

# Models@Run.Time to support adaptation in Future Internet Services

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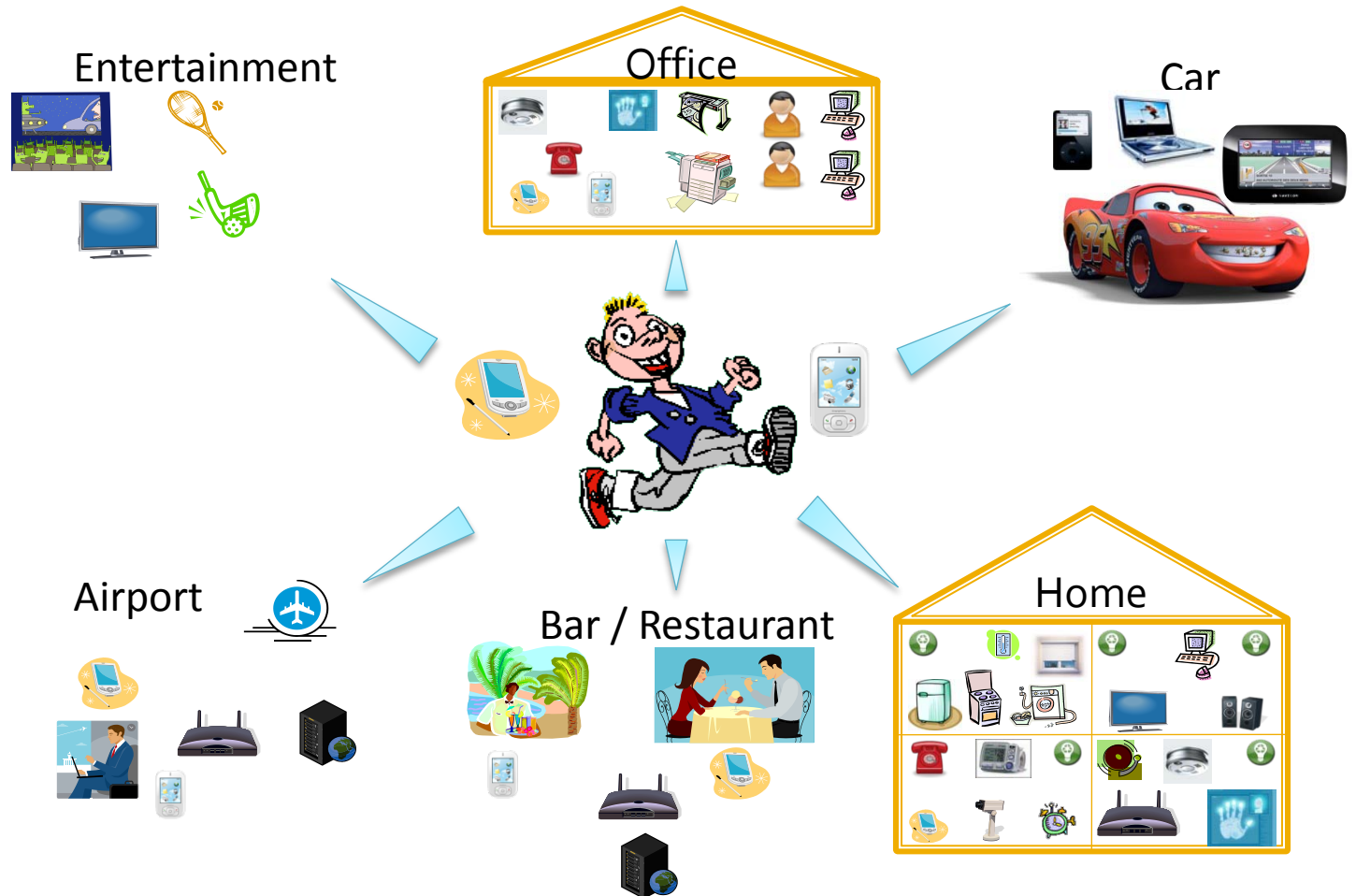
# Speaker Bio 1/2

