

# Dynamic Attributes and Functional PyTango

## Introduction

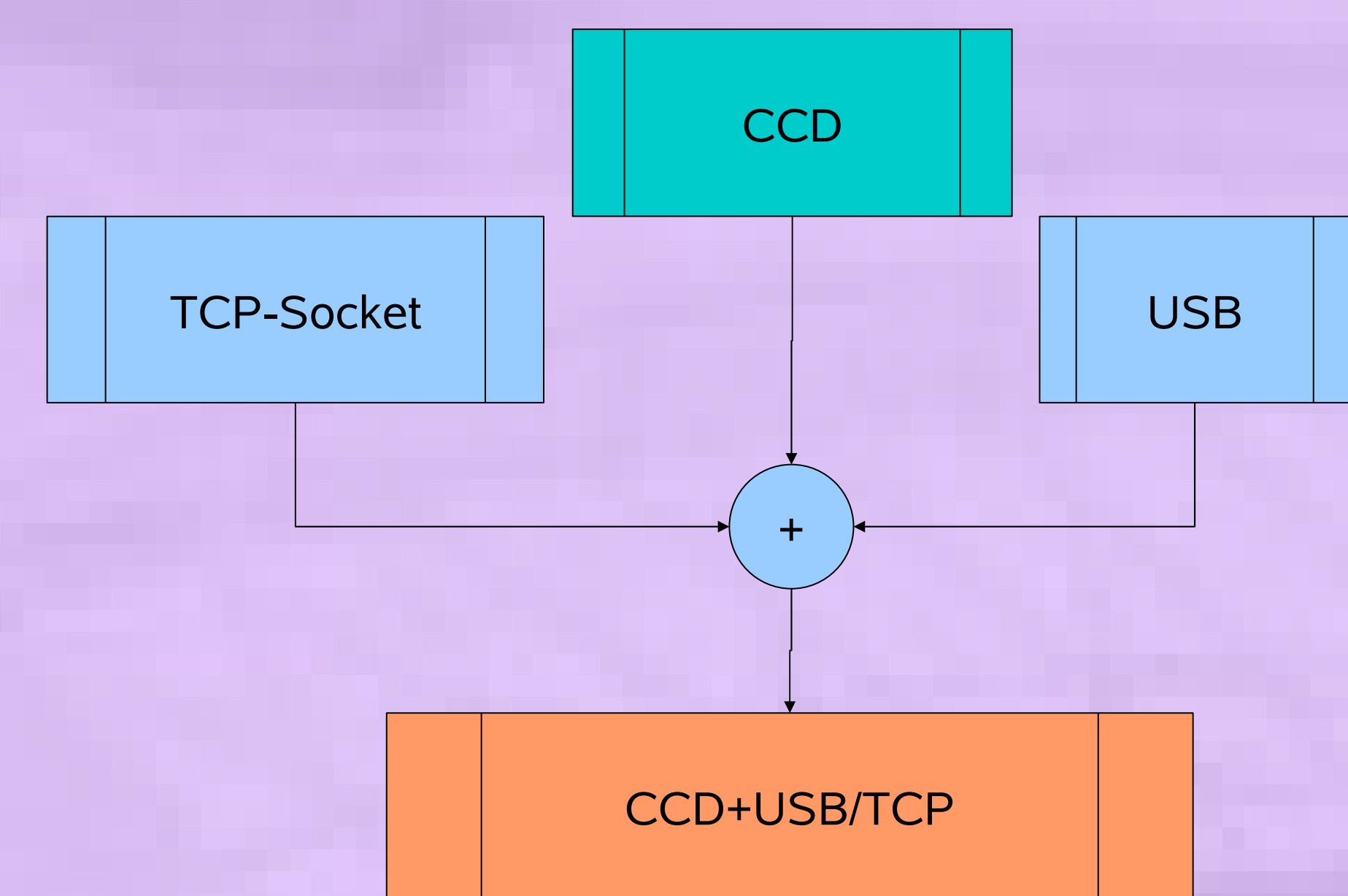
PyTango, the Python binding of Tango Control System, allowed to add dynamically new code to existing devices, loading new functions, classes and modules during startup (Multiple Inheritance); adding new variables and channels to a running device (Dynamic Attributes) or modifying its state-machine behaviour (Dynamic States and Qualities). This report describes some of the applications of such techniques in the Alba control system. Methods and classes described can be obtained from **PyTango\_utils** package, available at Tango-DS repository in sourceforge.



