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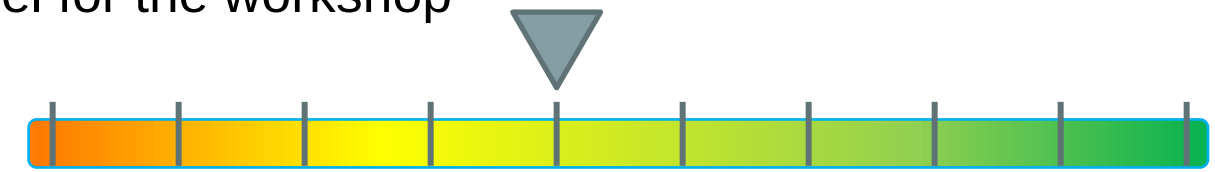
APROL Library Engineering Workshop

Agenda

APROL Library Engineering Workshop

Time	Topic	Presenter
Day 1	Python Tutorial	Marböck Wolfgang
Day 2	Python API for DisplayCenter	Marböck Wolfgang
Day 3	Python API for DisplayCenter, LoginServer, UCB, ListViewWidget	Marböck Wolfgang

Aimed level for the workshop

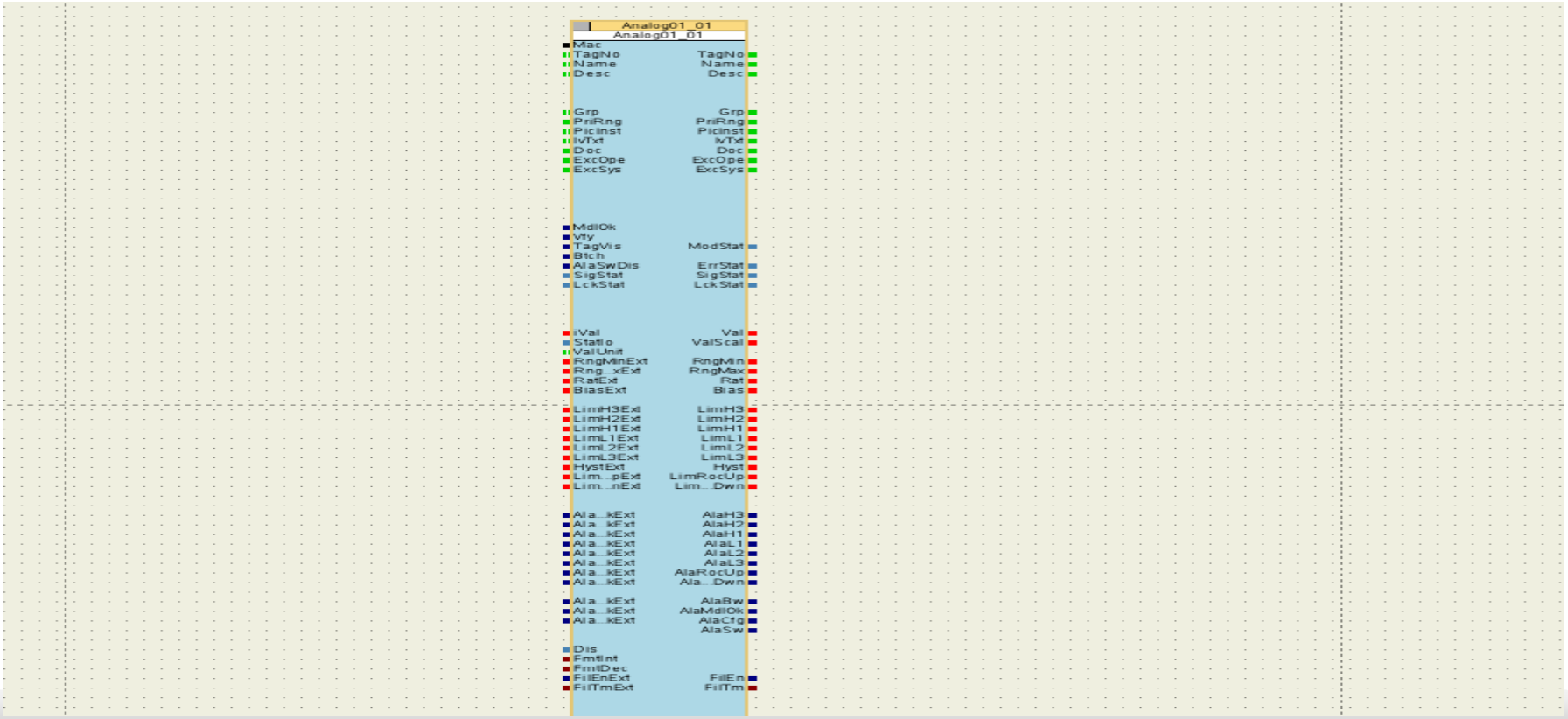


Beginner Expert

APROL Libraries

APROL Libraries basic concepts 1/9

- APROL Hypermacro concept
  - Includes logic functionality (C- FUB)
  - Includes visualization parts (graphic macros, faceplates)
  - Includes control system blocks (alarm, trend)
  - One block per typical, everything inside



