Context-aware Communication Services

Research & Experiences

Manuel Görtz, Ralf Ackermann, Johannes Schmitt, Ralf Steinmetz

Multimedia Communications (KOM)

Technische Universität Darmstadt

Merckstr. 25 64283 Darmstadt

http://www.KOM.tu-darmstadt.de

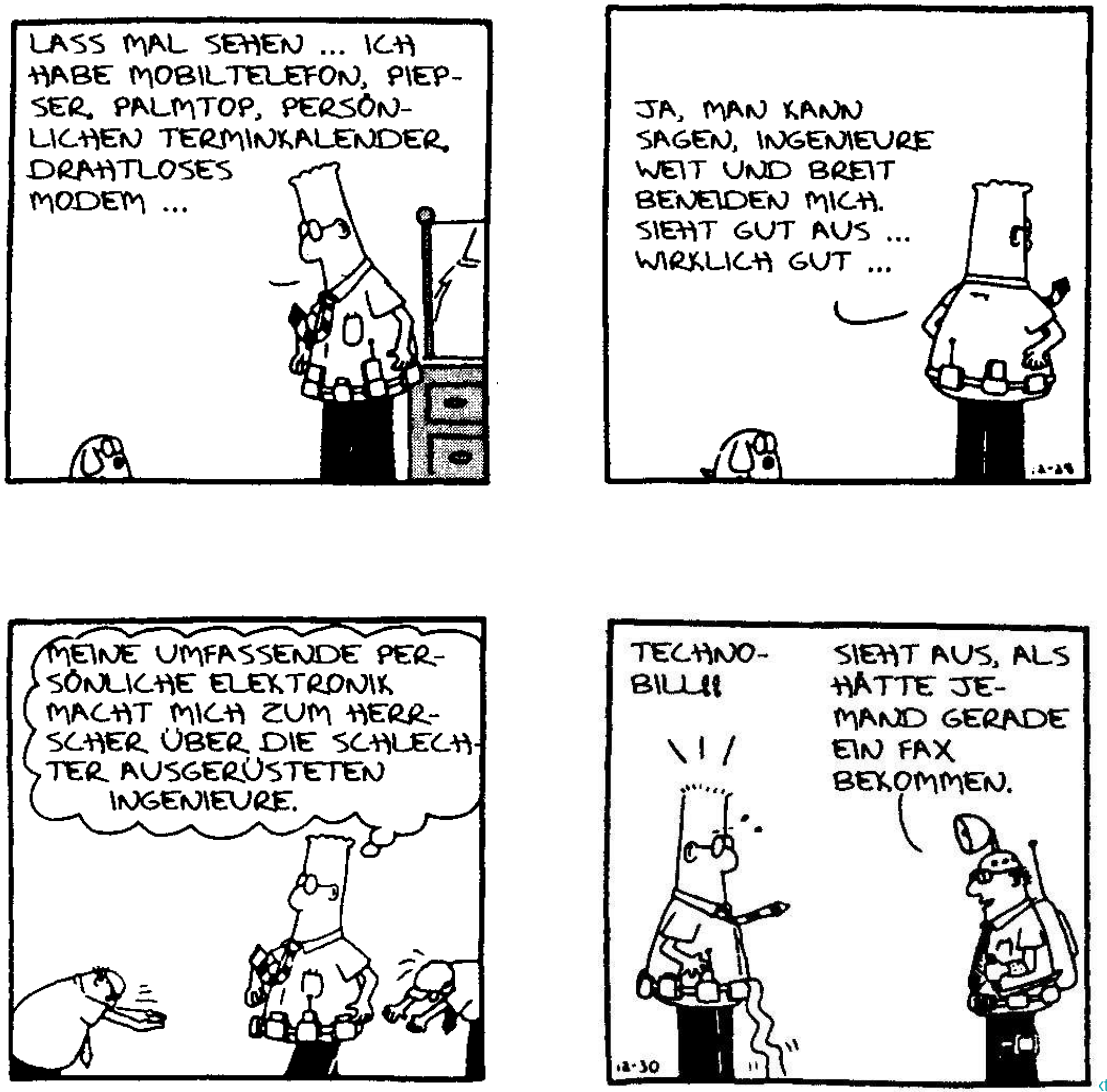
Introduction

Motivation

Observation of Daily Communication

- irrelevant communication
  - tele-marketing, surveys, out-of-office announcements
- annoying disruptions
  - meetings, dinner, movie, theater, tennis match, etc.
- caller unaware – not knowing the availability of the callee
  - lack of coordination leads to phone tag, missed opportunities, etc.
- interaction overload – decreasing latency increases junk
  - bombarded by irrelevant communication versus noticing timely communication (like flight changes)
- device overload
  - overwhelmed by managing and choosing the right channel
    - different media = different device = different address

Geek Solution



What do we want?

- Filtering of incoming communication requests
  - handle incoming communication requests
  - redirect/terminate calls
  - apply e-mail filter like mechanisms
- Avoiding unnecessary communication
  - caller does not want to be disturbed
  - callee wants to save time for unsuccessful calls
- Customized services
  - services that fit user's needs
  - develop & deploy mechanisms to create 'own' services
  - convenient and safe development and execution environment
  - "wizard"-like support

What do we have

Evolution of Communication Services

- POTS
  - Basic Call
  - alerting $\longrightarrow$ phone rings
  - user goes on hook/off hook
- ISDN/IN
  - Supplementary Services
  - calling party number can be displayed
  - user may switch services on/off
- Mobile
  - Multimedia Service
  - callers categorized and attributed (ring tones, pictures)
  - user manages profiles

Can we do better?

