Service Discovery and Composition in Body Area Networks

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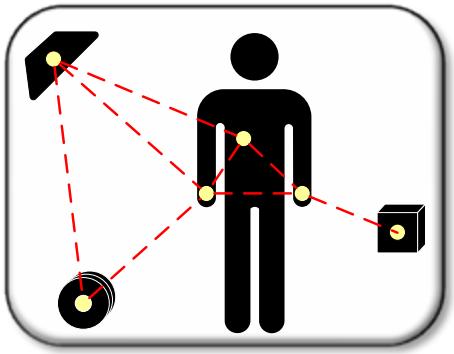
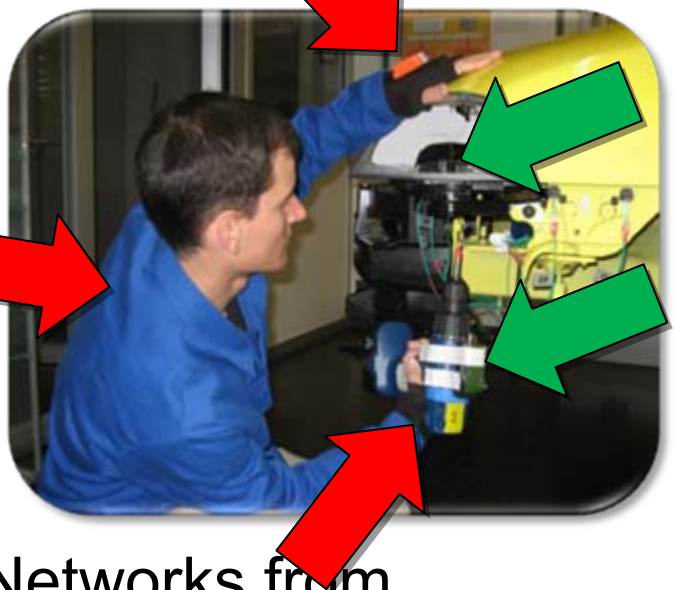
Motivation



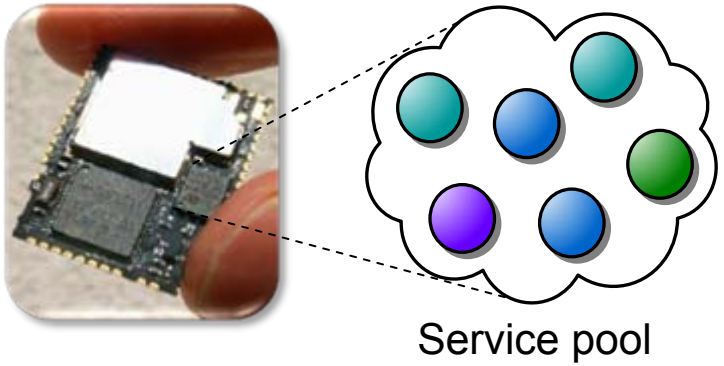


- Activity recognition in Body Area Networks from sensors worn on the body and on tools used
- Adaptation to environment without reprogramming
- Algorithm updates from outside

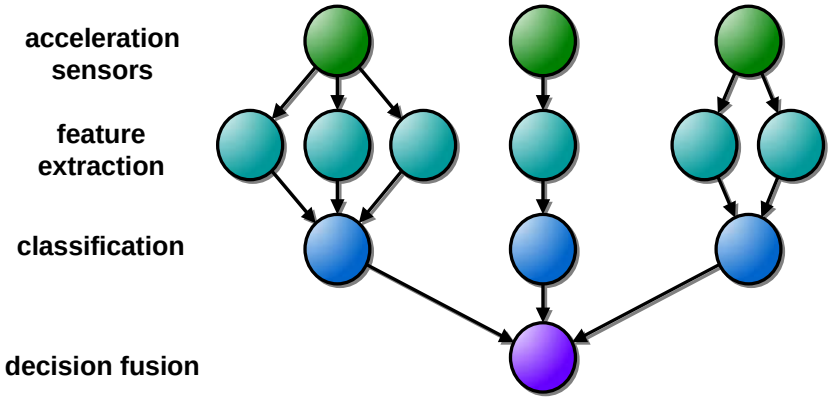
➡ Service discovery and composition enables this

