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A (Re)active Functionality Service for open distributed environments

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Motivation Motivation **Motivation** Motivation Motivation

- Active functionality: DBMS+ Event-Condition-Action rules
  - useful for enforcing business rules
  - designed for monolithic centralized systems
    - ➔ difficult to extend or adapt
  - one of a kind prototypes
- New business strategies depend on the timely dissemination of information and business events
  - event-driven supply chain management
  - zero-latency enterprise
- New generation of (global-scale) applications
  - trend in soft dev is moving from tightly-coupled systems towards loosely-coupled bound components
  - business rules out of scope of a specific application
  - events and operations may not be directly related to database operations
  - involves events from diverse sources, actions performed on different subsystems
- Miniaturization of sensors and their ubiquitous deployment
  - will result in massive amounts of signals/events

Problem Analysis **Problem Analysis** Problem Analysis

- Common functionality required
  - data exchange
  - data dissemination
  - continuous monitoring
  - appropriate reaction to simple and complex situations
  - often events need to be processed in real time
  - full-fledge DBMS functionality is not always needed

Today's Problematic

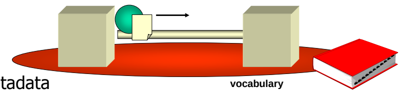
- Data exchange
  - implicit assumptions on data
- Data dissemination
  - implicit assumptions in subscriptions
  - flat objects
- Active databases
  - full-fledge DBMS functionality
  - centralized
  - almost no event composition for distributed systems

Our Approach Our Approach Our Approach Our Approach Our Approach

- Event-based paradigm well-suited for
  - integrating autonomous components
  - distributed environments
  - easy to evolve and scale
- Provide a middleware platform that supports event handling
  - event notification service
    - dissemination
    - filtering and
    - combination (composition) of events
  - reactive capabilities
- Support for
  - distributed environments
  - data heterogeneity

Dealing with data heterogeneity

- Use of the MIX Model
  - definition of concepts and their relationship
  - conversion functions
  - explicit additional context information
    - representation of data plus additional semantic metadata
    - allow correct data interpretation



Event dissemination

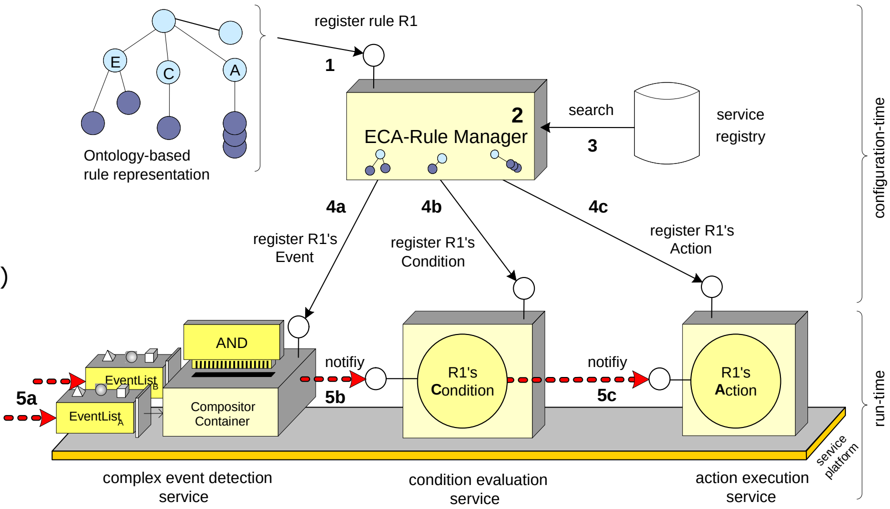
- Provide a higher level of abstraction to describe the interests of publishers and subscribers
- Events represented using MIX
- Subscribers can specify their assumptions
- The notification service delivers ready-to-process events to subscribers

Event composition

- Proper interpretation of time
  - different timestamp representations
  - same abstract functionality
- Consideration of transmission delays
  - separation of *stable past* and *unstable past and present*
- Adoption of partial order of events
- Container and component model
- No hidden semantics (all decisions are made explicit)

Reactive Capabilities

- Decouple (re)active functionality from active DBMS
  - Service-Oriented Architecture (SOA)
  - Event-Condition-Action Rule Engine
    - constructed composing *other* services
      - complex event detection, event filtering, alarm, event logging, condition evaluation, action execution,...
    - components combined and configured according to the required functionality and scenario
- Interaction with various systems through plug-ins
- High-level definition of rules
  - context-sensitive
- Flexible and extensible
  - non-monolithic piece of software



Main Contributions

- Autonomous, flexible and extensible (re)active functionality service
- Novel approach for event composition in distributed environments
- Correct interpretation of events coming from diverse sources
- Proof of concepts
  - vehicle personalization, Meta-Auctions