Knowledge Networks: Nervous System of an Autonomic Communication Infrastructure

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Scope

- need for knowledge networks
- role and position
- potentials of knowledge networks
- research agenda
- challenges
- Cascadas

- **“A balance has to be struck between (perhaps) overly complex, purely control-theoretic approaches on the one hand and AI approaches on the other hand that often do not take proper account of continuous processes”**

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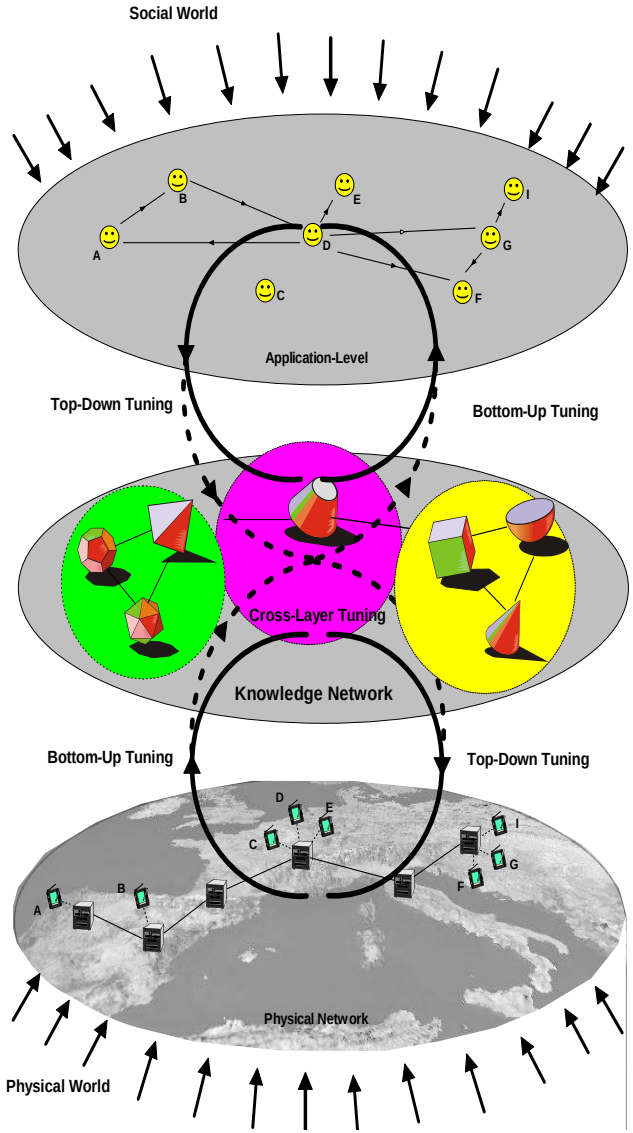
need for knowledge networks

- basic need for expressive and flexible means to promote context-awareness
- contextual information cannot be simply considered as local and locally available to components and services
- need for future autonomic communication scenarios to promote cross-layer interactions
- reasonable and effective way to promote self-ness in distributed systems

role and position

- reflective spaces (introspection)
- network memory
- all about knowledge
  - recognise-act
  - monitor-analyse-plan-execute
  - collect-decide-enforce
  - policy-based
  - service-orientated perspective
    - mediation
    - provisioning

