WP5 – Proof of Concept

WIDE End User Panel Meeting

June 2010

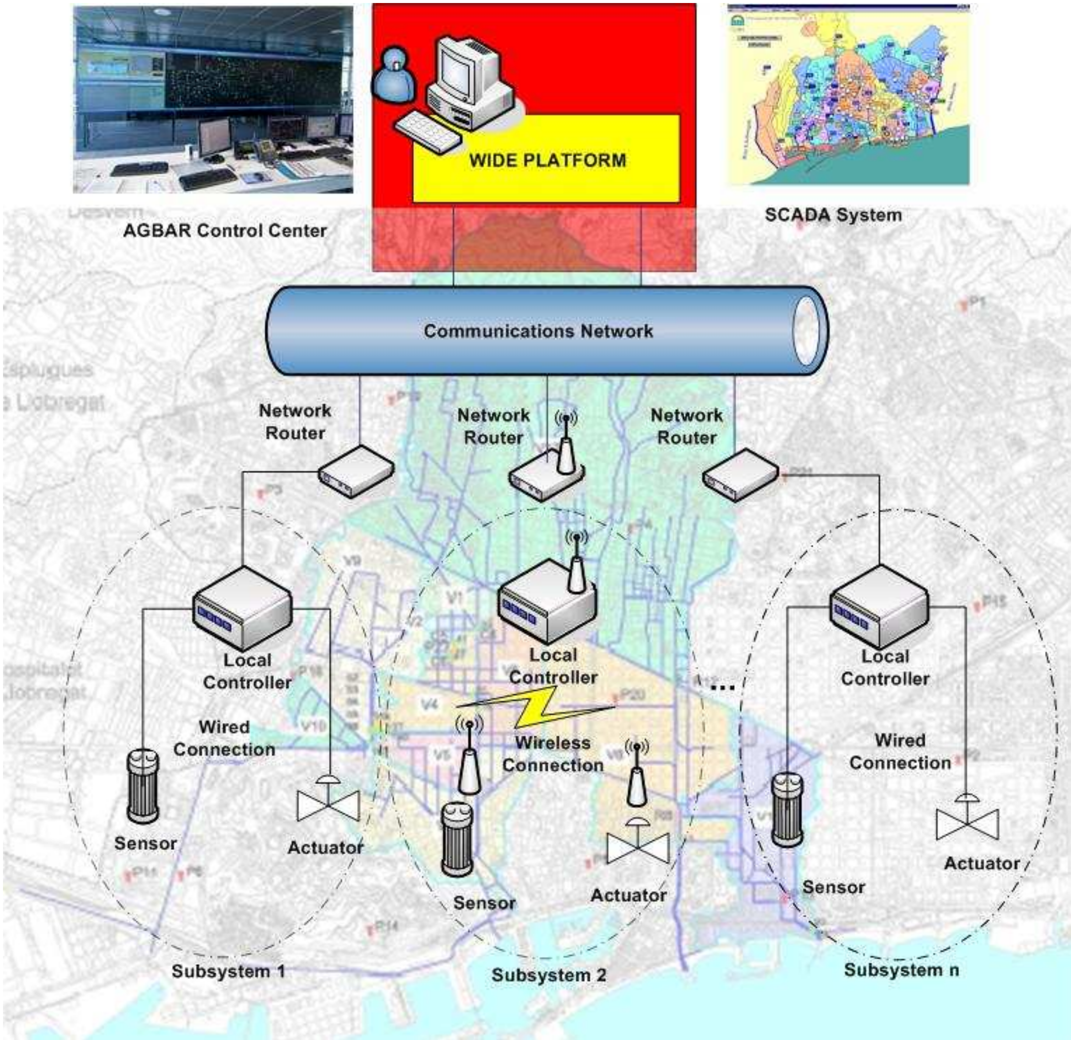
SEVENTH FRAMEWORK PROGRAMME

European Commission
Information Society and Media