## Tango Interfaces and Multiple Inheritance

Class merging is done at runtime—using the built-in **type** class—, as Python allows “online” modification of class objects and its inheritance before instantiating the Tango Devices. If desired, the new class may receive the name of the original parent (CCD in the example) to replace it .

Application of multiple inheritance between Tango Classes allows, using abstract classes, to fix common behaviours and create customized versions of existing classes.



### Dynamic Attribute Creation

Parsing a Python expression using the **eval** method of the Python interpreter. The scope of variables available for the evaluation of an attribute includes all the desired device commands and attributes and a set of tags that allow to access the device configuration and state.

```
ATTRIBUTE=Comm1() if READ else Comm2(VALUE))
```

≥ 1, Tags used in Dynamic Attributes

Tag	Value
t	Seconds since device startup
READ	True for read access
WRITE	True for write access
VALUE	Value passed by client
[AttributeName]	Last value of attribute
ATTR(name)	Force attribute update
PROPERTY(name)	Value of property
EVAL(PROPERTY(name))	Evaluation of property
STATE([value])	Read or set State
STATUS([value])	Read or set Status

### Dynamic Attributes, States and Qualities Declaration

Using an attribute that stores its modification time when it's written. State changes if value is above 10.0; quality changes for 10 seconds after writing (t is the number of seconds after start up).

