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



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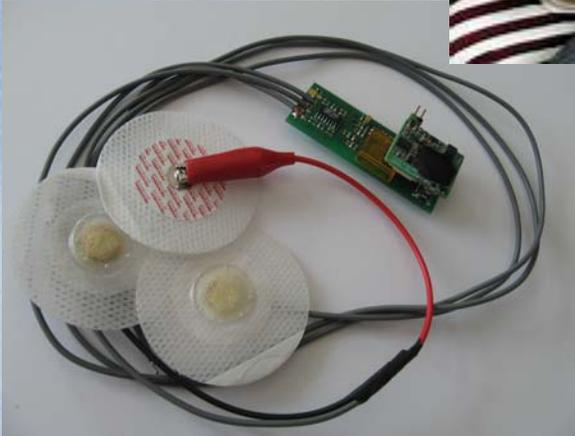
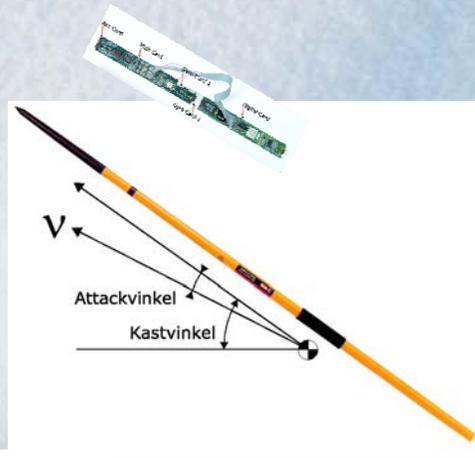
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# Ubiquitous inclusion of software and electronics

