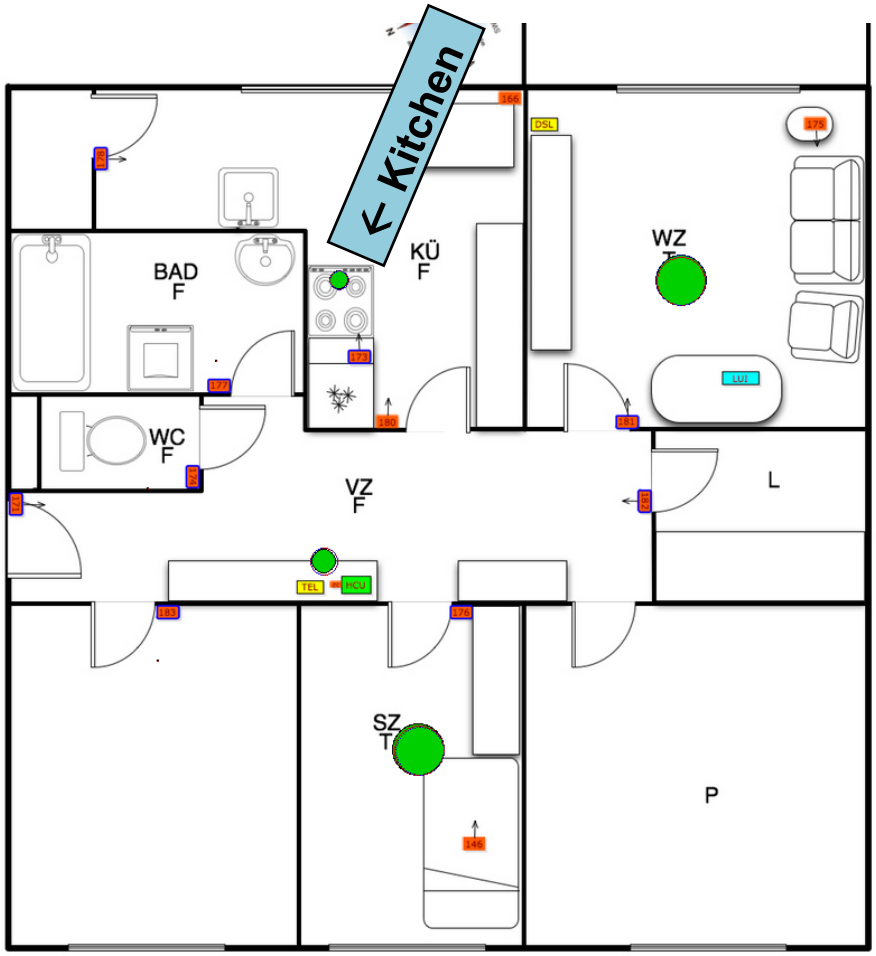


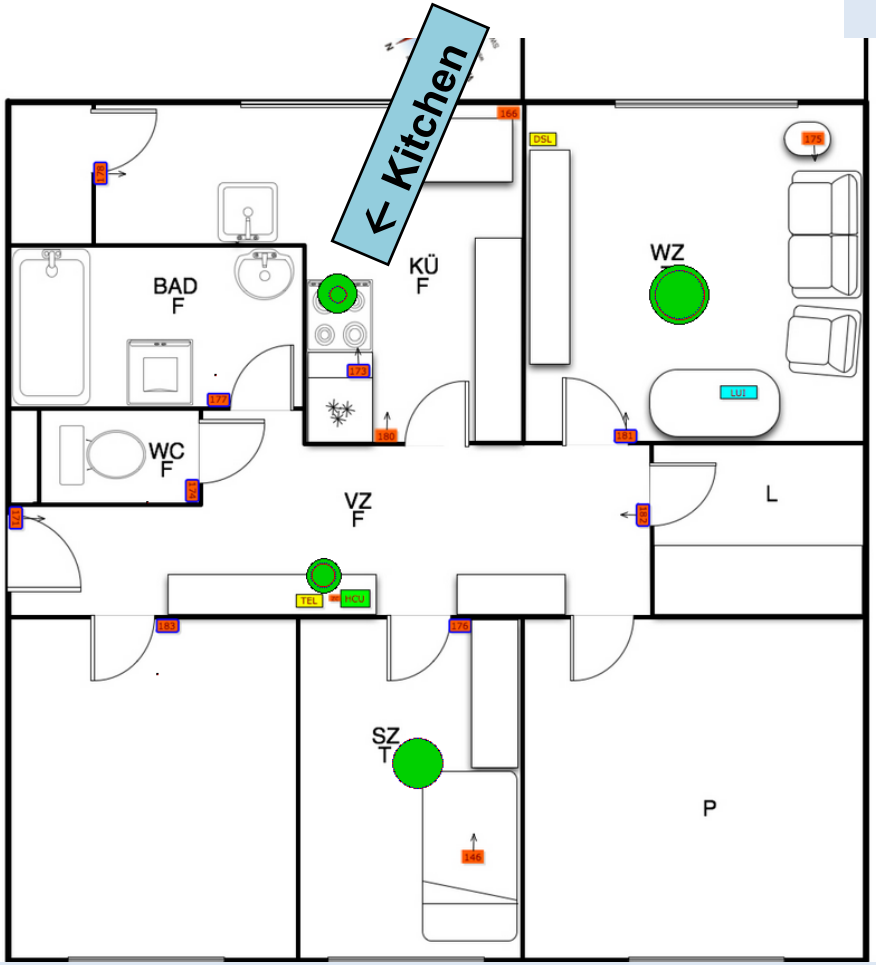
Room usage on different days