#### DynamicAttributes

```
Att_X=VAR('x') if READ or (VAR('x', VALUE) and VAR('t0',t))
```

#### DynamicStates

```
ALARM=(Att_X > 10.0)
```

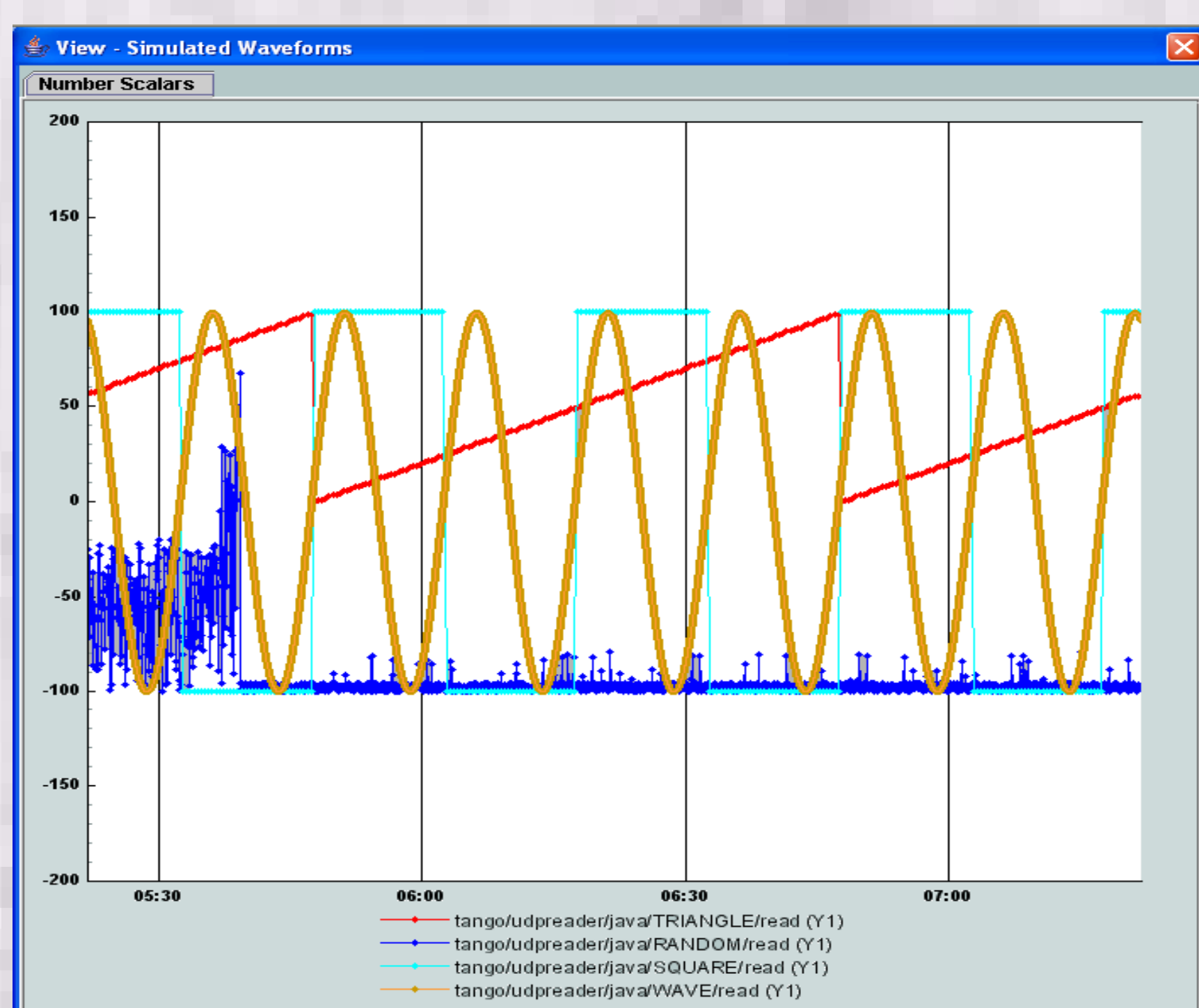
```
ON=1
```

#### DynamicQualities

```
Att_X=VAR('t0')+10>t and CHANGING or VALID
```

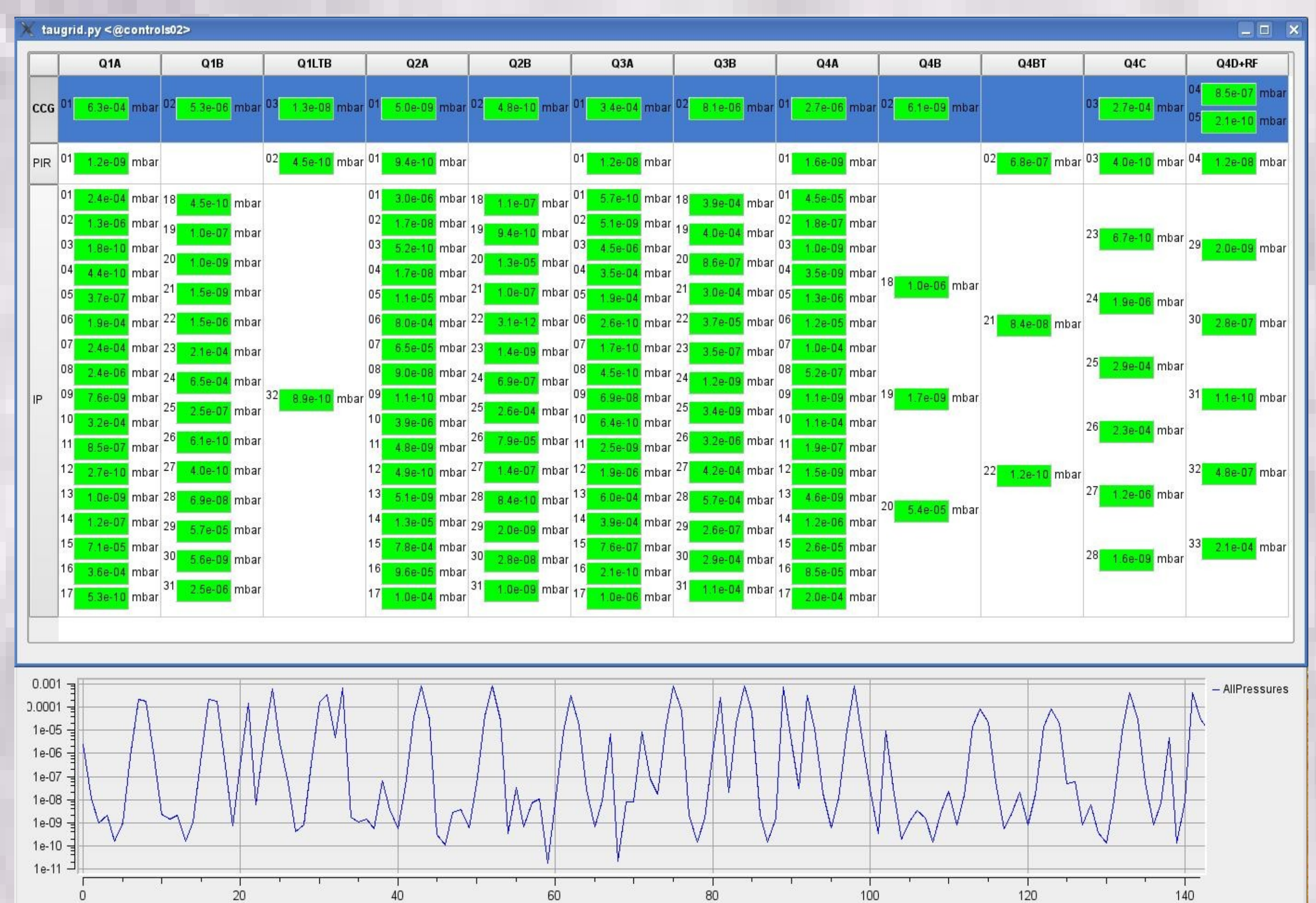
### PySignalSimulator

Using Dynamic Attributes, this PyTango Device Server allowed to produce any kind of signal needed for simulation or GUI testing by adding common mathematical signals to the scope of the evaluation (rampt(t), sin(t), cos(t), exp(t), triangle(t), square(t,duty), random()).



### State Composing

Adding two new tags to attributes evaluation, DEVICES and STATES, this Tango device helped to summarize not only the state of the different Tango subsystems (loading a pre-defined list of devices), also some key attributes if necessary.



#### Composed Pressure and State

##### DynamicAttributes

```
AllPressures=[XATTR(dev+' /Pressure' for dev in DEVICES)]
```