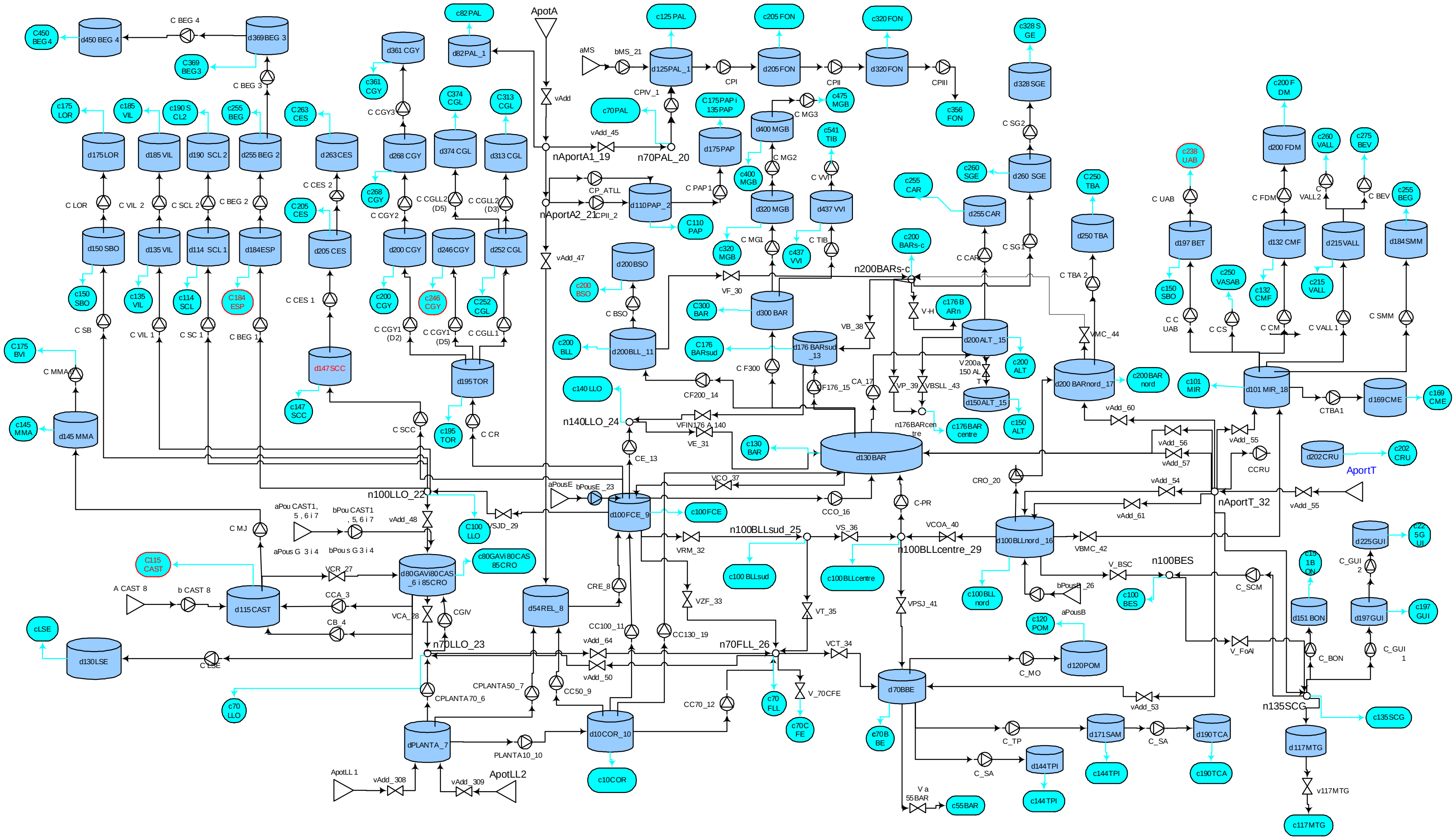
WIDE

PILOT 1: DISTRIBUTED MPC APPLIED TO BARCELONA WATER TRANSPORT NETWORK

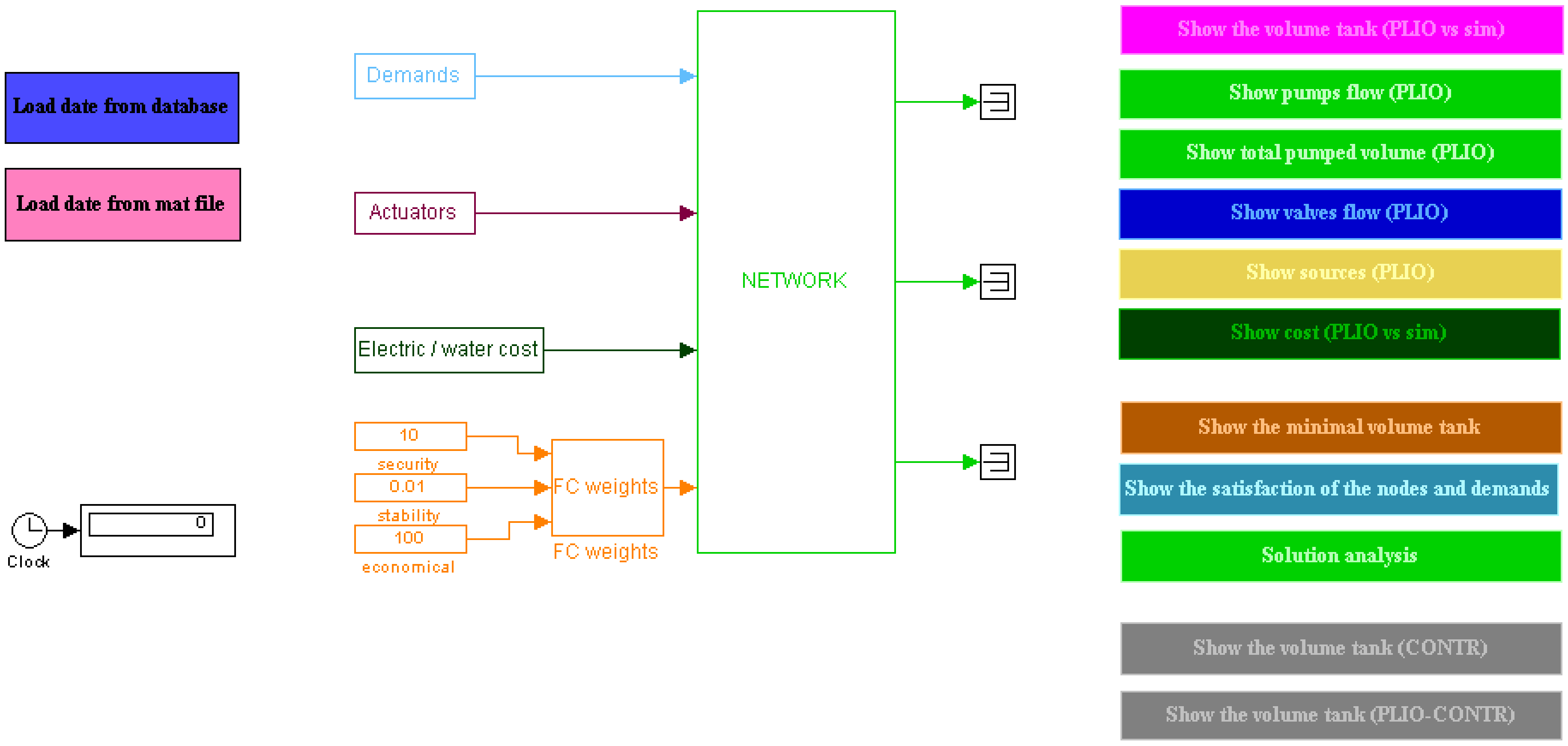
Distributed MPC in Barcelona Water Network



Barcelona Water Network Case Study



Simulator of Barcelona Water Network



Control Objectives

Objective Function Formulation...