APROL Libraries basic concepts 2/9

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Logic

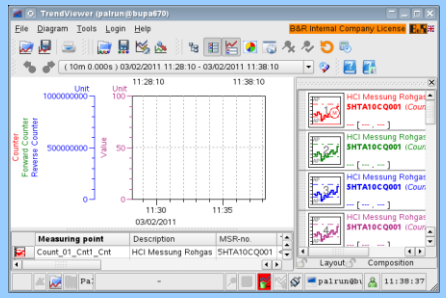
Graphic Macro

MOT_TAG123

Faceplate

Alarm

Trend



APROL Libraries basic concepts 3/9

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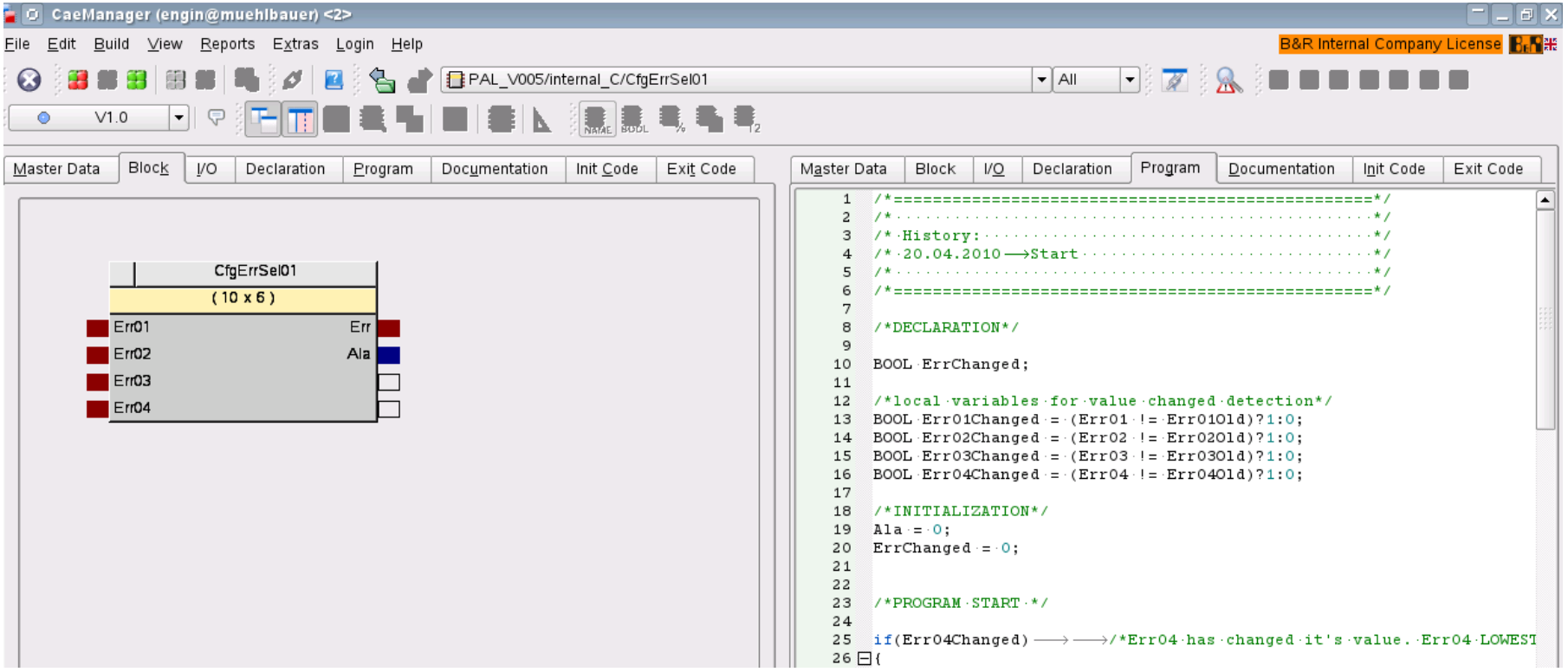
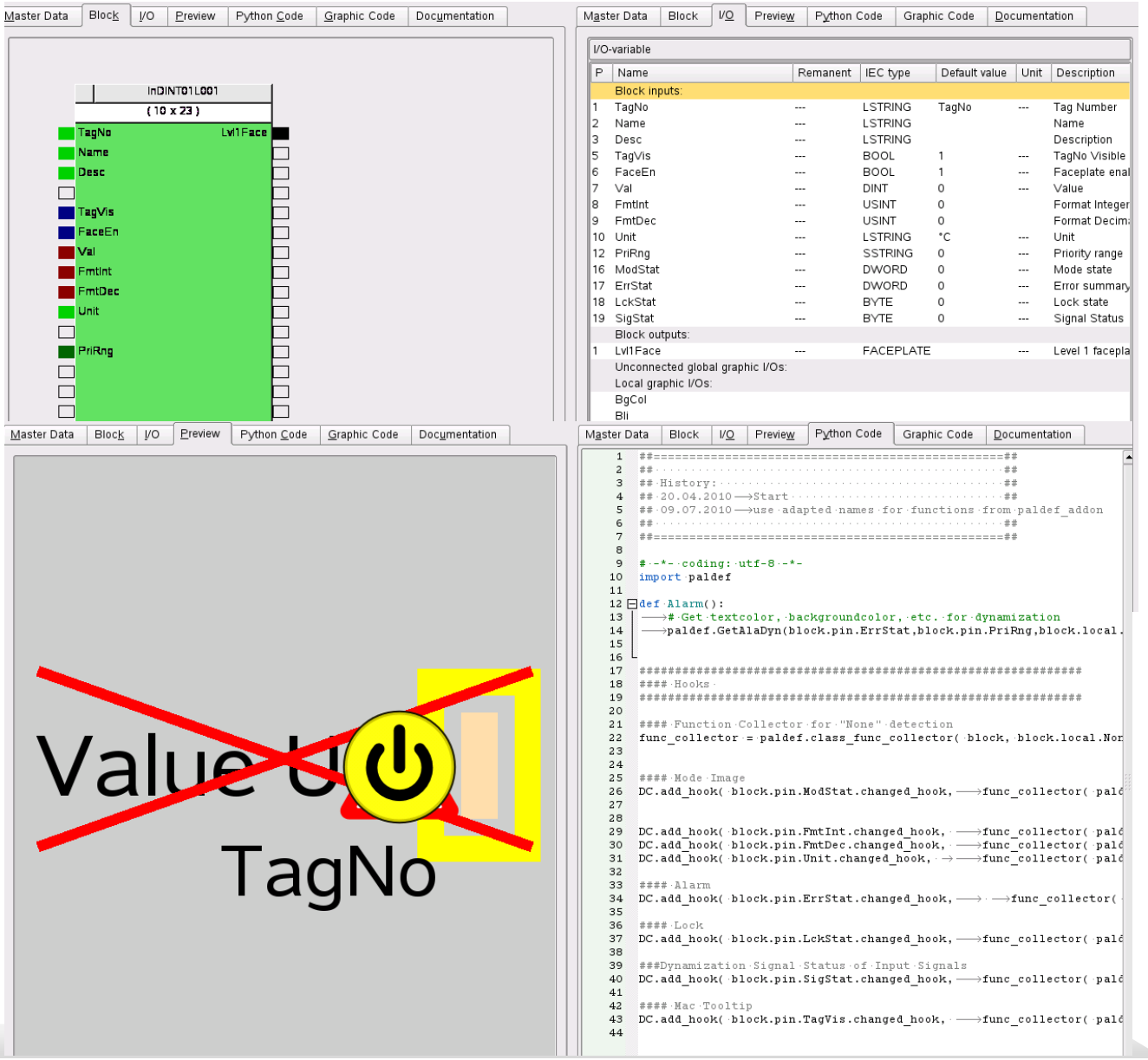
- Logic function blocks
  - Pins
  - Code = C programming
  - Documentation B3.2.7



