HRTC

Title

PCT Procurement

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Summary Sheet

IST Project 2001-37652
HRTC
Hard Real-time CORBA

PCT Procurement

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Abstract:

The present document describes the equipment required to build the Process Control Testbed (PCT) based on its design (D4.2).

This document has been issued in accordance with the document *IST-2001-37652 Annex 1 – "Description of Work"*. The identification of this deliverable is D4.3.

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Release Sheet (1)

Release: **0.1 Draft**
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Scope   Tentative scheme for comments
Sheets   All

Release: **0.2 Draft**
Date: 2002/12/23
Scope   Initial version
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HRTC

Table of Contents

1 Introduction

1.1. Purpose of the document

The present document describes the equipment required to build the Process Control Testbed (PCT) based on its design (D4.2).

1.2. Definitions, acronyms and abbreviations

Definitions

Acronyms

AI	Analog Input
AO	Analog Output
CORBA	Common Object Request Broker Architecture
DCS	Distributed Control System
DI	Digital Input
DO	Digital Output
GPS	Global Positioning System
GUS	Global User Station
HMI	Human Machine Interface
HM	History Module
HPM	High-Performance Process Manager
LCN	Local Control Network
NIM	Network Interface Module
PCT	Process Control Tested
PLC	Programmable Logic Controller
SI	Serial Interface
TPS	Total Plant Solution
TTP	Time Triggered Protocol
UCN	Universal Control Network

Abbreviations

1.3. References to Project documents

HRTC Project Annex 1 "Description of Work"
D1.1 "CCS Domain Analysis"
D4.1 "PCT Requirements Specification"
D4.2 "PCT Design"

2 Component elements

The following figure shows the complete topology of the proposed testbed. This final structure should hopefully be reached in several stages of increasing difficulty where different experiments shall be tried. The description can be find in document *D4.2 PCT Design*.
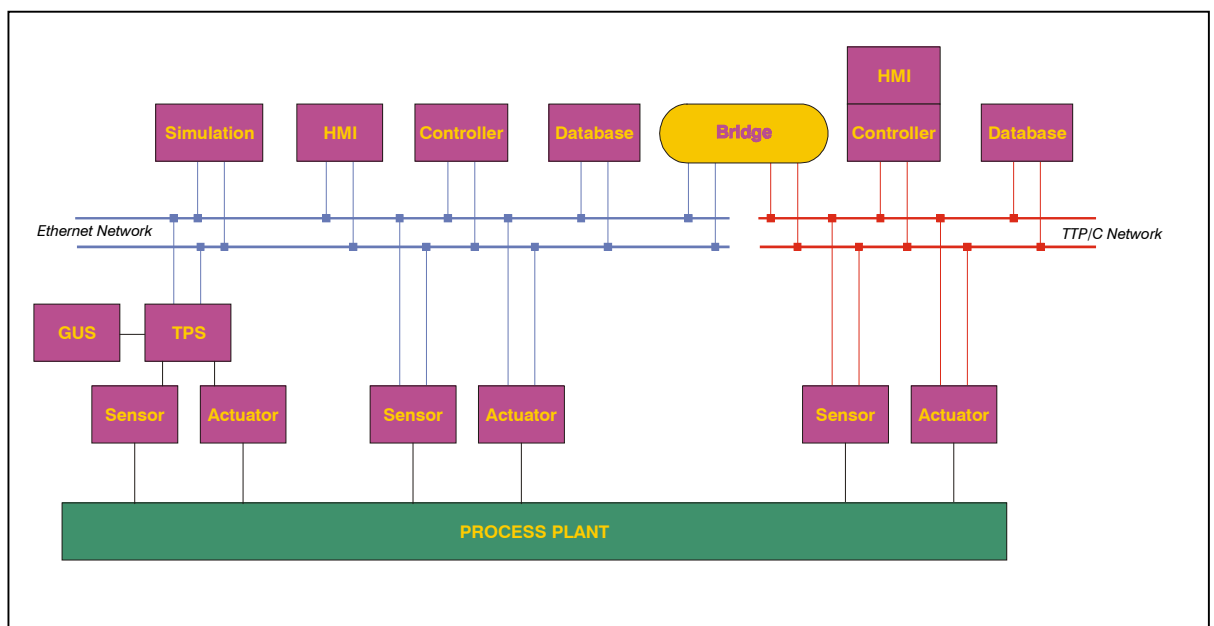

Figure 1: Process Control Testbed

All the item numbers in the following lists should add the prefix *"PCT."* that has been removed in the present document for convenience.

