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Embedded systems for extreme and harsh conditions. Present status and outlook for the future



Jerker Delsing
EISLAB

Luleå University of Technology, Sweden

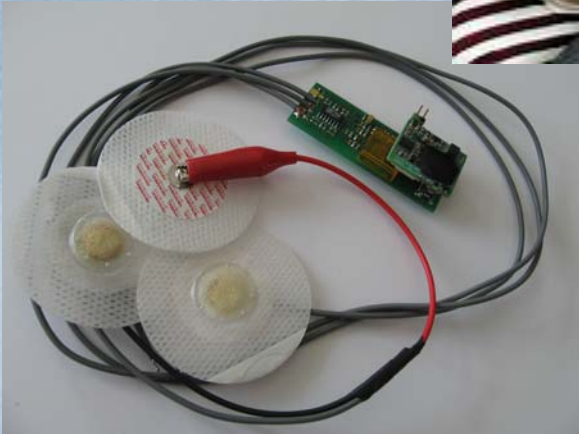
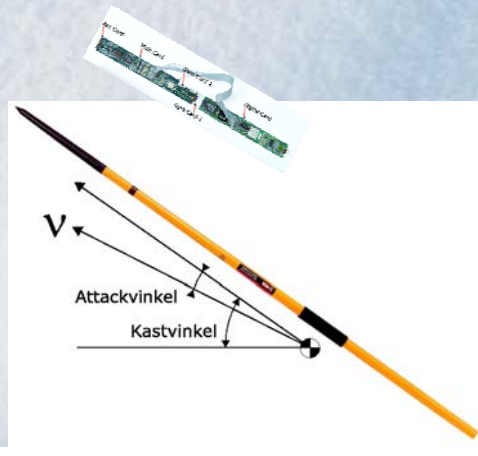
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Ubiquitous inclusion of software and electronics

