

Self-Testing and Self-Healing via Mobile Agents

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Position statement

Today, in the world, there are more embedded systems than people. The use of digital systems pervades all areas of our lives, and this trend of producing digitally-aware environments will keep growing. In the future it will be normal to live surrounded by large numbers of heterogeneous devices, from domestic systems to complex applications like automotive, transportations, and medical control systems, which will communicate together through distributed and wireless interfaces. These complex heterogeneous digital systems will provide higher productivity and greater flexibility, but it is also accepted that they will not be fault-free. Moreover, the percentage of faults detected by any End-of-Production test will not be enough to guarantee the level of availability and reliability required by the market. In this context, the ability of a complex digital system to detect and possibly correct a fault (self-healing) plays a critical role. The state-of-the-art of the research in digital systems' self-healing has only recently started to address this problem from a system-level point of view.

To address the complexity issue, and to efficiently exploit the computational capabilities that complex and distributed target systems are able to offer, an appealing solution is to address the problem using *mobile agents*. This new research is being carried out at Politecnico di Torino in collaboration with different European universities and companies.

A definition of software agent is suggested by IBM: *"Intelligent agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ some knowledge or representation of the user's goals or desires."* (Gilbert)

The goal is therefore to design a multi-agent society able to test the hardware components of a complex

heterogeneous digital system. Agents will be able to define a test plan for a new subsystem, to inquire the target systems about their status, to automatically update their Self Healing capabilities, to collect test results, and to adapt their healing capabilities to the modifications of the operative conditions or performance requirements.

The main characteristics of mobile agents are *Mobility* (a mobile agent can actively migrate from one host to another), *Autonomy* (Mobile agents perform operations without the intervention of a centralized control), and *Reactivity* (a mobile agent is capable of interacting with the environment or other agents). These features will allow designing a self-testing and self-healing software infrastructure that minimizes global test costs and the total hardware and software overhead required to implement the Self-Healing capabilities. When looking at the nature of a multi agent system, one needs to take into account many factors. These include: structure, environment, component or agent interaction, outside variable or actors, etc. All these aspects of the agent society need to be discussed and implemented so that the final methodology will provide a Self-Healing environment which will be:

- Updatable and upgradeable in-field and, when required, on-the-flight (i.e., concurrently with mission operations)
- Adaptable to the current operative environment
- Target system independent
- Applicable through the overall product life cycle of the target system
- Applicable to each abstraction level

A first implementation of a multi-agent society is under way and it will be ready before the end of 2003. The first three target systems chosen as demonstrators are a domotix application, and a PC LAN.