UCPC 6
UNICOS-Continuous Process Control v6
Operation new features
Talk goal

- **Who?** Operators of UNICOS-like applications
- **What?** Changes and new features of UNICOS
- **When?** From LS1
Outline

- Introduction
  - Objects library: Modifications, new features and new types
  - Plant Operation: HMI, Recipes and Local Operation
- Future trends
A look to the past

- **[1998] UNICOS** (Unified Industrial Control System) was born at CERN as a need to develop the LHC cryogenics control system.

- Many UNICOS CPC applications done:
  - **Cryogenics**
    - LHC Cryogenics
    - Detector and Test facilities cryogenics
    - Fresca 2 LN2
  - **Gas Control**
    - Detector gas control systems
    - Hydrogen Supply Linac 4
  - **Vacuum**
    - ATLAS, CMS, ISOLDE
  - **Cooling and HVAC installations**
  - **Interlocks**
    - LHC collimators: Environmental temperatures
  - **Motion Control**
    - AMS servomotors control
    - Superconducting cable winding machines
    - ATLAS Big wheels
  - **Others**
    - Magnet Control System
  - ...
UNICOS and UCPC

- UNICOS is a framework to create control applications

**UCPC:** A basic package (Continuous Process Control) to develop integrated process control applications.
Outline

- Introduction
- Objects library: Modifications, new features and new types
- Local Operation and Recipes
- Future trends
General Modifications

- **Naming**
  - *Equipment_Location_Name ➔ Name*
  - Expert Name for SCADA (optional)

- **PVSS archives**
  - Archive mode configurable for ALL objects
  - If no specified for field object, inherited from linked objects

- **Local operation management**
  - Field objects: Hardware Local (key, buttons ...)
  - All objects: Software Local (touch panel)
Alarms & Interlock management

- **Alarms (AL)**
  - Categorized type (standard 4 levels)

- **Same interlocks for PCO and Field objects**
  - Full Stop (FS)
  - Temporary Stop (TS)
  - Start Interlock (SI)

- **Empty red square in faceplate**
  - Interlock disappeared and not acknowledged

- **FS interlock user configurable**
  - Restart when FS disappeared and after acknowledgement (as before)
  - Restart when FS disappeared and after explicit “Allow Restart” action:
    1. Manual restart operator action allowed even if FS still active
    2. Manual restart operator action only allowed if FS has gone
CPC 6: Objects library

- **I/O Objects**
  - Digital Input
  - Analog Input
  - Analog Input Real (former AIC)
  - Digital Output
  - Analog Output
  - Analog Output Real (former AOC)

- **Control Objects**
  - Controller
  - Digital Alarm (former Alarm)
  - Analog Alarm (former Analog Delayed Alarm)
  - Process Control Object

- **Field Objects**
  - OnOff
  - Analog
  - AnalogDigital (Anadig)
  - Local
  - Mass Flow Controller
  - AnaDO

- **Interface Objects**
  - Digital Parameter
  - Word Parameter
  - Analog Parameter
  - Word Status
  - Analog Status
  - Analog Computed Deleted
  - Word Computed Deleted
I/O Objects

- Add bit “AulhFoMo” on the PVSS faceplate

- 10 parameters in .xml spec file for configuration
  - Periphery addresses

```
<table>
<thead>
<tr>
<th>DeviceIdent</th>
<th>FE Encoding Type</th>
<th>InterfaceParam1</th>
<th>InterfaceParam2</th>
<th>InterfaceParam3</th>
<th>InterfaceParam4</th>
<th>InterfaceParam5</th>
<th>InterfaceParam6</th>
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</thead>
<tbody>
<tr>
<td>RFQ_L4_PSL0007</td>
<td>1</td>
<td>130.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFQ_L4_D14_1</td>
<td>2</td>
<td>DB30</td>
<td>40</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFQ_L4_Pr24V</td>
<td>3</td>
<td>DB30</td>
<td>40</td>
<td>5</td>
<td>DB50</td>
<td>60</td>
<td>5</td>
</tr>
</tbody>
</table>
```
OnOff

- Widget Animation when no feedback available
  - \textit{Anim} = Full/Empty
  - \textit{Anim} = Full/Half/Empty