1. Energy/Production Costs

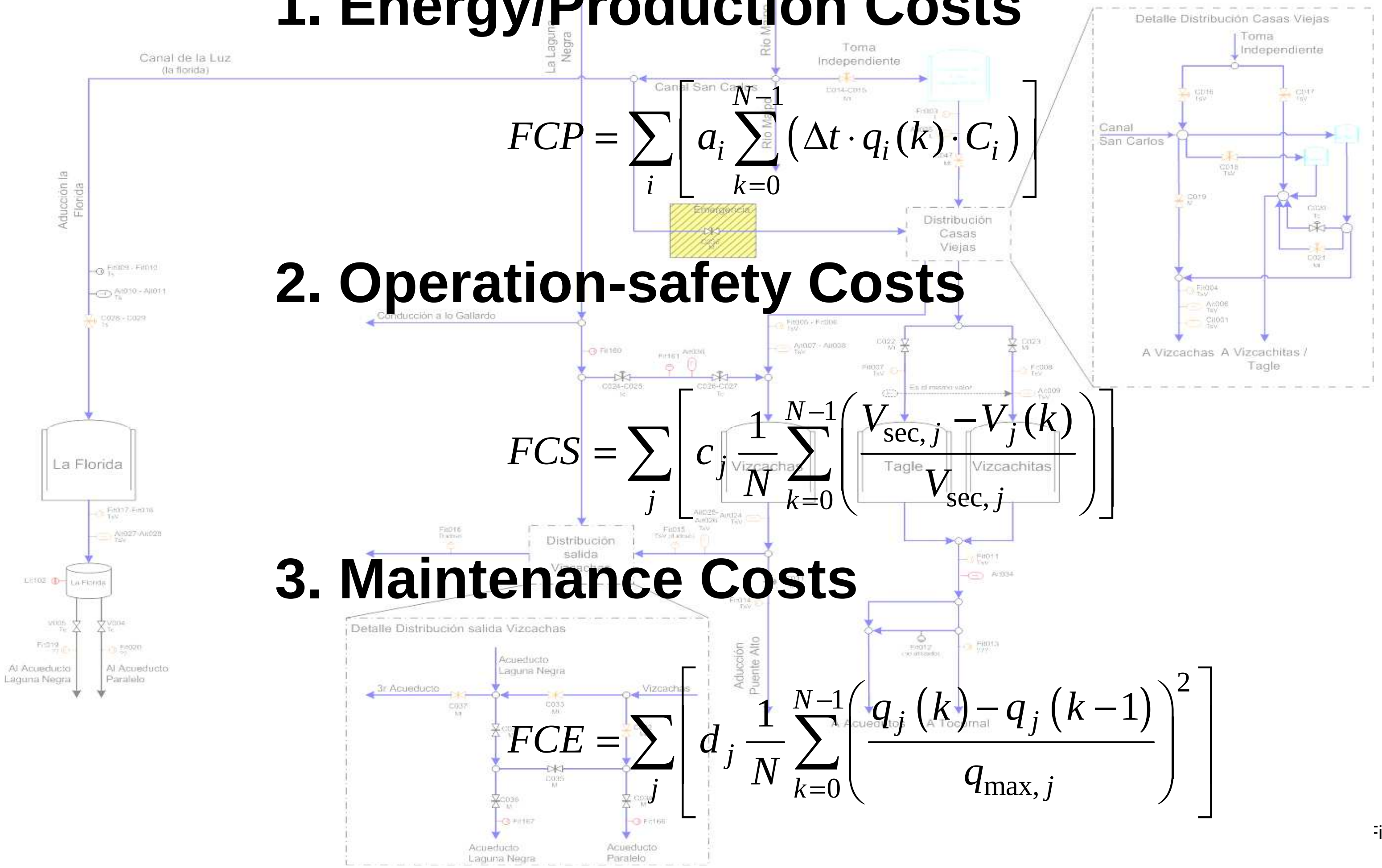
$$FCP = \sum_{i} \left[a_i \sum_{k=0}^{N-1} \left(\Delta t \cdot q_i(k) \cdot C_i \right) \right]$$

