Architectures for Smart & Sustainable Cyber-Physical Systems

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INRIA SeAS: «middleware for Sensor as a Service»
CPS Domain: Smart Home
Domain Specific Issues

- Aka «The Technology Jungle»

**Heterogeneity**

Devices  Technologies  Protocols  Information

**Mobility**

Clients  Services  Distributed

**Business Logic**
CPS Key Challenge

• «One Architecture Model to rule them all […]»
  • Managed Resources
    – Home devices
    – Sensor networks
  • Managing Resources
    – Home middleware infrastructure

• And regardless of
  • Technologies
  • Constraints
What about Smart CPS?

Adaptation Logic

Analysis

Knowledge

Planning

Monitoring

Execution

Feedback Control Loops (FCLs)

Heterogeneity

Context Integration

Representation

GET, PUT, DELETE, POST

Access

REST

Mobility

OpenSLP

UPnP

SotA Discovery protocols

INRIA Team

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SCA in a Nutshell

• SCA (Service Component Architecture)
  • Aka a «Component Model for SOA»
  • Since 11/2005

• Hosted by the Open SOA consortium
  • http://www.osoa.org

• Community connected to OASIS
  • http://www.oasis-opencsa.org

• Existing platform providers
  • Open Source (4): Apache Tuscany, Newton, Fabric3, FraSCAti
  • Vendors (7): IBM WebSphere FP for SOA, TIBCO ActiveMatrix, Covansys SCA Framework, Paremus, Newton, Rogue Wave HydraSCA, Oracle Fusion Middleware
SCA in a Nutshell (cont’d)

**Component** implements the business logic

**Concepts**

- **Service(s)**
  - *Interface type: Java, WSDL*
- **Reference(s)**
- **Property(s)**
- **Implementation**
- **Non functional property(s)**
  - *Intent & policy*
FraSCATI: Mixing SCA & Fractal

FraSCATI
An open SCA runtime platform built on top of OW2 Fractal

SCA
The standard component model for SOA

Fractal
A modular and reflective component model

Reconfigurable SCA Applications

SOA for Fractal
DIGIHOME: FRASTCAti Level
DIGIHOME: REMORA Level

DigiHome Sensor

Data Aggregator

Light Sensor

ZB
OS

Humidity Sensor

ZB
OS

Temperature Sensor

ZB
OS

Fire Detector

Remora Runtime

Sensor Node

Remora Platform
REMORA: Component Model for WSN

```xml
<composite name="digihome.node" autowire="true">
  <component name="humidity-sensor">
    <implementation.remora implementer="remora.sensors.Humidity"/>
  </component>
  <component name="temperature-sensor">
    <implementation.remora implementer="remora.sensors.Temperature"/>
  </component>
  <component name="fire-detector">
    <implementation.rule implementer="remora.detectors.Fire"/>
  </component>
  ...
</composite>
```
Scaling up to…

- Extended Smart Home
  - Cars
  - Office
  - Neighborhood

- Collaborative Smart Grids
  - Green Home / City / Country / Continent…

- Ephemeral Huge Events (World Expo)

- Very-Large-Scale Environment Monitoring
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