From Resilience-Building to Resilience-Scaling Technologies

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Content

- Resilient building technologies
- Ubiquity
- One example
- The scaling challenge
- Conclusion

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Resilience-Building Technologies (1)

Current state

- ReSIST's DoW
  - "The current state-of-knowledge and state-of-the-art reasonably enable the construction and operation of critical systems, be they safety-critical (e.g., avionics, railway signalling, nuclear control) or availability-critical (e.g., back-end servers for transaction processing)".

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Resilience-Building Technologies (2)

Current state

- State of art of the current knowledge and ongoing research on methods and techniques for building resilient systems dealing with different aspects of resilience building and the corresponding identified sub disciplinary areas:
  - Resilience architecting and implementation paradigms,
  - Resilience algorithms and mechanisms,
  - Resilient socio-technical systems,
  - Resilience evaluation,
  - Resilience verification.

D12 deliverable: Resilience-Building Technologies: State of Knowledge
(available on the Resist web site).

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Resilience-Building Technologies (3)

Arch

- Resilience architecting and implementation paradigms
  - Identification of four research lines
    - Services oriented architectures
    - Mobiles services and their infrastructures
      - Exploitation of large scale networks (flexibility, interoperability)
    - Building resilient architectures with off-the-shelf components
    - Intrusion tolerant architectures

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Resilience-Building Technologies (4)

Algo

- Resilience algotithms and mechanisms
  - Discussion of main categories of algorithms and protocols that underlie fault tolerance and distributed systems
    - Taking into account the scalability problem as part of their basic formulation
      - Number of nodes,
      - Number of faults to deal with,
  - E-voting
    - Secrecy of vote,
    - Protection from tampering

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Resilience-Building Technologies (5)

Socio

- Resilient socio-technical systems
  - Integrating the analysis and design of the technical and human organisational subsets of ubiquitous systems
    - The process of reasoning about complex socio-technical systems
    - Reasoning about both the human and automated parts of a system in combination, (and taking into account their difference).

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Resilience-Building Technologies (6)

Eval

- Methods and tools for resilience evaluation
  - Compositional modelling for large and evolving systems
  - Evaluation with respect to malicious threats
  - Dependability benchmarking
  - Diversity, i.e. probability of common-mode failure between redundant components

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Resilience-Building Technologies (8)

Verif

- Methods and tools for verifying resilience
  - Formal methods
    - Deductive theorem proving
    - Model checking
    - Symbolic execution and abstract interpretation
  - Robustness testing
    - Fault injection, …
    - *….strong resist partner competences…*

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Ubiquity

- Pervasive computing,
- Ubiquitous systems,
- Ubiquitous network,
- …

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Ubiquity (1)

- Ubiquitous/ pervasive computing
  - To provide "*spontaneous*" services/ applications
    - Explicit interactions between the user and the computers are reduced at the minimum level
    - The service is driven automatically by the events of the real world
      - "Invisible computers"
  - Sensors, tags
  - Wireless communication
  - HCI, (wearable computers)
  - Mobility
  - …

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Ubiquity (2)

- Ubiquitous systems
  - Transparency for computation, (grid computing)
  - Transparency for the storage (P2P architecture)
    - « The network is the computer »
- Assumptions/constraints
  - Number of nodes forming any one system (large scale systems)
  - Variety of component types and of their interaction with users,
  - Heterogeneity of architecture (hardware and software)
  - Heterogeneity of autonomous organisations involved in making the system

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Ubiquity (3)

- Ubiquitous networks
  - Heterogenous networks
    - Fixed and wireless networks
    - Cellular and short distance wireless communication architectures
    - Heterogenous network administrations
  - Seamless communication
    - Heterogenity is « invisible »

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One example

Resilient ambient systems (GE2)

Before, data can be produced on reliable server (well known solutions based on redundancy)

Now, new devices create data during disconnection period (wireless and mobile architectures) without any accessible reliable server.

- Short-range wireless communications *(WiFi, BlueTooth, etc…)*
- Mobile terminals *(cell phones, PDAs, digital cameras, mobile sensors, mobile robots, …)*
- New data *(Pictures, movies, schedules, contact lists, etc…)*

➡ Risk of data loss when the device fails

A collaborative backup system could solve with this problem

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One example

Resilient ambient systems (GE2)

- One simple scenario :
  - Alice takes notes on her devices during a meeting
  - After the meeting, she takes the bus home
  - Once at home, she notices that she has lost her PDA

➡ Lost of the device ⇒ Loss of data

- But, thanks to the “collaborative backup” service , Alice recovers her data from the Internet once at home
  - The data have been transparently and spontaneously backed-up on neighbour terminals by “collaborative backup” service.

