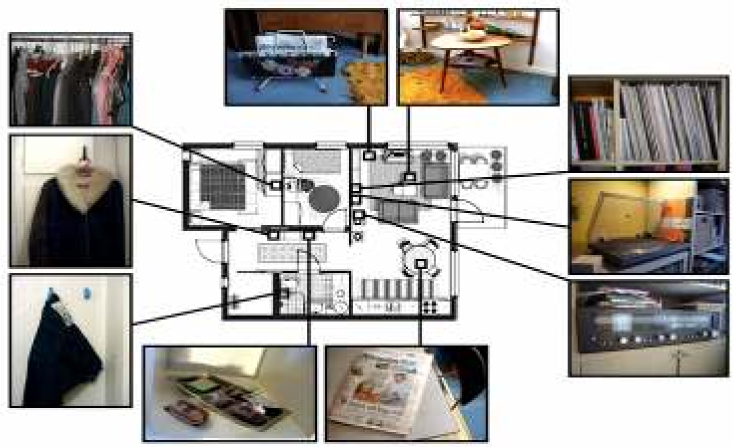
RFID in Internet of things:

from the static to the real-time



ETSI Workshop on RFID and The Internet Of Things, 3rd and 4th December 2007

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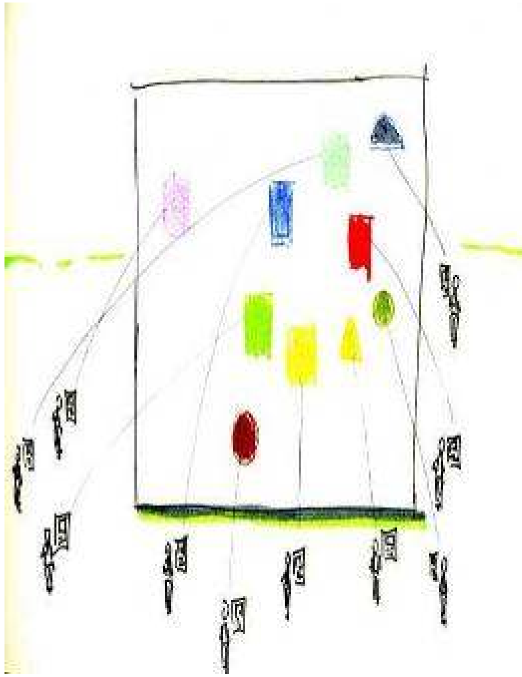
Mikhail Simonov

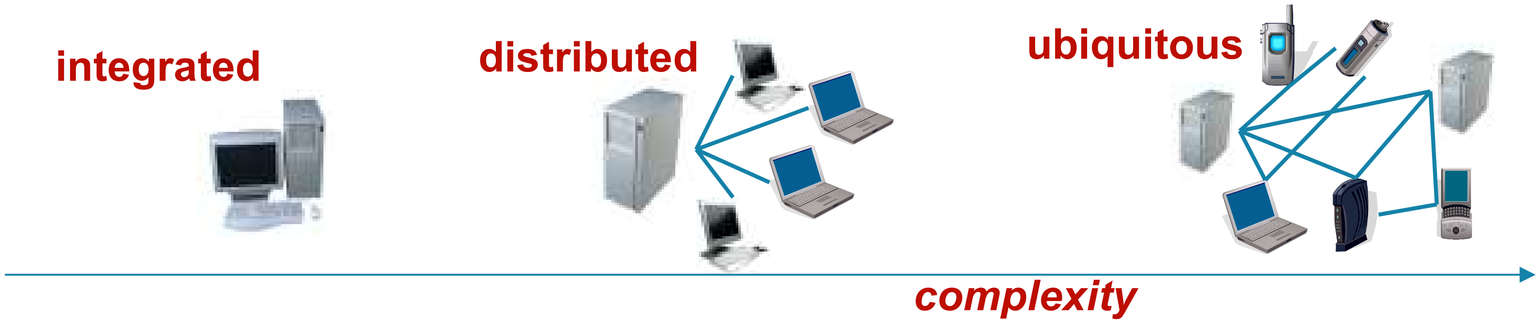
Outline

- Introduction
  - Complexity of the Internet of things
  - EPC middleware features
- Scaling up to the Internet of Things
  - ISMB middleware
  - Differentiation from EPC middleware
- Beyond RFID: connecting objects
  - Requirements
  - Near real time messaging
  - Communication patterns
  - Publish/subscribe
- Conclusions