APROL Libraries basic concepts 4/9

- Graphic block
  - Pins
  - Graphical part
  - Python Code
  - Documentation B3.2.8



APROL Libraries basic concepts 5/9

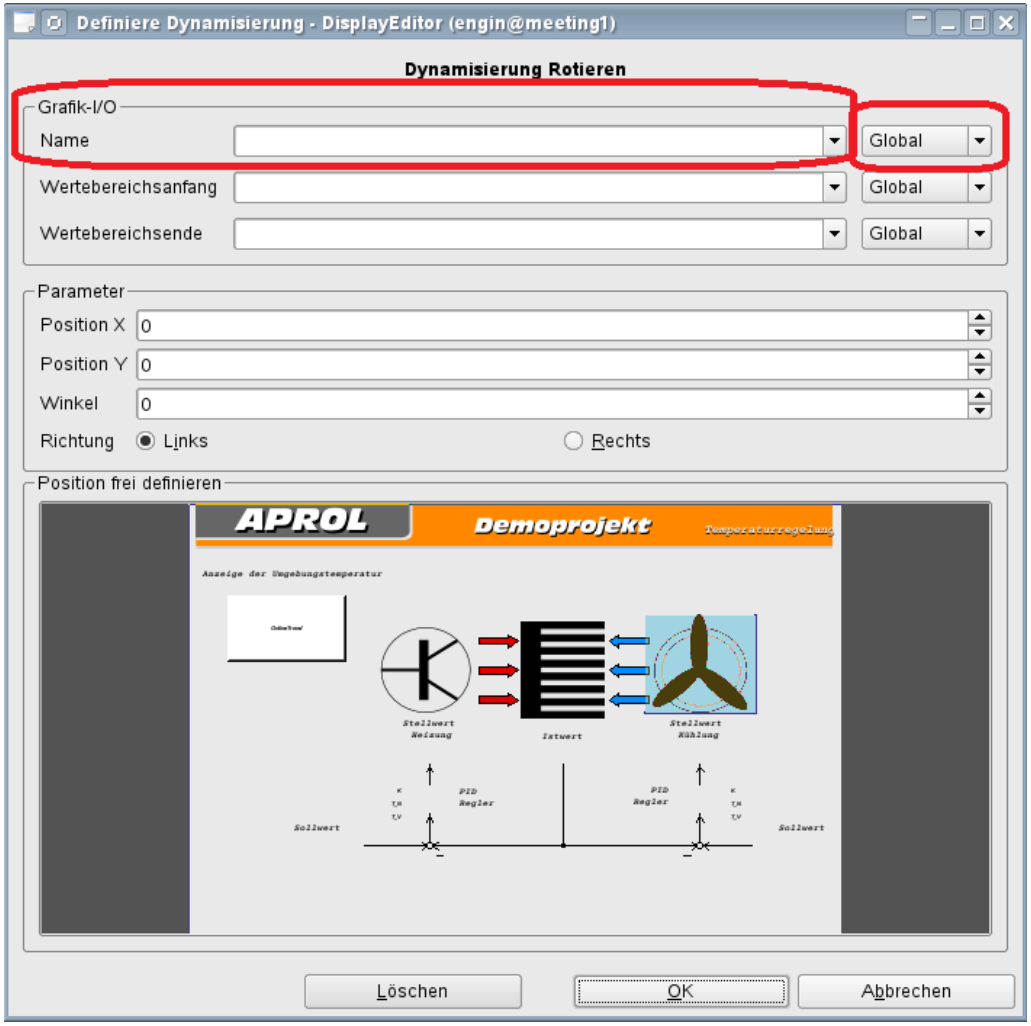
- available animations:

The following are the basic functions available for animation:

Animation type	Description
Blinking	Objects can be blink in many different ways depending on a process variable.
Colors	Objects can change colors depending on a process variable. Background and foreground colors, fill patterns, and line types can be changed.
Rotate	Objects rotate around a definable fixed point depending on a process variable.
Move	Makes it possible to move objects to a different location in the process graphic. Movement along the x-axis can be defined independently of that on the y-axis.
Scale	Objects can change their size depending on two process variables. The x and y axes can be defined independently of one another.
Percent	Objects are trimmed depending on a process variable and no longer displayed in full size.
Text	The actual value of a process variable is displayed. STRING variables can be displayed.
Text list	Defined texts can be displayed depending on a process variable.
Image list	Serves to dynamically display 1 from n images - depending on a process value. E.g. a significant increase in productivity can be reached during the creation of status displays from your system via image (icon).
Invisible	The object is switched invisible.

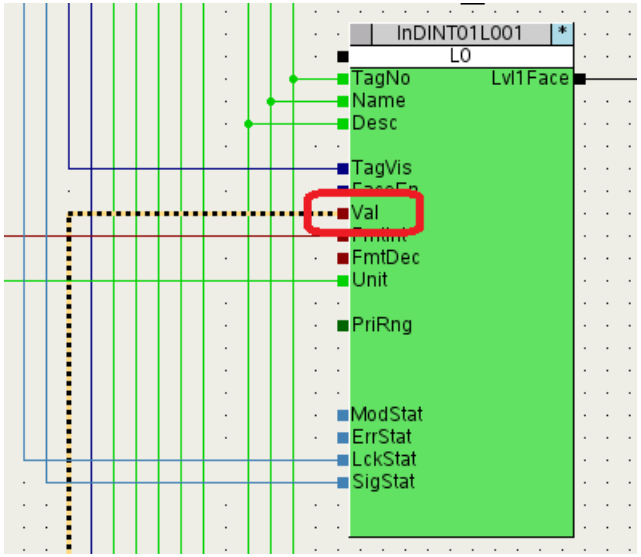
APROL Libraries basic concepts 6/9

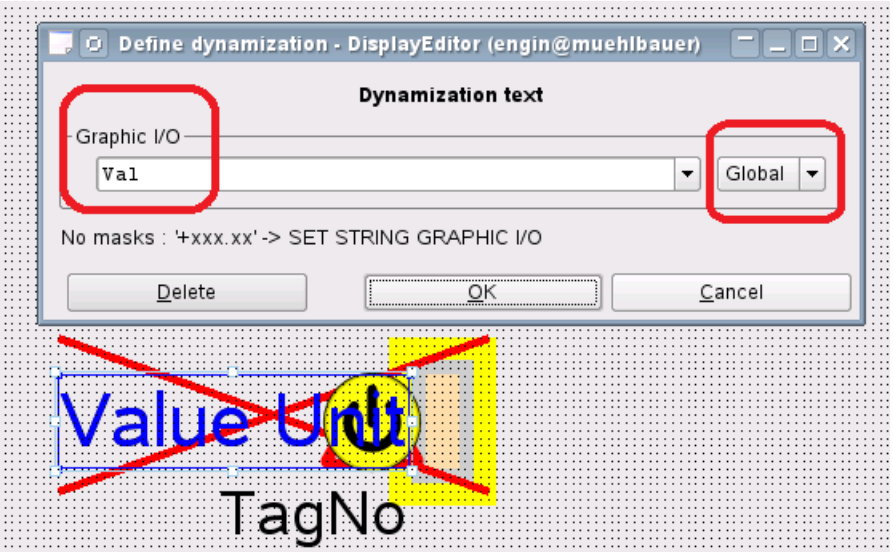
- Apply animation to a graphical element
  - Local/Global graphic IO
  - Documentation
    B3.2.8.2.3



Animation with global graphic IOs

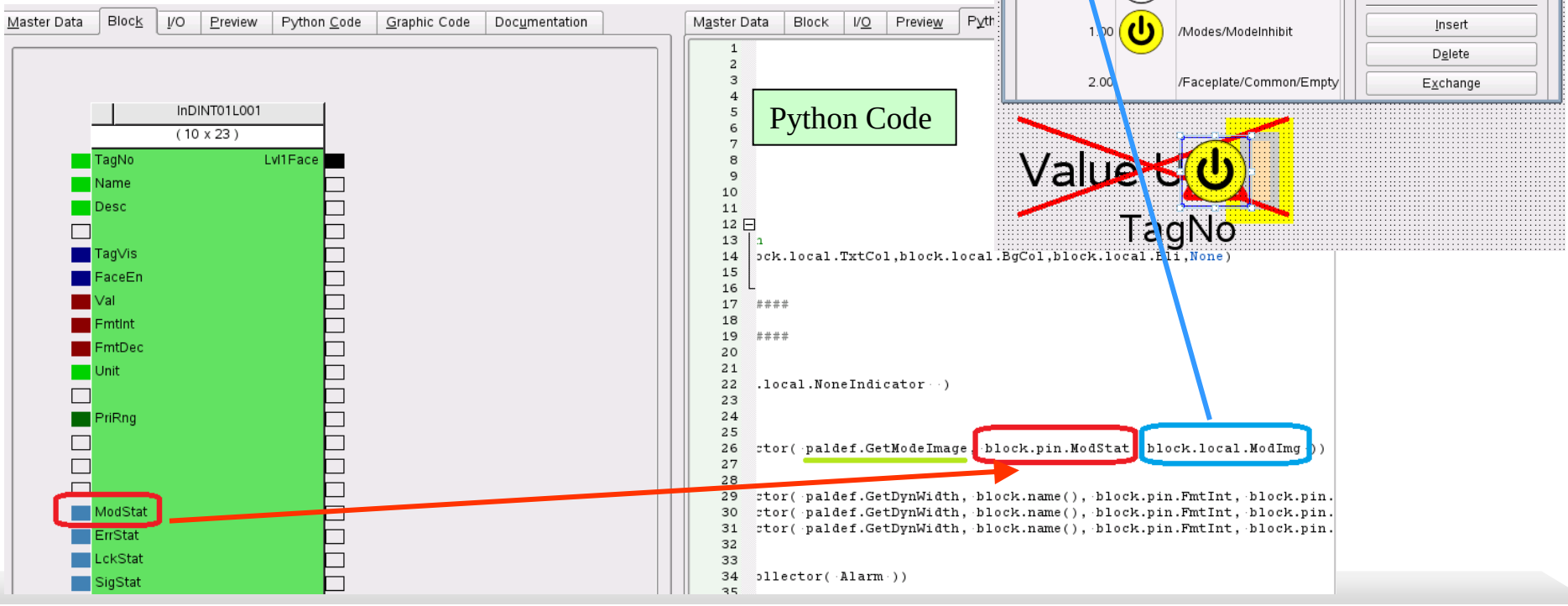
- Use a pin of the graphic block as signal source
- The pin of the graphic block can be connected to a signal coming from a logic block, input pin, gateway io, hm- constant, …