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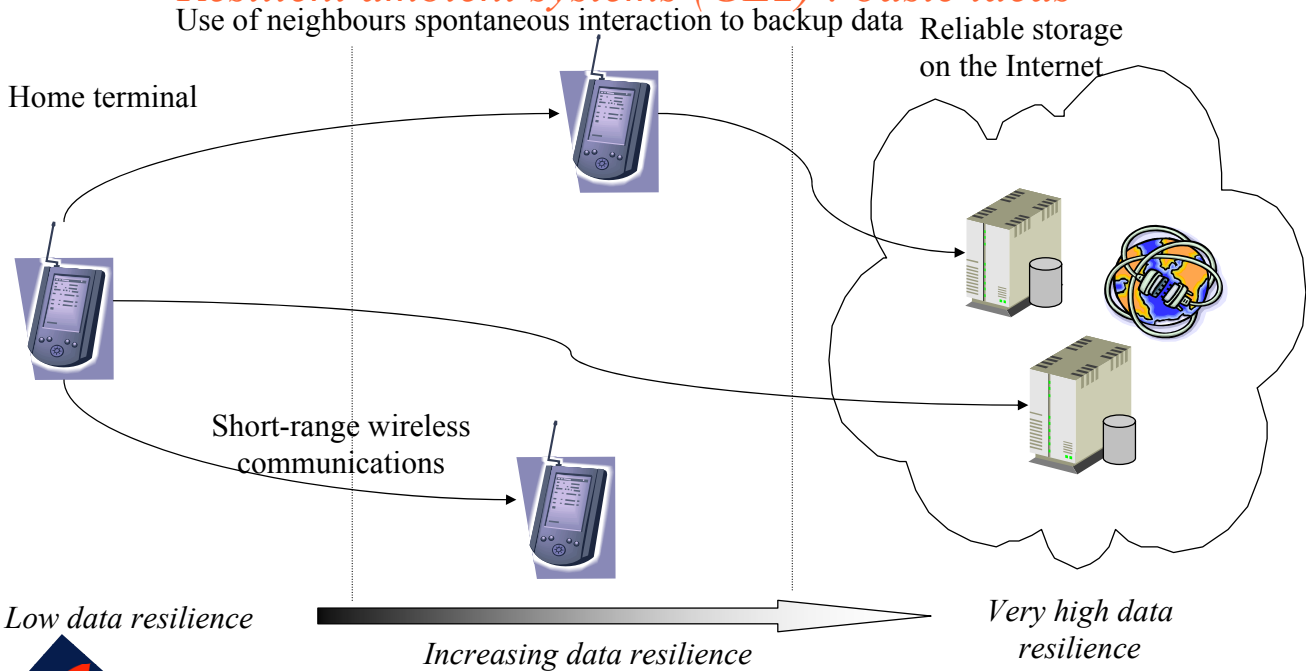
One example

Resilient ambient systems (GE2) : basic ideas



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One example

Resilient ambient systems (GE2) : some research issues

- Handling data coherency and data dissemination
  - Fragmentation, replication, etc...
  - Implementation of truly replicated services
    - How to migrate replicas
    - How to ensure atomic updates of a dynamic set of migrating replicas
    - …
- Resource management
  - Network management
    - Wireless communication management (spontaneous communication)
  - Device -PDA-
    - Battery/power management
    - Memory management
- Security
  - Data encryption
  - Trust between terminals

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One example

Resilient ambient systems (GE2): applications

- Personal devices
  - PDA
  - Cellphones (see- *http://www.laas.fr/mosaic)*
- Robotics
  - Mobile robots realizing collaborative tasks (swarm robots)
- Mobile sensors networks
  - Delivery tracking
  - Contagious disease tracking (for animals)

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The scaling challenge (1)

- To ensure the resilience of these new ubiquitous systems
  - *To identify the different research problems (or gaps) which have to be solve.*
  - To find solutions to these problems

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The scaling challenge (2)

- Identifying a roadmap of integrated research using the current resilience-*building* technologies to develop the required resilience-*scaling* technologies
  - Evolvability,
    - To preserve the system's functional correctness across steps of its evolution and its resilience
  - Assessability,
    - To assess their ability to function properly and to provide the quality of service that they will deliver under both nominal and stressful conditions
  - Usability
    - Human interaction and the potential effects of their action (strongly related to pervasive computing)
  - Diversity
    - To provide the service exploiting components replication facilities

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Conclusion

- The resilience scaling technologies have just been introduced
  - Place to the detailled presentations of these technologies and their associated gaps.

D13: From Resilience-Building to Resilience Scaling Technologies: Directions

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