- Secretariat
  - hub of incoming communication
  - call handling based on
    - callee‘s context
    - experience and knowledge
  - multi-modal interface to specify rules

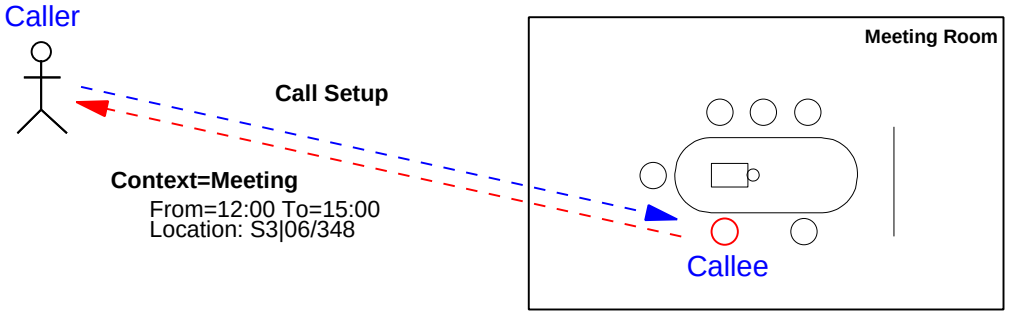
  $\Longrightarrow$ communication is efficiently handled according to the **context** of the users
- Human Face-to-Face Communication
  - learned from early childhood
  - follows certain rules
  - ‘good’ feeling for right starting point

  $\Longrightarrow$ communication and interaction between humans always happen in a specific situation, a certain **context**, and in a particular environment
- Context is the key concept

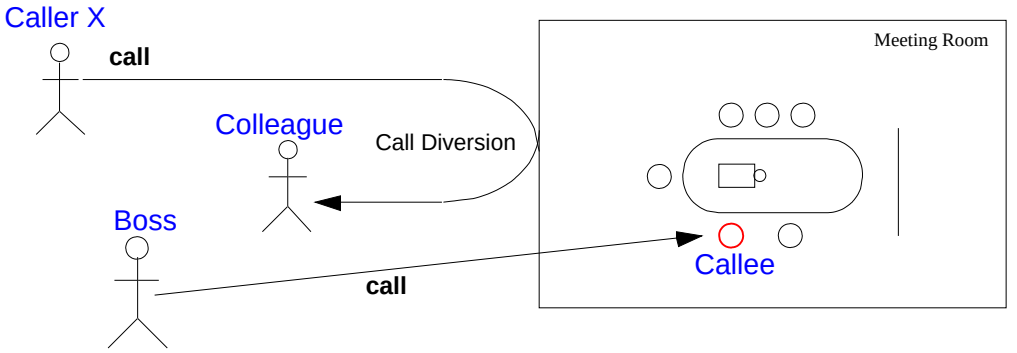
Context-aware Communication Services

Efficient Communication

- Context Sharing
  - caller can avoid unnecessary “calls” (alertings)
  - shift decision to start call towards the caller