VC&HCT

Saturday

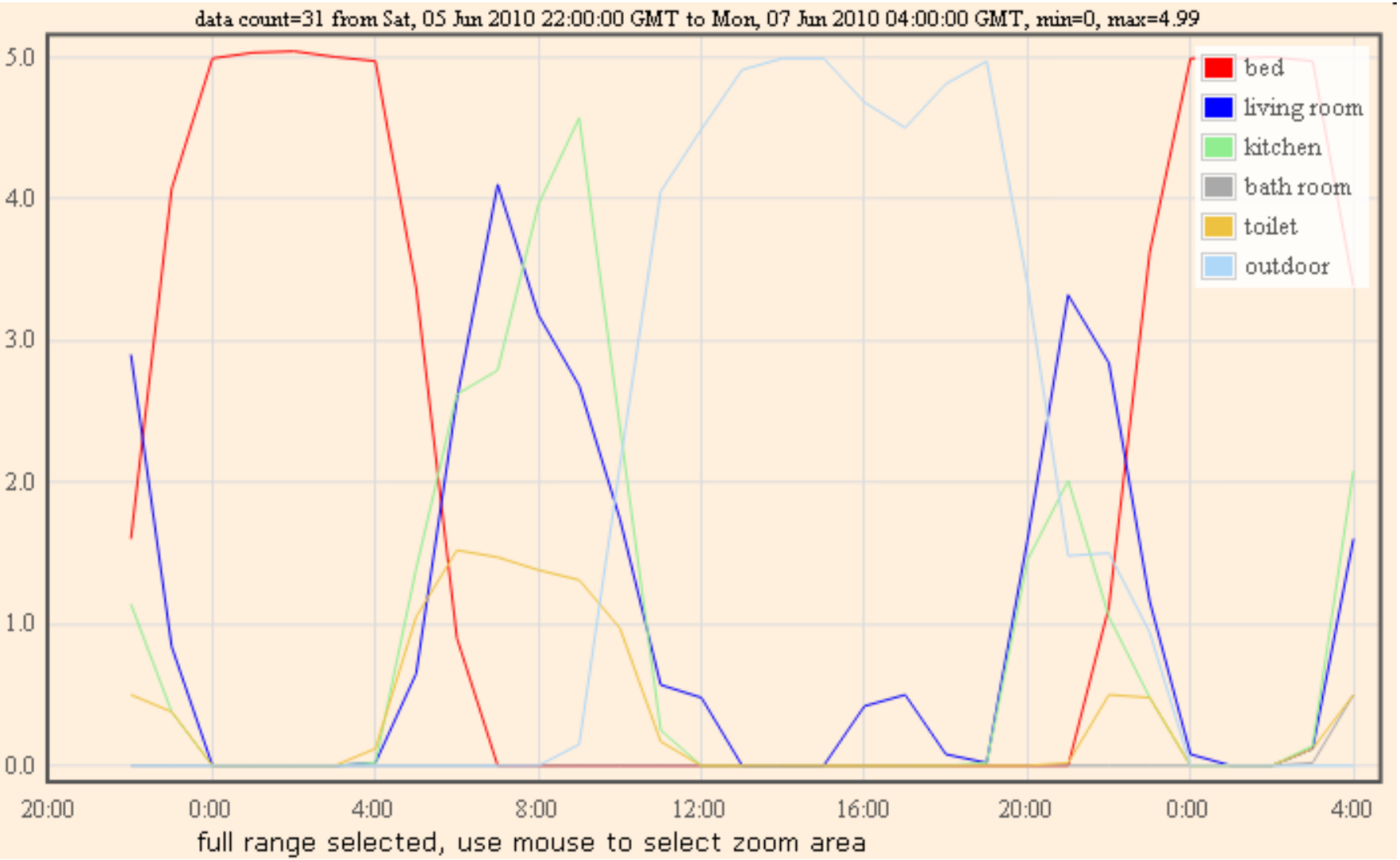
- Sunday(cooking, visitors at noon)