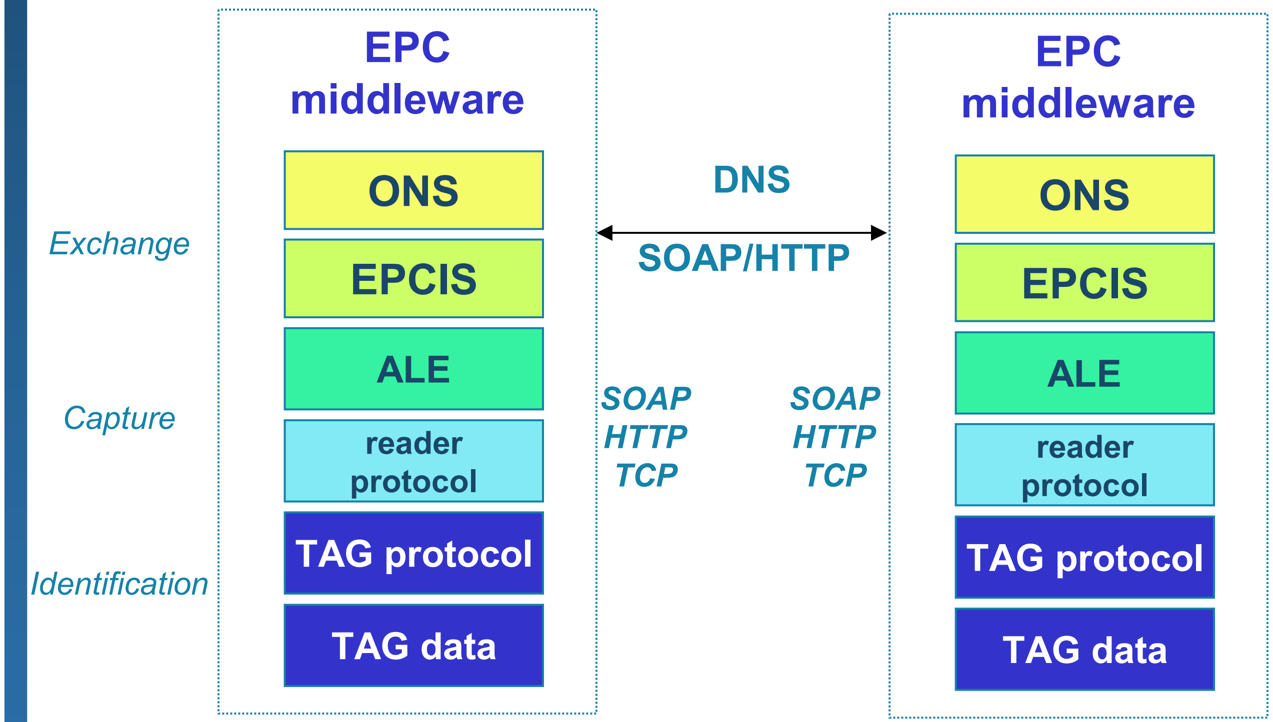
Introduction

- Evolution of communication technologies
  - Widening the scope of applications and increasing their complexity
  - Issues incrementally addressed, layered approach
    - (e.g. IP for routing, HTTP for accessing to remote resources)



- Further levels of complexity with new pervasive technologies
  - State of the art: different middleware approaches
    - vertical approach tailored to specific application fields
  - Any common pattern that should be standardized?
    - e.g. most communication issues and message patterns