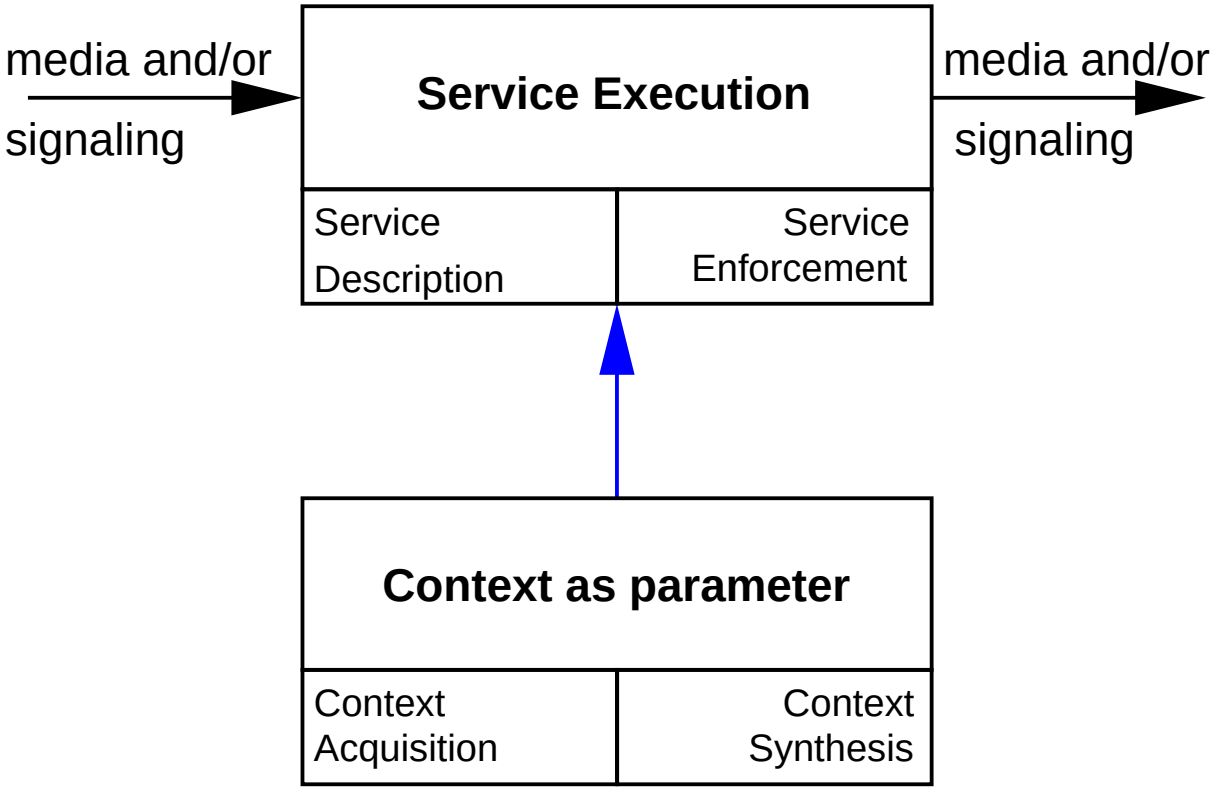


- Context Filtering
  - system avoids disturbing calls for callee
  - selects appropriate service to handle incoming calls



Context- Extended Service Model

- Concept
  - put user into focus
  - disappearing (technical) helper
  - context to adapt service control
  - context to trigger new services



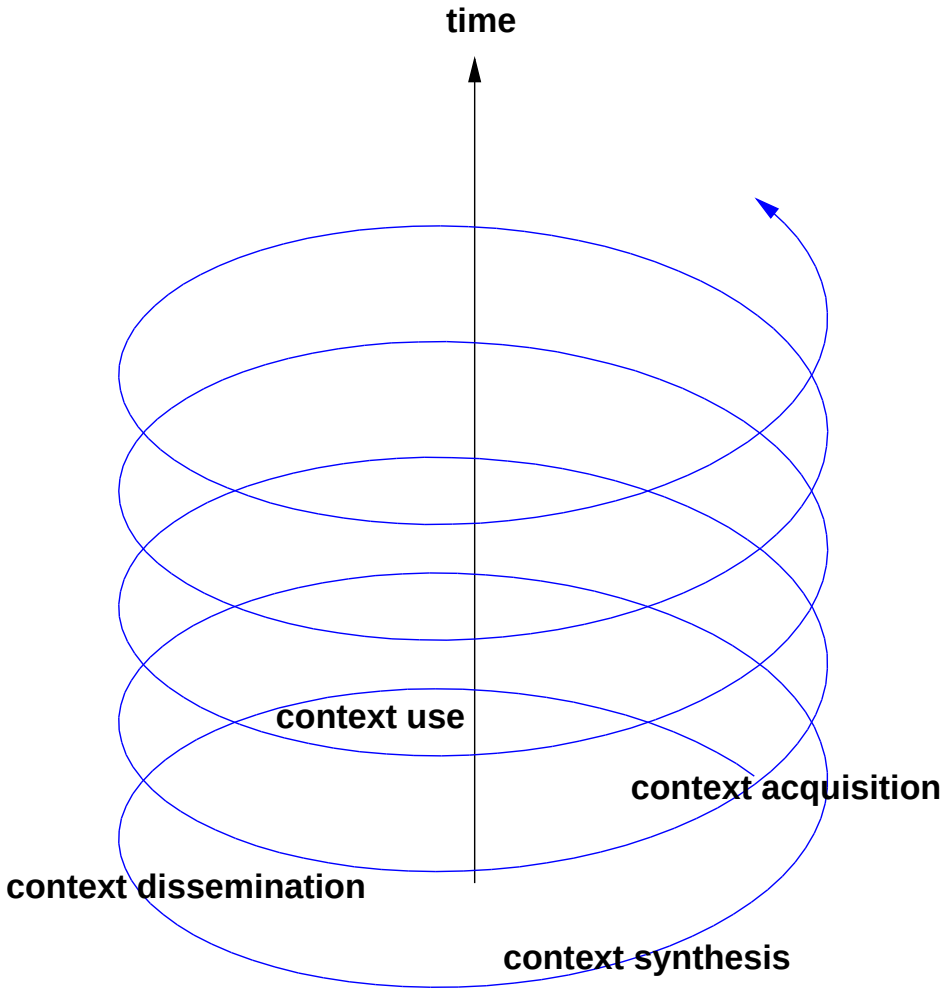
Context Definition

- Context Definition
  - Circumstances in which an event occurs [Dictionary Def]
  - A *Context* ξ is an abstract and meaningful description of the relationship between objects and their environment. A context is a rich object consisting of *context features* and can be approximated by a characteristic function χ. A *context label* λ is assigned to each context.
- Properties
  - enabling effect
    - new class of services
    - disappearing from the user‘s perception
  - automation
    - triggering of actions
  - reduction
    - of input and output

$\Longrightarrow$ for the system a context is just a label (e.g. data structure)

