

TANGO



Connecting things together

Overview of TANGO Control system

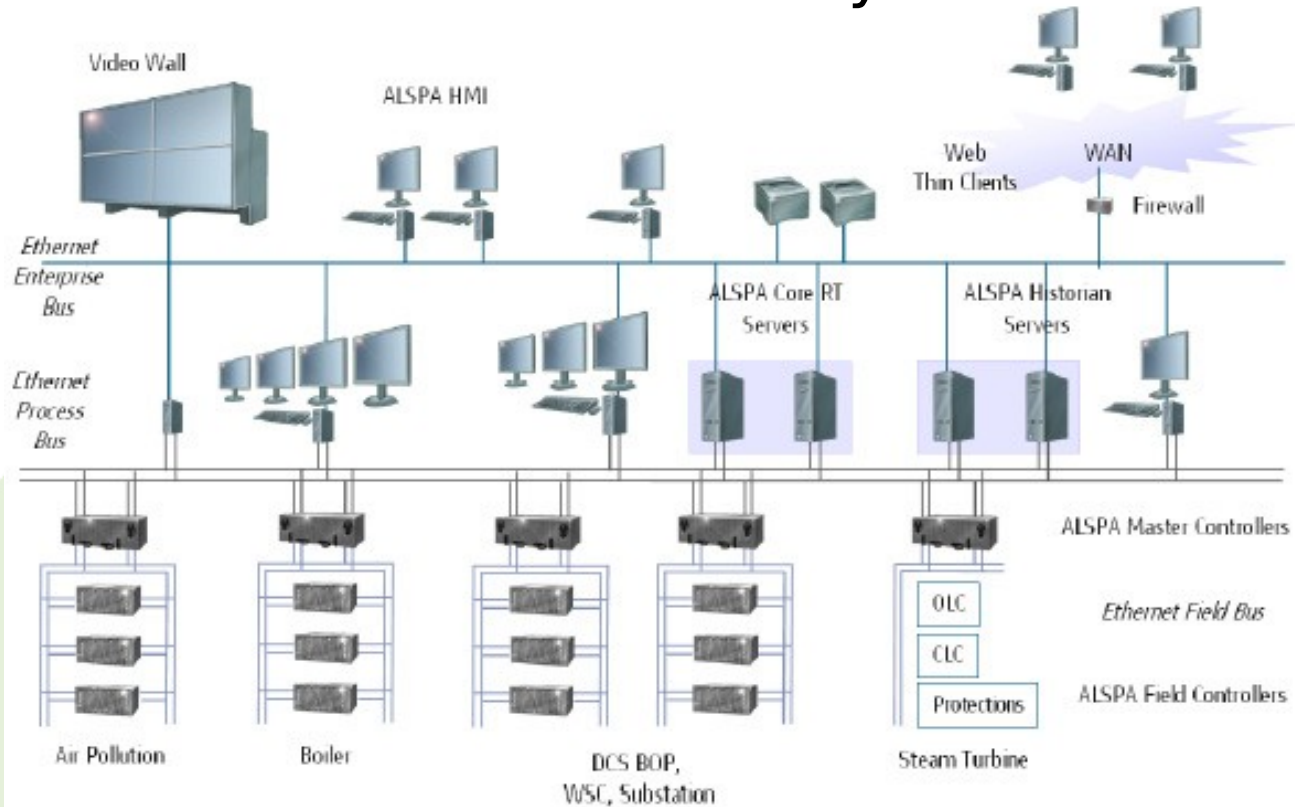
EUROPEAN **S**YNCHROTRON **R**ADIATION **F**ACILITY

A simple acquisition system

- For simple system
- Many tools exists
 - Labview
 - Scadas
 - Etc...
- Bigger systems need several computers



A distributed system



- Need inter-computer communication
- Heterogenic system (languages, machines...)
- Serialization/de-serialization
- Variable addressing topology

Object oriented

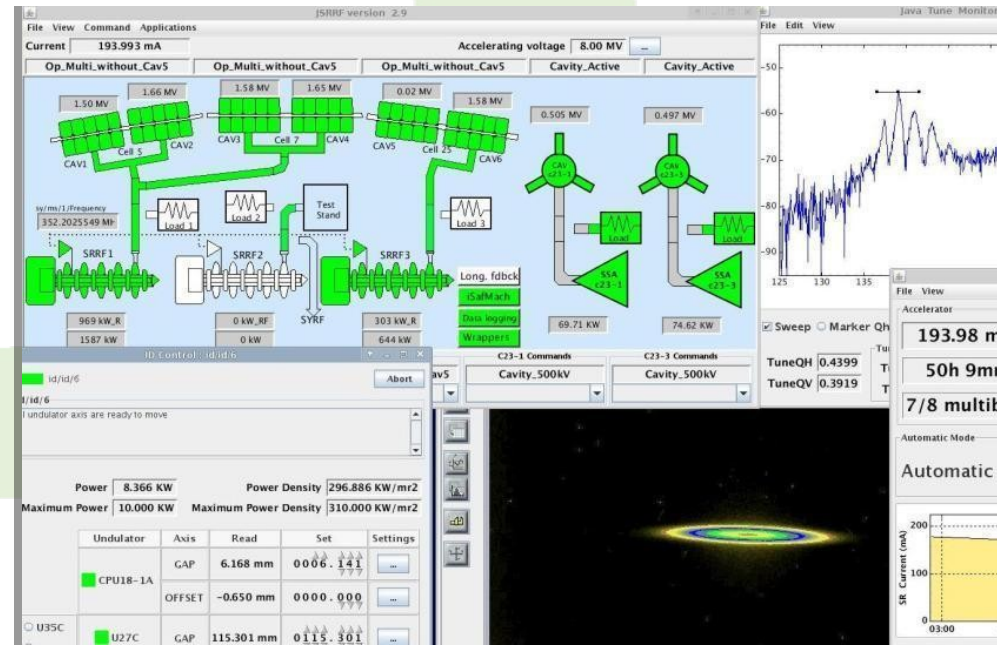


- Analyze a system as a set of objects communicating together
- Each object is in charge of its own life
- An object can be built on other objects

A European Control System framework

«Remote control anything and everything»

- A mature Open Source product
- > 100 man years of development
- Used in 15+ big instruments
- Active community
- Object oriented, topology independent, highly scalable,
- Operating system independent
- Multi language



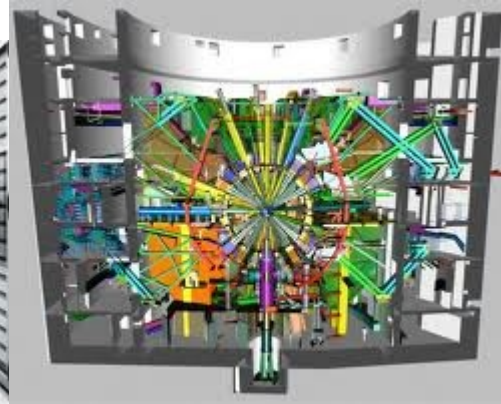
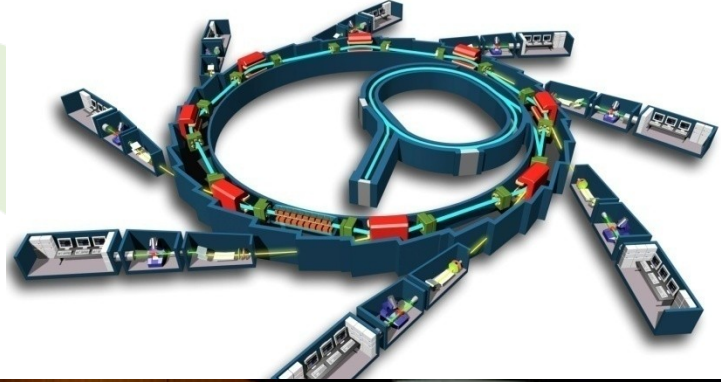


is HIGHLY scalable !