- PhD in Computer Science from Grenoble University France (2005 – 2008)
  - Auto-Home: A Framework for Autonomic Pervasive Applications
- Postdoc in Imperial College London
  - Self-adaptation in pervasive and embedded systems
- Associate Professor in University of Rennes 1 (2010 – current)
  - Models@runtime and self-adaptation for Future Internet Services

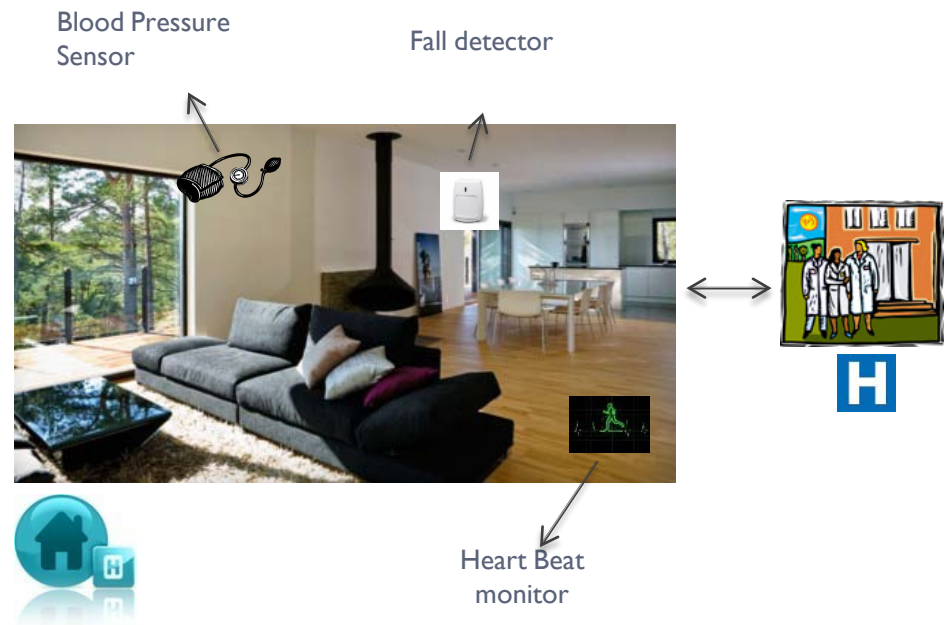
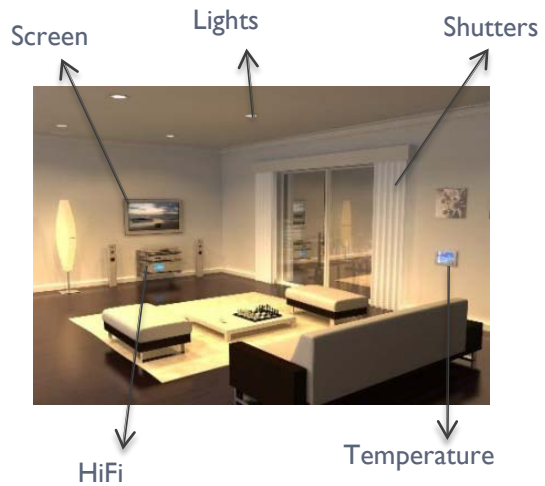
# Speaker Bio 2/2

- Projects involvement
  - Past
    - EU ITEA ANSO
      - Autonomic network for SOHO
    - EU OSAMi
      - Open Source for Ambient Intelligence
    - EU FP7 Diva project
      - [Models@Run.Time](#)
  - Current
    - EU ITN Relate
      - Cloud Computing
    - ANR (French) INFRA-JVM
      - A dedicated JVM for Pervasive environment
  - Upcoming very soon
    - EU FET Diversify
      - Investigating the impact of software diversity on system resilience

# Context



# Application domains



# A Borader view



# Software Intensive Systems

- Autonomic Computing
- Cloud Computing
- PaaS, SaaS, IoS, IoT...