2.1. Ethernet network

For the ethernet network two switches (one for every redundant network) are needed. It is assumed that every node has got two ethernet adapters. The maximum number of nodes is 8.

Item number	Item	Number of items	New
H001.1-2	Ethernet switch	2	yes
H002.1-8	Ethernet card	8	yes
H003.1-16	Ethernet Cable	16	yes

2.2. Time-triggered network

The time-triggered network will have 4 TTTech Monitoring Nodes with (redundant) connection to 2 switches. A 5th node will be the bridge between the Ethernet and TTP/C networks.

Item number	Item	Number of items	New
H004.1-2	TTP/C switch	2	yes
H005.1-5	TTTech Monitoring node	5	yes
H006.1-10	TTP/C Cable	10	yes

2.3. Sensors

Sensors are usually connected to conventional (4-20 mA) or 'smart' (digital bus) transmitters that send the process signal to I/O cards of the control system.

For connecting the sensors to the network in the PCT it is necessary to have a wrapper node that, ideally, could be integrated in the instrument.

Two kinds of sensors are going to be used:
1. Actual (physical) instruments with a transmitter and an input card in the DCS or the wrapper node. For the last case, a serial bus transmitter will send the signal to a PC connected to the network.
2. Simulated sensors instantiated on the wrapper node. They will allow testing the effect of a large number (a more realistic scenario at a reasonable cost) of sensors on the system performance.

In the TTP/C network, monitoring nodes embed a Power PC, so no additional wrapper is needed.

Item number	Item	Number of items	New
H007.1	PC (sensor wrapper)	1	
H008	pHmeter	1	no
H009.1	RS232 cable	1	yes

For sensors on both networks, software has to be developed.

Item number	Item	Source
S001	Sensor software (ethernet)	custom
S002	Sensor software (TTP/C)	custom

2.4. Actuators

Actuators are the final elements of a control loop, modifying the process conditions as the result of the controller command. For the control loop of the experiment the actuator will be a volumetric pump that injects a basic solution to neutralize the input stream.

The pump is connected to a PLC that communicates with a wrapper PC or DCS through a serial interface. Also two kinds of actuators shall be used:
1. Actual actuators
2. Simulated actuators

Item number	Item	Number of items	New
H007.2	PC (actuator wrapper)	1	
H010	Pump + PLC	1	no
H009.2	RS232 cable	1	yes

For sensors on both networks, software has to be developed.

Item number	Item	Source

S003	Actuator software (ethernet)	custom
S004	Actuator software (TTP/C)	custom

2.5. Controllers

As a node, it is a computer where a task reads values from sensor nodes, computes control algorithms as a function of their setpoints and writes output signals to actuators. It also communicates with HMI and database for configuration, recording and display.

A controller node can handle several control loops.

There are two controller nodes, one on the ethernet network and another on the TTP/C network.

Hardware

Item number	Item	Number of items	New
H007.3	PC (controller)	1	

Software

Item number	Item	Source
S005	Controller software (ethernet)	custom
S006	Controller software (TTP/C)	custom

2.6. Human-Machine Interfaces

The Human-Machine Interface in modern Plant Control Systems is usually a graphical interface, with or without windows. The HMI allows the monitoring function carried by human operators, as well as their interaction with the process by means or control actions, such as starting up/stopping units, changing setpoints, etc.

In the PCT, preferentially graphical HMI nodes shall be built in order to access and interact with the data and agents on the network.
In the TTP/C network, since only 5 TTTech nodes has been bought, the HMI is not connected to the network, but to the Ethernet interface of the controller node.

Hardware

Item number	Item	Number of items	New
H007.4	PC (Ethernet HMI)	1	
H007.5	PC (TTP/C HMI)	1	
H002.9	Ethernet card	1	yes
H011	Ethernet Cable (TTP/C node – PC)	1	yes

Software

Item number	Item	Source
S007	HMI software (ethernet)	custom
S008	HMI software (TTP/C)	custom

2.7. Databases

Historical databases records selected data from the control system configuration and/or operation. Operators can access to them through HMIs.

