

Corporate Technology

Intelligent Solutions for Smart Environments – From Consumer to Industrial Applications

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Internet of Things – Technology Roadmap



Internet of Things – Technology Clusters





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Technologies

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Siemens' Products (Things)



Industry and Automation Energy Medical 1 11 11 11 11 Others: 800 HE - 10 2008-03-28 Michael Berger, CT IC 6 © Siemens AG, Corporate Technology

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Sensors and Sensor Network Examples @ Siemens

- Fully passive Sensors, e.g. RFID, Surface Accoustic Wave (SAW)
- Semi-passiv Sensors, e.g. Backscatter
- Active Sensors, e.g. Gas, Camera

Security level of smart cards on low-cost RFID product: Chip area < 0.2 mm²; Computation time < 70 ms

Technology: Cryptography based on elliptic curves

Brand protection; no forge of the certificate of origin



Multi-hop Ad hoc & Ad hoc Mesh Networking











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ZigBee- based self orga-

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Siemens offering RFID Systems for all Applications





indoor: 20m .. 80m (depending on room size and reflexions)

Multifunction Tags

- Unique ID
- Read & Write over the air
- Set Beacon Rate o. the air
- Mute function
- User memory 112 Bytes
- Unique long battery lifetime

Sensor Tags

- Unique ID
- Temperature Sensor or Motion Sensor

Controller for all Tags

- Programmable Reading Range
- Interfaces : Serial RS232/RS485 or Ethernet WiFi/RJ45
- Reads 80+ Tags per second, up to 1000 Tags per Reader
- Suffisticated anti-collision
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Source: Zeno Stämmer, Siemens Schweiz AG, EIP Z

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Chemical Sensors





Source: Dr. habil. Maximilian Fleischer, Siemens AG, CT PS 6

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Software Intelligence - Agent Technologies

Represent a physical object or human actor and fulfil specific tasks Integrate heterogeneous data sources Analyse complex environments

Assist by decision making, planning, Coordinate and cooperate in dynamic, prediction; execute, adapt behaviour

heterogeneous distributed environments

Communicate and share information







Modeling and Integration World / System Modeling Information / System Integration e.g. modeling of context / environment, human behavior / processes / capabilities / preferences, ontology / model engineering, model patterns, data source abstraction, information fusion, tool integration, filtering, search

Local Intelligence

- Context / Situation Understanding Autonomous Behaviour, Decision Making, Adaptation
- e.g. control theory, rule engines, utility theory, decision networks, knowledge based reasoning, planning, scheduling, matchmaking, learning, contraint solving, social intelligence, emotions

Distributed Intelligence

Communication. Interaction **Cooperation / Coordination** e.g. game theory, market-mechanisms, auctions/negotiations, voting/grouping, conflict resolution, distributed planning / reasoning, high level communication, interaction protocols, conversations, swarm intelligence, emergent behavior





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Consumer and Industrial (Research) Applications

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Example: Easy Ticketing with NFC



Example: Corporate Phone - RFID based Mobile Medical Assistant



Different Roles: Chief of Medicine, Doctor, Nurse

Login and role selection

Role specific functions

Example: Context Aware Personal "Daily" Assistant

Example: Intelligent Train Compartement

Example: Emergency Monitoring and Prevention

EC Project EMERGE

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Example: Integrated Railway Monitoring I

EC Project InteGRail

Example: Integrated Railway Monitoring II

EC Project InteGRail

Service Agents:

Intelligently assist and support the user in difficult tasks with:

- Decision support
- Decision making
- Autonomous behavior

• E.g.: "Show all damaged tracks."

Technologies:

- Rule Engines, e.g. FIRE (IC6)
- Constraint Solver, e.g. Choco
- Match-Maker, e.g. SieMatch (IC6)
- Market-Mechanisms, e.g.
 NegEngine (IC6)
- Planner, e.g.: JPlan

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Example: Cooperative Traffic Control

Example: Cooperating Cleaning Robots

Cleaning of large rooms, by using multiple robots (airports, train stations, hospitals, ...)

Tasks:

- The area must be partitioned among the robots
- Paths for complete coverage must be planned
- Collisions must be avoided
- Assumption:

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• The robots can communicate, but only locally (the communication range is limited)

Examples: Self-organizing Production and Airport Baggage Logistics

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Example: Digital Product Memory

German Project SemProM

1.) Enhancement of real-world objects with digital memories and sensing capabilities

2.) Infrastructures, information models and execution environments for automated generation of Digital Product Memories

3.) Support of multi-modal user interaction with the digital product memory

- 4.) Applications in business processes:
- Warehouse / Retail / Consumer support
- Transport Logistics
- Manufacturing
- Maintenance

Partners: DFKI, BMW, Deutsche Post, Globus, 7x4 Pharma, SAP, Siemens

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Summary

Internet of Things

- Automates distributed dynamic environments and processes
- Improves user convenience
- Affects infrastructures, services, applications and user interfaces

Wide spectrum of promising application areas:

- Automation&Control
- Transportation&Logistics
- Health, Home
- Services&Robotics

Now: Sensors and Connectivity technologies, Information and Service platforms are on the way

Future: Software Intelligence / AGENT TECHNOLOGIES and User Interaction are the key factors for realizing the Internet of Things!