# Comparison

## IDEAL WORLD

- Seamless integration with our daily environment
- Context dependent behavior
- Seamless and secured access to personal data
- Global interconnection

## CURRENT STATE OF THE ART

- No real standard
- “Integration” for devices from one vendor
- Closed Business model
- Possibility to access some of your data
- No global interconnection



# Environment Properties

- Extremely Open
- Extremely Dynamic
- Extremely Unpredictable
- Extremely Sensitive

# Scientific Challenges

- Distribution
- Heterogeneity
- Dynamism
- Multi-provider
- Evolution
- Ease of use
- Privacy
- Safety
- Security

# "Eternal" system

- Dynamically adaptive systems (DAS)  $\Leftrightarrow$  ability to make their behaviors and/or functionalities evolve at runtime.
- Typically used for applications where it's hard/impossible to anticipate needs at design time  $\Leftrightarrow$  Continuous design
- Necessity to define a manipulation granularity  
 $\Rightarrow$  common approach : component based development

# "Eternal" systems need continuous adaptations

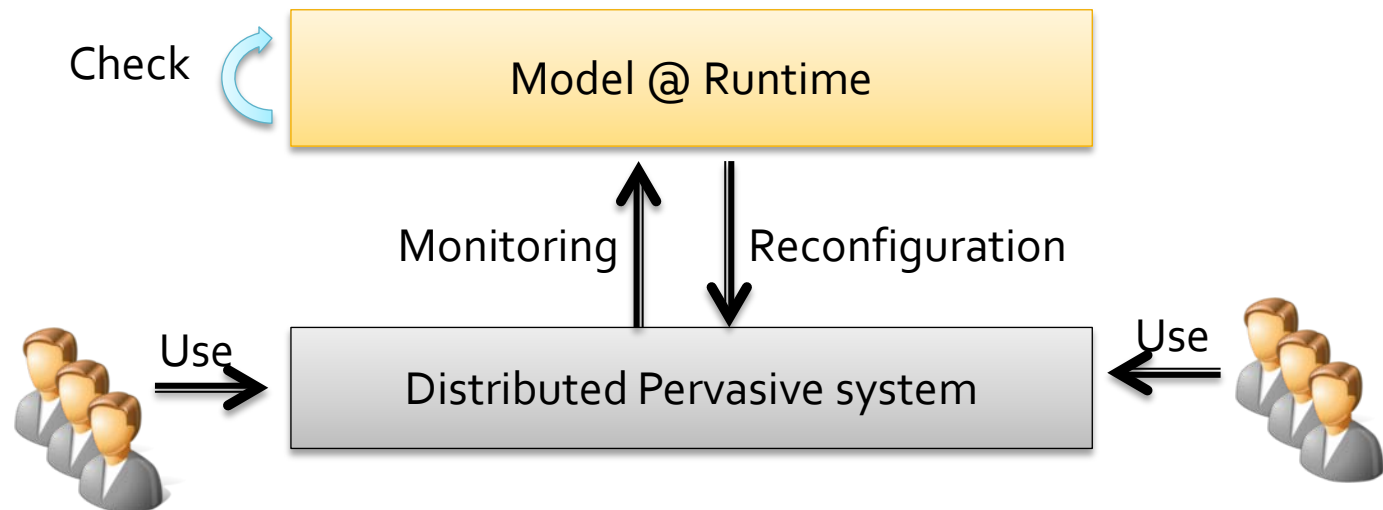
- Once reserved for critical systems, DAS approaches are now used for more humble systems, for several reasons
  - High availability
    - Cloud , web servers, 4 monitoring sensors network, etc ... need the famous 99,99% uptime
- Time to market and hyper agility
  - Agile methods <-> release often / continuously improve the design