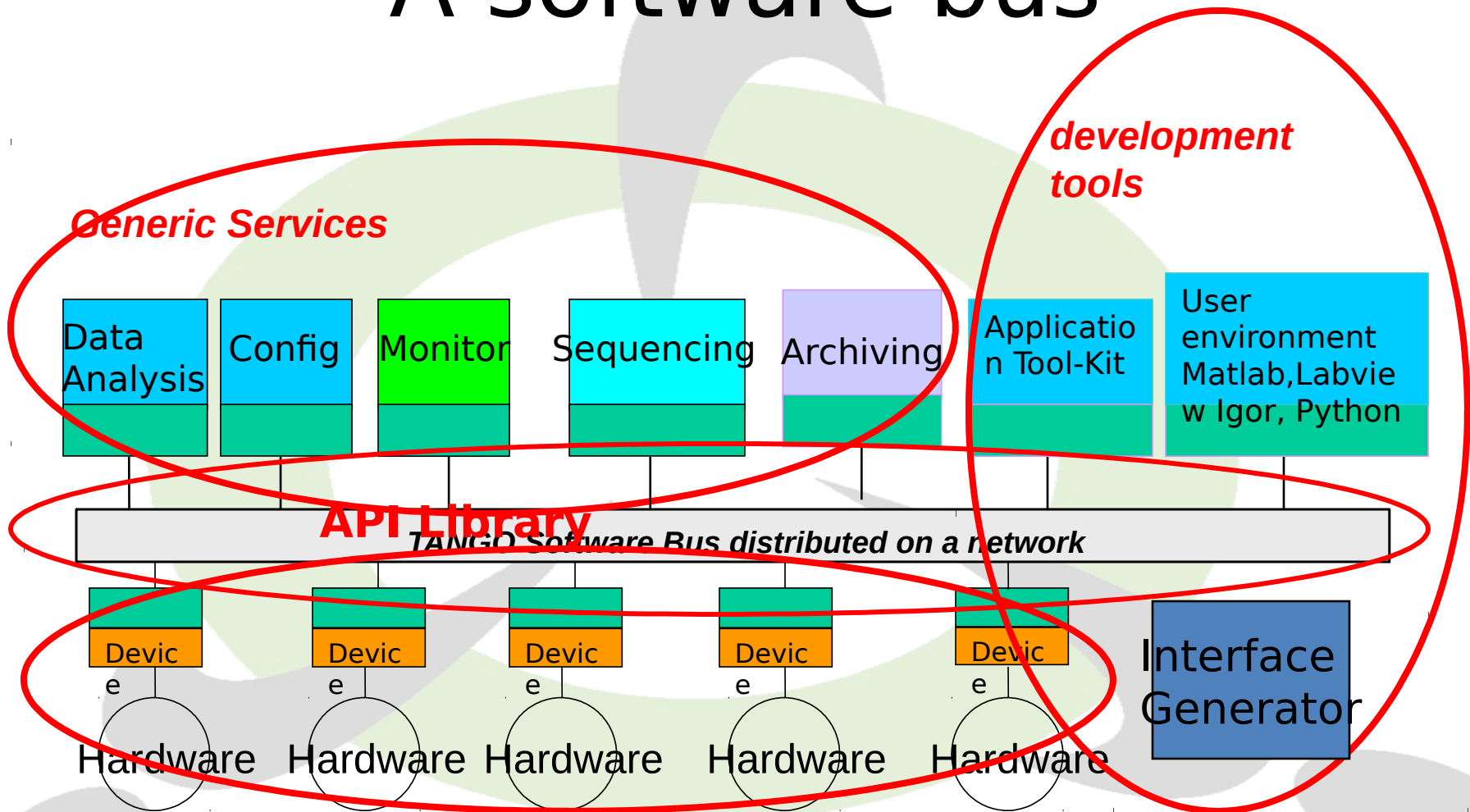
From small embedded platforms



- ... to big scientific instruments
- > 1 000 000 signals and actuators



A software bus



Catalog of device servers

Topology independent

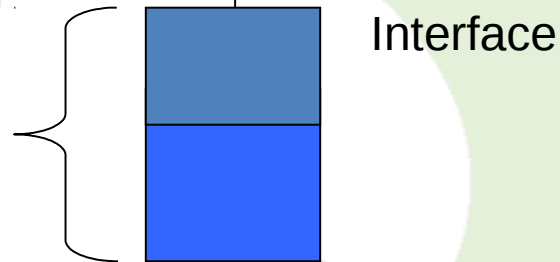
- An element is identified on the overall network
- The computer is just a container
- The system is seen globally
- A database is used to localize the objects

The fundamental brick of TANGO is the **Device**

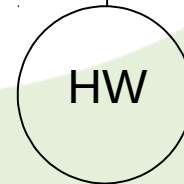


The device is a remote object

Device class



Standard interface for hardware equipment or service

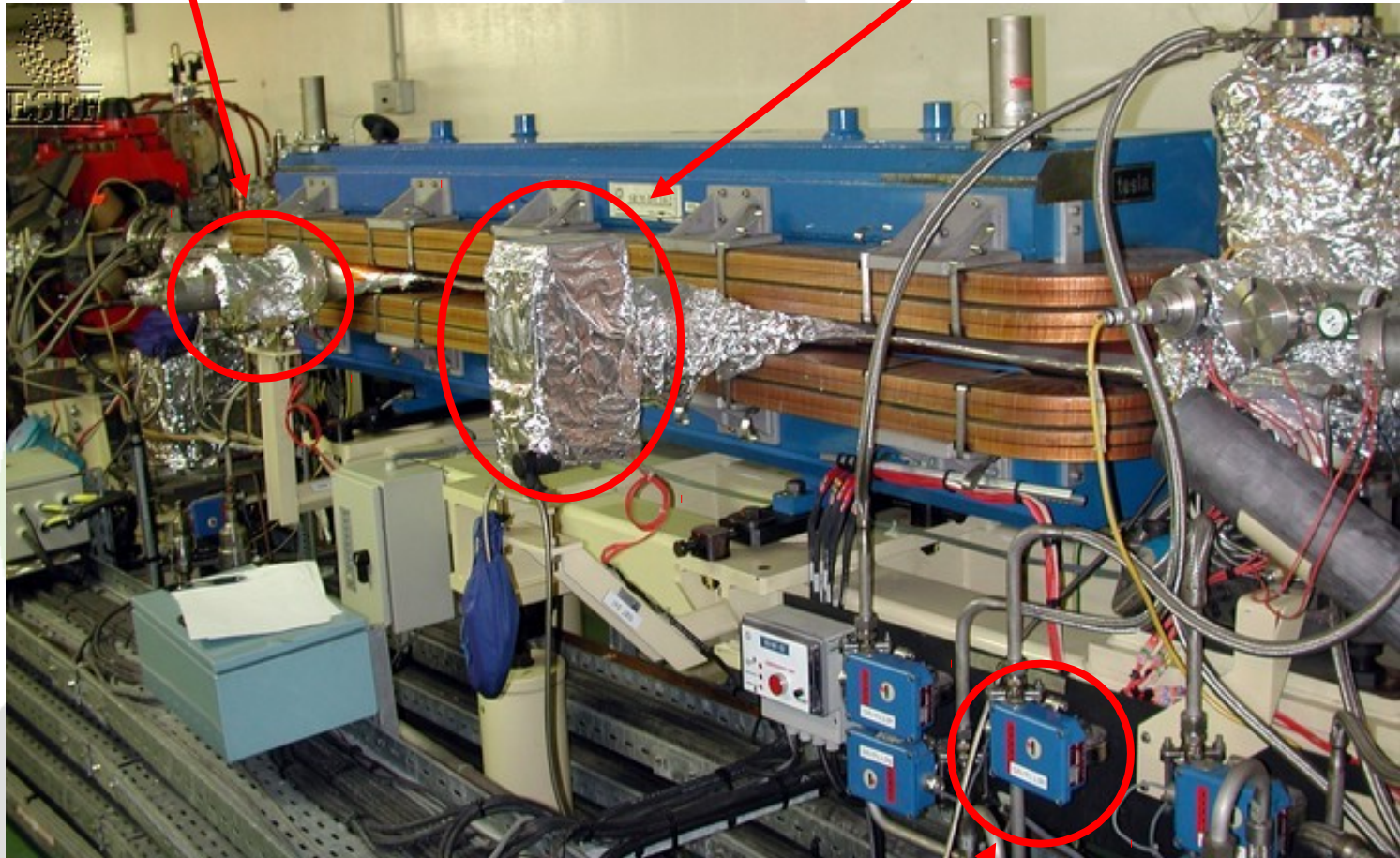


(motor...)