Simple and complex services

- Miniature WSN nodes provide service pools
  - **Simple services** like sensors or data processing functions
  - Preprogrammed, sharing RAM resources



- Applications are formed by interconnecting those simple services to **complex services**
  - Allows distributed execution of activity recognition algorithms



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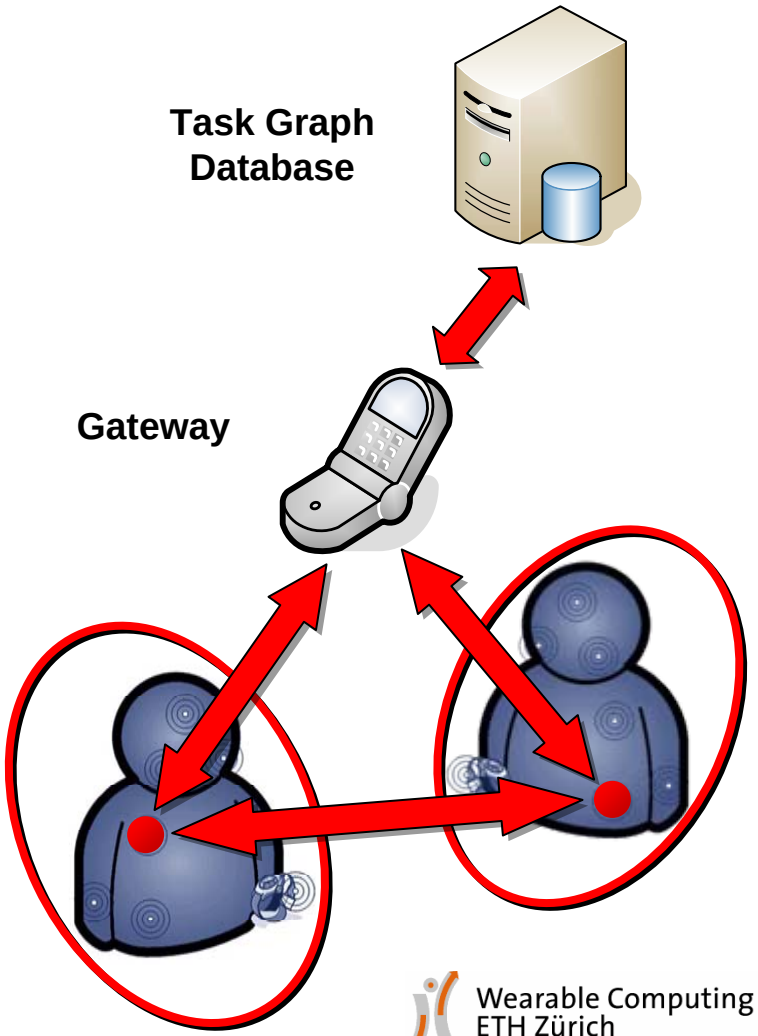
Simple service discovery

- The WSN is clustered according to connectivity time
  - Stable processing base
  - Clusterhead keeps service directory for the *service cluster*
- Service directories interconnect to form a service backbone
  - Allows instantiating services not available inside the own cluster
- Extended over a gateway to the **Task Graph Database (TGD)**



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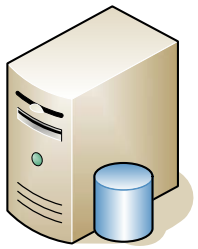
Complex Service Discovery

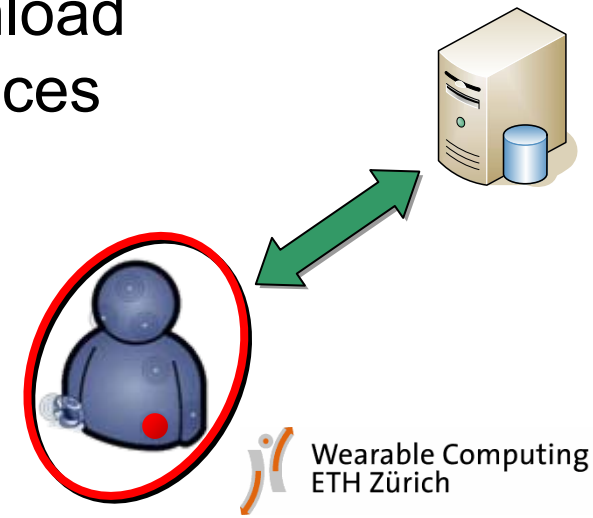
The Task Graph Database



- A database for complex services
  - For various applications
  - For different requirements (QoS, environment)
- Advertises possible complex services
  - Receives updates on available WSN functionality
  - Keeps track of different possible services
  - Easy addition of new complex services

