Methodology for the LABIHS PWR simulator modernization

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Keywords: simulator, PWR maintenance, Portability

Introduction

The Human-System Interface Laboratory (LABIHS) simulator is composed by a set of advanced hardware and software components whose goal is to simulate the main characteristics of a Pressured Water Reactor (PWR).

This simulator serves for a set of purposes, such as: control room modernization projects; designing of operator aiding systems; providing technological expertise for graphical user interfaces (GUIs) designing; control rooms and interfaces evaluations considering both ergonomics and human factors aspects; interaction analysis between operators and the various systems operated by them; and human reliability analysis in scenarios considering simulated accidents and normal operation. Fig. 1 shows the simulator's current architecture.

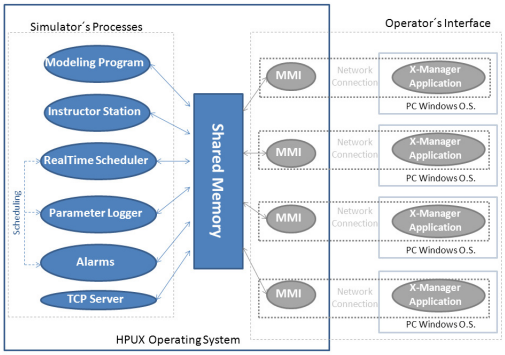

Fig. 1 - Current simulator's architecture overview.

Description

The simulator runs in a PA-RISC architecture server (HPC3700), developed nearby 2000's, using the HP-UX operating system. All mathematical modeling components were written using the HP Fortran-77 programming language with a shared memory to exchange data from/to all simulator modules. Although this hardware/software framework has been discontinued in 2008, with costumer support ceasing in 2013, it is still used to run and operate the simulator.

Due to the fact that the simulator is based on an obsolete and proprietary appliance, the laboratory is subjectet to efficiency and availability issues, such as: downtime caused by hardware failures; inability to run experiments on modern and well known architectures; and lack of choice of running multiple simulation instances simultaneously. In this work [1] we propose a new architecture for the simulator, so that:

- the simulator can be ported to the Linux operating system, running on the x86 instruction set architecture (i.e. personal computers);
- one can simultaneously run multiple instances of the simulator;
- the operator terminals run remotely; and
- the following known issues are overcame: hardware obsolescence, portability, scalability and data exchange efficiency.

The Fig. 2 presents the proposed new architecture for the simulator. Note that the Shared Memory will be replaced by a Network Data Server (NDS) module, responsible for all data exchange among simulator modules (core and interface).

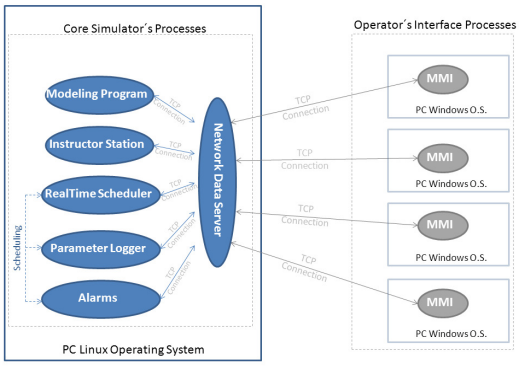

Fig. 2 - Modernized simulator's architecture overview.

Results and Discussion

The NDS module is currently ready, and was carefully implemented to cope with the presented issues (hardware obsolescence, scalability, efficiency, portability). This phase also required us to define a communication protocol so that simulation modules are able to exchange data among them.

The simulator's core modules were changed in order to comply with standard FORTRAN compilers. The Shared Memory of the original version uses proprietary techniques (HP Fortran) which prevents it to compile on standard FORTRAN compilers.

Currently, we are working on the integration of the core modules with the NDS. In order to perform, we are developing a library which will allow simulation core modules to use some functions, written in C programming language, to communicate with the NDS.

References

[1] Jaime, G.D.G., Oliveira, M.V., *Methodology for the LABIHS PWR Simulator Modernization*, INAC 2011, Belo Horizonte, Brasil.