APROL Libraries basic concepts 8/9

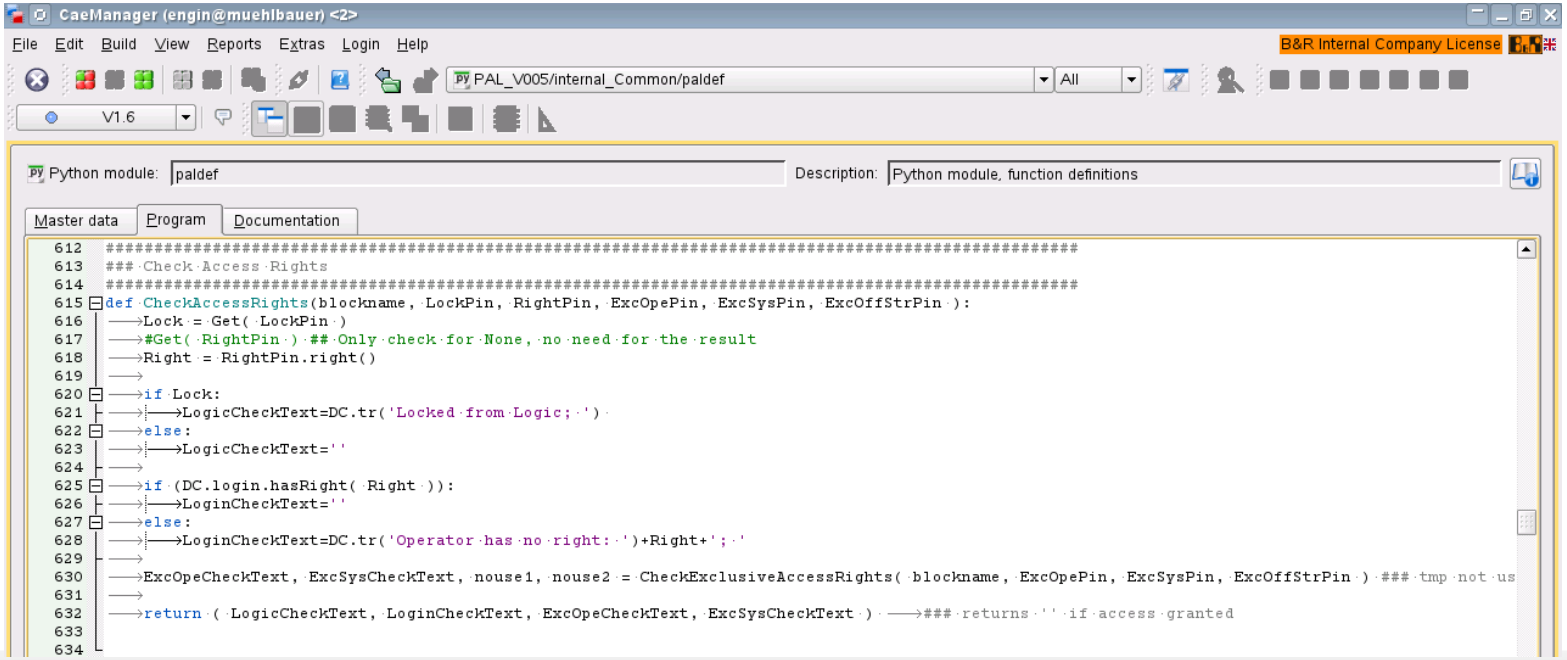
- Animation with local graphic IOs (= Python variables)
  - Use pin(s) of the graphic block in Python Code.
  - The result of the Python Code is a local graphic IO



APROL Libraries basic concepts 9/9

- In general all animations are possible without Python (use global graphic IOs)

- Python is available for extended possibilities with animations
- Python-API gives you access to system events via HOOKS
- Python-API offers FUNCTIONS to perform specific actions