Presence per room on some day

VC&HCT

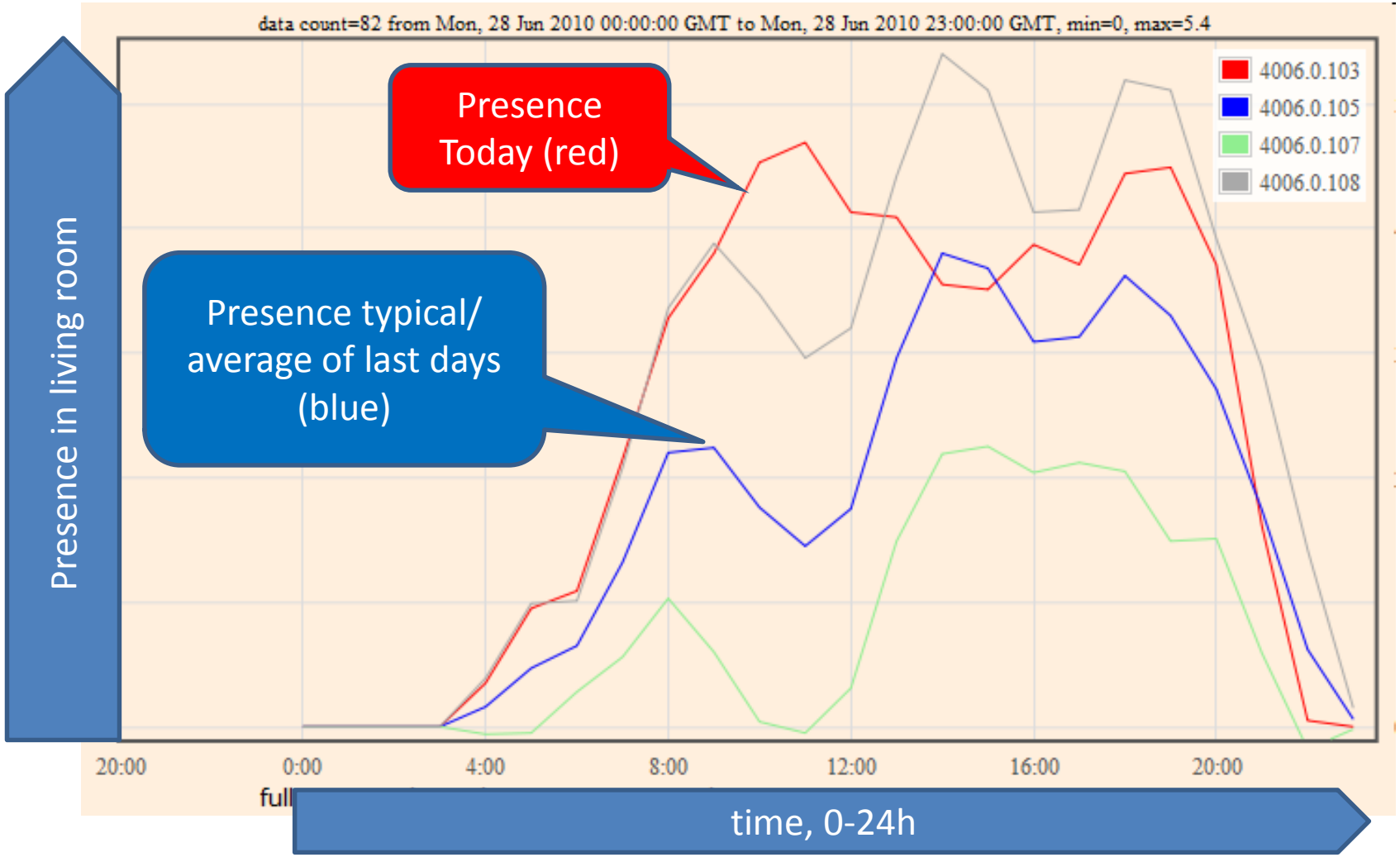


eHome data

Learning - user behaviour

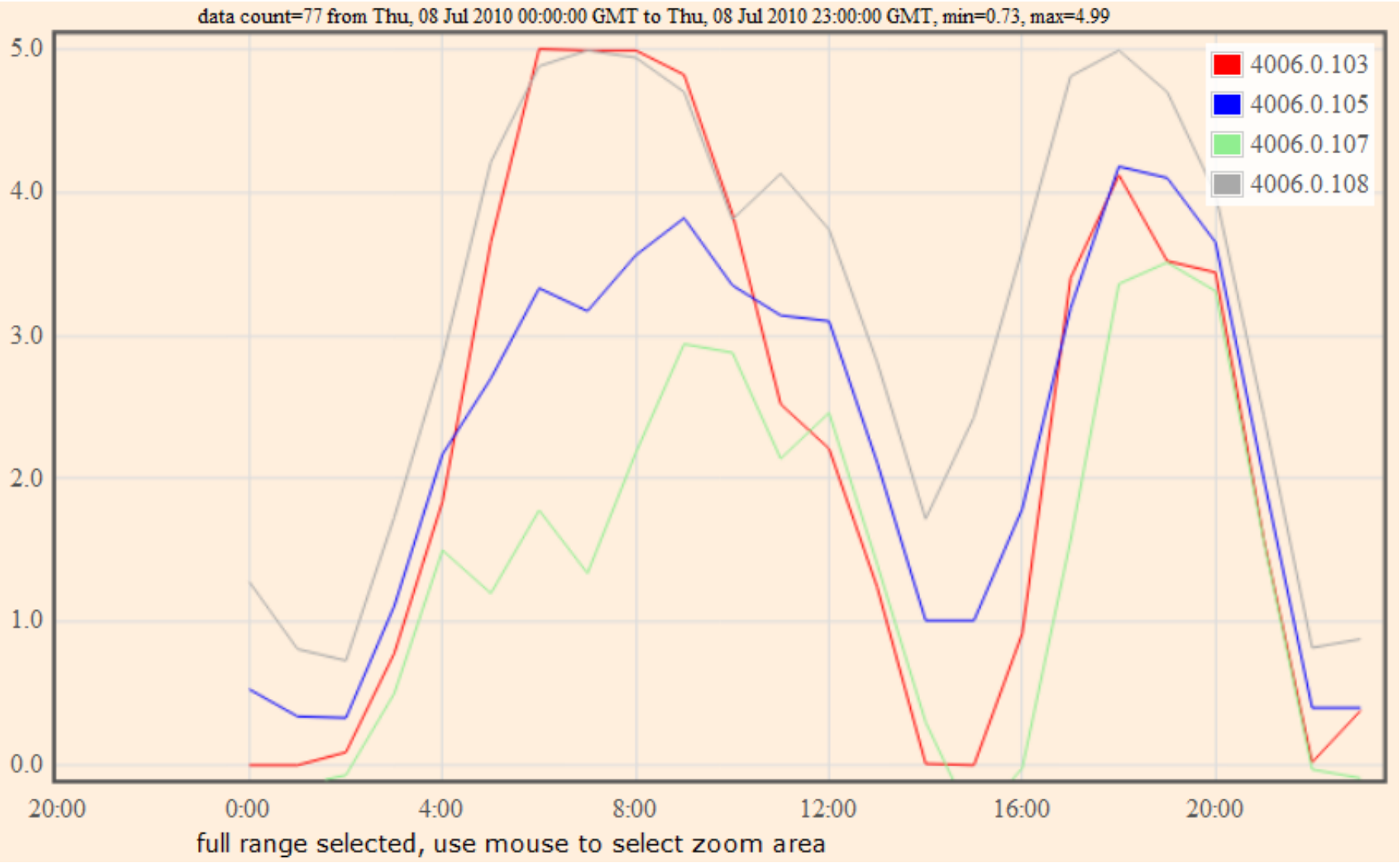
VC&HCT

e.g. presence in some room



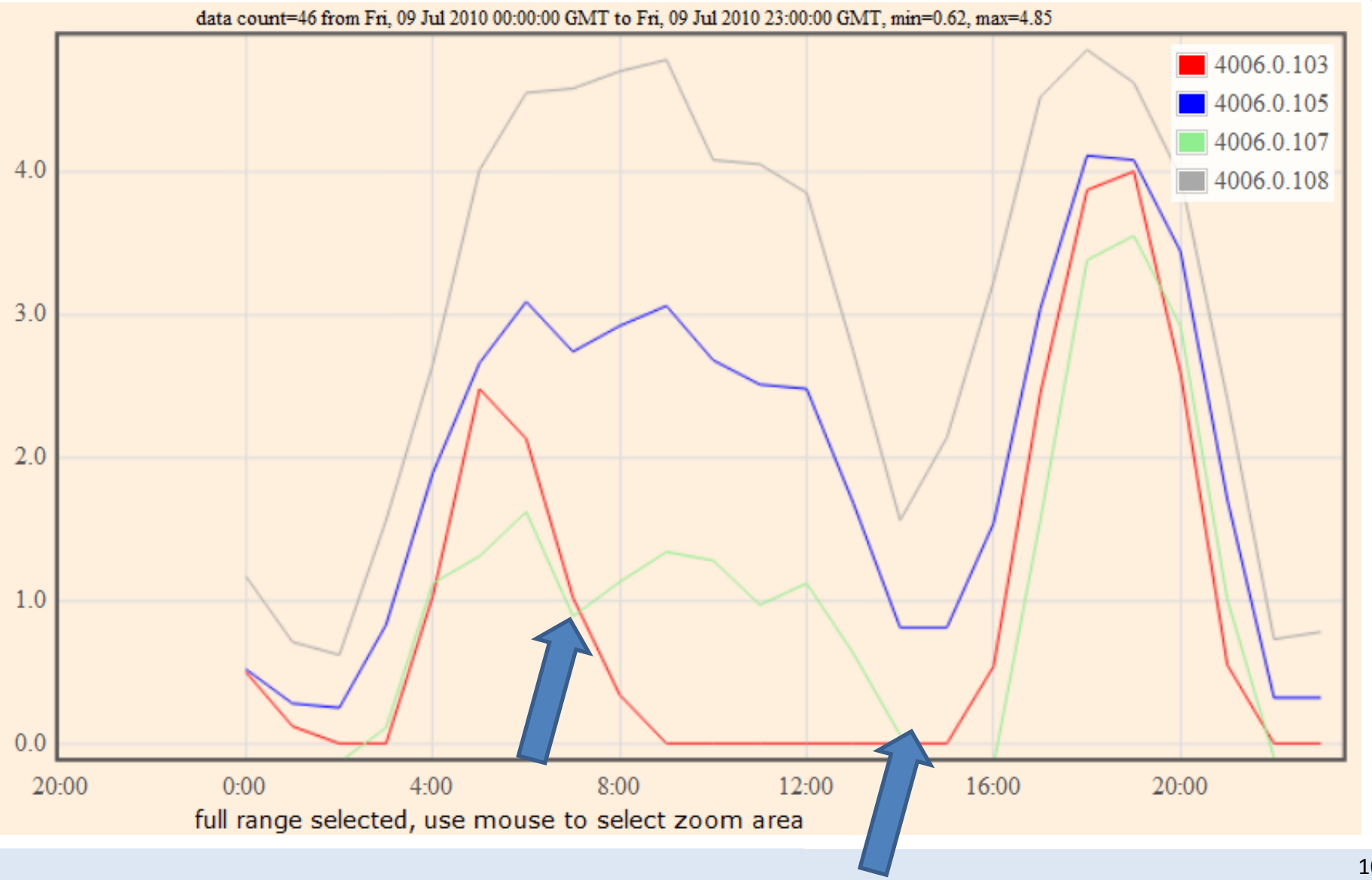