role and position



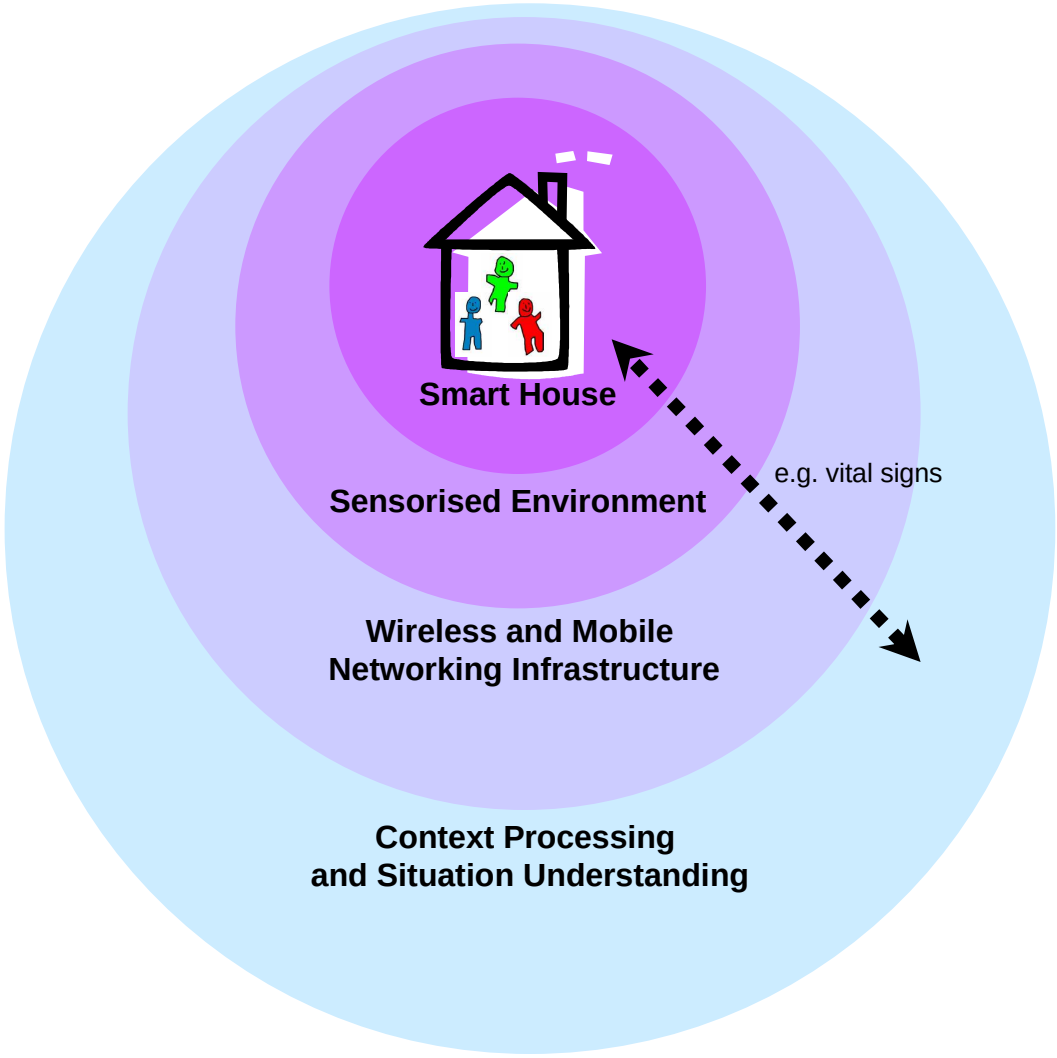
role and position

- **knowledge has to be:**
  - **dynamically generated and represented in ontological relations**
  - **correlated, i.e., networked with existing knowledge on the basis of what it represents and of what use it and related knowledge may be to the application or the network level**
  - **(fused)**
  - **global-to-local**
  - **global coherence**