APROL Python API

APROL Python API 1/4

- Documentation:
  - APROL Product documentation – D2 – System API
- API available for following components
  - Visualization (DisplayCenter)
  - Login (LoginServer)
  - Parameter (ParameterCenter)
- Don’t use python for creating cyclic programs!
  - D2.1.2 – IMPORTANT!
  - Code is executed by Python interpreter, DC/LS wait for termination
  - DC/LS are blocked when code has long execution time or endless loop

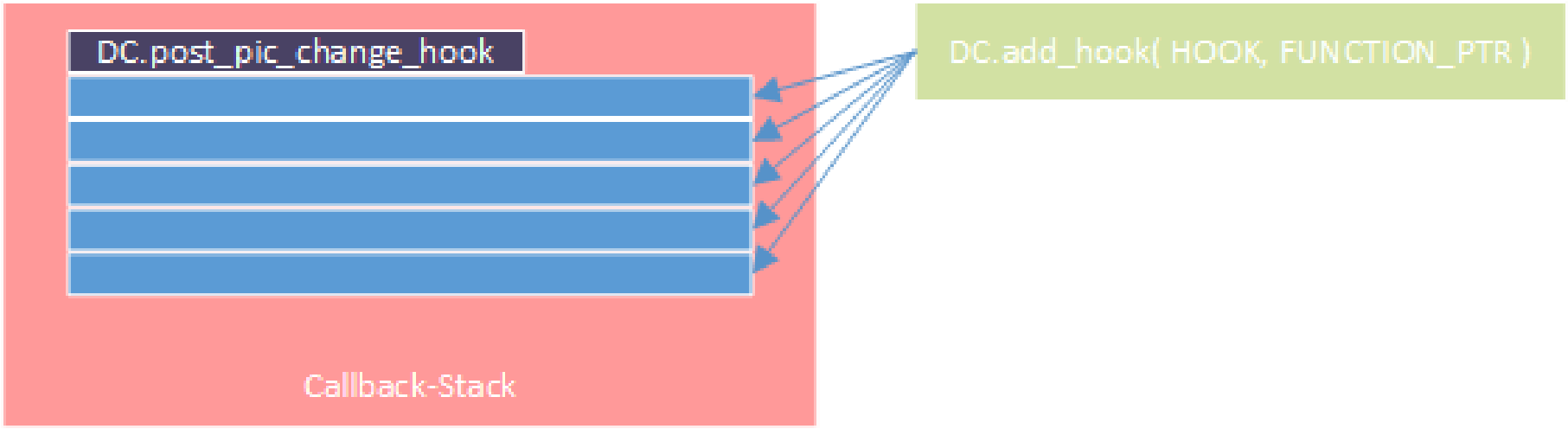
APROL Python API 2/4

- Python code execution
  - Code has context (DisplayCenter, process graphic, graphic block, ...)
  - As long as the same context is active, the python code specific to this context is run in the Python interpreter.
  - All the “static” code (code which is not run within the context of a hook) is only run once, when this context becomes active.
  - You can use HOOKS to connect to system events. Therefore in the python code you just make a connection between hook and a user defined function. Always when the specific event occurs, your user defined function is run.

APROL Python API 3/4

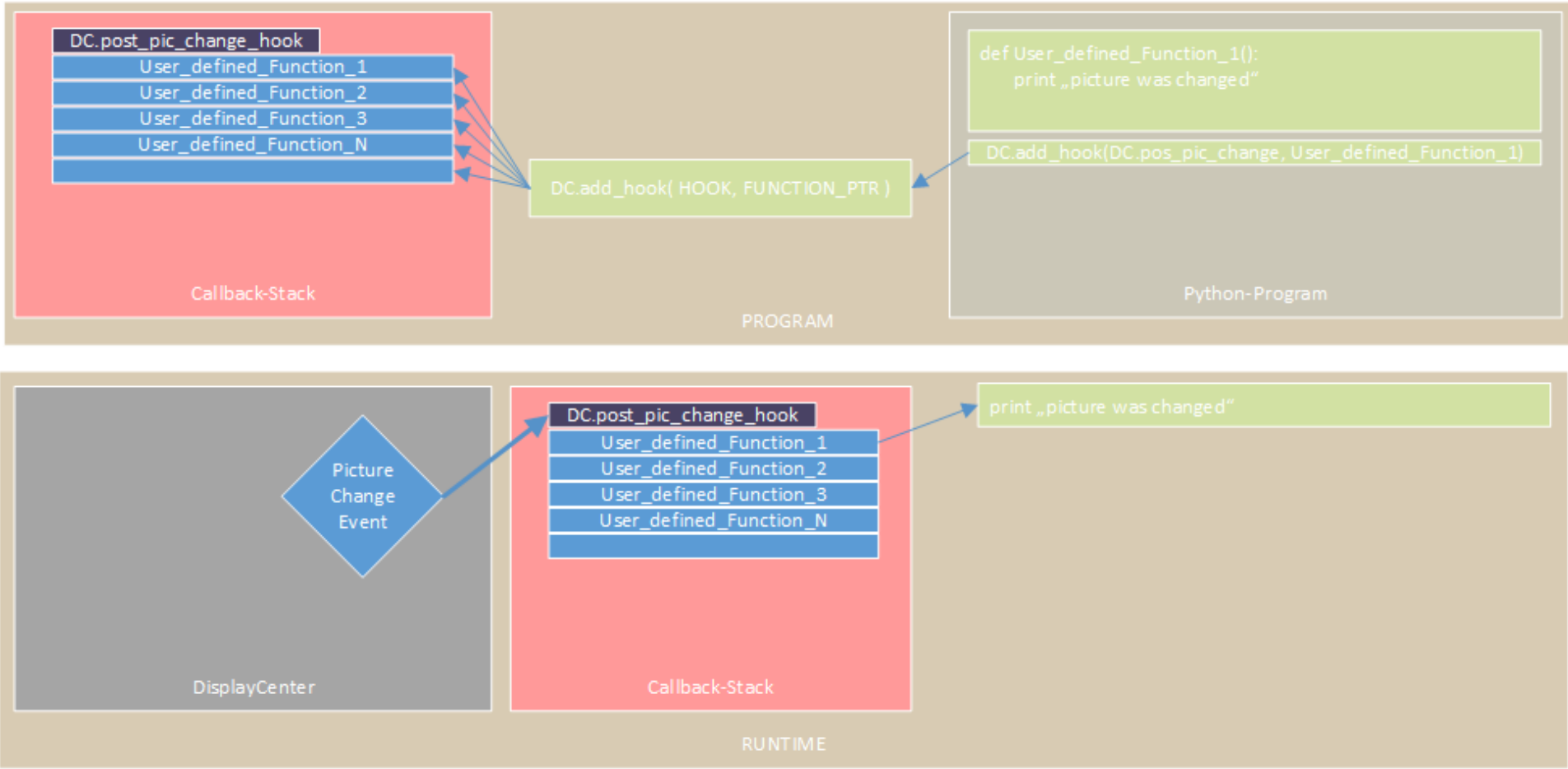
- HOOK
  - Event in the system (e.g. picture change)
  - Possibility to react to this events – connect user functions to hooks with