Hardware

Item number	Item	Number of items	New
H007.6	PC (Ethernet Database)	1	
H007.7	PC (TTP/C Database)	1	

Software

Item number	Item	Source

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S009	Database software (ethernet)	custom
S010	Database software (TTP/C)	custom

2.8. Commercial DCS (TPS)

An already available commercial DCS, the Honeywell TPS (TDC 3000), will be used. The system is composed by:

1. A High-Performance Process Manager (HPM) controller
2. A Global User Station (GUS)
3. A History Module (HM)
4. A Network Interface Module (NIM)
5. A redundant Local Control Network (LCN)
6. A redundant Universal Control Network (UCN)
7. Several I/O cards:
   a. Analog Input (AI)
   b. Analog Output (AO)
   c. Digital Input (DI)
   d. Digital Output (DO)
   e. Serial (Modbus) Interface (SI)

With the available hardware, to integrate the TPS in the Ethernet network the system could be wrapped (with a PC) via the serial bus or via the GUS. The serial bus has the advantage of directly accessing the controller (HPM) like sensors or actuators do.

A temperature sensor and transmitter enter the system through the AI card. The heating module is controlled by the an AO output signal.

Hardware

Item number	Item	Number of items	New
H012	Honeywell TPS	1	no
H013	Temperature sensor + transmitter	1	no
H014	Heating module	1	no
H007.8	PC (TPS wrapper)	1	
H009.3	RS232 cable	3	yes

Software

Item number	Item	Source
S011	TPS wrapper software (ethernet)	custom

2.9. Simulation

A simulation node is basically a PC running a commercial simulator (ABACUSS II) and a CORBA wrapper. For distributed simulation experiments several simulation nodes interact in a network. In other experiments one simulation node interact with nodes that are not simulation nodes.

Hardware

Item number	Item	Number of items	New
H007.9	PC (simulation)	1	

Software

Item number	Item	Source
S012	ABACUSS II	commercial
S013	Simulator wrapper software (ethernet)	custom

2.10. Bridge

A bridge handles the communication between two networks. One of the TTTech monitoring nodes, with connections to TTP/C and Ethernet, will be act as a bridge between both networks. Bridging software has to be developed

Item number	Item	Source

S014	Bridge software	custom

2.11. Monitoring tools

The monitoring tools in the PCT are mainly software, and many of them observers included in the nodes. For recording purposes, it is initially planned to use the database modules.

Two GPS clocks that can be connected to all the nodes will be used for timing measurements.

Item number	Item	Number of items	New
H015	GPS clock	2	yes

3 PCT Procurement lists

3.1. Hardware

Item number	Item	Number of items	New	Notes
H001.1-2	Ethernet switch	2	yes	
H002.1-9	Ethernet card	9	yes	
H003.1-16	Ethernet Cable	16	yes	
H004.1-2	TTP/C switch	2	yes	
H005.1-5	TTTech Monitoring node	5	yes	
H006.1-10	TTP/C Cable	10	yes	
H007.1	PC (sensor wrapper)	1		
H007.2	PC (actuator wrapper)	1		
H007.3	PC (controller)	1		
H007.4	PC (Ethernet HMI)	1		
H007.5	PC (TTP/C HMI)	1		
H007.6	PC (Ethernet Database)	1		
H007.7	PC (TTP/C Database)	1		
H007.8	PC (TPS wrapper)	1		
H007.9	PC (simulation)	1		
H008	pHmeter	1	no	
H009.1-3	RS232 cable	3	yes	
H010	Pump + PLC	1	no	
H011	Ethernet Cable (TTP/C node – PC)	1	yes	
H012	Honeywell TPS	1	no	
H013	Temperature sensor + transmitter	1	no	
H014	Heating module	1	no	
H015	GPS clock	2	yes	

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3.2. Software

Item number	Item	Source	Notes
S001	Sensor software (ethernet)	custom	
S002	Sensor software (TTP/C)	custom	
S003	Actuator software (ethernet)	custom	
S004	Actuator software (TTP/C)	custom	
S005	Controller software (ethernet)	custom	
S006	Controller software (TTP/C)	custom	
S007	HMI software (ethernet)	custom	
S008	HMI software (TTP/C)	custom	
S009	Database software (ethernet)	custom	
S010	Database software (TTP/C)	custom	
S011	TPS wrapper software (ethernet)	custom	
S012	ABACUSS II	commercial	
S013	Simulator wrapper software (ethernet)	custom	
S014	Bridge software	custom	