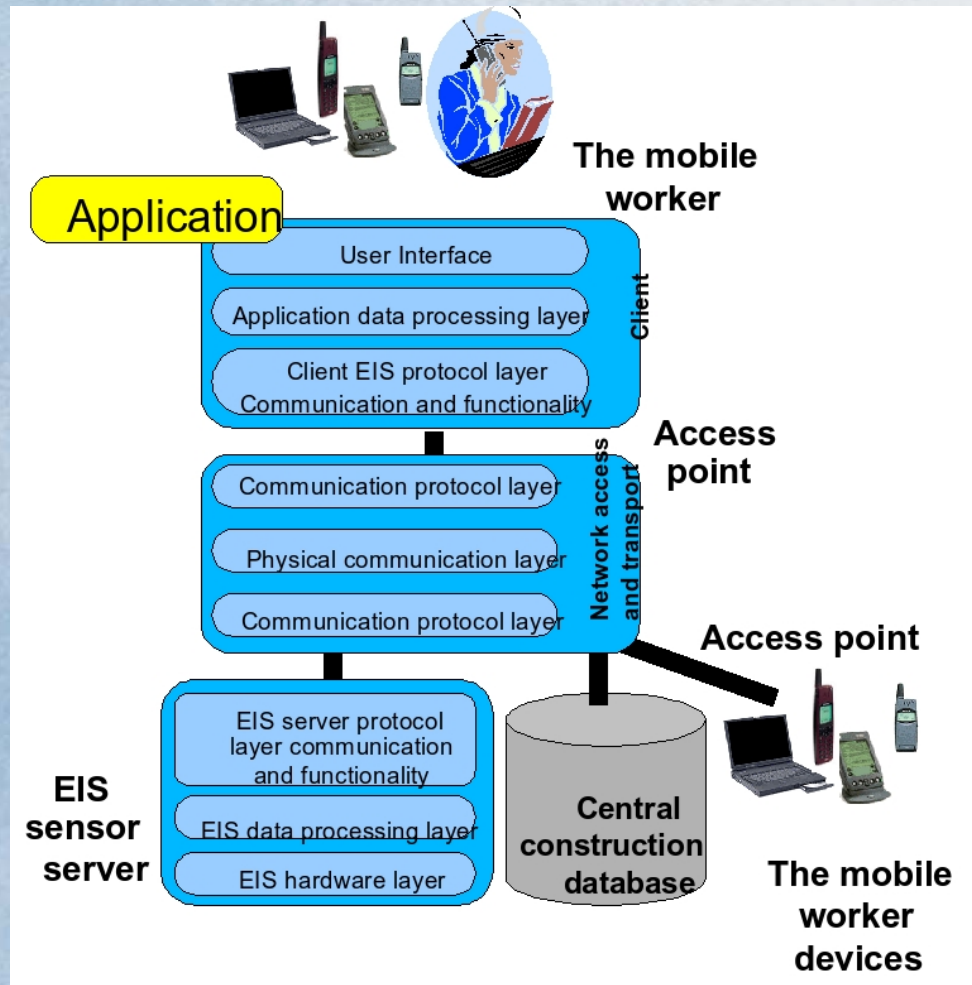


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Networking systems





Automation effects in process industry

- × Reduced production cost
 - Higher equipment efficiency
 - Less people
- × Improved product quality
- × Production flexibility





Hinder for massive deployment in industry

- × Technology not robust enough for the application environment
- × System integration not seamless
- × System and human interactions not understood well enough
- × Slow development of industrial equipment and competence structures





Technology not robust enough for the application environment

- × Mechanical robustness
 - × OK, but too expensive and too large
- × Electronic HW robustness
 - × OK, reasonable
- × Software robustness
 - × NO, much improvements required
- × Power supply
 - × NO, much improvements required
- × Communication robustness
 - × NO, work in progress, improvements still required





System integration not seamless

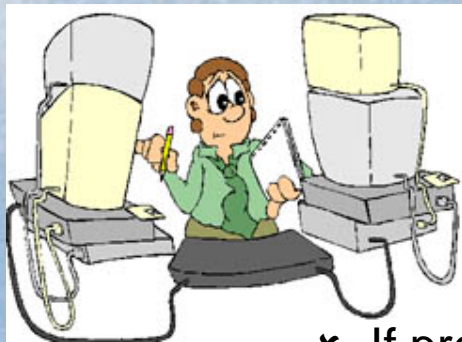
- × A jungle of service standards and technologies
- × Very diversified communication HW technologies
- × Lack of feasible architectures, methodologies and tools for developing very large systems





System and human interactions not understood well enough

- × Humans and technology speaks different languages



- × Hi how are you?



- × If present=1 then test(happy, sad)

- × Humans and technology think differently
 - × Neural network
 - × Fixed program, adaptive program



Slow development of industrial equipment and competence structures

- × Incremental developments of technology
 - × Big changes are risky
 - × Suppliers are business driven, low hanging fruit strategies

- × Technology becomes threat in organizations
 - × People involvement in technology development is difficult
 - × Changing work situations becomes a threat
 - × How to educate on new technology



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Future perspectives



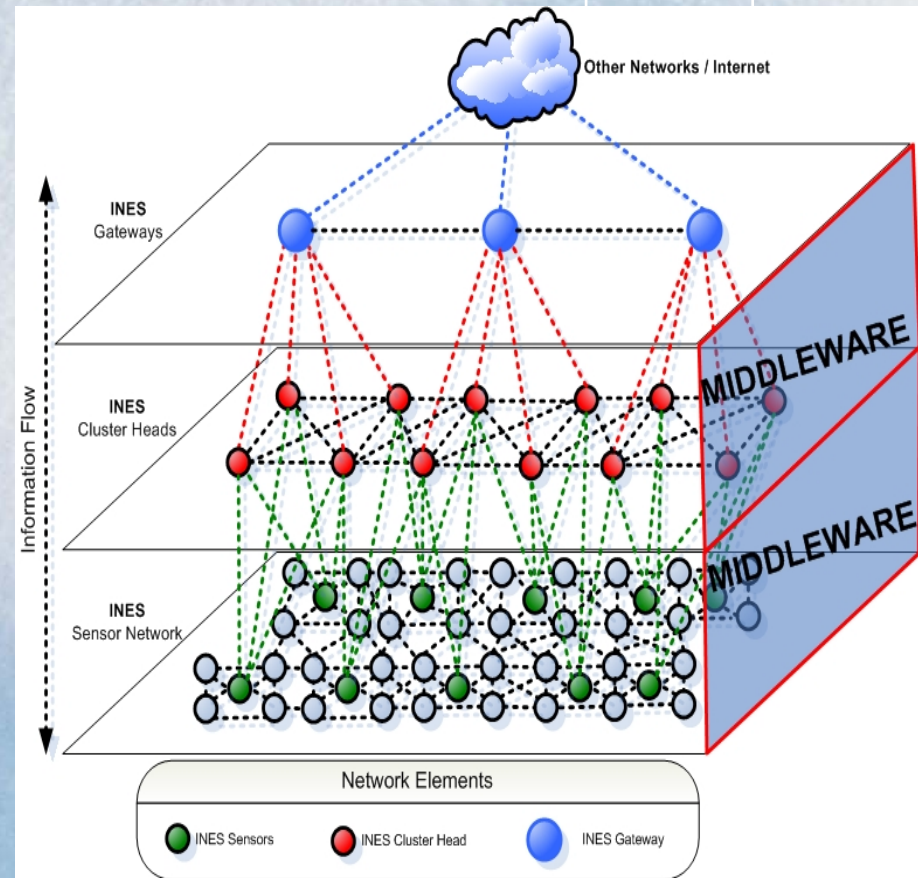
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Massive deployment of wireless sensors and actuators