2. Operation-safety Costs

$$FCS = \sum_{j} \left[c_j \frac{1}{N} \sum_{k=0}^{N-1} \left(\frac{V_{\sec,j} - V_j(k)}{V_{\sec,j}} \right) \right]$$

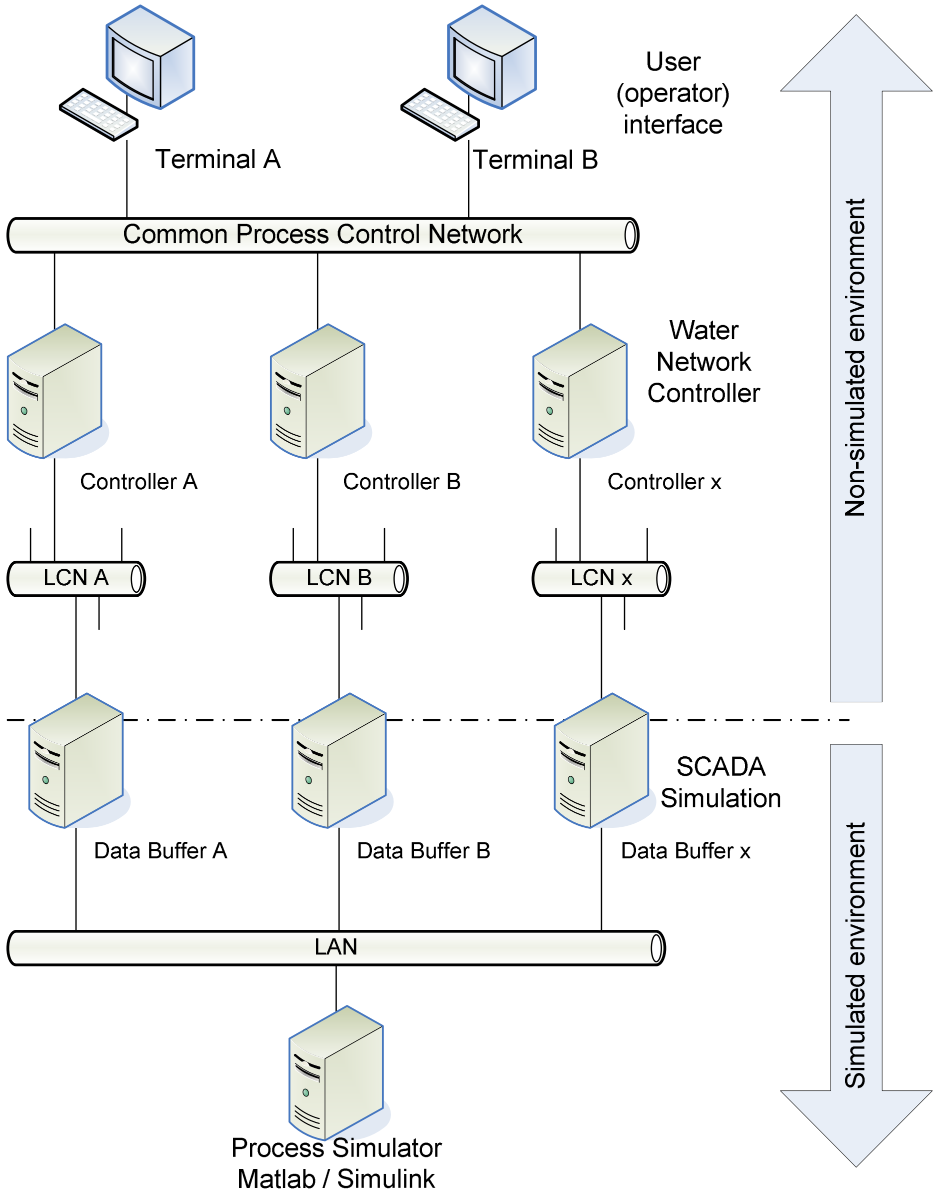
3. Maintenance Costs

$$FCE = \sum_{j} \left[d_j \frac{1}{N} \sum_{k=0}^{N-1} \left(\frac{q_j(k) - q_j(k-1)}{q_{\max,j}} \right)^2 \right]$$



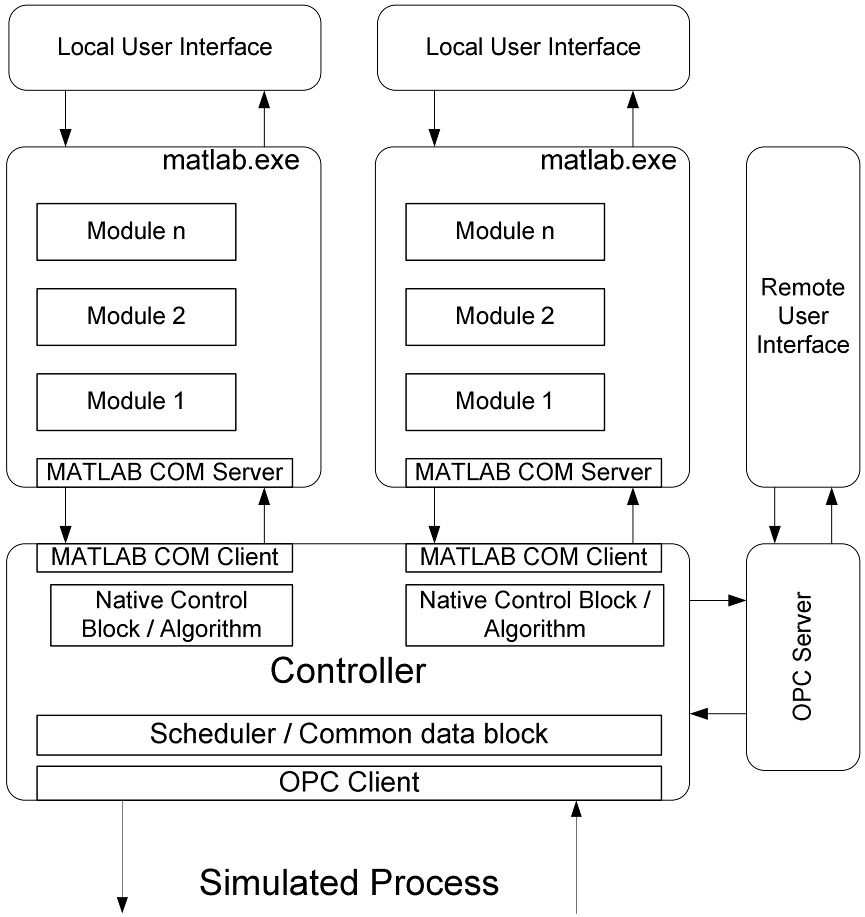
Testing Environment at a Glance 1

- Algorithms developed in WIDE will be demonstrated on a water network control case.
- **Real water network will be replaced by a Simulink™ model of the transport layer of Barcelona Water Network**
- Simulink™ model of the network will be appended by a model of ***base-layer control*** including essential features of industrial DCS/PLC/SCADA
- The models will communicate with the tested controllers on the **advanced control** layer via OPC communication protocol.
- **The demo setting will provide to the controllers conditions that are fully equivalent to those of the real process.**
- Optionally, it will be possible to speed-up the demonstration against the real time.