Context Spiral Model

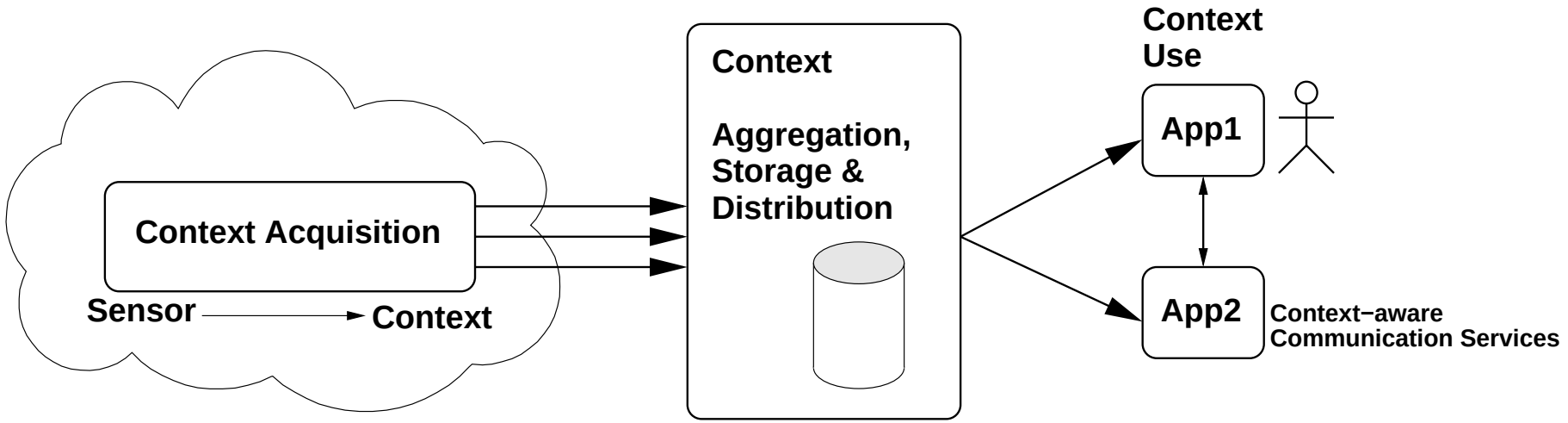
How to handle context



- Acquisition
  - sensing
  - data fusion
- Synthesis
  - feature extraction
  - aggregation
  - decision making
- Dissemination
  - store context (data)
  - distribute context (data)
- Use
  - apply context

System Archicture

- Design recommendation
  - divide context acquisition from context use
  - provide framework for program developer
  - provide communication mechanisms to distribute context



- Components
  - context aggregation network
  - context server
  - context-aware communication services

Presence Information Data Format – PIDF

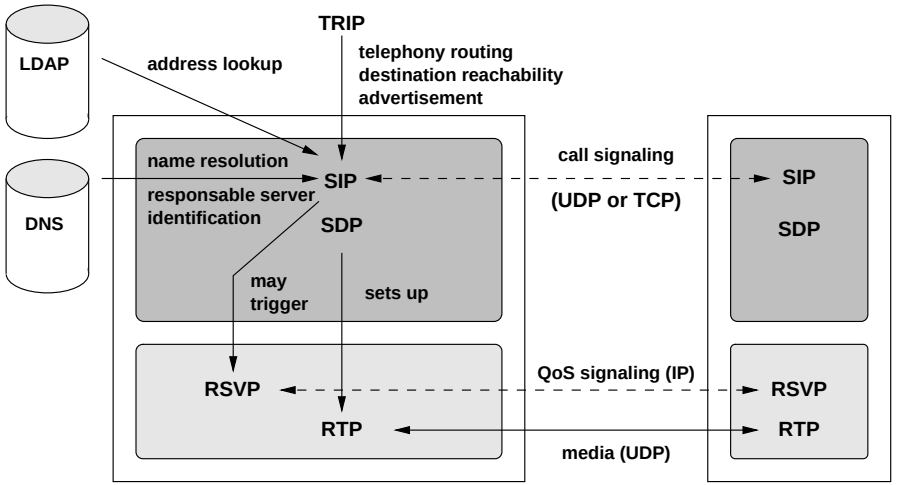
Exchanging context/presence information

- Purpose of notation
  - store all relevant information incl. history
  - provide interoperability to PIDF clients
- Joint work with tzi (Ott, Kutschner)
- Added tags for context
  - <context> element:
    - <current-context>
    - <where>, <privacy>
    - <future-context>, <past-context>
  - <sensor> element:
    - <auth-class>, <owner>, <decay function>
    - <value>, <unit>, <type>, <dependability>

Session Initiation Protocol

Session Initiation Protocol – SIP

Application Level Signaling Protocol



- Concept
  - fast in the core, smart at the edges
  - horizontal integration (of protocols)
  - request/response transaction model
    - register users, setup, modify, terminate sessions
  - components
    - end-systems (UA), SIP proxies, Registrars

- Protocol extensions
  - subscribe/notify event package
  - SIP for instant messaging
  - SIP security extensions
  - QoS extensions

Communication Services

Demand for new services

- Distinction of provider
  - argument for customers to change provider
  - and technology (PSTN $\longrightarrow$ IP Telephony)
- Public Switched Telephone Network
  - service provided by the network
  - rather closed group for standardization
- IP Telephony
  - service intelligence in the end-systems
  - open standards
  - users have access to the network
- Two principle services classes (here)
  - end-system services
  - 3rd party call control services running on a server