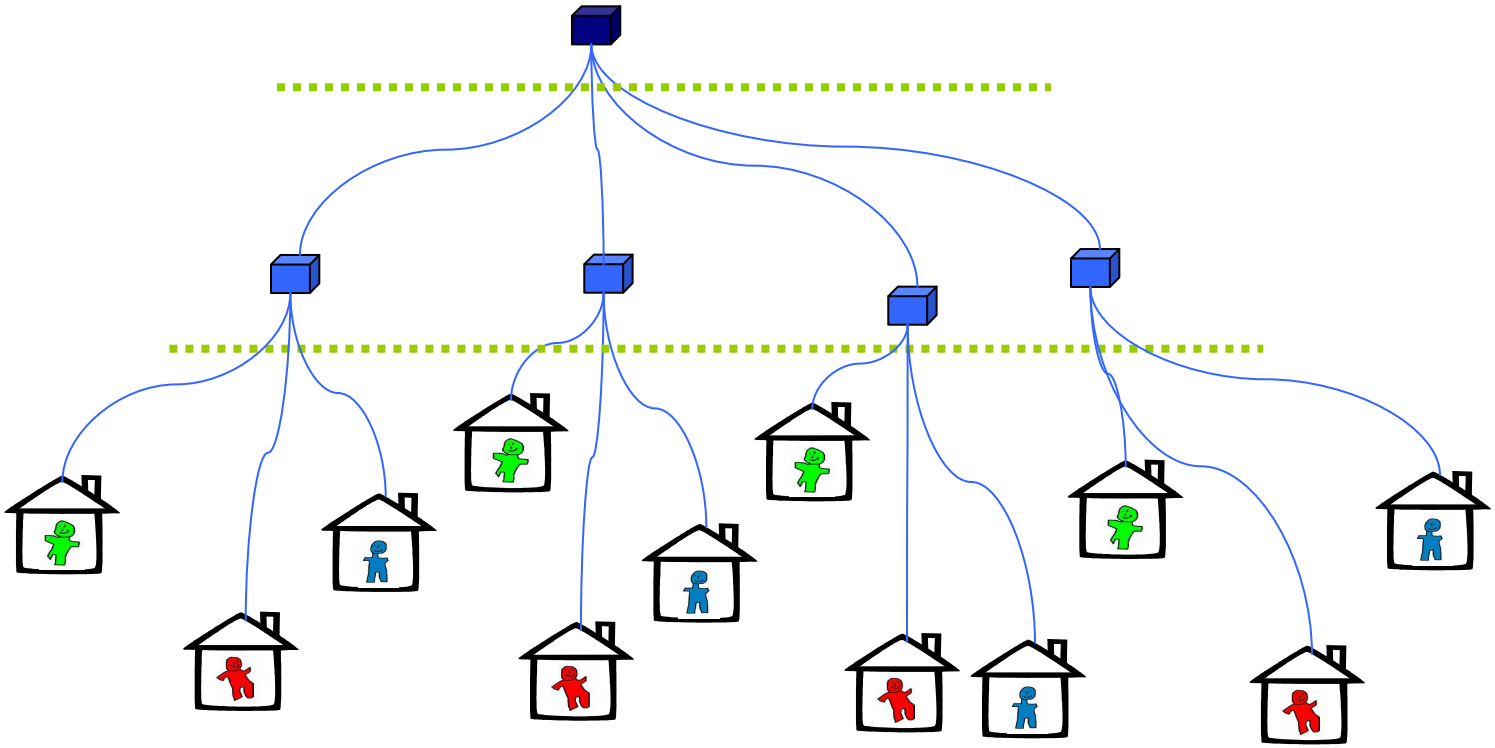
potentials of knowledge networks

- resource management and load balancing
- pervasive computing
  - supporting independent living /
    - smart(er) homes and beyond
    - social world
    - physical world

