ADVANCED CONTROL FACILITY FOR THE CERN-UNICOS FRAMEWORK

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Objectives

In order to provide a control testing platform, easy to use and allowing rapid control algorithm implementation for testing purposes, the simulation software Matlab/Simulink® was combined to the CERN / UNICOS control framework. With this facility it will be possible to control cryogenic process which typically have large time constants directly from Simulink® control models. This flexible advanced control facility is referred as *Virtual Control Platform* (VCP).

The Virtual Control Platform (VCP)

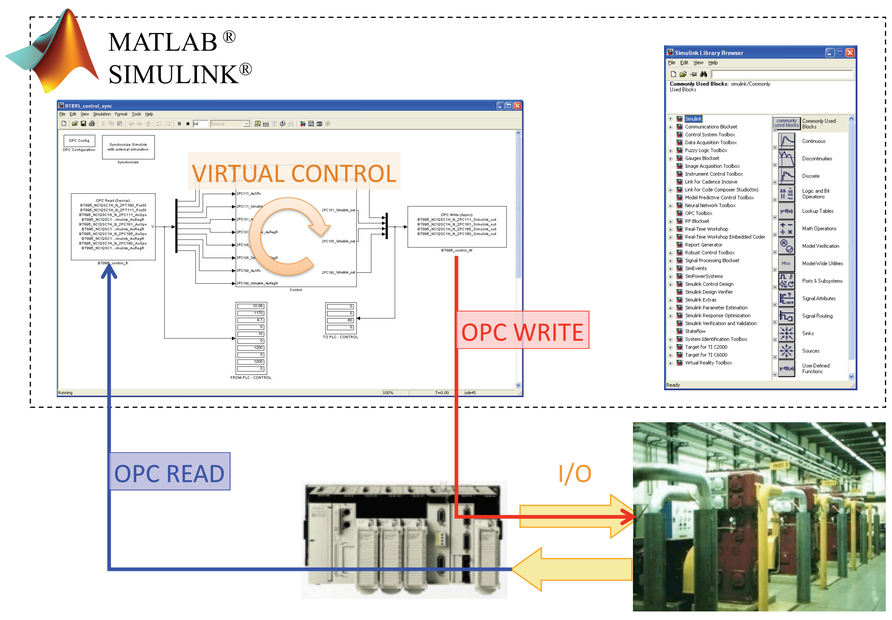

Fig.1. Virtual Control Platform principle.

VCP uses the OPC communication standard to make Simulink exchange measured variables and control commands with an industrial process. A PLC intermediates this exchange.

Simulink has the advantage to propose a large range of features to optimize control algorithms. Complete new control strategies which are not yet available in the local framework (UNICOS) can be tested without need of implementation on PLCs. Sequential operations, security interlocks and alarm triggering are still managed by the PLC. Protection against VCP failure is provided by a watchdog mechanism implemented on the PLC. In case of failure, safeguard PID controllers are switch on.

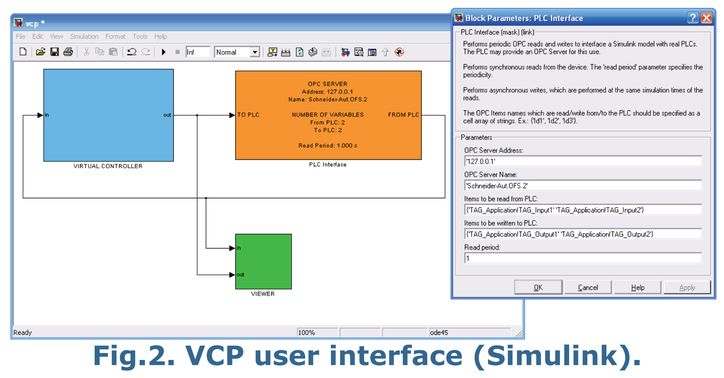

Fig.2. VCP user interface (Simulink).

Analysis of networked control issues

VCP introduces time delays due to network link and to the finite calculation time required by the control algorithm implemented on Simulink (virtual controller).

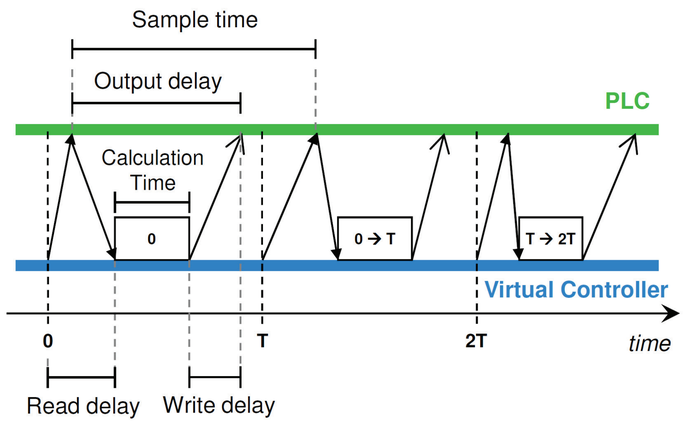

Fig.3. Timeline of VCP operation.

The operation of the platform was modelled with a pragmatic approach.

The time delays were considered as distributions. They were further experimentally indentified.

Integration to CERN-UNICOS Framework

UNICOS framework uses typical three-layer control architecture (field, control and supervision layers).

In order to integrate VCP to this architecture, a workstation hosting the OPC server and Matlab/Simulink is added to the control layer.

The original PID controllers of the PLC programs are by-passed when VCP operates.

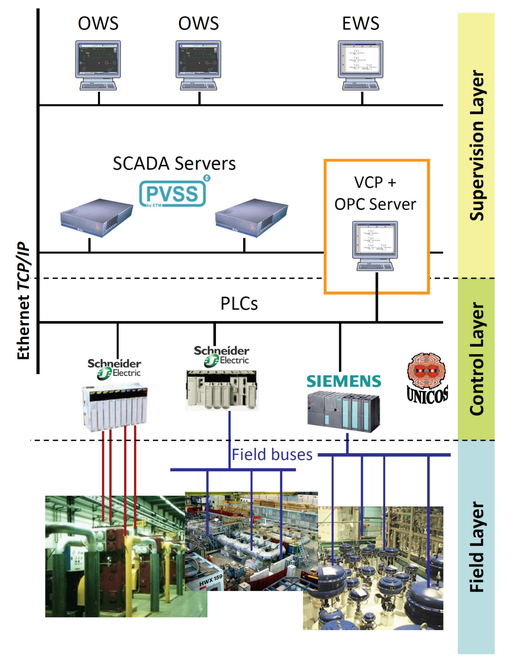

Fig.4. VCP inside UNICOS architecture.

Tests and Results

The time delays were measured for VCP operation inside CERN's control network. For a PLC scan time of 50 ms and VCP sample time of 0,5 s, the total delay introduced by the OPC communication (read delay + write delay) was **167 ± 99 ms** and the actual sample time varied from **0,47 s to 0,53 s**, considering 3 standard deviations as confidence interval. 8000 data points were collected. Other configurations were also tested.

Perspectives

The Virtual Control Platform is still a concept under development at CERN. The first results show that under certain known conditions the platform can be safely used to control real cryogenic plants, especially for processes with large time constants. As a testing tool, it can serve as an efficient guide in the conception of controllers for the UNICOS framework. Further studies will focus on a theoretical approach of the time delay issues.