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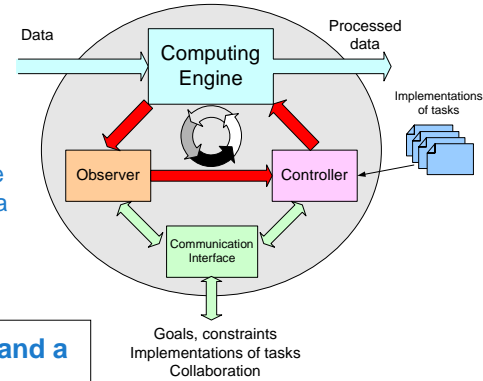
Self-Adaptive Embedded Technologies for Pervasive Computing Architectures

Self-Adaptive Networked Entities Concept, Implementations, Demonstrations

æ SANE Concept

The **Self-Adaptive Networked Entity** is composed of:

- a reconfigurable **computing engine** devoted to execute all the required computations needed by future complex algorithms;
- an **observer** whose role is to monitor crucial variables of the environment and computation. It provides a feedback loop that enables self-adaptivity;
- a **controller** that is in charge of taking all the needed decisions regarding the ongoing computation task (that can be a software task for a soft-core CPU or a dedicated hardware task, both loaded in the computing engine);
- a **communication interface** devoted to the collaboration between different SANE elements that form a SANE assembly.



The SANE is a tightly-coupled hardware/software unit and a computing entity at which an autonomous and local decision process occurs that affects its own operation.

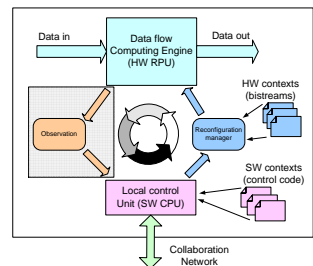
æ SANE Hardware Implementations and Demonstrations

Online routing of high-level descriptions of tasks

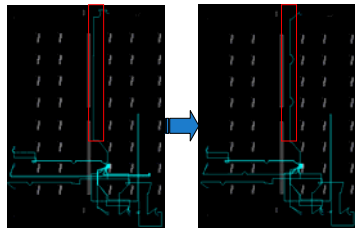
- Increasing the flexibility of systems by increasing the level of abstraction of the description of a task
- Enables bitstreams to be re-routed during runtime according to constraints on power and performance
- Use of ADB router and JBits to manipulate bitstreams on Xilinx FPGA targets

Self-reconfiguration of a SANE

- Closing the reconfiguration loop of traditional systems
- Studying the integration of an observation process



Providing traditional systems with an observation process that enables self-adaptivity



Identification of critical nets (fast long lines that consumes a lot of power)

Re-routed wires to optimize the power/performance trade-off



Self-adaptation of the computing process
Self-adaptation of the routing according to the power-performance trade-off

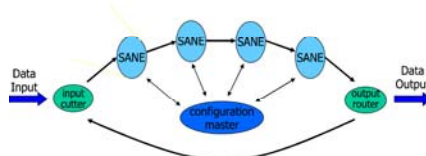
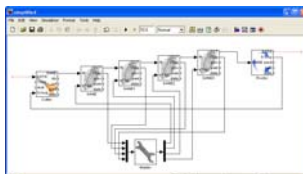
Self-organization

Applicability of the SANE concept on common DSP applications

Self-adaptive DSP applications

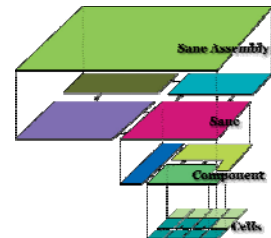


- Validating the SANE concept with a SANE network of FIR filters on MATLAB/Simulink and with « hardware-in-the-loop » simulations
- As a first temporary solution, data are tagged by an input cutter and are processed by a closed linear chain of SANEs that self-configure according to the array of tags describing the computation they are intended to execute



- First example system composed of the input cutter, four SANEs, an output router and a configuration master that manages the tasks
- Unprocessed data return to the network (if there remains at least one tag in the packet that arrives in the output router)

- Study of an appropriate substrate to enable dynamic and distributed self-placement and self-routing
- Self-organization based on local interactions among cells/components
- Takes into account congestion and delay constraints
- Preliminary studies done at the simulation level



Organization of the architecture



Simulator of the self-placement and self-routing algorithm