Some device(s)

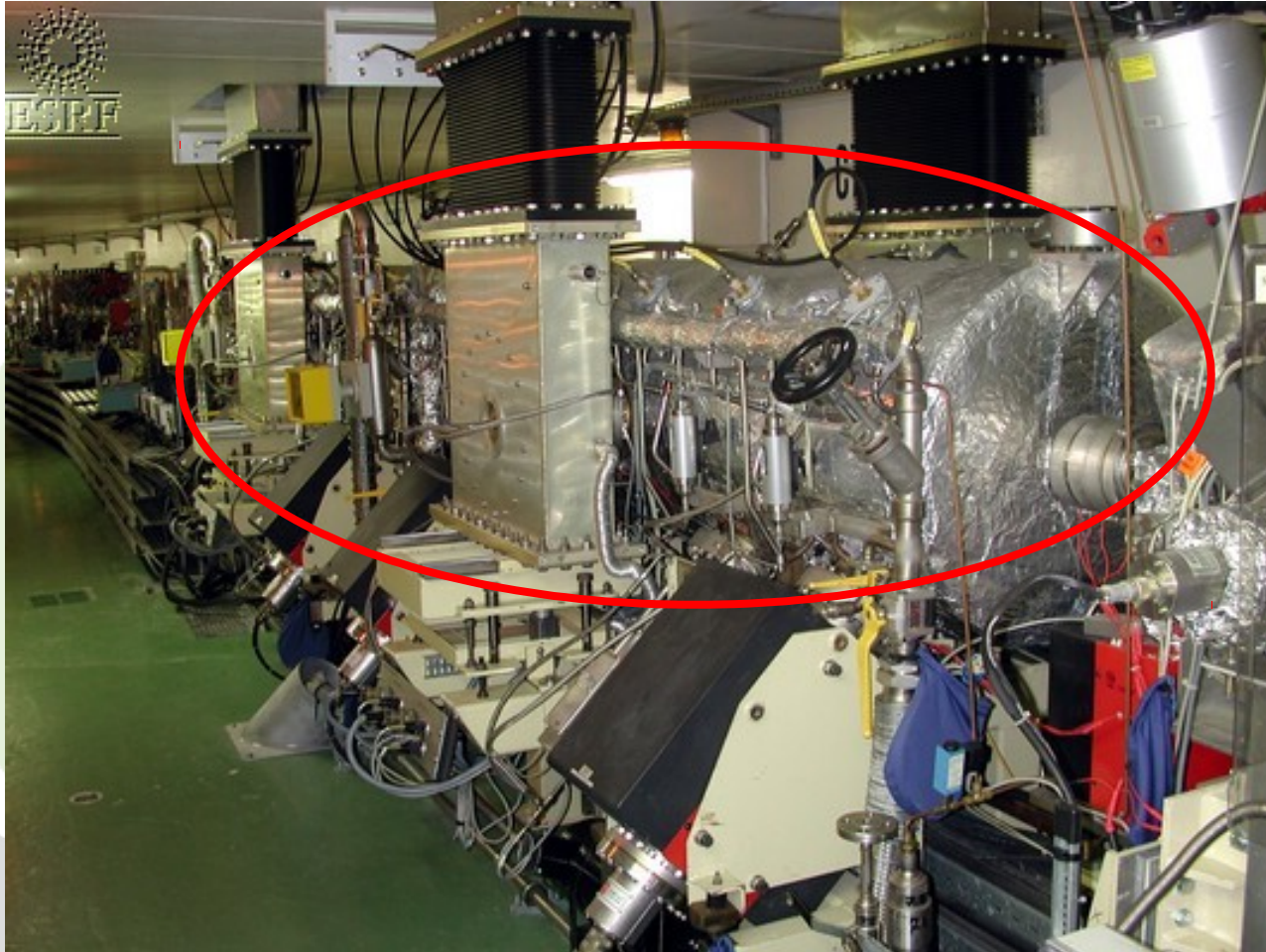
One device

One device



One device

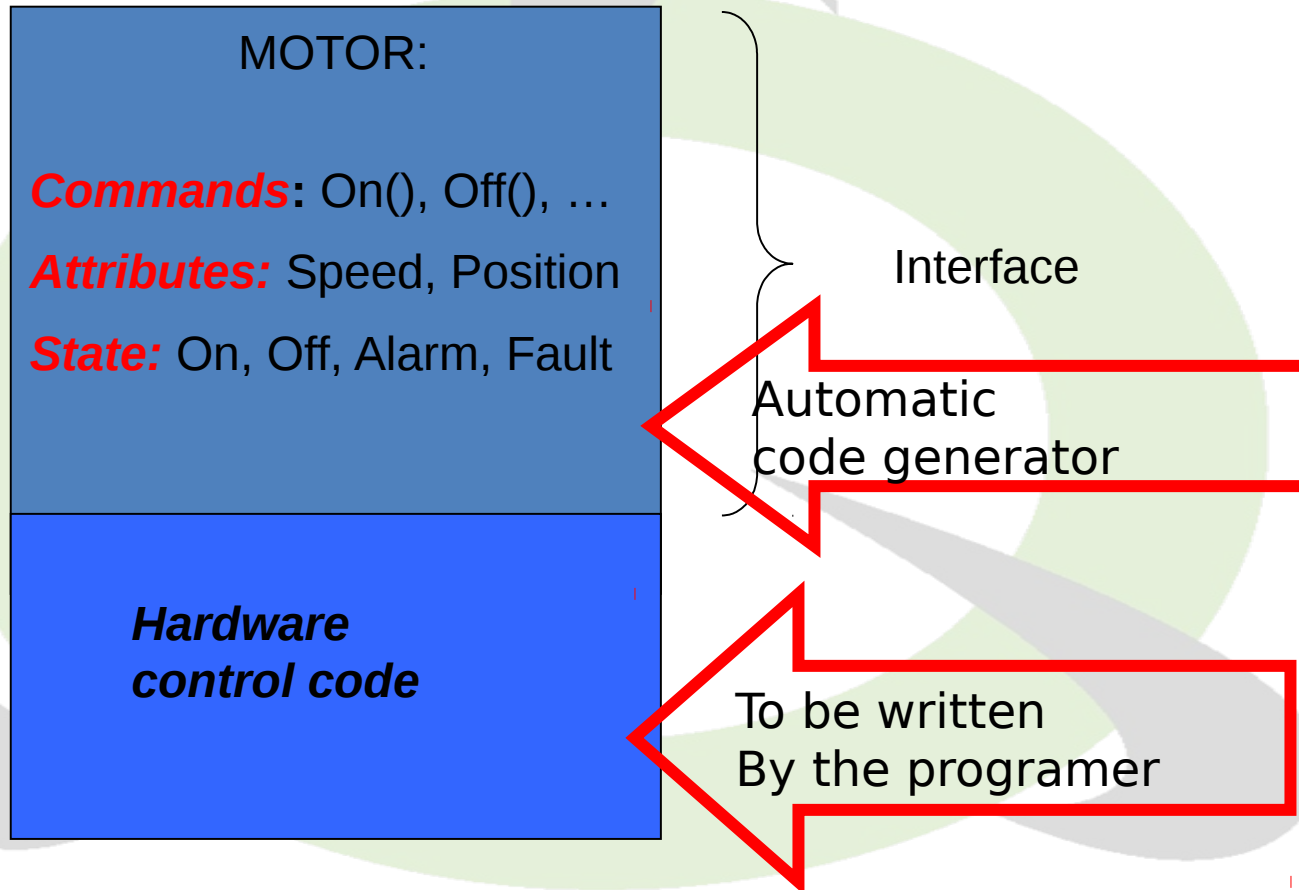
A sophisticated device (RF cavity)