Middleware example
EPC Global Infrastructure



Vertical approach

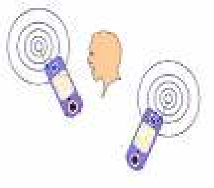
- Standard communication points between organizations (at high level)
- Optimized for one particular class of applications
- Leveraging on standard protocols

Focus on data

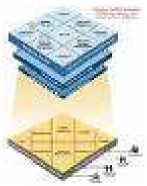
- Business processes are hidden inside corporate networks
- Built-in mechanisms for filtering and identifying data (ALE)

Scaling up the Middleware Towards the Internet of Things

- What if …



  - readers becomes mobiles devices
    - Changing address, NAT, offline nodes, unreliable connections
    - Discovery may not be sufficient (usually based on low level broadcast, ideal for local network)

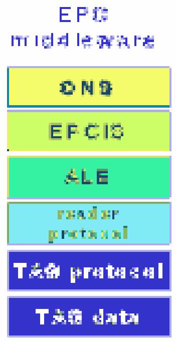


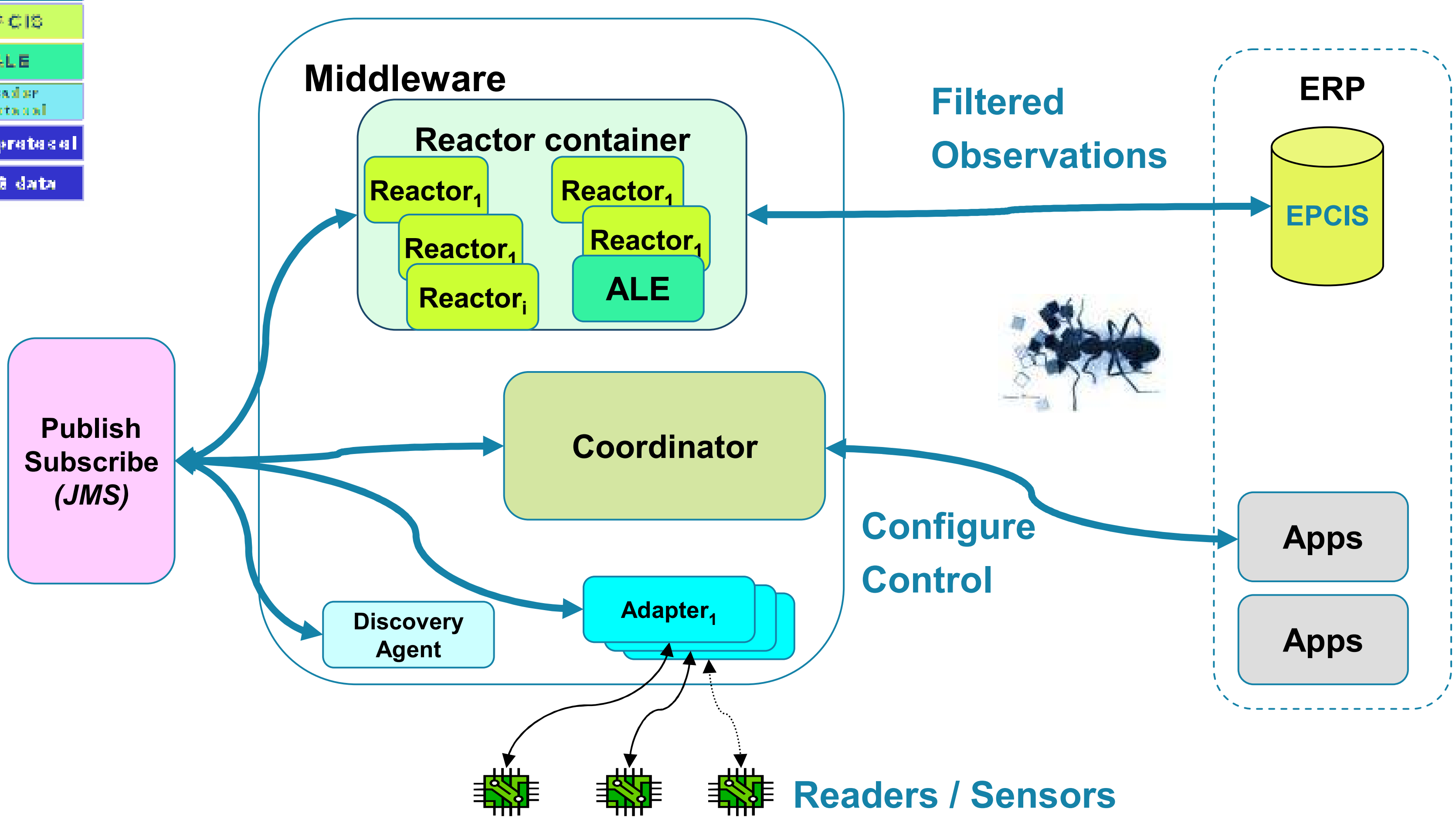
  - applications require business logic inside or near the reader
    - Autonomous readers need application logic, not only filtering (e.g. mobiles phones, PDAs, etc)
    - Allow uploading and configuring "tasks", not just rules