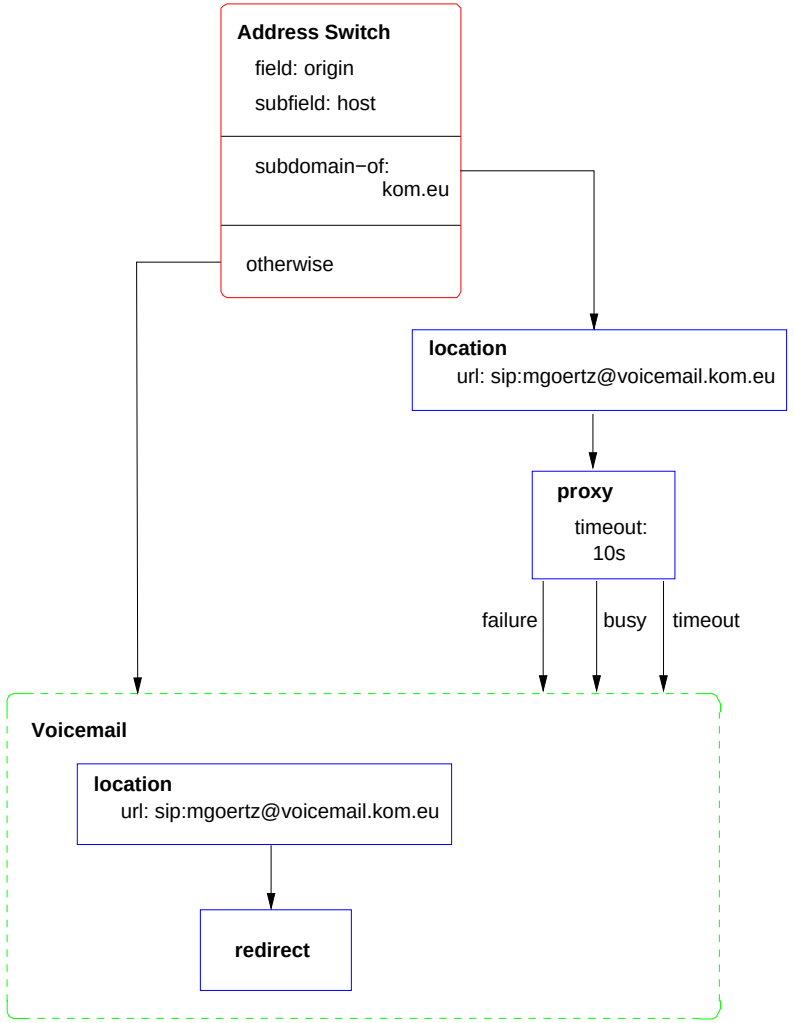
Service Creation

Call Processing Language (CPL) [RFC 2824]

- 3rd party call control
  - XML-based script language
- Simple, extensible, not Turing-complete language
  - no loops, variables, recursion
  - no execution of external programs
- Call processing action represented as Directed Acyclic Graph
  - bounded and predictable
  - finite memory and time
- Components
  - switches
    - address, time, string, priority, ...
  - actions/subactions
    - re-direct, proxy, reject, ...

CPL Example


```
<cpl>
  <incoming>
    <address-switch field="origin" subfield="host">
      <address subdomain-of="kom.eu">
        <location url="sip:mgoertz@kom.eu">
          <proxy timeout="10">
             <busy> <sub ref="voicemail" /> </busy>
             <noanswer> <sub ref="voicemail" /> </noanswer>
             <failure> <sub ref="voicemail" /> </failure>
          </proxy>
        </location>
      </address>
      <otherwise>
         <sub ref="voicemail" />
      </otherwise>
    </address-switch>
  </incoming>
  <subaction id="voicemail">
    <location url="sip:mgoertz@voicemail.kom.eu">
      <redirect />
    </location>
  </subaction>
</cpl>
```



