BAT preliminary vision for wireless automation
Competitive edge through cost effective solutions, easy commissioning and up-keeping

Flexible real-time automation architecture

Automatically optimized and configured, robust, carefree, energy-aware hybrid automation system enabling significant cost savings

Secure and safe

Wireless automation system design

System modeling, simulation and optimization

De-Facto industrial standards

Design criteria
BAT preliminary vision for wireless automation
Competitive edge through cost effective solutions, easy commissioning and up-keeping

Flexible real-time automation architecture

Easy to implement hybrid system (fixed and wireless networks)
Configuration of heterogeneous networks
Energy consumption modeling and optimization
Battery durability simulation
Integration to engineering tools

De-Facto industrial standards

Automatically optimized and configured, robust, carefree, energy-aware hybrid automation system enabling significant cost savings

Design criteria

Secure and safe

Industrial standards (e.g. WirelessHART and ISA100.11a)
Future wireless industrial solutions with IPv6
Control for hybrid systems (delays, losses, robustness)
Wireless short range broadband solutions
Correct wireless solution for different needs
Engineering tools for hybrid and wireless systems

System modeling, simulation and optimization

Wireless automation system design

Location-aware

Battery durability simulation

Integration to engineering tools

Secure

Energy consumption modeling and optimization

Engineering tools for hybrid and wireless systems
Main long-term objectives

• O1: Flexible wireless automation architecture
• O2: System modeling, simulation and optimization
• O3: Wireless automation system design
• O4: Validation
OBJECTIVE 1

- Flexible wireless automation architecture
  - Flexible automation system architecture that allows use of hybrid solutions in the implementation
  - Configuration and management of heterogeneous networks and automation system
  - Industrial standards (WirelessHART, ISA100.11a, 6LoWPAN, IPv6...)
  - Location-awareness: location-based data aggregation, information of fault locations etc.
  - Network monitoring, self-diagnostics
OBJECTIVE 2

- System modeling, simulation and optimization
  - Tools and methods for modeling and optimization of sensors, nodes, batteries and protocols
  - Tools and methods for system level energy consumption optimization (planning & online support)
  - Battery durability simulation (different scenarios)
  - Simulation tools for wireless automation
  - Robustness & sensitivity analysis, failure detection, reaction and recovery methods
  - Hybrid solutions and wireless automation system design by simulation
  - Simulator and design tool integration to engineering tools
OBJECTIVE 3

• Wireless automation system design
  - Methodology and design criteria
  - Wireless communications in automation
  - Data aggregation and fusion, fault diagnostics, distributed & embedded computing
  - Control design for hybrid systems (delays, losses, asynchronism, robustness, realtimeliness)
  - Interoperability, reliability, security, safety
  - Engineering & design tools for hybrid and wireless systems
  - Simulation-aided rapid prototyping of protocols & algorithms
OBJECTIVE 4

• Validation
  - Testbeds
  - Case studies
  - Long-term large-scale piloting
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<table>
<thead>
<tr>
<th>Now, recent</th>
<th>Long-term objectives</th>
<th>Vision</th>
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<tbody>
<tr>
<td>State-of-the-art</td>
<td>Technologies that enable the vision</td>
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<td>Access to technology</td>
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<td>Current projects</td>
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<tr>
<td>Flexibile real-time automation architecture</td>
<td>Flexible automation system architecture that allows use of hybrid solutions in the implementation</td>
<td>carefree, secure and safe, energy-aware hybrid automation</td>
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<tr>
<td>Proprietary solutions that solve some problems, system level not addressed (little work on hybrid systems)</td>
<td>Configuration and management of heterogeneous networks and automation system</td>
<td>system enabling significant cost savings</td>
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<tr>
<td>WirelessHART, ISA100.11a standards and networks available - no support for real-time control applications (currently)</td>
<td>Location-awareness: location-based data aggregation, information of fault locations etc.</td>
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<td>ISA100.12 converging committee, 6LoWPAN implementations in sensor network stacks</td>
<td>Network monitoring, self-diagnostics</td>
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<td>RF-based localization indoors has poor accuracy (5-10 m)</td>
<td>System modeling, simulation and optimization</td>
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<tr>
<td>Various simulators for subproblems, some simulators for wireless automation design</td>
<td>Tools and methods for modeling and optimization of sensors, nodes, batteries and protocols</td>
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<td>Load balancing protocols</td>
<td>Tools and methods for system level energy consumption optimization (planning &amp; online support)</td>
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<td>WirelessHART aims at equalizing the energy consumption of the nodes by intelligent route management</td>
<td>Battery durability simulation (different scenarios)</td>
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<td>PiccSIM simulator, TrueTime, ns-2 extensions</td>
<td>Simulation tools for wireless automation</td>
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<td>Wireless automation system design</td>
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<td>PIDPLUS (Emerson), various complex controller structures (inappropriate), few simple solutions</td>
<td>Methodology and design criteria</td>
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<td>The two standards are non-interoperable, but provide reliable and secure communications, but not realtimeliness</td>
<td>Wireless communications in automation</td>
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<td>Control algorithm code generation is possible</td>
<td>Data aggregation and fusion, fault diagnostics, distributed &amp; embedded computing</td>
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<td>Protocol code generation from WSN simulators not generally available</td>
<td>Control design for hybrid systems (delays, losses, asynchronism, robustness, realtimeliness)</td>
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<td>WirelessHART implementations on TrueTime, ns-2</td>
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