  - application tasks are driven by remote events
    - In the EPC mw operations are triggered by who reads the tags (e.g. tag read -> ONS query -> request information owner)
    - Allow applications to remotely track tags

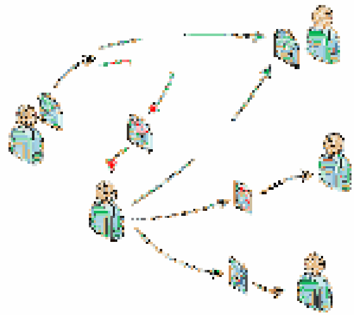
  - the middleware should handle more than tag IDs
    - Tag with memory, NFC communications (exchange of resources), remote sensors or controllers?

A first step: ISMB Middleware





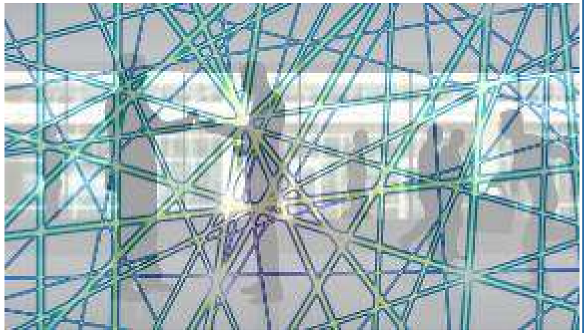
ISMB middleware differentiation



- **Processing level**
  - **EPC: ALE rule engine for matching, filtering tags**
    - **Data oriented, rule based, standard defined working cycle**
    - **Sort of publish subscribe, with one to one and one to many messages implemented standard protocols like http, soap**
  - **ISMB: "Reactor container", active modules reacting to events**
    - **Process oriented: modules supply business logic, ALE is one possible option**
    - **Interface based: all modules must implement a given interface for being managed by the container (sort event oriented, persistent, servlets)**
    - **Completely asynchronous messaging based on publish/subscribe**
- **Communication**
  - **EPC: mostly synchronous and point-to-point using HTTP / SOAP**
  - **ISMB: mostly asynchronous using pub/sub messaging (JMS is one option, considering XMPP)**
- **Coordinator responsible for the life cycle of all modules**

