OCµ
Organic Computing Middleware for Ubiquitous Environments

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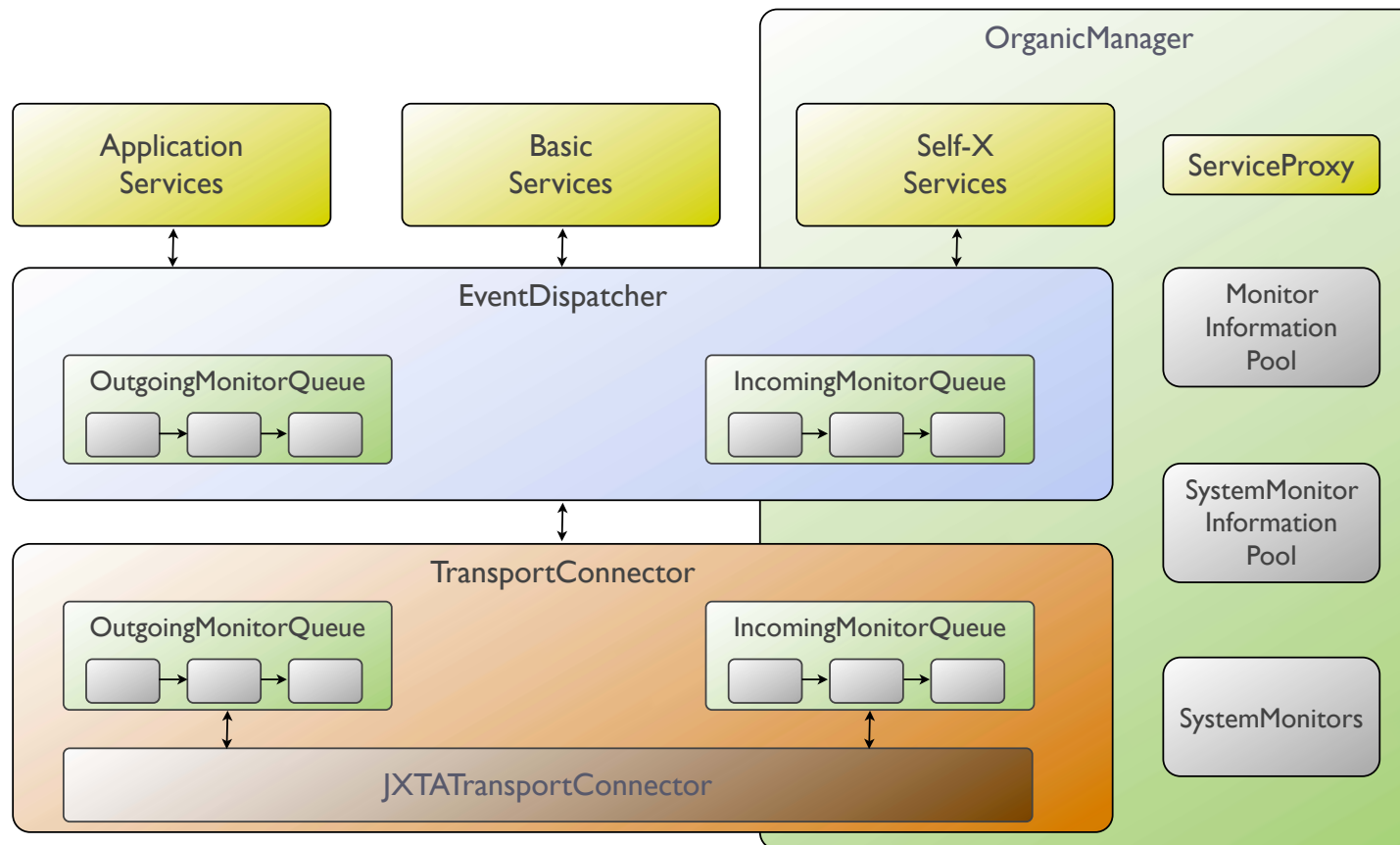Chair of Systems and Networking
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Outline

- OCµ Architecture

- Smart Doorplates Video

- Results of the 1. Phase

- Workschedule for the 2. Phase

- Conclusion

Objectives of 1st Phase

- OCμ Middleware
- Self-configuration
- Self-optimization
- Self-healing
- Self-protection

Self-configuration

- Based on a cooperative social behavior
- Distributed and decentralized approach
- Collision avoidance mechanism
- Good scalability

Self-optimization

- Idea of an artificial hormone system

- Nodes exchange current load values

- Four transfer strategies

- Optimize static and dynamic services

- Scales perfectly

Self-healing

- Distributed self-healing Data Store

- Failure Detector
  - Detects node failures in distributed systems
  - Statistical analysis of arrival times of heartbeats
  - Adaptive – adapts to changing network conditions
  - Accrual – outputs suspicion information
  - Fast – O(log n) (n = number of heartbeat messages)
  - Good detection quality

Self-protection

- Based on the biological immune system

- Theoretical basis about binary receptors and negative selection

- Detects unknown (malicious) message in OCµ

- Optimizations:
  - Minimization of memory usage by combining receptors
  - Detection speed up with binary tree structure
  - Improvements with additional positive selection

Challenges of 2ⁿᵈ Phase

- Self-configuration improvements
- Full self-healing functionality
- Self-protection architecture
- OCµ adaptation

Self-configuration

- Improve the configuration process

- Add more constraints

- In cooperation with SAVE ORCA Project

  - Formal verification of the self-configuration process

  - Build an example with robot production cells

Self-healing

- Self-healing architecture

- Failure detection
  - Improving scalability of failure detector using grouping techniques
  - Lazy monitoring by information piggybacking

- Failure recovery
  - Design of a Self-healing Manager applying principles of psychology and sociology
  - Use of automated planning

Self-protection

- Complete self-protection architecture
- Decentralized thymus for
  - Receptor generation and distribution
  - Efficient redistribution of receptors after reconfiguration
- Defending threats
  - Threat analysis
  - Threat combat

Conclusion

- We over-performed our goals of the 1st Phase

- Results at the end of the 2nd Phase

  - Improved self-configuration

  - Full self-healing functionality

  - Complete self-protection architecture

  - Redesigned OCμ to better support self-protection

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- Wolfgang Trumler, Jan Petzold, Faruk Bagci, Theo Ungerer. *AMUN - Autonomic Middleware for Ubiquitious eNvironments Applied to the Smart Doorplate Project.* International Conference on Autonomic Computing (ICAC-04), New York, NY, May 17-18, 2004