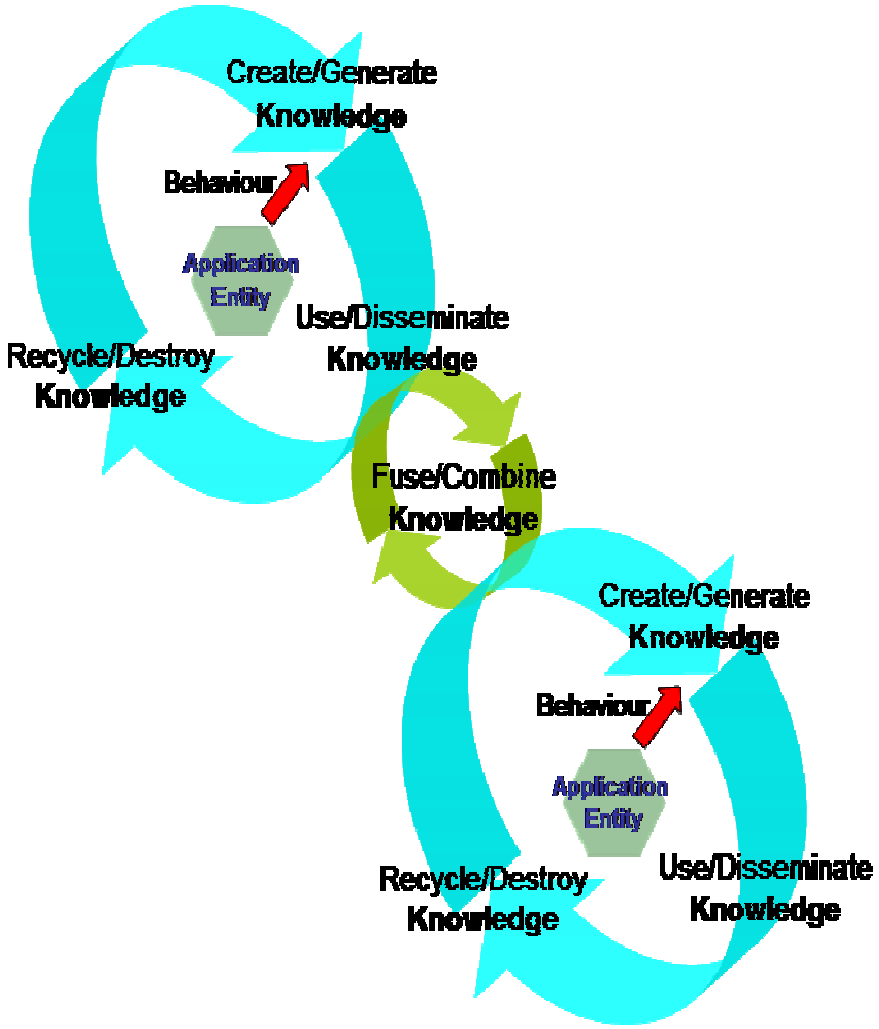
smart(er) homes



smart(er) homes



research agenda



research agenda

- how components can generate, maintain, and exploit knowledge
- how to represent knowledge using some form of ontological constructs
- how to have knowledge networks evolve and according to which structure
- how to exploit this knowledge to achieve autonomic behaviour at both the network and the application level

research agenda

- knowledge ‘consumers’ in the network must be able to access and use the ontological formalisms developed
- scalable global distributed data structures
- semantic overlay networks
- reflect the structure of those networks
- evolution
- scalable - promoting composability
- cognitive stigmergy – indirect social communication (social navigation)

challenges

- managing the ontology lifecycle, in particular automated knowledge acquisition for dynamic ontology construction
- the use of knowledge-level techniques to address provable, correctness-preserving transformations and adaptive algorithms
- working to understand the role of planning knowledge, including understanding and changing global and local goals
- protection of use of sensitive security and privacy information raised by applying such a shared knowledge space to a highly distributed application

challenges

- **imbue network with knowledge that facilitates self-ness v. overhead in performance that results**
- **ameliorate network knowledge mismatch issues, where knowledge scale does not match the situation for application**
- **marshalling of distributed knowledge**
- **‘semantic’ network efficiency**
- **standards and quality (QoC) {Buchholz, 2003}**
- **management of emergent behaviours ;-)**
- **habitual behaviours**

lightweight ants

- **“clearly, to preserve the advantages of swarm intelligence approaches, this should occur without requiring ants to become heavyweight agents, and a proper trade-off between the purely reactive behaviours promoted by traditional stigmergy and the purely cognitive behaviour promoted by artificial intelligence approaches have to be found”**

– Franco