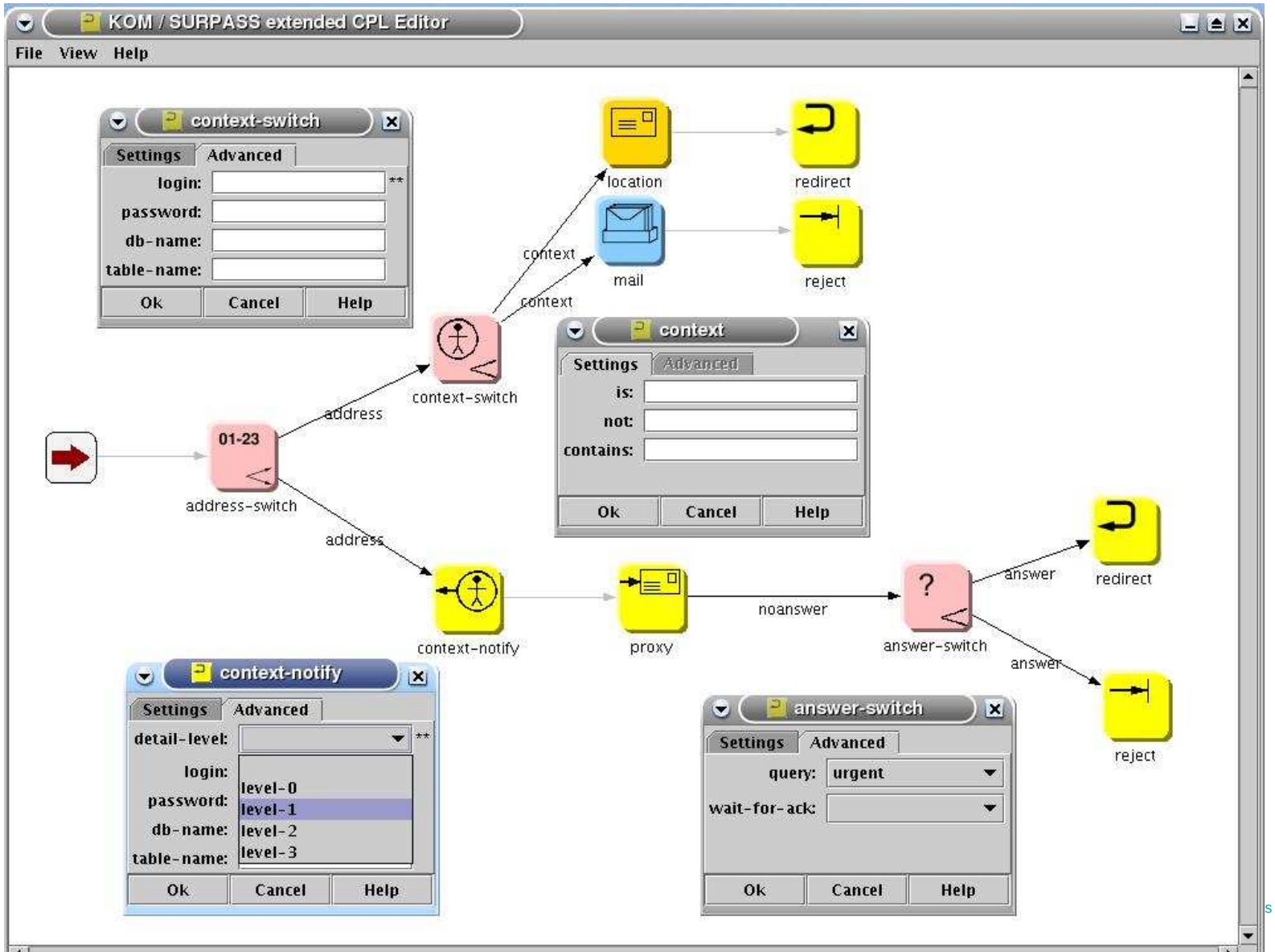
Extension of CPL

Providing methods to develop context-aware communication services

- New Elements
  - Context-Lookup
    - provide context to CPL-Engine
    - query Context Server
  - Context-Notify
    - context is shared on request
    - send context using NOTIFY-Messages
  - Context-Switch
    - select next path depending on current context
  - Answer-Switch
    - select appropriate next path depending on current context
- implemented in VOCAL and SER CPL-Engines