another
device

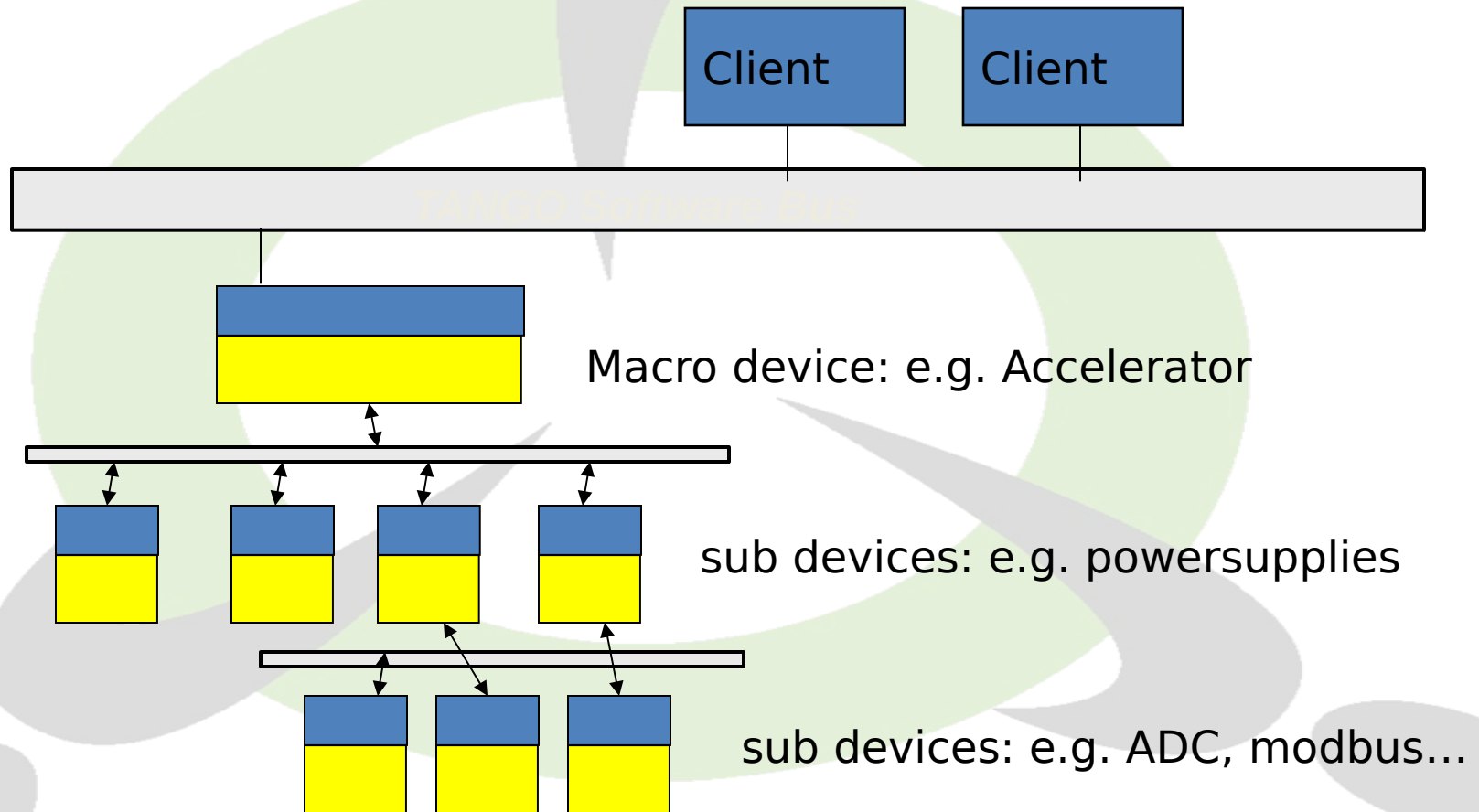
TANGO devices

Example: motor interface:



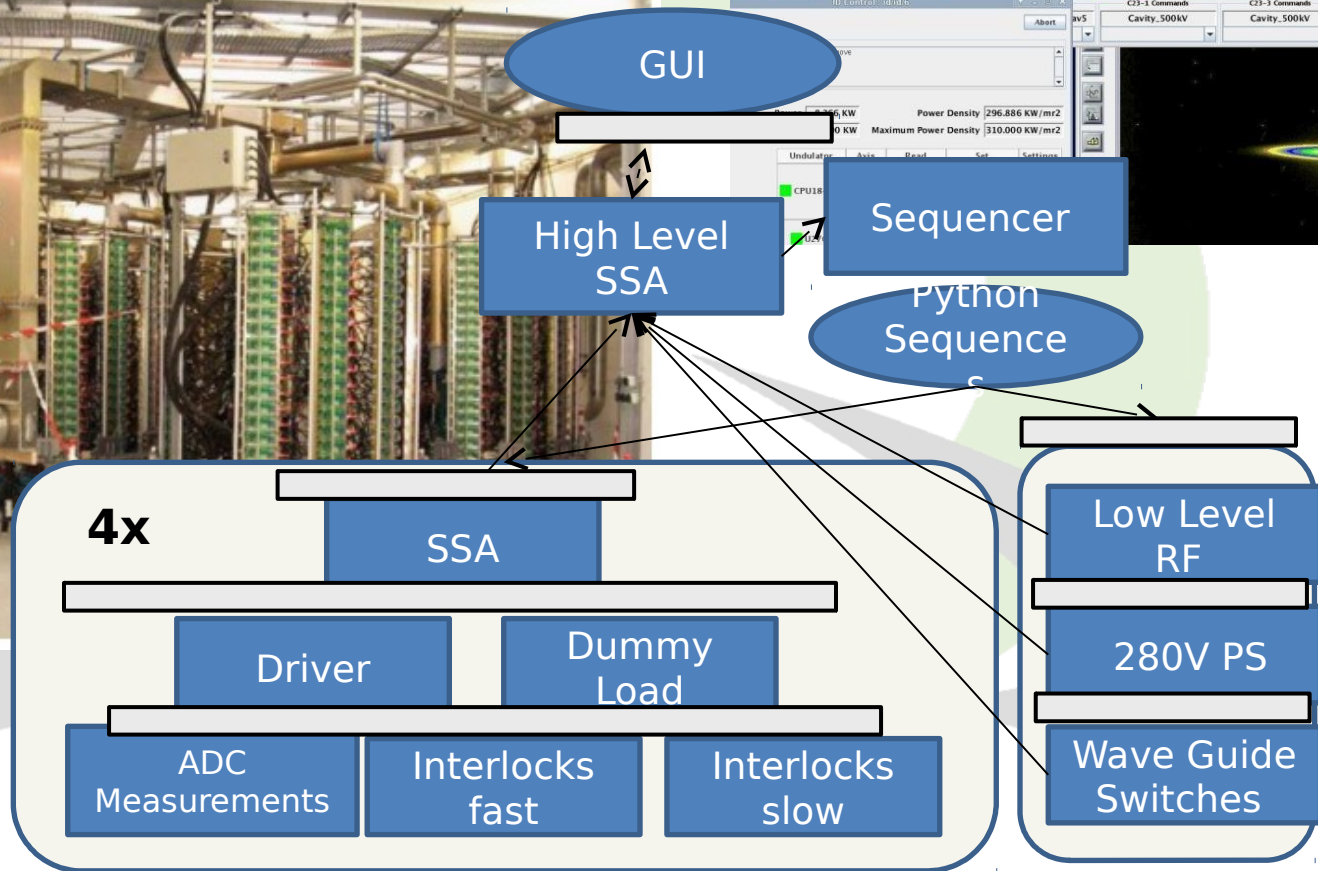
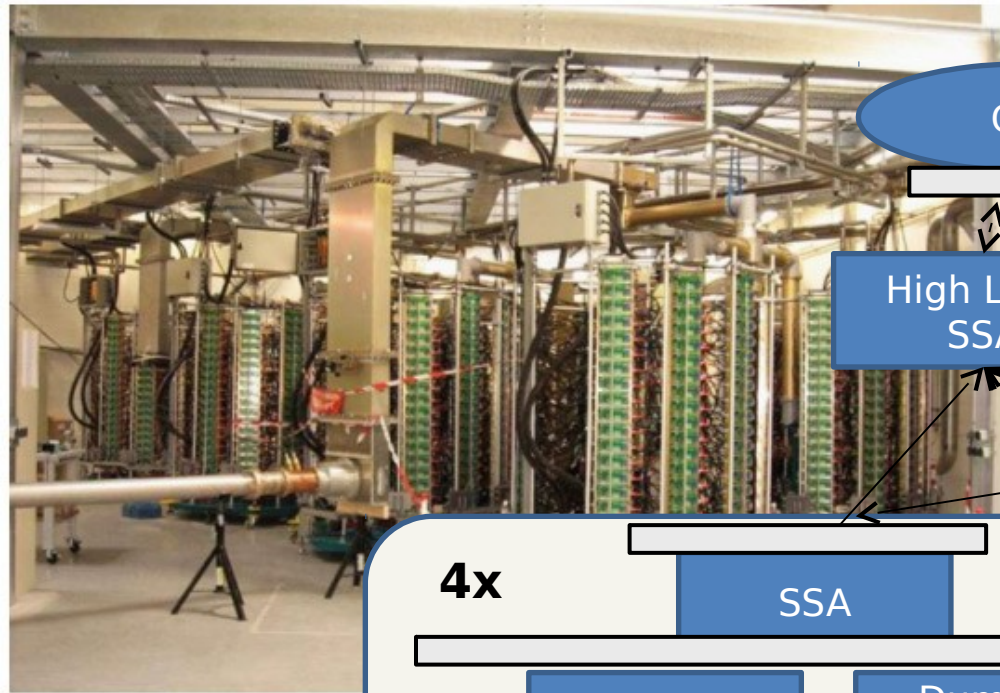
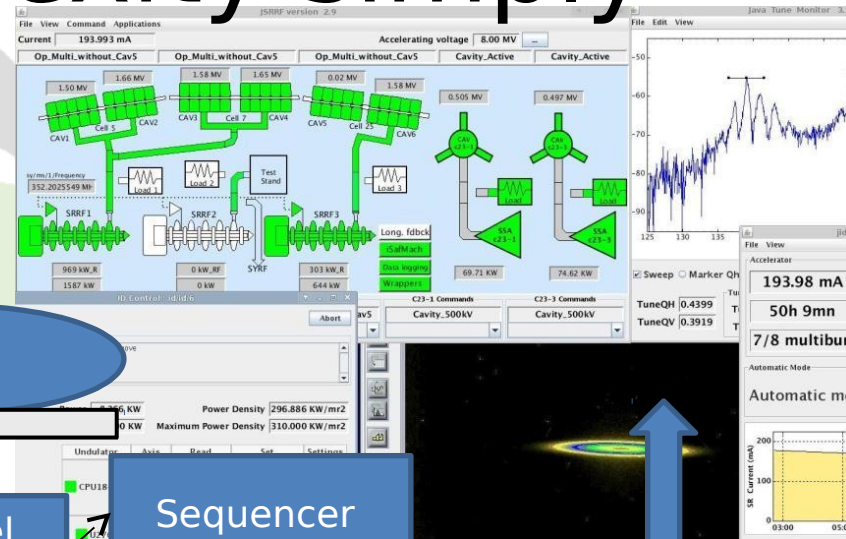
TANGO devices