    DC.add_hook(HOOKNAME, POINTER_TO_USERFUNCTION)
  - DC.add_hook creates a list of functions which need to be called on this event (callback-stack)
  - Available Hooks see D2.1.2.1



APROL Python API 4/4

- HOOK in action



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APROL Python API for DisplayCenter

APROL Python API DisplayCenter 1/11

- What?
  - Expansion of the possibilities for dynamizations in graphic macros
  - Possibility to react to events in the visualization
  - Usage of specific API-functions
- Why?
  - Offer extended functionality for the engineer
- Where?
  - In graphic blocks (graphic macros, faceplates, sub- faceplates)
  - Own “tab” for python code
  - Use of “local” variables (=python variables”) alternatively beside “global” variables (=block pins)
  - Python code is executed event-triggerd, certain events provide a **hook**, python code can be connected to those hooks

APROL Python API DisplayCenter 2/11

- Debugging of python code
  - For extended debugging the **python console** needs to be activated

    RuntimeSystem->Monitoring->DisplayCenter->Prio3

    -showPythonConsole ; (value = number of lines)
  - Python console can be used for debug messages (e.g. code: “print var”)
  - Errors in the python code are always shown in python console, independent of python console enabled or disabled
  - For interactive mode also need to enable

    RuntimeSystem->Monitoring->DisplayCenter->Prio3

    -pythonDebugging
  - See D2.1.2.4
- Workshop
  - Enable the python console in your project

APROL Python API DisplayCenter 3/11

- Global python module for the DisplayCenter
  - One python module from the project can be used as global python module
  - For each runtime system or operator system a own global python module can be used
  - This module is available at DisplayCenter start on the specified systems

    RuntimeSystem->Monitoring->DisplayCenter->Prio2

    -pythonModule = “Instancename”
  - See D2.1.5.2
  - Provides hooks for global actions
    - See hooks in D2.1.2.1
    - DC.init_hook, DC.user_changed_hook, DC.post_pic_change_hook
- Workshop
  - This example should write the instance name of the actual picture to the python console of the DisplayCenter
    - Create a global module for Display Center in your project
    - Import module DC
    - Write a function (name “MyFunc1”)which prints the name of the actual picture instance
    - Connect the function with DC.add_hook() using the DC.post_pic_change_hook
    - Assign the global python module for DisplayCenter in the RuntimeSystem

- Global python module for process graphics
  - Can be created in the project
  - Can be importet from a process graphic
    - See D2.1.5.1
- Workshop
  - This example should write the name of the logged in user to the python console of the DisplayCenter
    - Create a global python module for process graphics in your project
    - Import module DC
    - Write a function (name “myFunc2”) which prints the name of the actual logged in user
    - Create a new picture in the visualization
    - Add a hook with DC.add_hook(); use the DC.login.user_changed_hook and connect the function (“MyFunc2”) from your global python module

APROL Python API DisplayCenter 5/11

- Global python modules for CAE- Libraries
  - Can be created in the library
  - Global library module for collecting all functions in your library
  - Can be imported from a graphic block
- Workshop
  - This example should write the actual system time to the python console of the DisplayCenter
    - Create a test library
    - Create a global python module for graphic blocks in your library
    - Import module DC
    - Write a function (name “myFunc4”) which prints the actual system time. Use the python module time ; function ctime().
    - Create a new picture block
    - Import the library global python module you created before
    - Add a hook with DC.add_hook(); use the block.show_hook and connect the function (“MyFunc4”) from your global python module
    - Create a new picture in the visualization, use an instance of your graphic block

- Workshop
  - Use the DC.save_snapshot function when a block is shown
    - Create a new picture block
    - Write a python function to save a snapshot (use DC.save_snapshot)
    - Add a hook with DC.add_hook(); use the block.show_hook and connect to your function
    - Create a new CFC, use an instance of your block
    - Create a new picture in the visualization, use the instance which you placed in the CFC
  - Block.show_hook provides no argument, the hooked function must take no arguments !