Communication

- Service clusters sends service *registration* and *deregistration* messages to the TGD
  - Only updates on changes in the availability
- The TGD sends *advertisment* and *removal* messages to the service clusters
  - Service cluster can choose to download the description of the complex services



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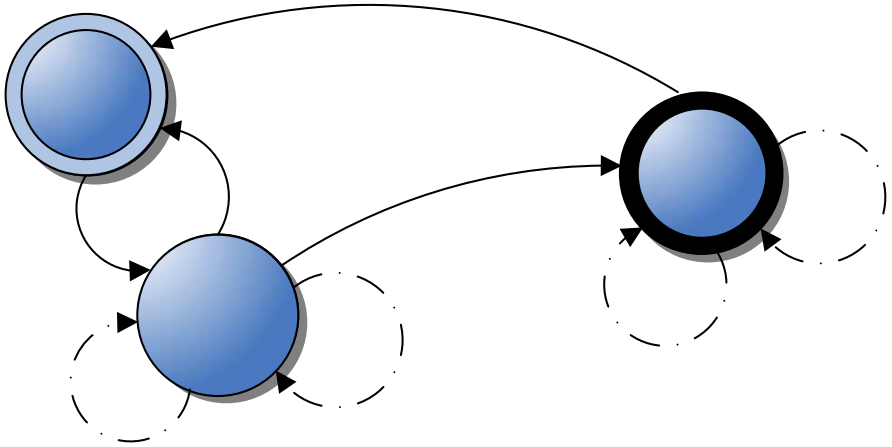
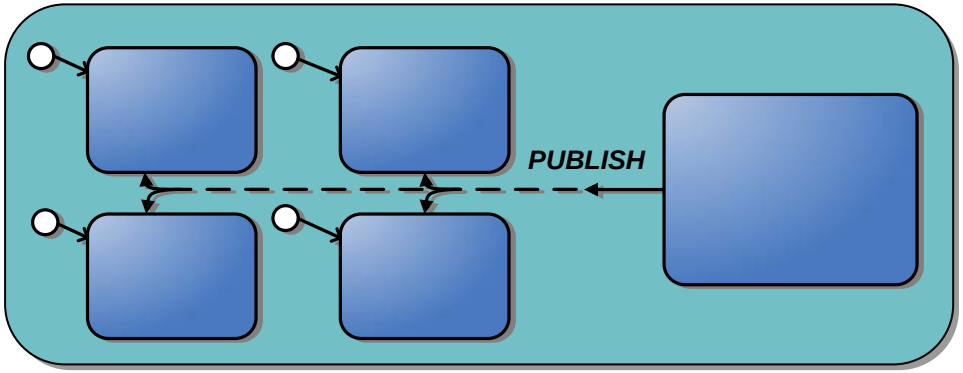
Complex Service Agent