Beyond RFID: connecting objects

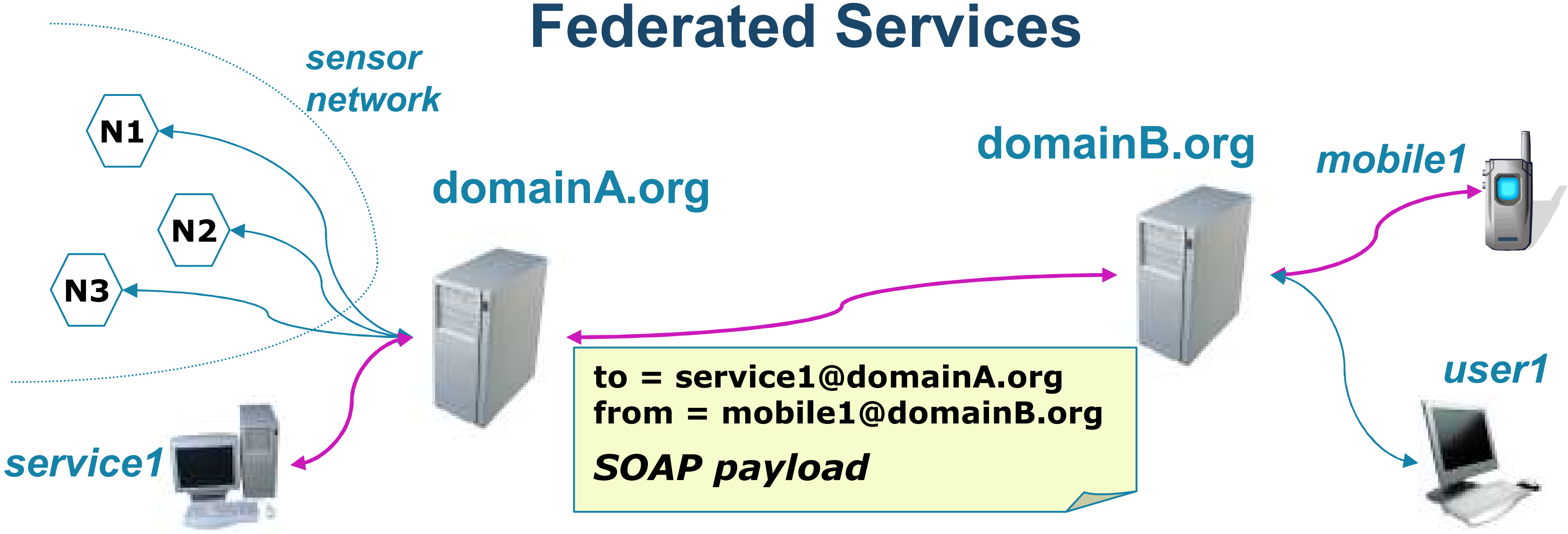
- RFID mw is just a particular instance of a more general problem in M2M, distributed sensor networks, ubiquitous computing
  - NFC, with full duplex communications will stress the concept
- Attention points
  - Low level communication (messaging framework)
    - IP does not address mobility issues (addressing, offline nodes, etc)
    - IPv6 and Mobile IP solve only some problems (e.g. addressability)
    - Need of messaging infrastructures supporting secure and reliable end to end communication (also when nodes are temporary offline)
  - Messaging patterns (event distribution)
    - Data or event selection and delivery
    - Support for complex interaction patterns
  - Business logic
    - It should be configurable by applications



Messaging Framework

- First 4 levels of ISO/OSI stack optimized for the *static Internet*
  - Purpose: "delivering data" in the most effective way
  - Generality: no built-in application specific requirements
  - Higher levels add required features
    - e.g. HTTP for structured access to remote resources, TLS for security, …
- An additional level is required for in the *Internet of Things*
  - Near real time messaging
    - Data must delivered as soon as the recipient becomes available
    - Addressing must be independent from network location
    - Most data made of events, i.e. messages with extensible payloads
    - Possibly lightweight protocol
  - Usually implemented with overlay networks
    - Some protocols have already faced most of these problems: e.g. eXtensible Messaging and Presence Protocol (RFC 3920 and 3921)

