# A Component-based Middleware Architecture for Sentient Computing

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# Goal

- New generation of applications
  - Wide variety of mobile context-aware nodes with different connectivity and different requirements

Infrastructure-based network

Mobile ad hoc network

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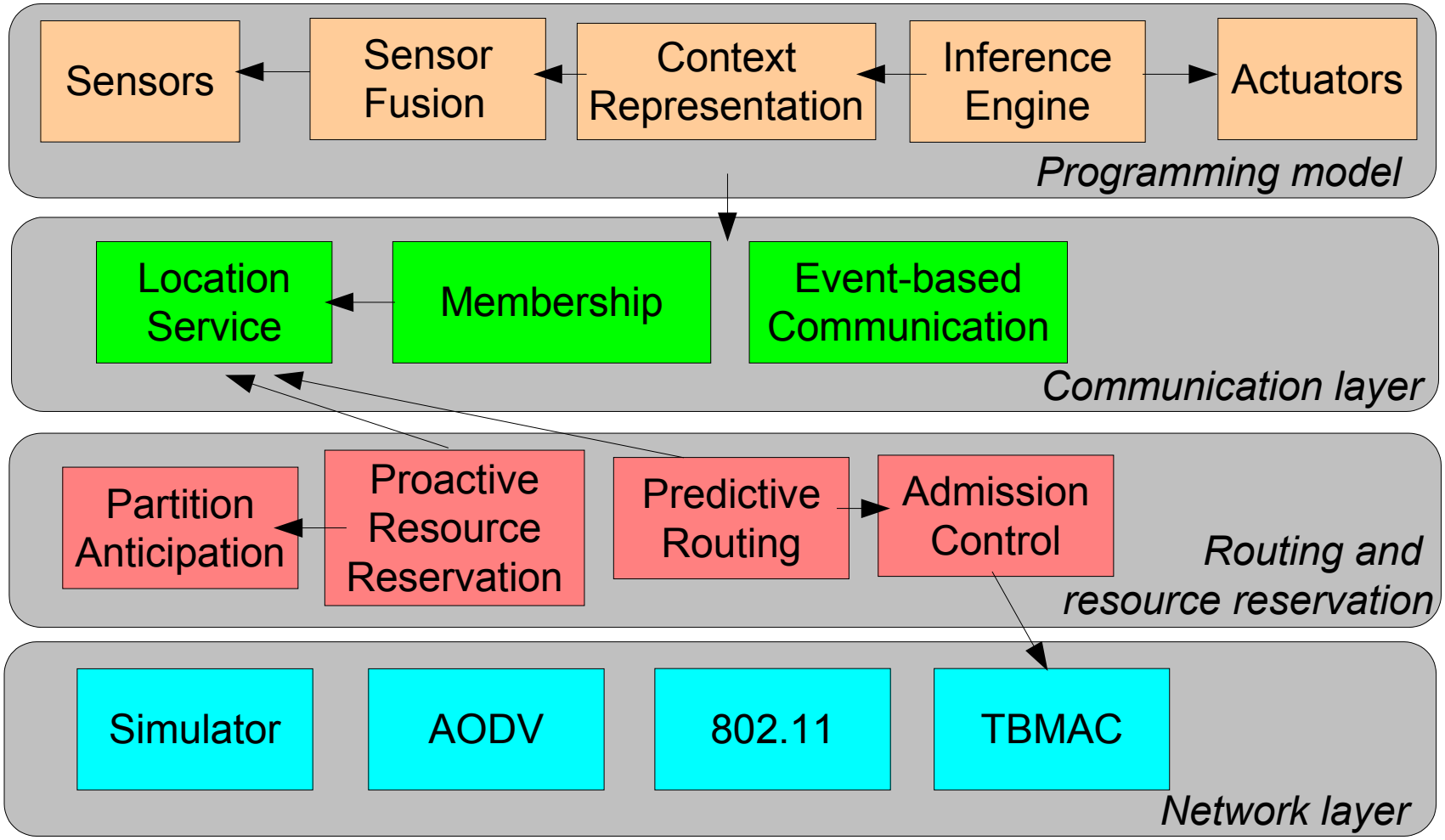
→ *Construction of customised middleware*

# Approach

- Defining sentient objects
  - Mobile intelligent entities able of sensing their environment and reacting accordingly
- Providing a middleware architecture
  - For non-functional properties (mobility, real-time)
  - For different platforms (embedded systems, simulators...)
  - Based on off-the-shelf components
    - To fit application requirements exactly