CPL Editor

Creation of Services by script writing – not user friendly → GUI



Real World Experiences

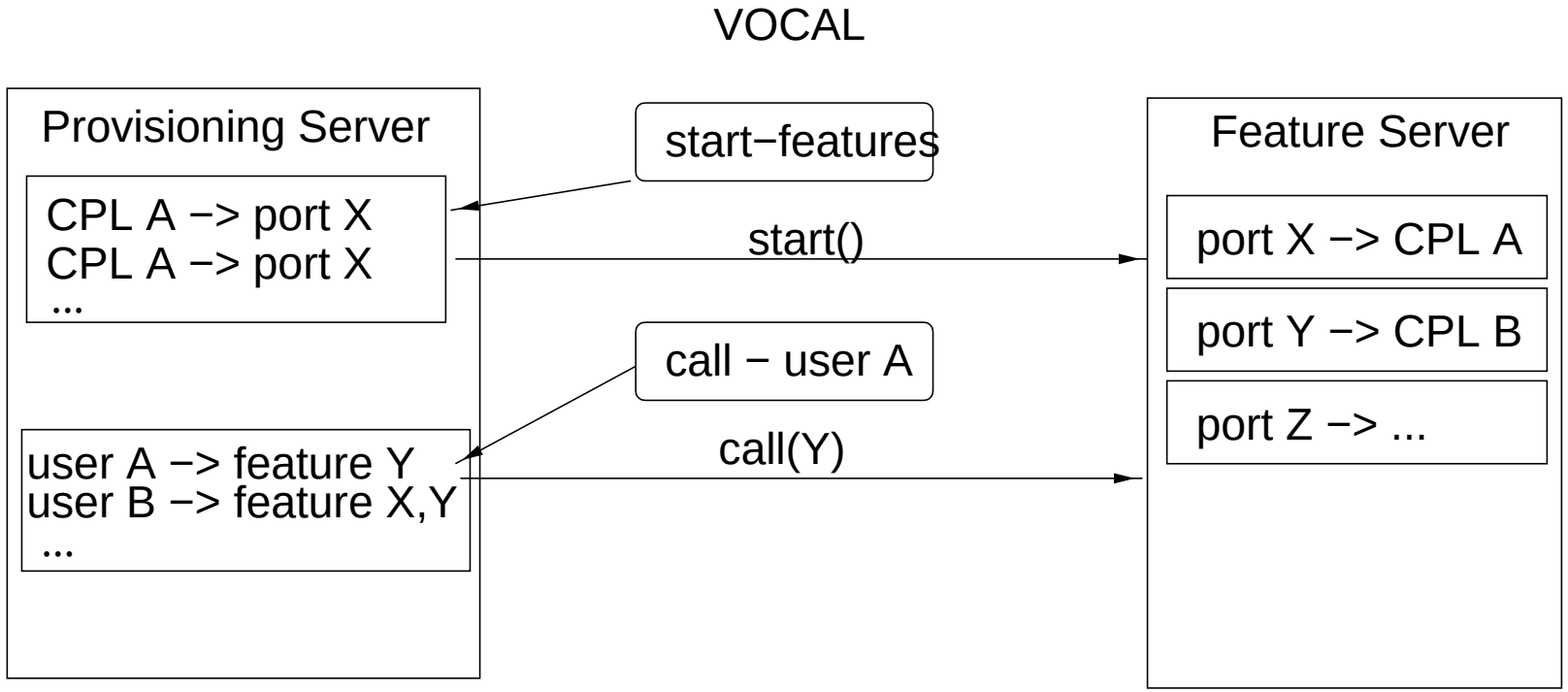
Implementation / VOCAL

SIP suite from VOVIDA

- Open source SIP Server / (www.vovida.org)
- “all in one” packet with multiple server-processes:
  - Provisioning (maintenance / management)
  - Marshall (Message processing / conversion)
  - Authentification
  - Redirect / Registrar
  - Call Detail Record (Billing)
  - Heartbeat Server
  - Policy Server

CPL Engine VOCAL

- Properties
  - executing on incoming/outgoing calls
  - every feature has own process/port
  - transform CPL script to feature FSMs at first call



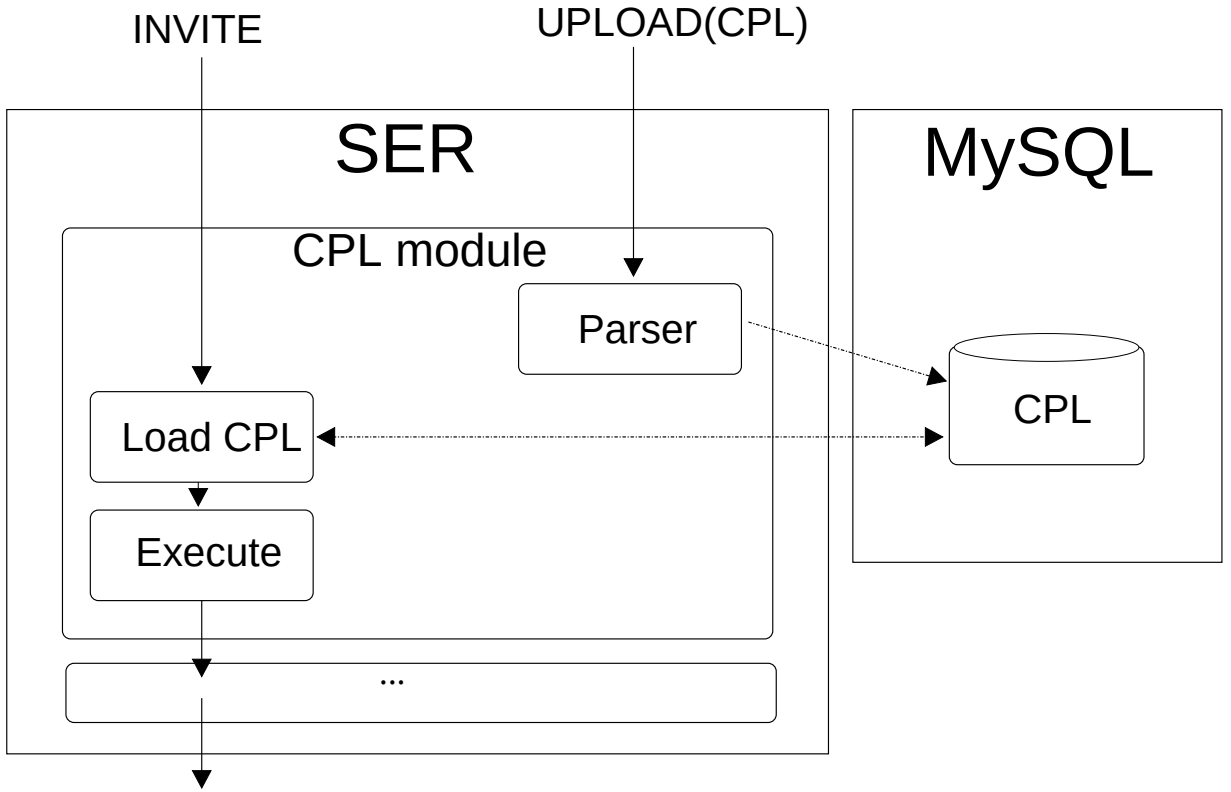
Implementation / SER

Sip Express Router – SER

- Open Source SIP server (www.iptel.org/ser/)
  - lightweight basic installation:
    - only Redirect / Registrar
- Modular / Plugins
  - authentification
  - MySQL
  - web interface
  - CPL
  - 3rd party modules