Testing Environment at a Glance 2

- Control algorithms will be implemented on an *industrial platform for advanced process control.*
- ***'Unified Real Time'*, URT** of Honeywell will be used
- **Control algorithms may be implemented as**
  - native URT components (in C++),
  - External components in MATLAB executed from URT via COM interface



PILOT 2: WIRELESS VALVE CONTROL IN THE BARCELONA WATER TRANSPORT NETWORK

Test Pilot 2: Demo of wireless functionalities

i) Lab Test

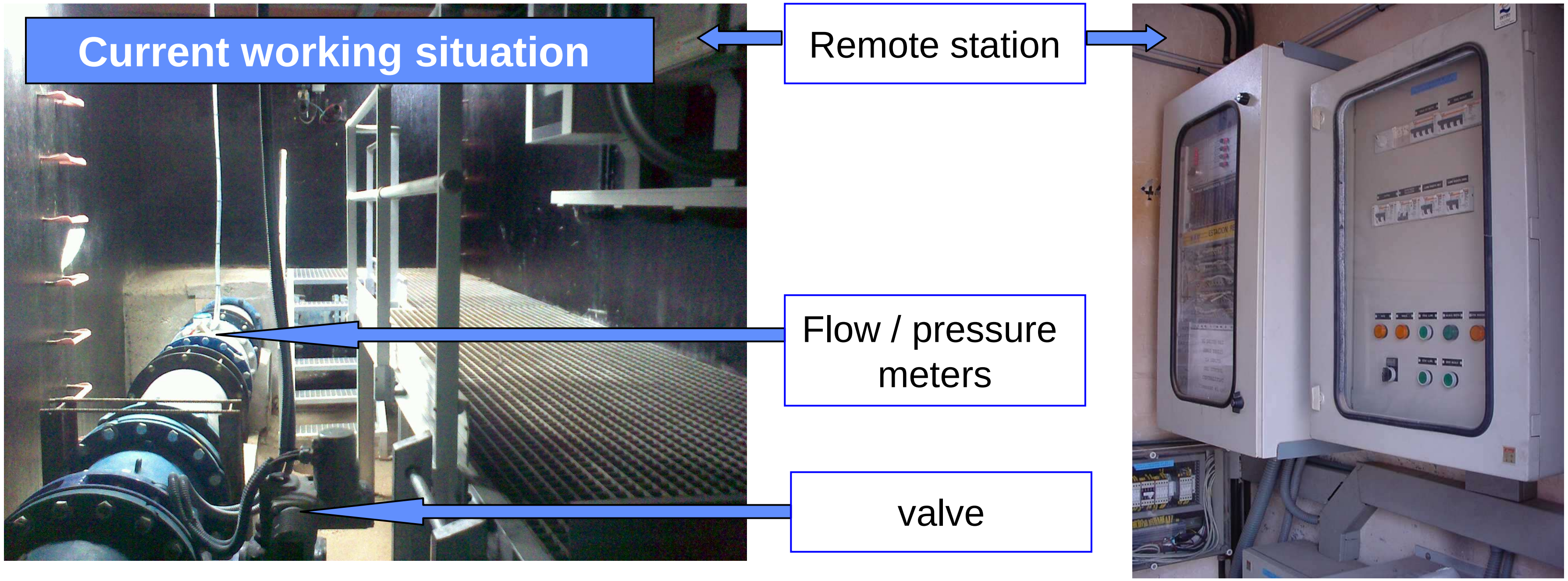
- To use wireless devices without any previous check would be too risky and any failure or inconvenience would affect customers supply.

- A previous lab-test will highlight the main issues that could arise in a real situation.

- In an isolated remote station, input/output signals will be generated and sent between two wireless devices, one of them directly connected to the remote station.