##### DynamicStates

```
ALARM=ALARM in STATES
```

```
ON=1
```

### References

- [1] D.Fernández et al. “Alba, a Tango based Control System in Python”, ICALEPCS 2009, Kobe, Japan.
- [2] A.Götz, E.Taurel, J.L.Pons, P.Verdier, J.M.Chaize, J.Meyer, F.Poncet, G.Heunen, E.Götz, A.Buteau, N.Leclercq, M.Ounsi, “TANGO a CORBA based Control System”, Proceedings of ICALEPCS 2003, Gyeongju, Korea
- [3] S. Rubio “Abstract Classes for Data Acquisition”, 2006, Tango Meeting, ESRF, Grenoble, France
- [4] N. Leclercq “Writing a SubSystem Device Server Manager using YAT”, 2009, Tango Meeting, ESRF, Grenoble
- [5] R.Sune, E.Taurel and S.Rubio, “Adding Dynamic Attributes to a C++ Device Server”, available at [www.tango-controls.org](http://www.tango-controls.org)
- [6] D.Beltran et al. “Alba Control & Cabling Database”, ICALEPCS 2009, Kobe, Japan.
- [7] D.Fernández et al. “Alba, The PLC based protection systems”, ICALEPCS 2009, Kobe, Japan.
- [8] A.Götz, “Abstract Device Pattern and Tango”, ICALEPCS 2007.