- 1 Device can also interface complex systems
 - Hierarchical structure

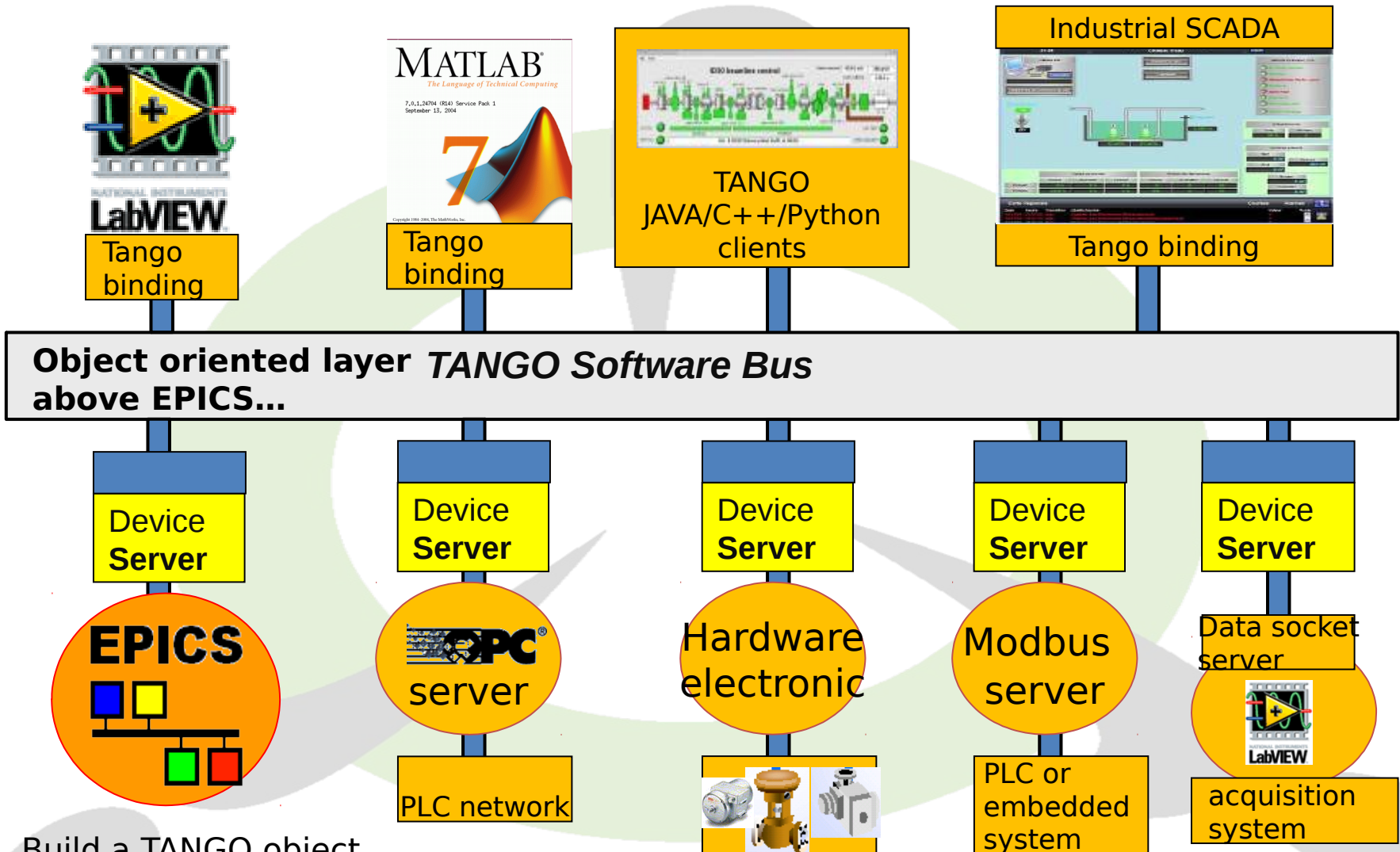


Managing complexity simply

- Hierarchical structures ideal for managing complex systems



TANGO as a bridge



Build a TANGO object from a set of channels

Commands & Attributes

- On the network a Tango device mainly has
 - **Command(s)**: Used to implement “action” on a device (switching ON a power supply)
 - **Attribute(s)**: Used for physical values (a motor position, a temperature, a spectrum, an matrix)
- Clients ask Tango devices to execute a command or read/write one of its attributes
- A Tango device also has a **state** and a **status** which are available using command(s) or as attribute(s)

Commands

- A command may have one input and one output argument.
- A limited set of argument data types are supported
 - Boolean, short, long, long64, float, double, string, unsigned short, unsigned long, unsigned long64, array of these, 2 exotic types and State data type