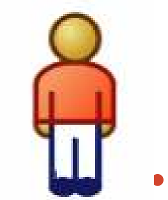
Messaging Framework
Federated Services

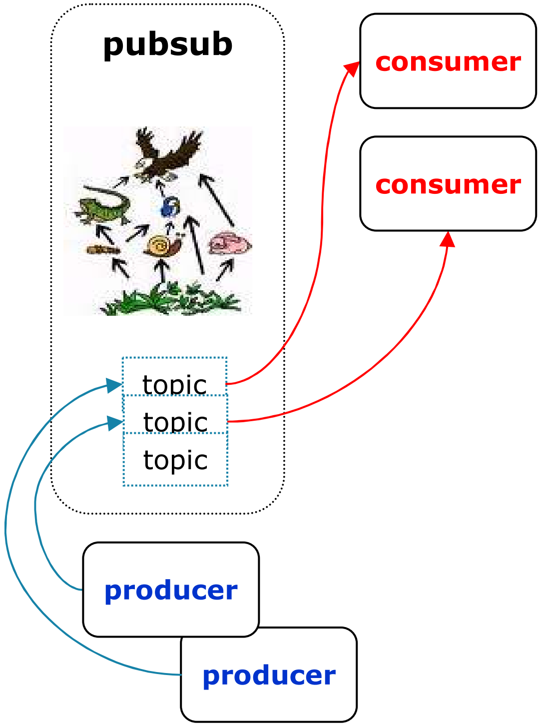


- Remote services can be addressed independently from location
- Servers relay messages also behind NATs, firewalls
- Support for offline nodes
- Support for presence: nodes know when peer are available
- Remote services / nodes are accessible from third parties with direct messages
- Security: strong authentication, servers may enforce access rules
- Extensible: e.g. SOAP over XMPP (ref. XEP-0072 Fabio Forno, Peter Saint Andre)

Common Communication Patterns

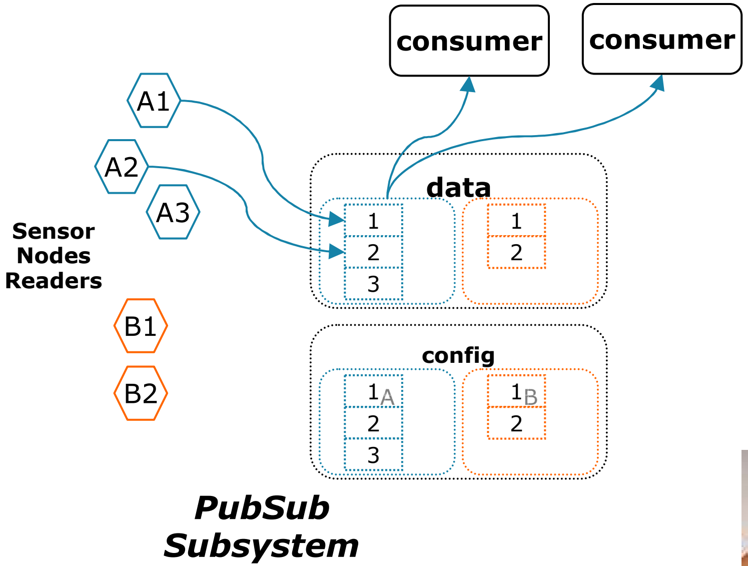
- Event based notifications
  - Producers
    - Remote nodes (things): tag observations, NFC communications, data from remote sensors
    - Server side: coordinators, business elements
  - Consumers
    - Remote nodes: RFID readers, remote sensors (configuration), controllers
    - Server side:
- Requirements
  - One to one, one to many, many to many communication
  - Hierarchical node addressing (single node, per class, destination, owner etc..)
  - Discovery
  - Internet wide publish/subscribe, federated servers