- OUTPUT configurations
  1 or 2 output DOs
  - Mono-Stable: 1 DO
  - Bi-Stable: 1 DO for opening + 1 DO for closing
Analog

- Fail-Safe Position
  - Off/Close
  - On/Open normal output
  - On/Open inverted output
AnaDO

- ANALOG + ONOFF functionality in 1 single object
  - Pump/compressor with Variable Frequency Drive
  - Electrical Heater / Thyristor
  - Control Valve with safety Electro-Valve
Anadig

- Local Drive: Same implementation as in Analog

- PWM Mode
  - Classic unipolar PWM: positive DO only
  - Bipolar PWM: Positive and Negative DO on internal loop

- Output Maintain: Force DO to stay at 1 or 0 on limits
  - Sliding valves compressors (to avoid erratic movements)
Local

- Widget Animation when no feedback available
  - \( \text{Anim} = \text{Full/Empty} \)
  - \( \text{Anim} = \text{Full/Half/Empty} \)

- Position Warning
  - When the 2 feedbacks are the same (and declared)

- Position Alarm
  - 1 feedback declared as normal position and not activated
Controller (1/2)

- UNICOS Mode management as other field objects
  - Auto/Manual/Forced with same meanings

- + Working States
  - Regulation
  - Positioning
  - Tracking

- PID new features:
  - 1\textsuperscript{st} order filter on Measured Value
  - PID Cycle time on Schneider applications
  - Scaling mode (No Scaling / Input Scaling / IO Scaling)
Controller (2/2)

- PID parameters (save/restore)
  - Same as before

- PID cascade automatically generated
PCO

- Automatic Alarm panel (Also included in all Field objects!)
  - List of linked alarm in a dedicated panel

- Status calculation embeds RunOSt by default
  - OnSt = Fon AND RunOSt
  - OffSt = Foff AND Not RunOSt
Digital Alarms

- Input configurable in spec and Multiple alarm definition

<table>
<thead>
<tr>
<th>DeviceIdentification</th>
<th>EDeviceParameter</th>
<th>FEDeviceAlarm</th>
<th>FEDeviceEnvironmentInputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Alarm Delay [s]</td>
<td>Type</td>
<td>Multi Types</td>
</tr>
<tr>
<td>HRM_876_COOL_L1</td>
<td>0</td>
<td>AL</td>
<td></td>
</tr>
<tr>
<td>HRM_876_COOL_F51</td>
<td>0</td>
<td>FS</td>
<td></td>
</tr>
<tr>
<td>HRM_876_VMA0001_disc</td>
<td>10</td>
<td>Multiple</td>
<td>AL,FS</td>
</tr>
<tr>
<td>HRM_876_VMA0002_F51</td>
<td>0</td>
<td>FS</td>
<td></td>
</tr>
<tr>
<td>HRM_876_VMA0002 диск</td>
<td>5</td>
<td>Multiple</td>
<td>AL,FS</td>
</tr>
</tbody>
</table>

- Time delay
  - after “Unblock” action if the condition is true and the delay time expired the output is immediately set to 1.

- Faceplate
  - Delay time (Can be an APAR)
  - Alarm type
Analog Alarm

- Input configurable in spec and Multiple alarm definition
- Configurable Thresholds:
  - Literal threshold: Initialized in PLC and then modified from SCADA
  - Logic: Set by control logic in the PLC
  - APAR: Linked object APAR sets the value

### Device Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>HH Alarm</th>
<th>H Warning</th>
<th>L Warning</th>
<th>LL Alarm</th>
<th>Type</th>
<th>Multiple Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRM_876_TT0002_AL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL</td>
<td></td>
</tr>
<tr>
<td>HRM_876_TT0004_AL</td>
<td>5</td>
<td>Logic</td>
<td></td>
<td></td>
<td>AL</td>
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<tr>
<td>HRM_876_CT0001_AL</td>
<td>10</td>
<td>Logic</td>
<td></td>
<td></td>
<td>AL</td>
<td></td>
</tr>
</tbody>
</table>

### Configuration

- HH: 0.000
- H: 2.500
- L: 1.000
- LL: 1.100

- Alarm Not Ack
- Event not Ack
- Alarm blocked
- Config VIO
- VIO Error
- VIO Simulated
Interface objects