Attributes

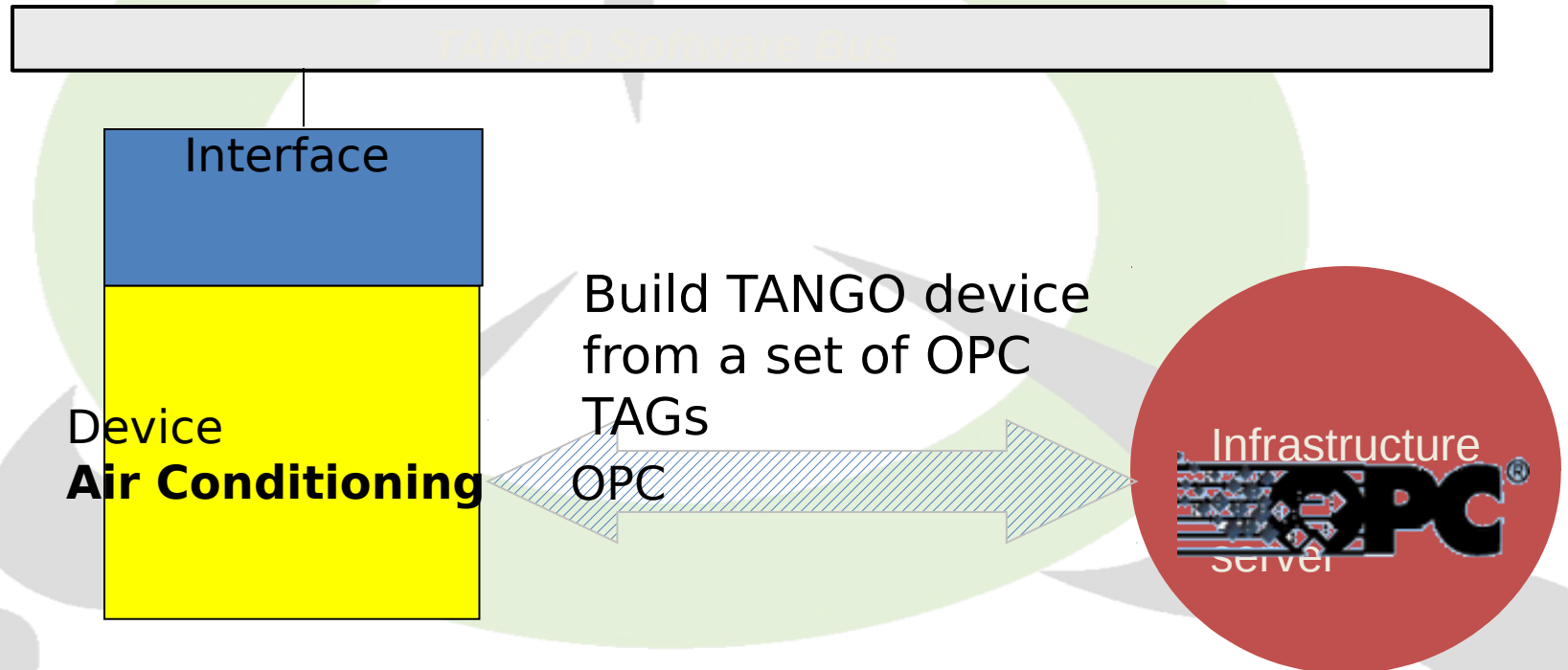
- Self describing data via a configuration
- Thirteen data types supported:
 - Boolean, unsigned char, short, unsigned short, long, long64, unsigned long, unsigned long64, float, double, string, state and DevEncoded data type
- Three accessibility types
 - Read, write, read-write
- Three data formats
 - Scalar (one value), spectrum (an array of one dimension), image (an array of 2 dimensions)

Attributes

- When you read an attribute you receive:
 - The attribute data (luckily...)
 - An attribute quality factor
 - ATTR_VALID, ATTR_INVALID, ATTR_CHANGING, ATTR_ALARM, ATTR_WARNING
 - The date when the attribute was acquired by the server (number of seconds and usec since EPOCH)
 - Its name
 - Its dimension, data type and data format
- When you write an attribute, you send
 - The attribute name
 - The new attribute data