**Need to adapt SE method from the V cycle to continuous delivery ...**

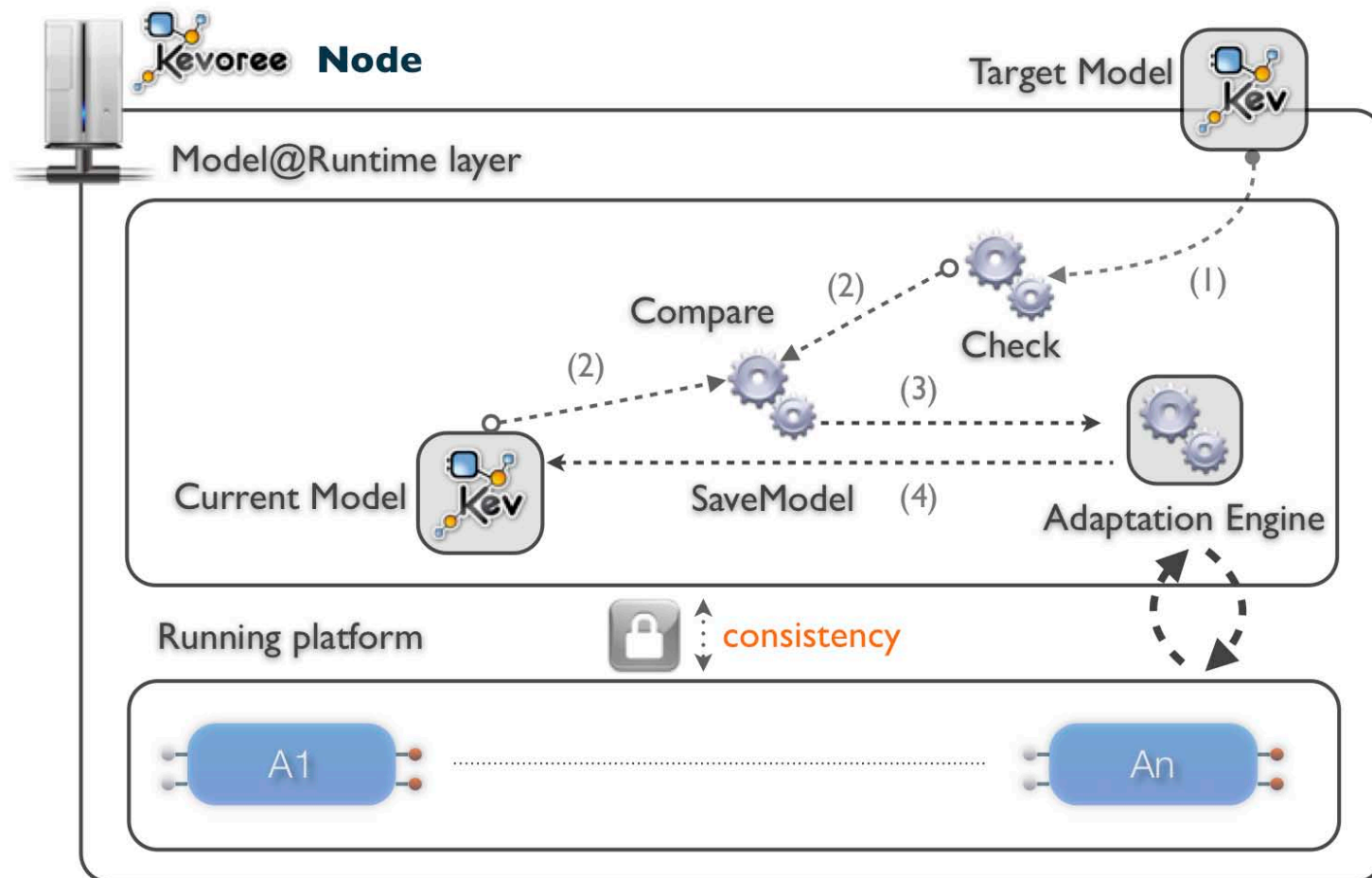
- *We need to provide an abstraction to manipulate and compose dissemination strategies*

# Models@Run.Time

- Based on the idea of reusing MDE techniques at runtime
- Provide an abstraction to reason about and manipulate systems at runtime.