Presence in living room on 8 July

VC&HCT



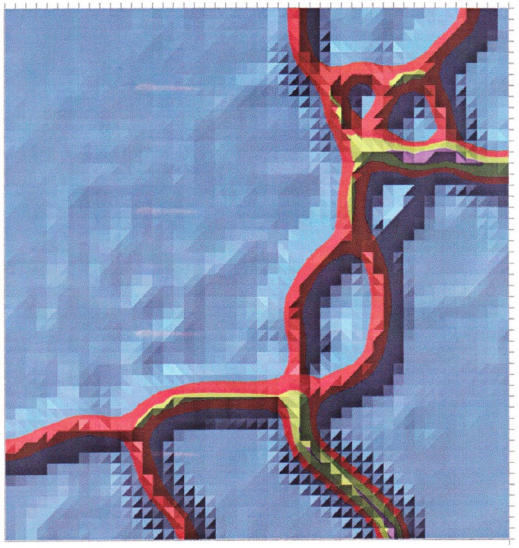
Presence in living room on 9 July

VC&HCT



VO Assistive Systems

Learning user behaviour



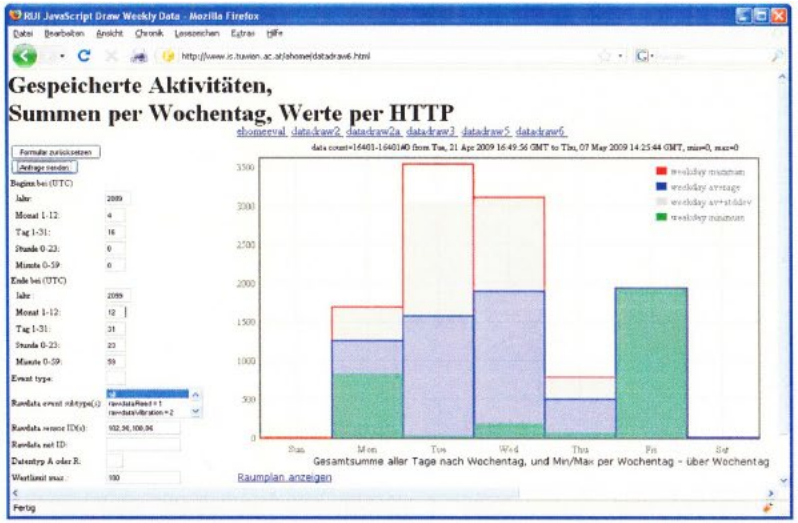