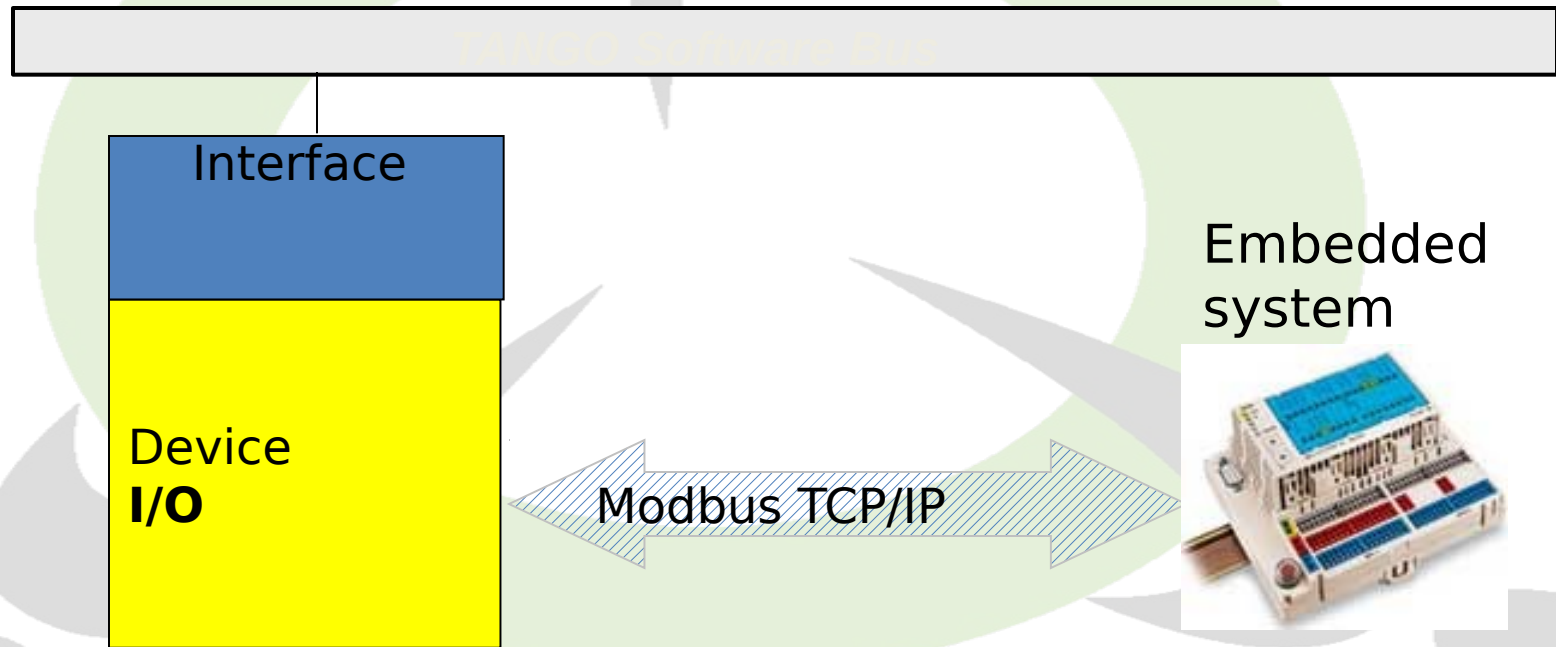
TANGO devices

- 1 Device can also interface complex systems
 - Bridge to other protocols



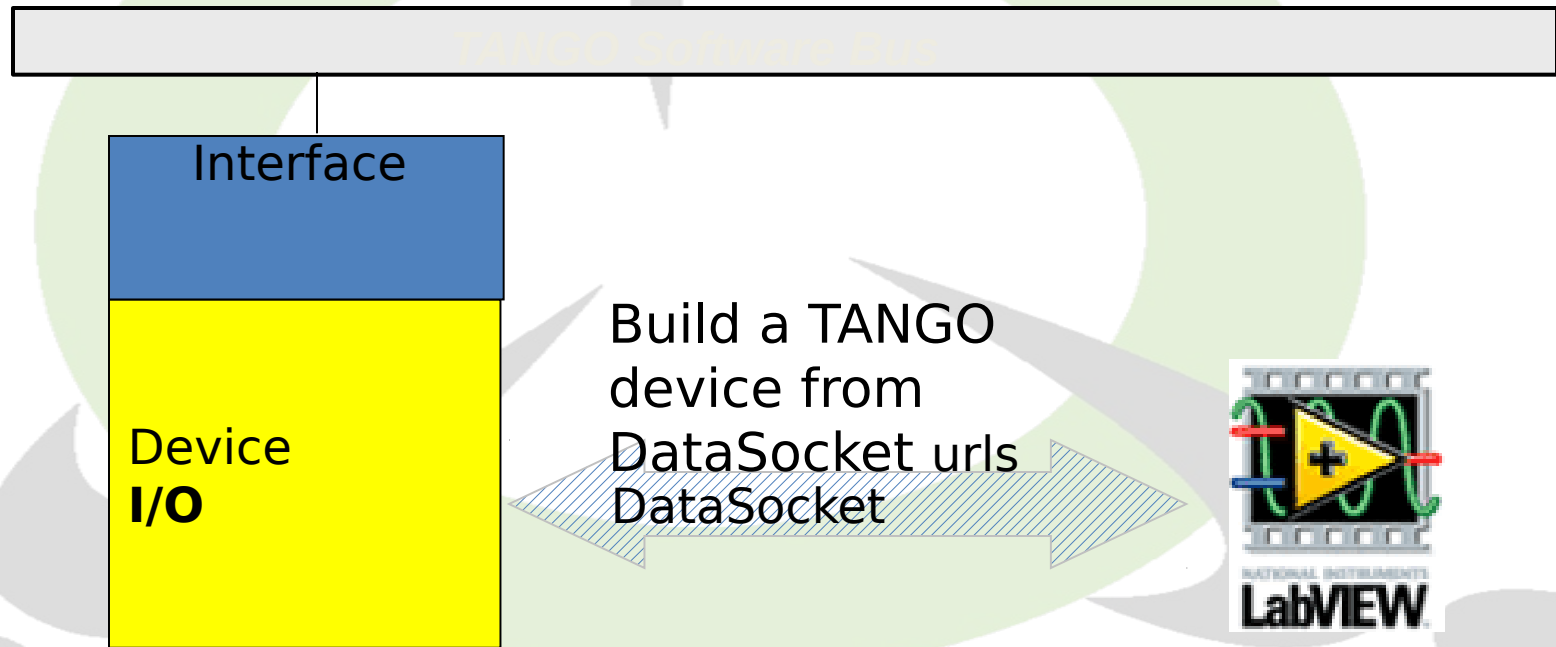
TANGO devices

- 1 Device can also interface complex systems
 - Bridge to other protocols



TANGO devices

- 1 Device can also interface complex systems
 - Bridge to other protocols



Embedded TANGO servers