Test Pilot 2: Demo of wireless functionalities

ii) Real test: closed-loop control system for a valve of the Barcelona water network (I)

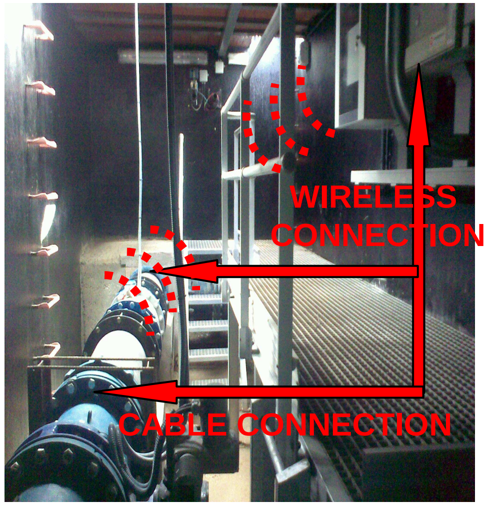


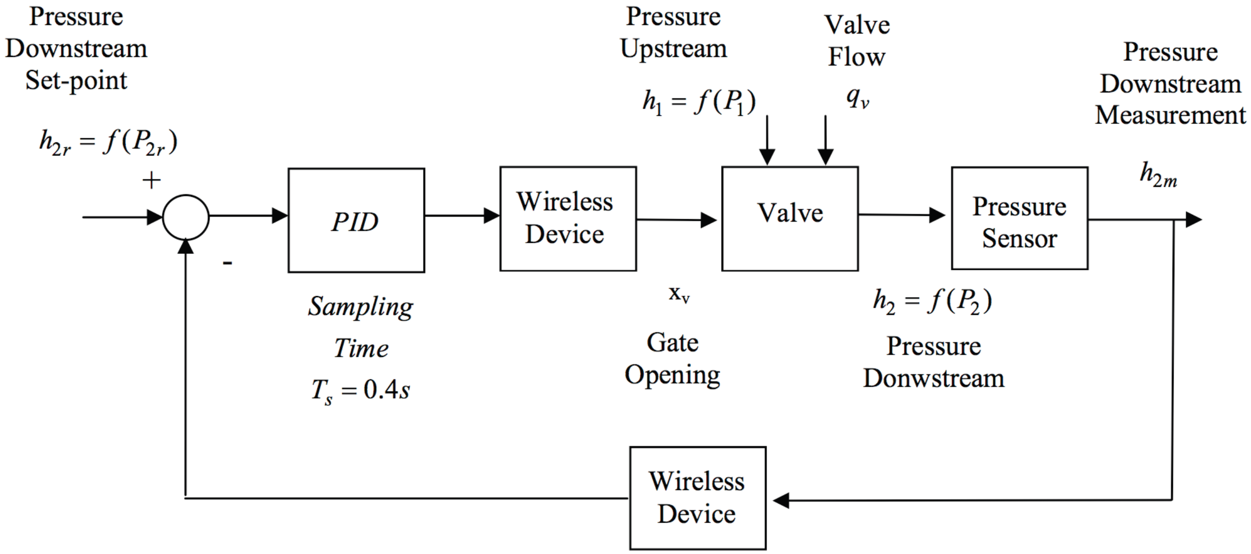
GENERAL PARAMETERS

- Pressure and flow data are stored every 0.4 s in the remote station.
- Input data + desired pressure downstream→ the PID controller in the remote station changes valve position.
- The remote station sends flow and pressure data every 4-5 s to the Control Centre.
- Set points of pressure or flow can be sent from the Control Centre to the remote station when necessary.
- Alarms due to values out of the acceptable range also pop up at the alarms panel in the Control Centre.

Test Pilot 2: Demo of wireless functionalities

ii) Real test: closed-loop control system for a valve of the Barcelona water network (II)





• The overall idea is to check the use of wireless connection between the sensors and the remote station.

• Each signal will be doubled (cable connection and wireless connection) as a protection to the overall control system. Both sets of data will be compared and contrasted afterwards.

• Double aim: a) Transference of information through wireless.
b) **Operational feasibility/constraints** regarding the overall **valve control** (delays, etc.)