Self organising Kohonen nets:
unsupervised competitive learning
Instead of backpropagation, gradient Descent method, without supplying a correct, external output pattern.
The neural net “finds” categories from similarity of the fed input patterns.
Example in image: signals of several PIRs in a hallway
Problem: meaning of each category

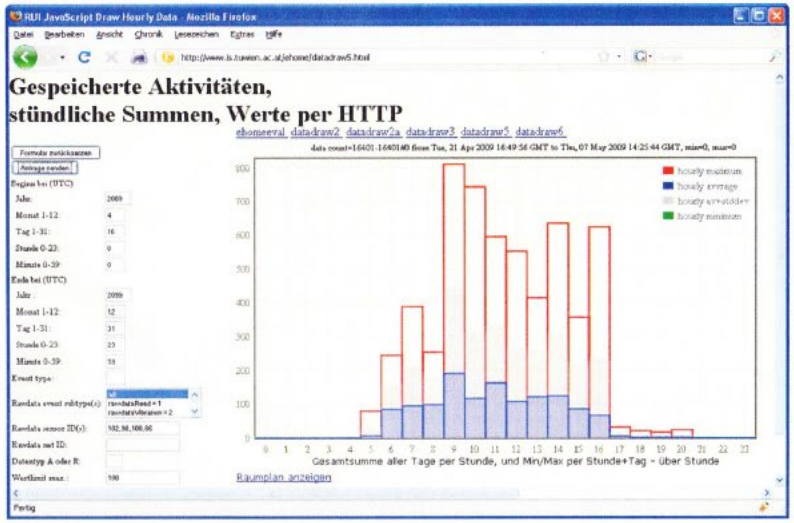
Microsoft Infer.NET: model based learning as Open source, creates automatically a learning algorithm