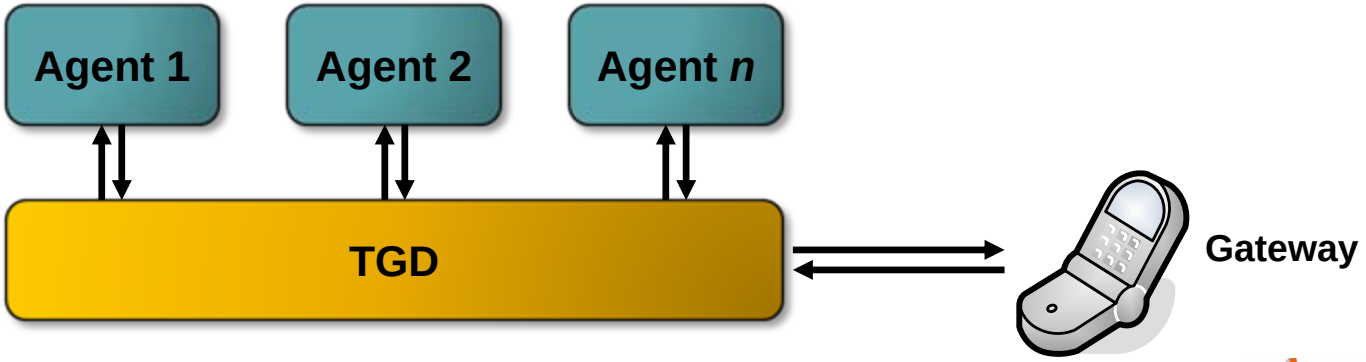




- Every complex service availability is handled by an agent
- It keeps an Finite State Machine for every service needed
- Updates the state on reception of messages from the WSN
- Publishes service when all services are available

TGD Architecture

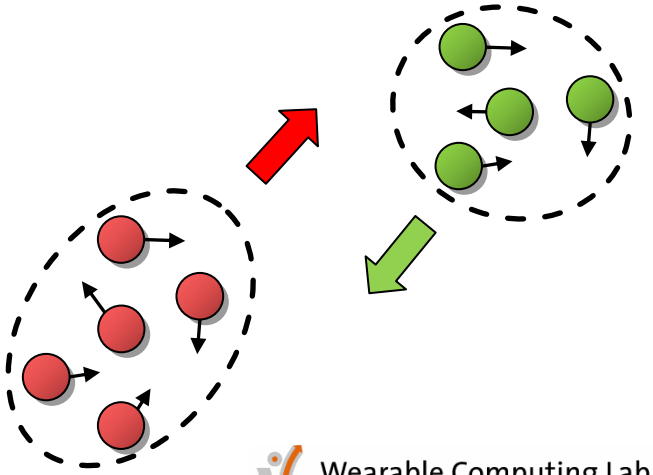
- Multi-agent structure following a congregation model
- Each agent as producer-consumer
  - Consumes other service publish announcements
  - Produces own service publish announcements
- Publication messages produced by agents may be consumed by other agents
  - Complex services containing other complex services are possible



Evaluation

- Simulation
  - Reference Point Group Mobility Model (RPGM)
  - 100 runs with 50 nodes in 10 clusters
  - 3 – 20 simple services per node
  - 40 complex services to be detected

- Results
  - 92% of the complex services found within first 60 simulation seconds
  - Limited by the clustering algorithm
  - Fast execution



Conclusion

- Activity recognition in Body Area Networks
- Two layered architecture for service discovery and composition
  - Clustering for adaptation to dynamics of BAN
  - Light-weight architecture (no semantics)
  - Efficiently detects complex services to download

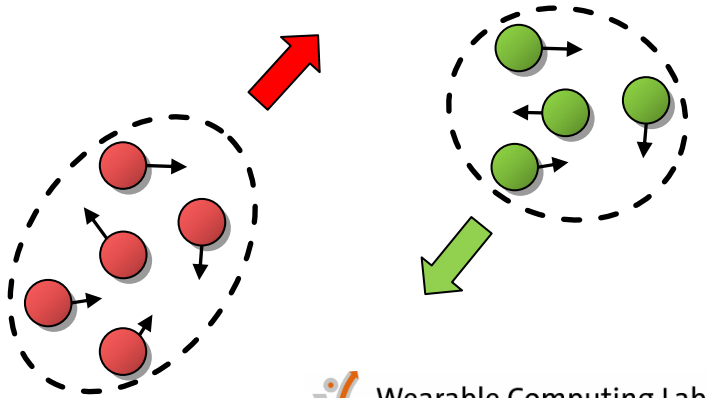
Further work

- A language for complex services
  - Describing different options of implementation, i.e. QoS, resources needed, or similar
- Modeling the sensor network
  - Important parameters for service distribution
  - Resources for the execution of complex services