# Library of components



# Programming model: Sentient object model

- Sensors: software entities that produce events
- Sensor capture and fusion
  - Determination of a higher-level context from events of diverse sensors
- Context representation
  - Hierarchy of contexts: actions are limited by the current context
- Inference engine
  - Reasoning mechanisms based on rules that may produce events
- Actuators: software entities that consume events

# Communication layer

- Event-based communication
  - Does not depend on any fixed infrastructure
  - Subject, content and proximity filters
- Membership management
  - Classical & proximity group communication
- Location service
  - Fusion of data coming from different sources
  - Convertors of location data format

# Routing and resource reservation

- To offer real-time guarantees
  - Key requirement: location-awareness
- Predictive resource reservation
  - Slots allocated in advance by the slot manager
  - Policies applied to reduce the number of participants by admission control
- Proactive routing
  - New path found prior to failures detected by the partition anticipation component

# Network layer

- Number of protocols supported
- TBMAC
  - Reduces the probability of collisions by providing time-bounded access to the medium
  - Used to provide predictable access latency for real-time communication

# The “sentient sofa”

An instantiation of our middleware architecture

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LPX load sensors

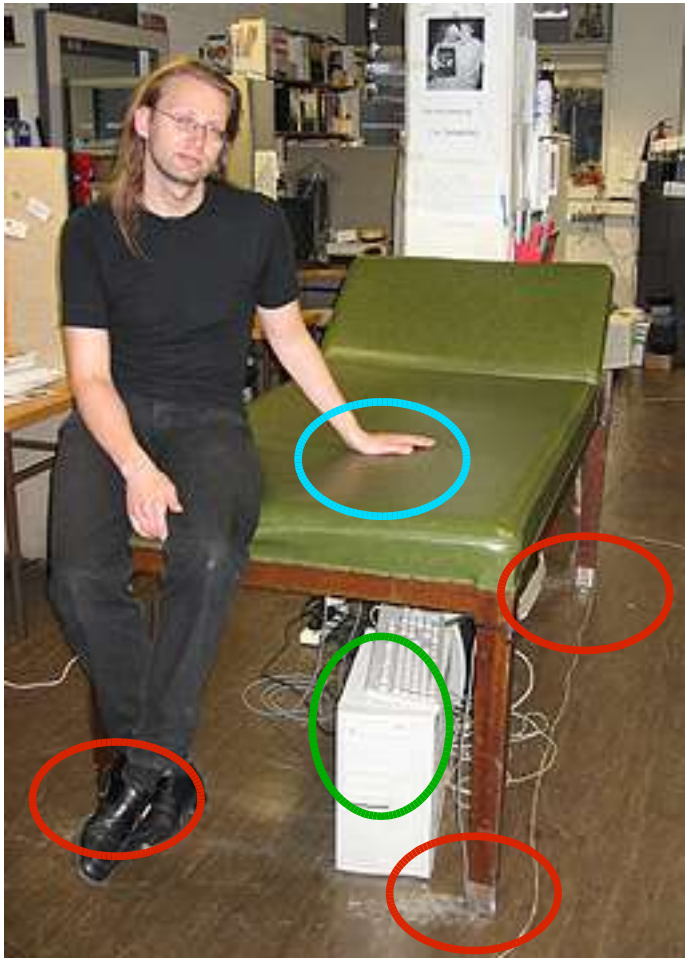
# The “sentient sofa”

An instantiation of our middleware architecture

LPX load sensors

CPU connected via serial port

# The “sentient sofa”



An instantiation of our middleware architecture

Voice generator

***“Hello Maads! You are sitted in the bottom left part of the sofa.”***

LPX load sensors

CPU connected via serial port

# Components of the “sentient sofa”

- Programming model
  - Fusion of sensor readings
    - Sum of the four readings to determine the user
    - Average of the four readings to determine user location
  - Context representation for location
  - Inference engine activating the voice generator
- Communication layer: STEAM between sensors, “sentient sofa” and voice generator
- No routing and reservation mechanisms
- No components for ad hoc networks
- ➔ *Reduced development time*

# Conclusion & future work

- Middleware architecture for context-awareness
  - Customised to various requirements (real-time, mobility, simulation...)
  - Based on components available in a library
- Middleware instantitated for a “sentient sofa”
  - Improvement in development time
- Definition of a formalism to describe the middleware & development of tools
- Development of the component library