- **APAR/WPAR/DPAR**
  - Can be connected to output periphery or internal memory
- **AS/WS**
  - Can be connected to Input periphery or internal memory
Outline

- Introduction
- Objects library: Modifications, new features and new types
- **Plant Operation: HMI, Recipes and Local Operation**

- User support and future trends
Plant operation: Architecture

- **Enterprise computers**
- **WTS**
- **Ethernet Corporate**
- **EWS**
- **WTS**
- **Ethernet Technical**
- **Local OWS Touch panel**
- **PLC(s)**
- **Fieldbus**
- **I&O and devices**
- **SCADA Server(s)**
- **OWS**
- **Operator Control Process Room(s)**
- **CERN Control Room(s)**
- **PTC**
- **Ethernet**
- **Technical**
- **CERN**
- **UNICOS-CPC**

UCPC Team (CERN, EN/ICE)

Date: 6/14/2013
Plant Operation: Local control

- Local operation by industrial touch panels
  - Simatic Panels with MPI/Profibus and to Modbus/TCP
  - Include access control (login) and alarms list
Plant Operation: Recipes

- Dynamic recipes replaces its *a priori* definition and eliminates dedicated object definitions on the control application.
- Allows bulk parameterization and/or multiple setting in one shot.
- Established list of recipe-able objects (i.e. PID parameters, Xparameters, AAlarm).