CPL Engine SER

- CPL script parsed after upload
- binary CPL script stored in external MySQL db
- script can be executed during incoming/outgoing call



The next step

Self-learning mechanisms

- Drawbacks
  - writing rules takes time
  - rules become outdated and must be modified/replaced
- Automatic adaption of rules
  - provides user friendly handling
  - user intervention: only by “feedback”
- Dynamic evaluation model building
  - based on a set of user feedbacks and the related sensor values in this situation
  - Methods: Bayesian net / neural net / fuzzy logic / decision trees

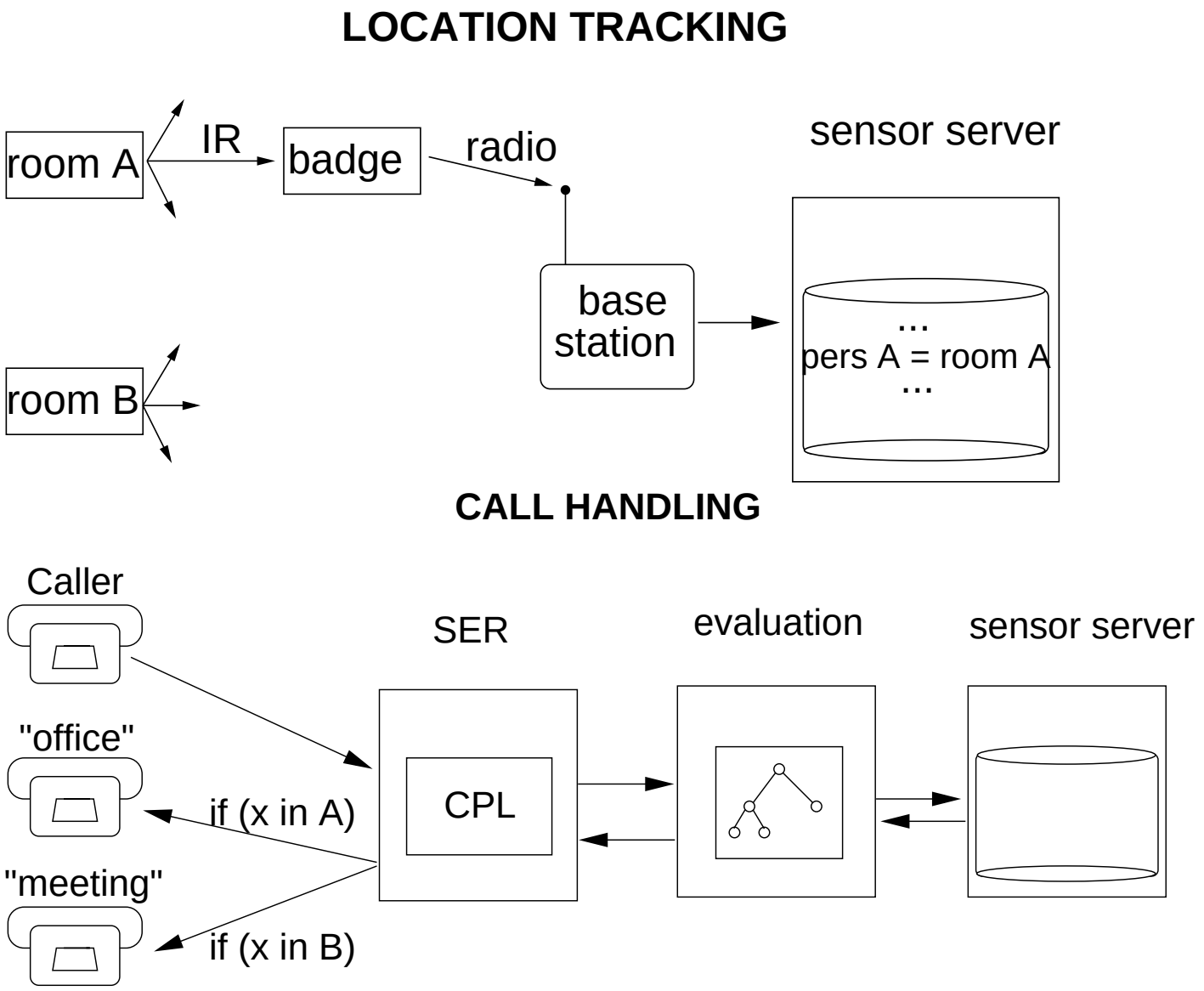
Self organizing sensor evaluation

- self description (type/location/relation) for sensors
- automatic discovery, selection, query of sensors
- provides scalability

Summary

- Communication
  - has become ubiquitous
  - demand to handle communication
- Services
  - distinction between different providers
  - might become driving force of IP Telephhony
  - demand for customized services
- Context
  - provides information to make communication more efficient
  - allows to build customized and adaptive services
  - support whole chain from sensors to context representation
- Call Processing Language – CPL
  - provides mechanism to build and deploy safe services
  - have been enhanced to consider context information
  - changes implemented in wide spread CPL-engines

Demo Setup – Context-aware Call Diversion



Thank you!