# Models@Run.Time



# Models@Run.Time for distributed systems

1. Model of the distributed systems
2. Take decision locally
3. Apply reconfiguration locally
4. Disseminate reconfiguration



# The Kevoree Project

<http://kevoree.org>

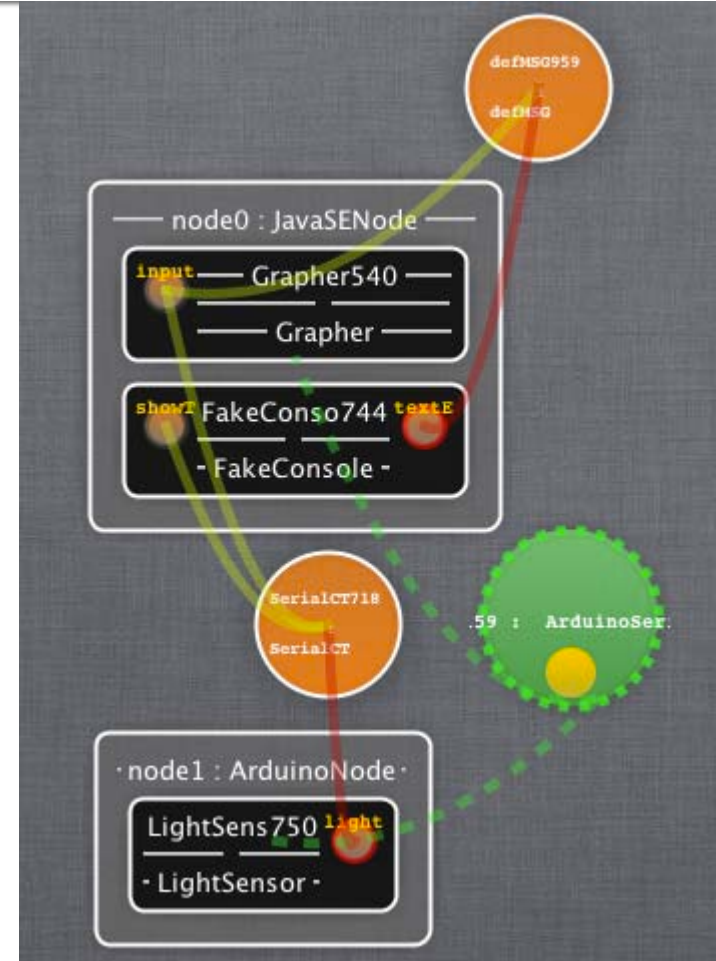


# Model@Runtime for DDAS

- **MDE@Runtime**
  - Shared model representation for distributed nodes
  - Offline & online operation, compute@Model level, apply @Runtime
- **Component-based**
  - Communication semantics between component in channel
- **Heterogeneity management with NodeType**
  - Java Node, Dalvik Node, Arduino Node
  - Cloud Node (Jails/\*BSD, JCloud, mini-cloud, EC2)

# Kevoree Concepts

- **ComponentType**
  - Encapsulate domain features
- **ChannelType**
  - Encapsulate communication semantics
- **GroupType**
  - Encapsulate model@runtime dissemination semantics
- **NodeType**
  - Encapsulate adaptation semantics



# Kevoree tools



The screenshot shows the Kevoree IDE interface. On the left, a 'DICTIONARY' panel lists 'pin' and 'PORTS' with sub-items 'on' and 'off'. On the right, a 'DigitalLight' component is shown with 'on' and 'off' ports. Below these panels is a table with the following data:

Name	Nature	Type
pin	Property	enum=0,1,2,3,4,5,6,7
on	ProvidedPortType	
off	ProvidedPortType	

Design your code



```
1 @ComponentType
2 @Provides({
3     @ProvidedPort(name = "on"),
4     @ProvidedPort(name = "off"),
5 })
6 public class DigitalLight
7     extends AbstractArduinoComponent {
8     //hard code goes here ...
9 }
```