- × First step from today's paradigm



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Embedding technology into the manufacturing process flow and the product

- × “Submarine” technology for continuous process monitoring
 - × 1mm³
 - × Location aware sensing with real time communication

- × Embedded product self monitoring
 - × Pellets
 - × Sheet steel
 - × ..

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Enabling self organizing "thinking" systems

✘ Using human like technology

✘ Biology

Neuron

Neuron firing

Lower "brain" functionality

Cortex

Immune system

✘ Human build

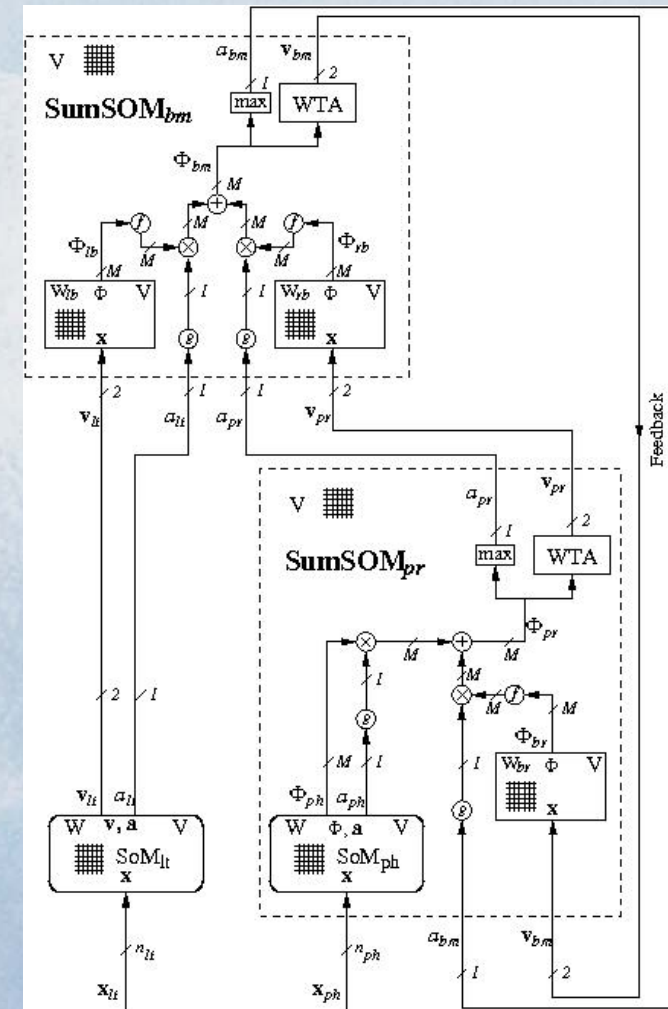
MULLE - silicon

TCP/IP communication

Hard coded sensor & actuating fusion

Self-organization with Feed-forward - Feedback

Immune agents??



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Thank you



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