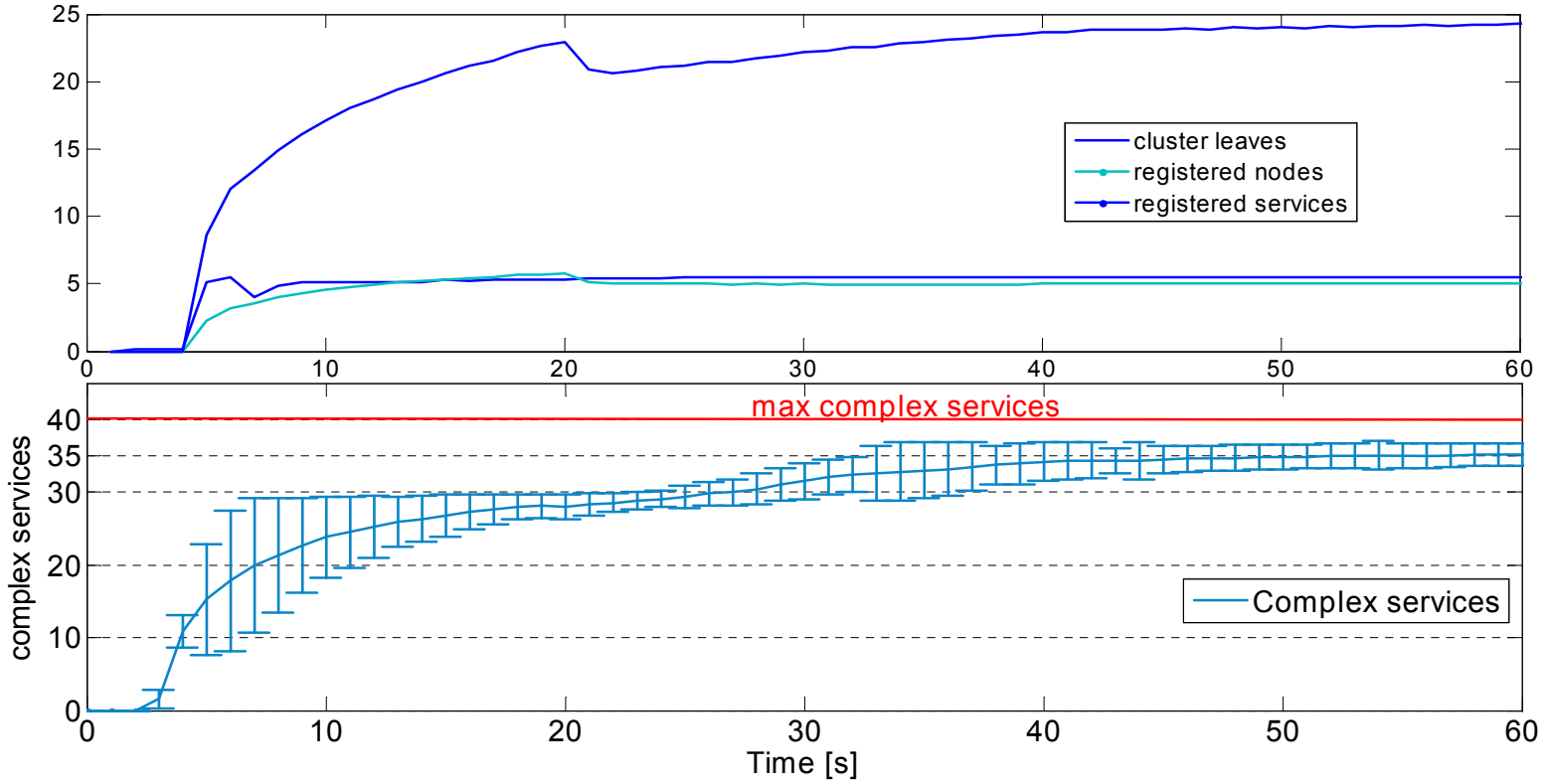
Thank you

Evaluation

- Simulation based on Reference Point Group Mobility (RPGM)
  - Group movement with random target within the simulation area, random movement within the group perimeter of each group member
  - 50 nodes in groups with average of 5 nodes, 100 simulations
- Service distribution
  - Complex service composed of 3 to 20 services
  - Random simple service distribution



Results



- Delay of the service discovery protocol to discover first nodes
- Delay until first other groups are met – confusion between some of the nodes, but generally very stable

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Results

- About 25 simple services per cluster
- Each service available 3.2 times in the whole network
- After 60 seconds, 92% (σ=1.5) of all complex services discovered