# Kevoree tools



```
1 @ComponentType
2 @Provides({
3     @ProvidedPort(name = "on"),
4     @ProvidedPort(name = "off"),
5     @ProvidedPort(name = "toggle"),
6     @ProvidedPort(name = "flash")
7 })
8 public class DigitalLight
9     extends AbstractArduinoComponent {
10     //hard code goes here ...
11 }
```



**Code** your design

A screenshot of the Kevoree IDE. On the left, a 'DICTIONARY' panel shows a tree view under 'PORTS' with a sub-entry 'Provided' containing the items 'on', 'off', 'toggle', and 'flash'. On the right, a diagram shows a component labeled ': DigitalLight' with four circular ports labeled 'on', 'off', 'toggl', and 'flash' connected to it.

Name	Nature	Type
pin	Property	enum=0,1,2,3,4,5,6,7
on	ProvidedPortType	
off	ProvidedPortType	
toggle	ProvidedPortType	
flash	ProvidedPortType	



# Kevoree Usage



# Model@Runtime platform for distributed dynamic adaptive system

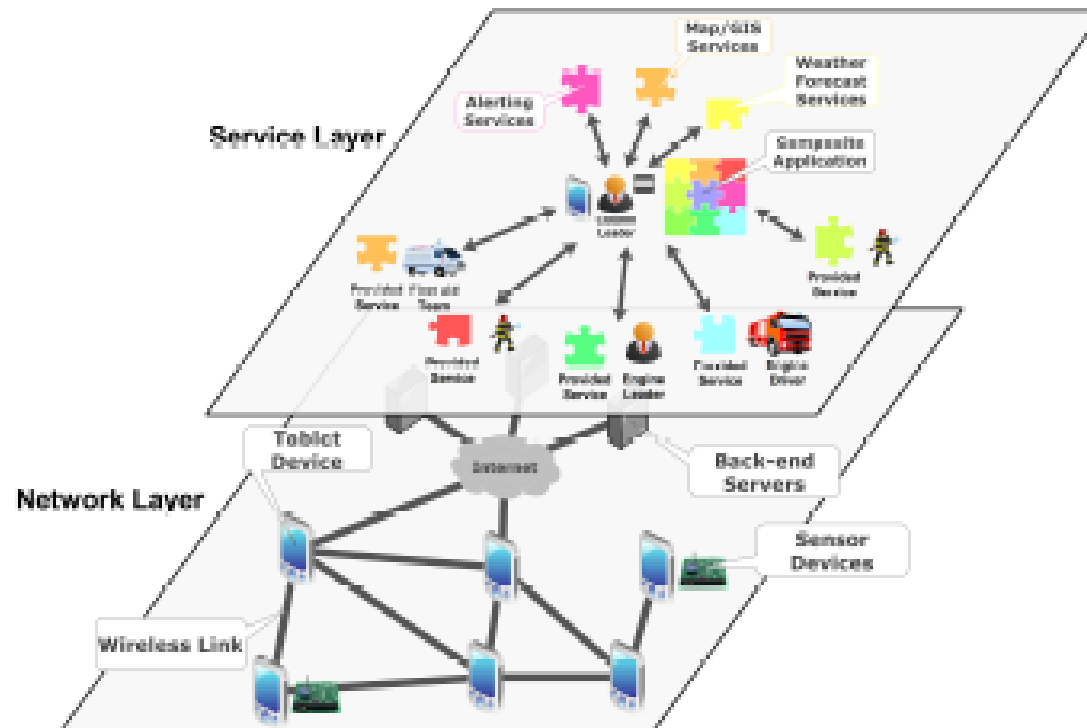


*Triskell private heterogeneous cloud*

- From low power nodes...
  - Arduino
- ... to Clouds
  - EC2 etc.
- DAUM platform
  - Tactical Information System
    - for civil security
    - Sensors on firefighters, tablets, cloud...