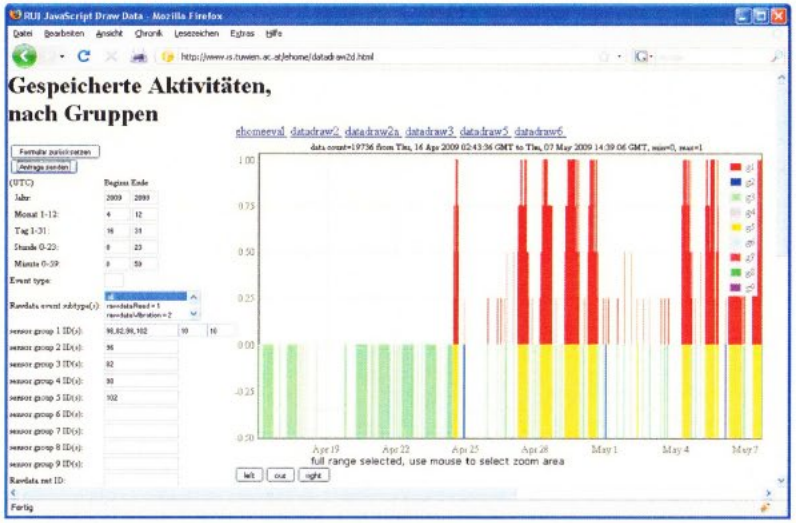
Visualisation of user behaviour

VC&HCT

Visual interpretation helpful for many sensors





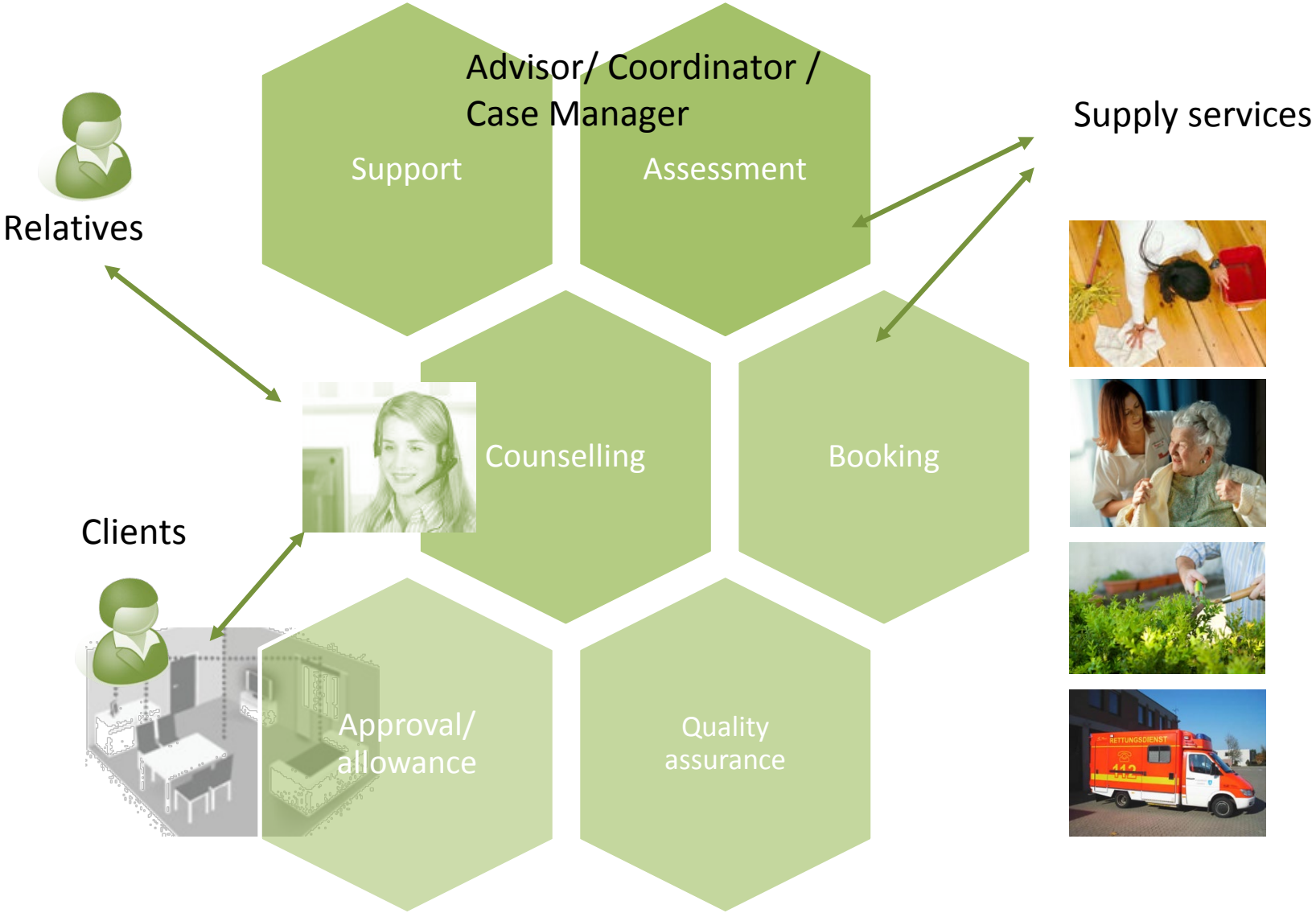


VO Assistive Systems

Concepts, future and pitfalls

Upcoming: from emergency recognition to „assisted living at home“

VC&HCT



Structure of future domestic alarm systems

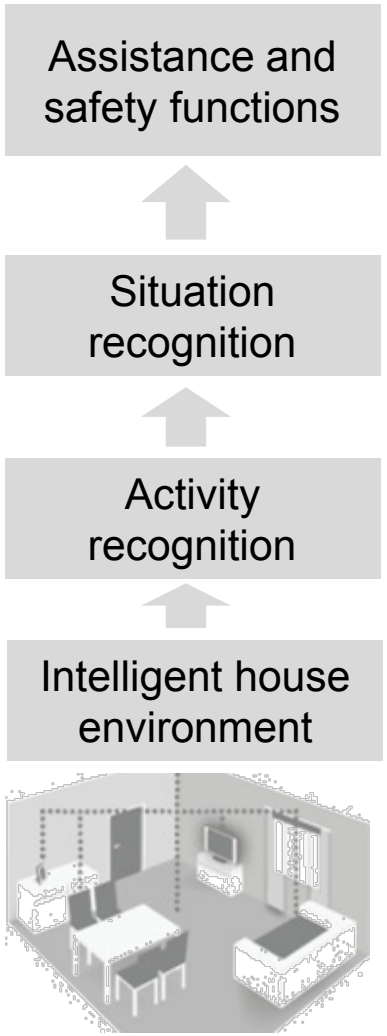
VC&HCT

Reminder functions, orientation assistance safety functions, …

Inactivity, desorientation, sleeping disorders, …

Aktivities of daily living, …

Building automatisation, networked appliances, vital data sensors, …



Perspective: safety solutions

- In the coming years manyfold new domestic safety solutions+services can be expected
- These will allow more precise and individual situation recognition
- In the mid-term they will replace the classic senior alarms
- Additional to emergency alarming and assistance these will also support automatic documentation and assessment
- Systems will get more complex and networked

Sensors, trade-off

Desire: much data, high resolution
-> many sensors
-> high redundancy
-> big amount of data
-> much energy
-> high costs

Reality: minimal/sparse data
-> low resolution (spatially, temporal)
-> Data economy
-> incomplete overview of situation

Sensors, localisation problems

Example: movement sensors (PIR)

- Widespread, cheap
- Range, field of view
- Errors cause by light fluctuations
- Signal only for first detected movement
- Afterwards dead time, reasons:
  - Main application in building automation e.g. switching on lights, which gets off automatically after 15 minutes – deadtime 5 min OK
  - Power saving for RF devices, especially with Energy Harvesting

Future: camera based sensors with built-in processing

Sensors, localisation problems

Consequences:

- Room change by user can be missed, if there is no detection in new room -> wrong assumptions. Especially problematic: user walks from room A to room B and shortly after back during deadtime of PIRs.

- Occluded areas, with sunlight possibly no reaction, strong light sources with fluctuating occlusion cause wrong detections

Sensors, power problems

- Mains supply needs power sockets, messy cabling. Reliability at power loss?
- Battery supply needs regular change, timely warnings resp. status monitoring
- Energy Harvesting is an interesting option for simple sensors, but also needs monitoring e.g. by “heartbeats” (Solar cells collect less during wintertime or with curtains closed for longer period)

Sensors, data safety

Data on user behaviour are sensitive data and must not become publicly accessible.