- Workshop
  - Use the DC.save_snapshot function when a button is pressed
    - Create a new picture block
    - Use a python button; define local variable (“localIO”)
    - Write a python function to save a snapshot (DC.save_snapshot)
    - Add a hook with DC.add_hook(); use the block.local.localIO.button_press_hook and connect to your function
    - Create a new CFC, use an instance of your block
    - Create a new picture in the visualization, use the instance which you placed in the CFC
  - button_press_hook provides 1 argument, the hooked function must take this argument !

APROL Python API DisplayCenter 8/11

- Using lambda
  - Doc D2.1.1.7
  - Anonymous function (=function without function name, only function pointer)
  - Google for “python lambda”
  - Why
    - Modularity 1: When you want to use the same function with different kinds of hooks (different hooks deliver different amount of arguments)
    - Modularity 2: When you want to pass an attribute of the block (e.g. block.pin.XXX) to the connected function
  - Alternative
    - Write own functions for each case
    - ->result: many similar functions, more effort for code development and maintenance
  - Facts
    - The add_hook always wants to have a function object (=function name, =pointer to a function)
    - The add_hook doesn’t accept a function call (which means also a function call including parameters is not accepted)
    - With lambda you make an anonymous function (which is a function object), allowing to pass parameters
    - With lambda it’s possible to pass over the block object to the function

APROL Python API DisplayCenter 9/11

- Workshop(1)
  - Use a lambda function in python interactive mode
  - Write a lambda equivalent to following function – addition of 3 parameters
    - Func1(): return(a+b+c)

- Workshop(2)
  - Use the DC.save_snapshot function when a button is pressed
    - Create a new picture block, with 2 input pins (Pin01, Pin02)
    - Use two python buttons; define local variables (“localIO1, localIO2”)
    - Write python function to save a snapshot (DC.save_snapshot)
    - The function should take an argument; the argument should be a pin from a graphic block. The pins should contain the filenames for the snapshots.
    - Add a hook with DC.add_hook(); use the block.local.localIO1.button_press_hook and connect to your function using lambda and pass over Pin01(do the same for localIO2, Pin02)
    - Create a new CFC, use an instance of your block
    - Create a new picture in the visualization, use the instance which you placed in the CFC
  - button_press_hook provides 1 argument, the hooked function must take this argument !

APROL Python API DisplayCenter 10/11

- What can I do with the DC-Python-API in APROL ?
  - See D2.1.3 – The DisplayCenter API classes
  - See D2.1.4 – The DisplayCenter features

APROL Python API DisplayCenter 11/11

- Practical use of python in the PAL
  - Adapt system functions to specific needs (default values, …)
    - LoadProcessPicture, StartDocumenation, ShowOperatorNote, ShowLogbook, StartAlarmReport, StartTrendViewer,…
  - Function to define output format (integer / decimal places of values)
  - Access functions: use different images to display if a button is enabled or disabled, give the user information why a button is disabled,…
  - Image dynamization with images from image container (e.g. for the motor you can choose if you want to have a motor or a pump or a fan as symbol)
  - Alarm-Faceplate with ListView-Widget
  - Alarm color dynamization according PriRng
  - Open faceplates via instance name
  - Concatenate tooltips out of a few text snippets
  - Error List Dynamization
  - Scaling functions for bargraph
  - …

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APROL Python API for LoginServer

APROL Python API LoginServer 1/1

- Global python modules for LoginServer
  - Can be created in the project
  - Global library module for functions modifying the login process
    - See D2.1.6.4
  - The global module needs to be assigned to the RuntimeSystem

    RuntimeSystem->System Services->LoginServer->Prio3

    -pythonModule (instance of the module)
  - Has an own python console that can be activated, open console via context menu of runtime-login-symbol in systray

APROL Python for UCB

APROL Python UCB 1/1

- UCB…User configuration block
  - Interface to operating system functionalities
  - Automatic execution of scripts via trigger signal
  - Use of any script language
  - APROL System service UCB-Server is responsible for execution
  - The first input pin (“UcbTrigger”) is mandatory and automatically generated
  - The first output pin (“UcbStatus”)is mandatory and automatically generated
  - Communication from block inputs to script with environment variables
  - Communication from script to block outputs with stdout
  - Doc B3.2.12
  - Very detailed description of UCB block creation in
    Doc B3.2.12.2
- Workshop
  - Create an UCB-block
  - Block reads system time with python (module time; function ctime())
  - Block provides this time on an output
  - Test this block in an CFC; block “AprFbTrig” can be used as trigger

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Extended Workshop

Extended Workshop

- APROL Widgets in Visualization
  - Widgets can be used in a graphic block (context library)
  - Documentation B2.6.4 (Widgets in Visualization)
  - Documentation D2.1.3.12 (BlockInstWidgetMap)
  - Can be used with pins (global variables)
  - Extended functionality with python
- Workshop(1)
  - Use one widget using global variables (InputOutputBox)
    - Graphic block with one output pin
    - Entered value in the InputOutputBox should be written to the output pin

Extended Workshop

- Workshop(2)
  - Use ListView widget, fill up the conent with Python-API
    - Need to assign a control variable in widget properties
    - Accessible via “object name” from widget properties
    - block.widget.YOUROBJECTNAME.set_colums()
    - See D2.1.3.12.3
    - .set_columns() to set the header of the ListView
    - .set_items() to set the content of the ListView
    - .selected_item().value delivers the value of the selected entry
    - .selected_item().columns delivers the contents from selected row
- Workshop(3)
  - Use DC.Timer
  - Object oriented programming necessary
  - Count up a value periodically as basis for a dynamization (e.g. rotate an rectangle)

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