Example of a recipe instance:

```
<table>
<thead>
<tr>
<th>Recipe Class</th>
<th>Instance1 Example of RcpClass2 Instance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RcpClass2</td>
</tr>
<tr>
<td></td>
<td>Recipe Instance1</td>
</tr>
<tr>
<td></td>
<td>Recipe Instance2</td>
</tr>
<tr>
<td>Description</td>
<td>RcpClass2 Description</td>
</tr>
<tr>
<td></td>
<td>Recipe Instance1</td>
</tr>
<tr>
<td>Status</td>
<td>[Active]</td>
</tr>
<tr>
<td>Class</td>
<td>RcpClass2</td>
</tr>
<tr>
<td>Last Activated</td>
<td>RcpClass2/Instance2</td>
</tr>
<tr>
<td>Creator</td>
<td>admin</td>
</tr>
<tr>
<td>Creation Time</td>
<td>2011-11-07 14:00:32.112</td>
</tr>
<tr>
<td>Last Modifier</td>
<td>admin</td>
</tr>
<tr>
<td>Last Modification Time</td>
<td>2011-11-09 10:37:22.206</td>
</tr>
<tr>
<td>Last Modifier</td>
<td>admin</td>
</tr>
<tr>
<td>Last Modification Time</td>
<td>2011-11-09 10:37:22.206</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index</th>
<th>Alias</th>
<th>Description</th>
<th>Value</th>
<th>Unit</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DEMON_1_A2</td>
<td>Analog Alarm 2 HH</td>
<td>500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>2</td>
<td>DEMON_1_A2</td>
<td>Analog Alarm 2 LL</td>
<td>500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>3</td>
<td>DEMON_1_AP26</td>
<td>Analog Parameter 26</td>
<td>5.500</td>
<td>bar</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>4</td>
<td>DEMON_1_AP26</td>
<td>Analog Parameter 26</td>
<td>5.500</td>
<td>cm</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>5</td>
<td>DEMON_1_Ctr2</td>
<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>6</td>
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<td>°C</td>
<td>[0, 100]</td>
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<td>7</td>
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<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>8</td>
<td>DEMON_1_Ctr2</td>
<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>9</td>
<td>DEMON_1_Ctr2</td>
<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>10</td>
<td>DEMON_1_Ctr2</td>
<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
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<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
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<td>°C</td>
<td>[0, 100]</td>
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<tr>
<td>13</td>
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<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
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<td>°C</td>
<td>[0, 100]</td>
</tr>
<tr>
<td>15</td>
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<td>Controller 2</td>
<td>1.500</td>
<td>°C</td>
<td>[0, 100]</td>
</tr>
</tbody>
</table>

Example of a recipe instance tool (creation, activation, edit,...)
HMI UNICOS

- Look & Feel change (UNIX based machine OWS)
HMI UNICOS

- Configuration menus (e.g. email configuration)
HMI UNICOS

- Alarms & Events
HMI UNICOS

- Front-End Diagnostics
### Plant Operation: HMI

#### Colors

<table>
<thead>
<tr>
<th>INFORMATION/ORDERS/STATUS</th>
<th>Faceplate</th>
<th>Widget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status (status/modes)</td>
<td>Green {RGB: 0,255,0}</td>
<td>56.9</td>
</tr>
<tr>
<td>Request (Request/Orders)</td>
<td>Green {RGB:0,175,0}</td>
<td>56.9</td>
</tr>
<tr>
<td>Parameters / Information</td>
<td>Black</td>
<td>4.56</td>
</tr>
</tbody>
</table>

#### PROCESS ALARMS

<table>
<thead>
<tr>
<th>Alarms</th>
<th>Faceplate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarms</td>
<td>Red</td>
</tr>
</tbody>
</table>

#### WARNINGS/FORCED

<table>
<thead>
<tr>
<th>Warnings</th>
<th>Faceplate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warnings</td>
<td>Orange</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forced by operator</th>
<th>Faceplate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forced by operator</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

#### ABNORMAL SITUATION

<table>
<thead>
<tr>
<th>Invalid/Old data</th>
<th>Faceplate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid/Old data</td>
<td>Cyan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data not accessible</th>
<th>Faceplate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data not accessible</td>
<td>Violet</td>
</tr>
</tbody>
</table>

---

**Diagram:**

- [Image of HMI Interface](image-url)
Background color in trends

- Improve the background color
  - Print outs are replaced by screenshots!
Plant Operation: HMI

- UCPC devices **hierarchical** visualization
Plant Operation: HMI

- Alarms panels
Widget information

(W) DATA QUALITY (warnings)
- Invalid data
- Old (data not up to date)
- Field object with alarm blocked
- IO object with IO error blocked
- IO error
- IO simulated
- Forced <> Auto
- Manual <> Auto
- Position Warning
- Configuration Warning

Object | Letter | Color | Priority
--- | --- | --- | ---
all | N | Cyan | highest
all | O | Red
Field, I/O | B | Orange
all except xPAR, xSTATUS | E | Green
PCO, Field, I/O | W | Green
AA | C | Green

(Ai) ALARM & INTERLOCKS
- Full stop interlock
- Temporary Stop Interlock
- Start Interlock
- Alarm
- Position Alarm (Local)
- Manual Restart Required (after a full stop interlock)

Object | Letter | Color | Priority
--- | --- | --- | ---
PCO, Field | F | Red | highest
PCO, Field | P | Orange | lowest

(Ai) Info (Alarm objects)
- Alarm condition
- High Threshold alarm
- Low Threshold alarm
- High Threshold warning
- Low Threshold warning

Object | Letter | Color | Priority
--- | --- | --- | ---
AA, AI, AIR, AO, AOR | A | Red | highest

(Ai) MASK & BLOCK info
- Alarm Blocked (PLC)
- Alarm Masked (only SCADA)
- Event Masked (only SCADA)

Object | Letter | Color | Priority
--- | --- | --- | ---
PCO, Field | B | Yellow | highest
PCO, Field | M | Yellow | lowest

(M) Mode & Working State
- Local Mode
- Auto Mode
- Manual Mode
- Forced Mode
- Inhibit Manual/Forced

Object | Letter | Color | Priority
--- | --- | --- | ---
PCO, Field | L | White | highest

(F) Feedback & (O) Order
- Feedback value
- Order value

Color
- Green
- White
Outline

- Introduction
- Objects library: Modifications, new features and new types
- Local Operation and Recipes
- Future work
Future work ...

- Integration of PID auto-tuning algorithms ONLINE
- Operator comments on faceplates
- Alarms and events on faceplates
- Statistical analysis (e.g. how many hours has been my pump running within a particular period?)

- Additional information on faceplates
- Multiple commands per device type
Now it is your turn!

- You are the **SOURCE** for new improvements for operation!!!

- Questions?
- Suggestions?
- Improvements?
- Needs?
- Proposals?
- Ideas?

- Support
  - Icecontrols.support@cern.ch