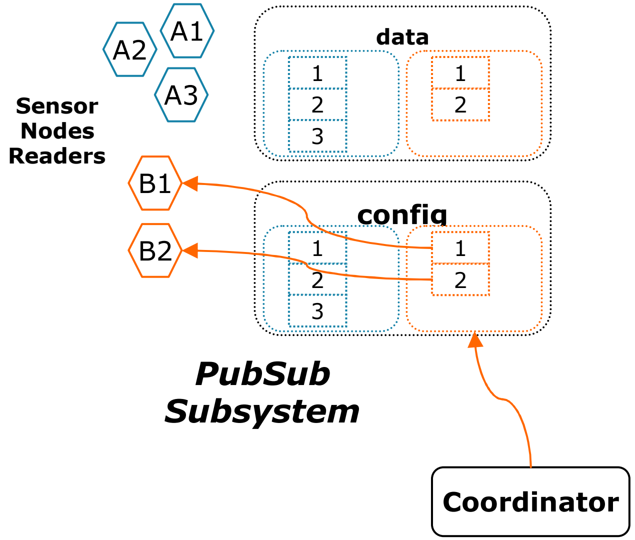
Publish/Subscribe use cases

Observation / distribution



behind…

Configuration / Control



Conclusions

- Evolution of communication technologies
  - New application opportunities
  - New levels of complexity
- Middleware approach
  - Solving a set problems for specific applications
  - Enabling a first step towards interconnectivity
  - Risk of having isolated silos when integrating different technologies
- Toward the Internet of Things
  - Near real time messaging infrastructure
  - Federated services with advanced message patterns
  - Hot pluggable business logic

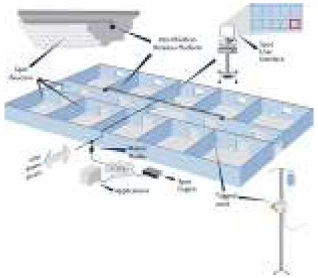
About us

- **2000 ISMB is established**
- **2001 Motorola, STMicroelectronics, Telecom Italia become industrial partners**
- **2001 ISMB signs Torino Wireless District MoU**
- **2003 ISMB becomes** “Stable Structure” **of Compagnia di San Paolo**
- **2003 ISMB in the** new 4.000 m² **via Boggio building;** excellent facilities
- **2005 SKF becomes a new industrial partner of ISMB**
- **2007 Joint lab. established in S. Giovanni (Molinette) Hospital**

- Highly qualified research institution
- Excellent facilities and Infrastructures
- Around 200 researchers (100 ISMB and 100 Politecnico/industrial)

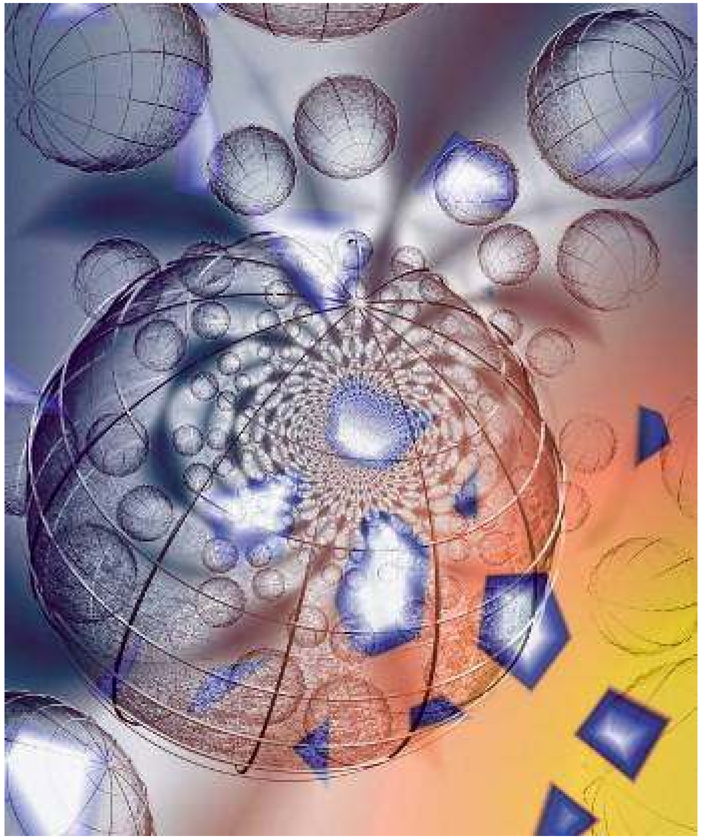









Thank you. Any further questions: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