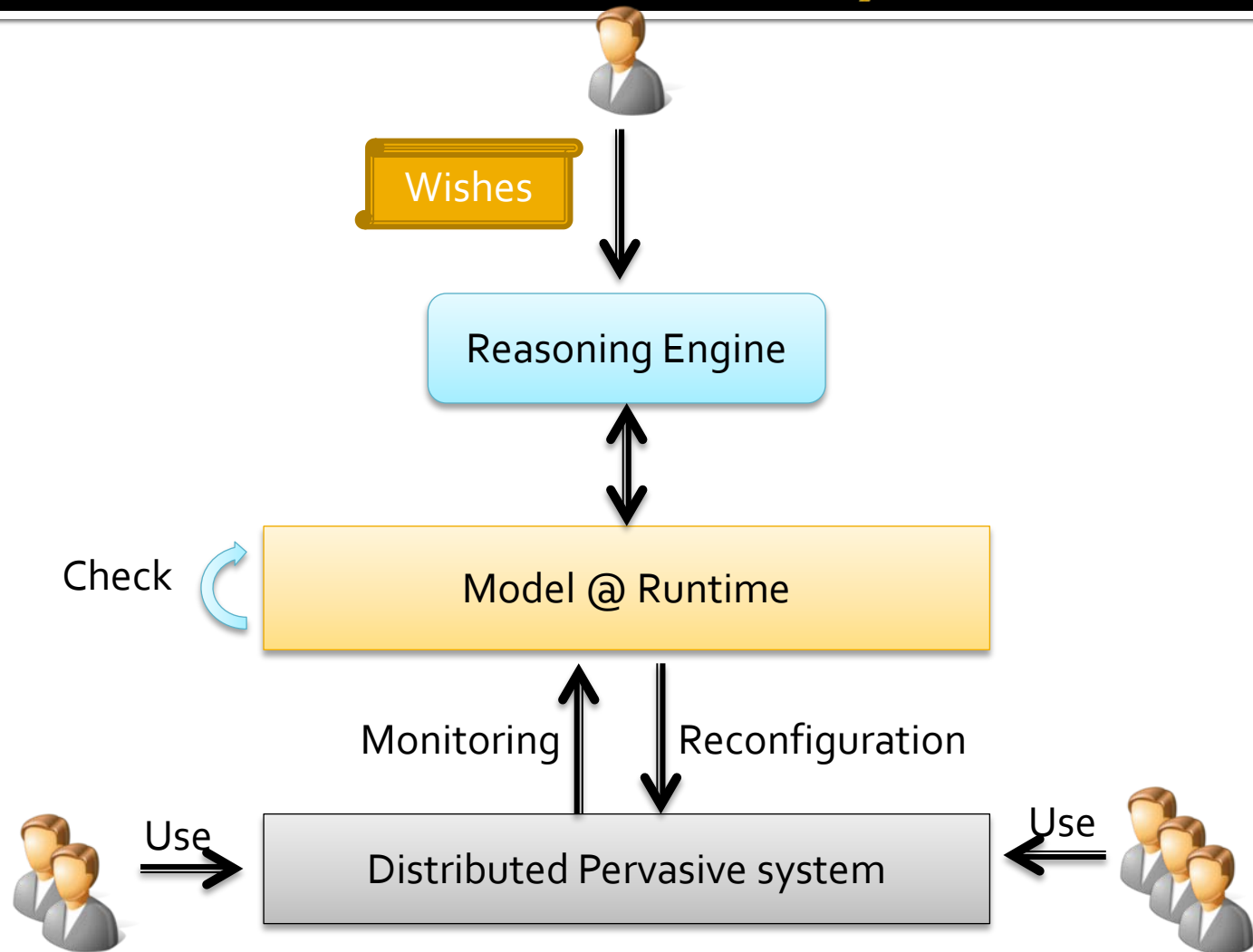
# DAUM

- Define a tactical on-field operating system for firefighters





# On going work – Self-adaptation for Cloud / IoT / Pervasive systems



# Very simple Demonstration



# References

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