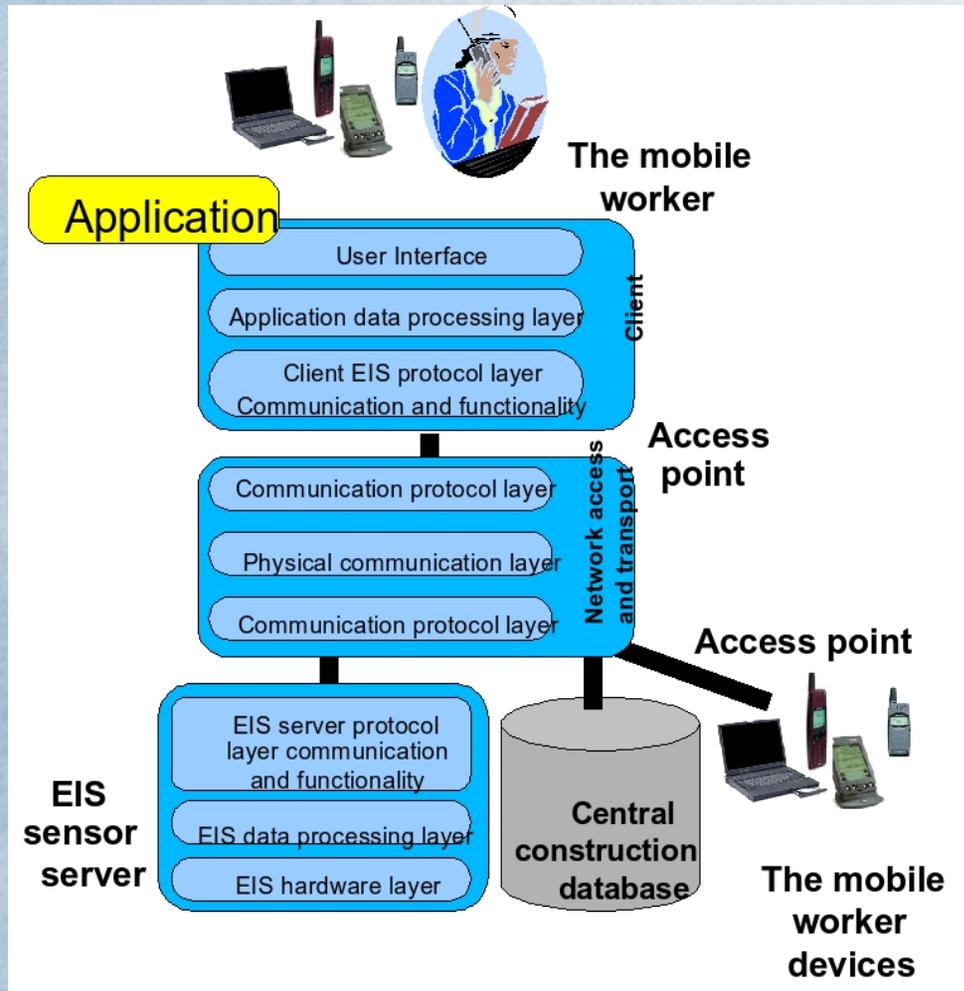


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# Networking systems





## 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



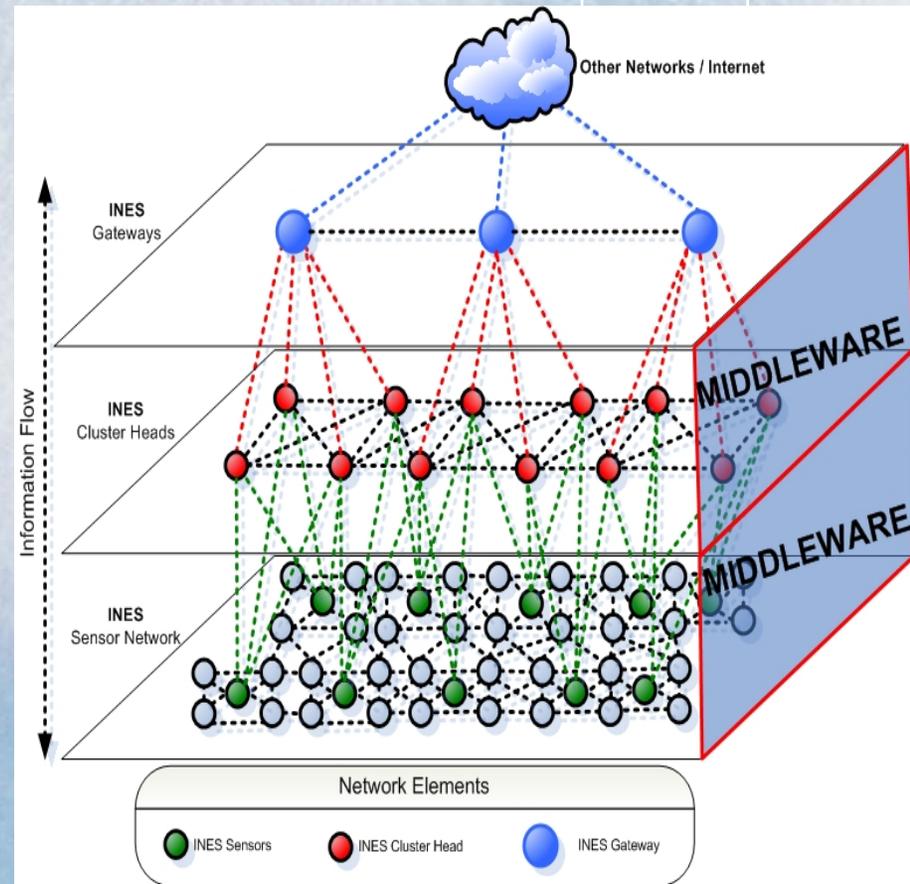
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# Massive deployment of wireless sensors and actuators

- × First step from today's paradigm





## Embedding technology into the manufacturing process flow and the product

- × “Submarine” technology for continuous process monitoring
  - × 1mm<sup>3</sup>
  - × Location aware sensing with real time communication
  
- × Embedded product self monitoring
  - × Pellets
  - × Sheet steel
  - × ..



# Enabling self organizing "thinking" systems

✘ Using human like technology

✘ Biology

Neuron

Neuron firing

Lower "brain" functionality

Cortex

Immune system

✘ Human build

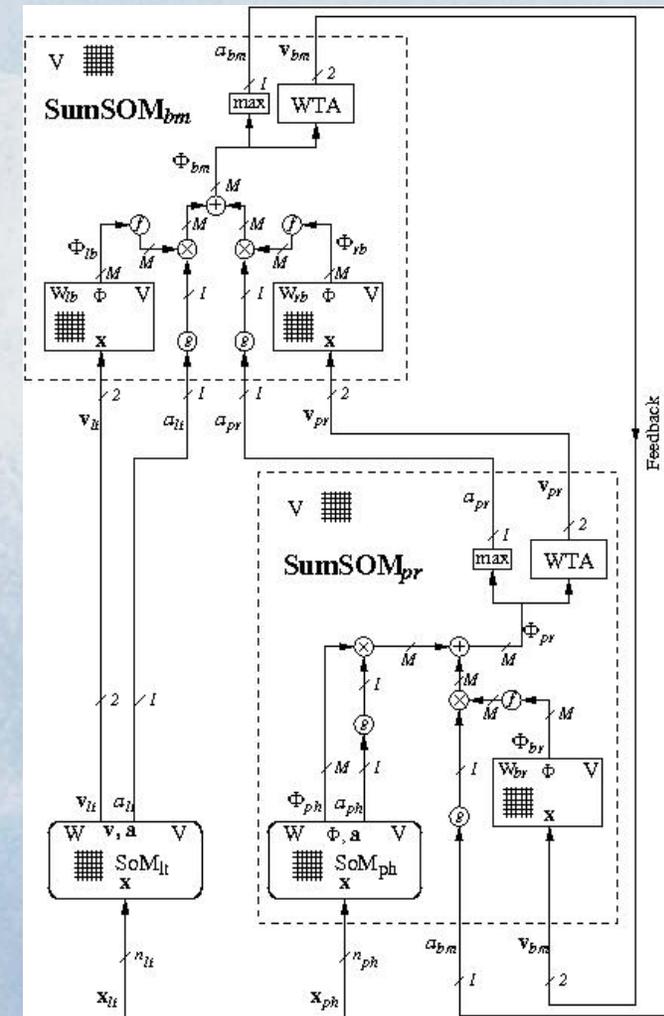
MULLE - silicon

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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