- As first step only necessary data should be collected
- These data should be kept local and processed locally as much as possible (also locally no “broadcast” if possible)
- Transmission to outside house has to be protected and authentificated
- The user should always remain in control of the data and must be informed

Sensors, conclusions

Plausibility of data should be verified, if possible redundancy of sensors should be achieved

The availability status of the system has to be monitored by heartbeats, the user must be notified, and according technical alarms have to be implemented

Detection and alarms should follow clear rules even under error situations

Assistive Systems: Applications in AAL area

Important:

- Simple installation and removal as well as adaption to changing needs without expensive/complex installation works
- Inclusion of already existing (automation-) technology and upcoming technology (Smart Meter)
- Preferably local processing/evaluation
- Secured connections to outside home
- Possibility to rent instead of purchase
- Integration with documentation systems

Summary on sensors

VC&HCT

Solutions to increase safety
- High demand from carers and users
- Building block for „Ambulant instead of stationary“

Classic Senior alarms are conditionally accepted

New approaches for „passive“ alarming and situation detection

No established/standardised solutions

Intermediate solution:

Add-ons to classic Senior alarms

Literature

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J. Diermaier, K. Neyder, F. Werner, P. Panek, W. L. Zagler: Distributed Accelerometers as a Main Component in Detecting Activities of Daily Living, Proc ICCHP, Linz, Austria, 2008, LNCS 5105, Springer, pp. 1042-1049

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Outlook, next parts:

- V. Ethics, Law and Economics
- VI. Requirements Analyse and Evaluation

Assistive Systems - Abbreviations

VC&HCT

AAL	Active and Assisted Living (Ambient Assisted Living)
AmI	Ambient Intelligence
AS	Assistive System
ASR	Automatic Speech Recognition / Spracheingabe
AT	Assistive Technologie
GUI	Graphical User Interface
HCI	Human Computer Interaction
IKT	Informations- und Kommunikationstechnik
ICT	Information and communication technology
IoT	Internet of Things
IR	Infrared
MMI	Man machine interface / Mensch Maschine Interface
OS	Operating System / Betriebssystem
PSTN	Public Switched Telefon Network (traditionelles Fernsprechnetz)
TTS	Text to Speech / Sprachausgabe
UI	User Interface / Benutzerschnittstelle
UPnP	Universal Plug and Play
VoIP	Voice over Internet Protocol