- Next steps

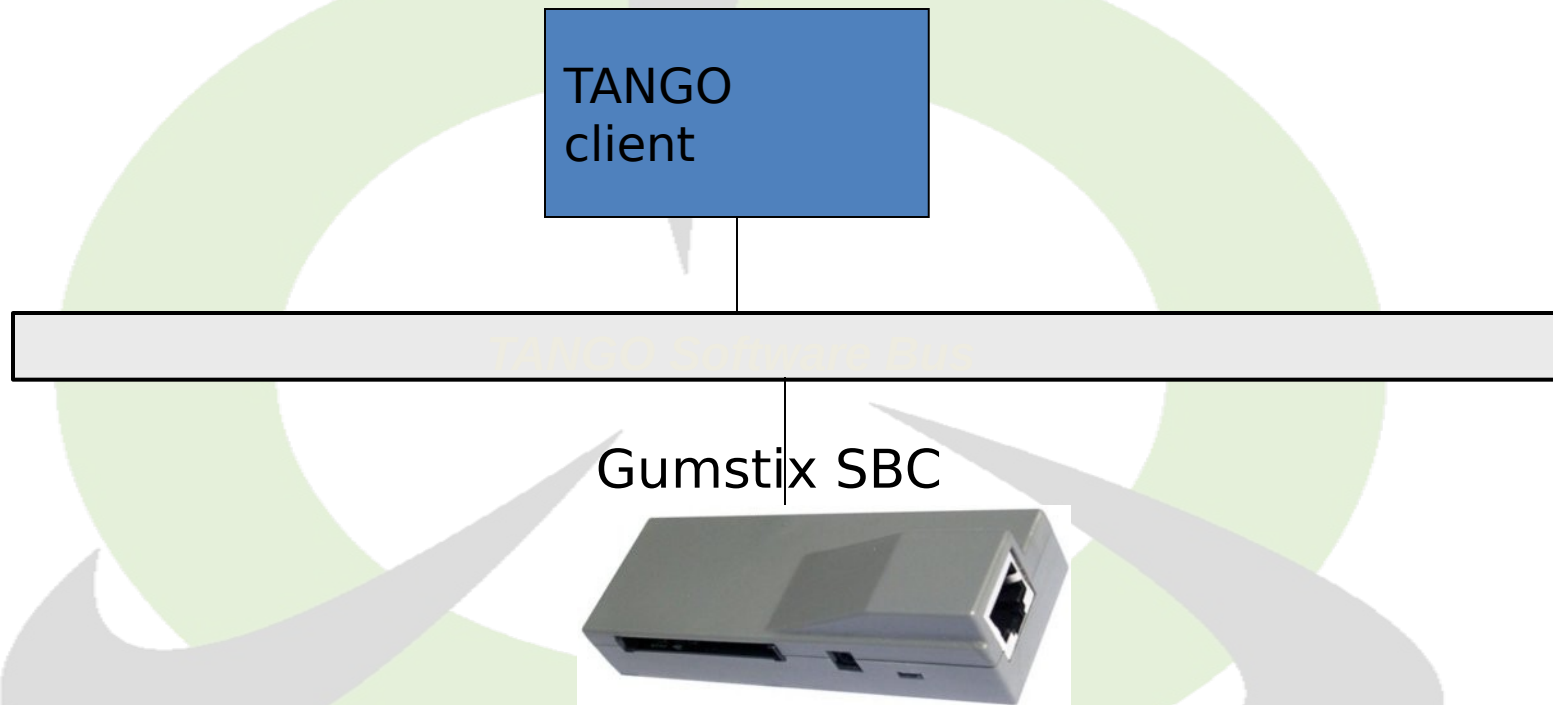
TANGO
client

TANGO server
Mapped into a
FPGA



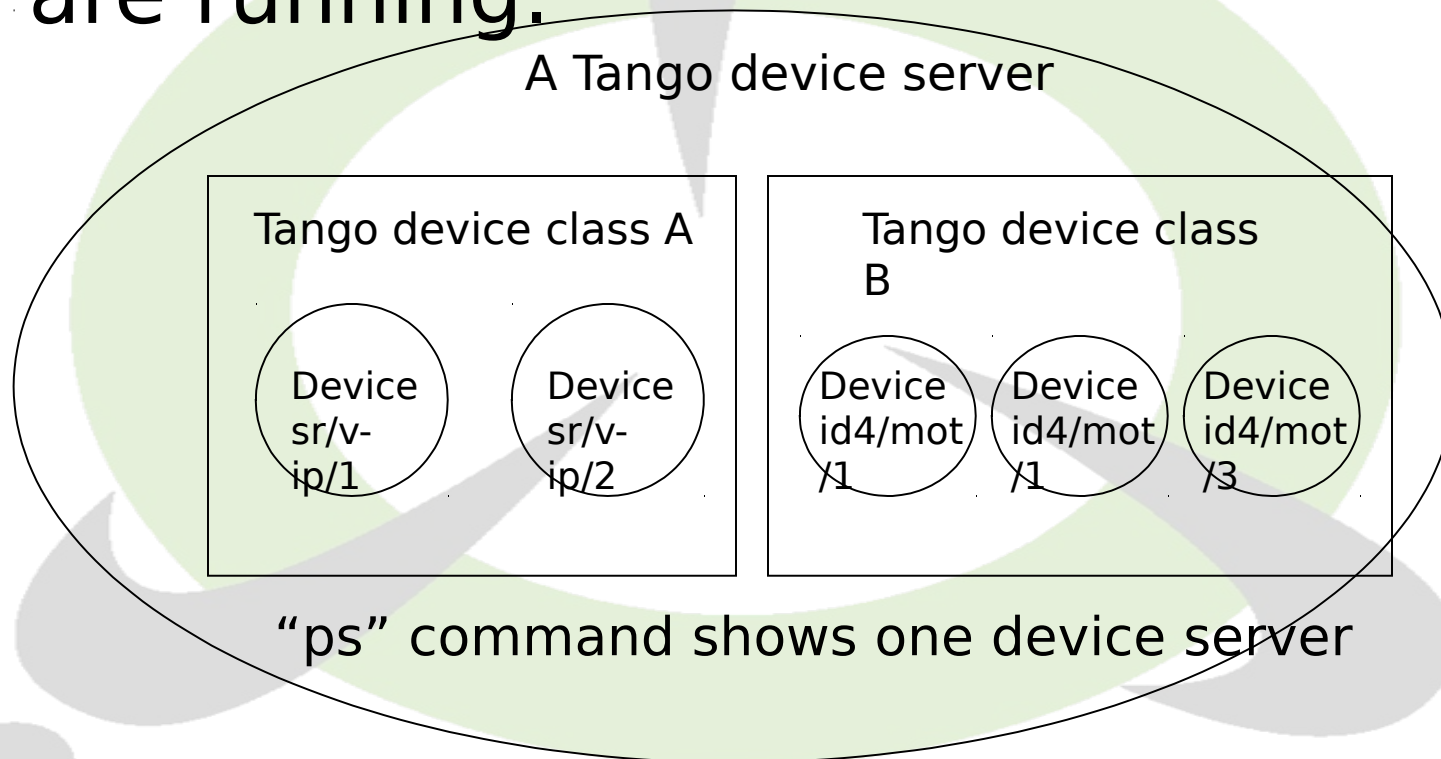
Embedded TANGO servers

- Next steps



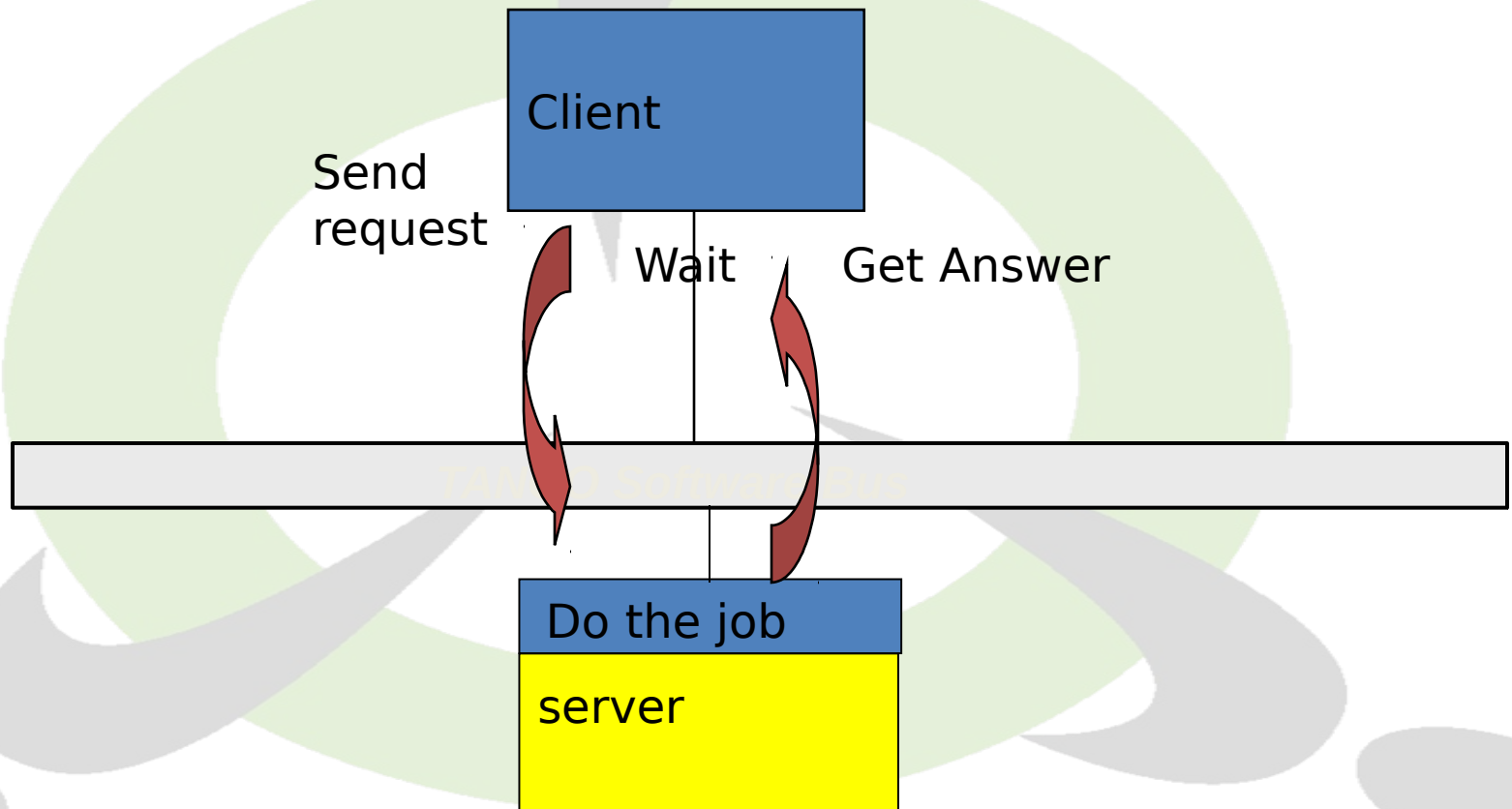
The Tango Device Server

- A Tango device server is the process where the Tango class(es) are running.



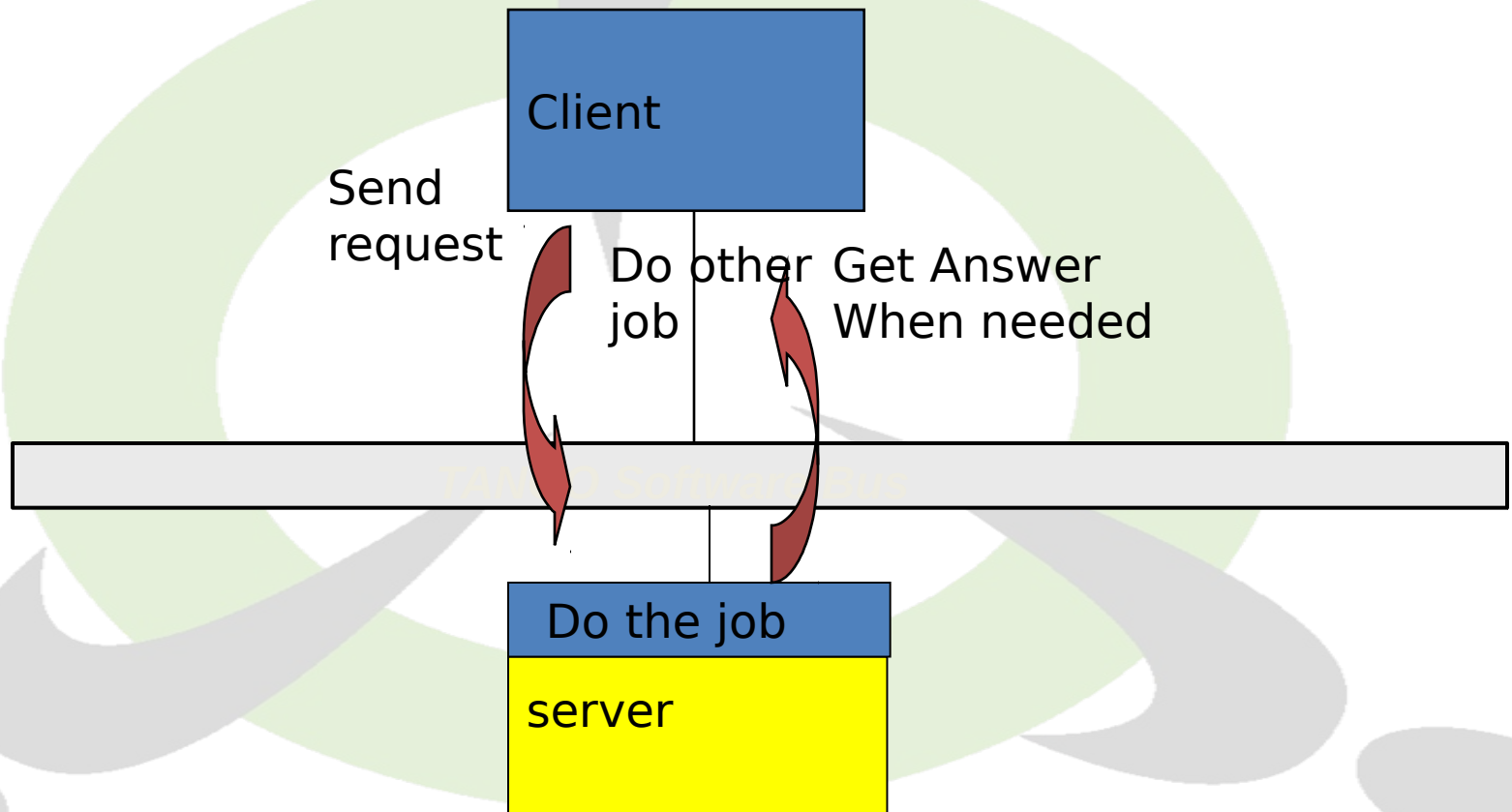
TANGO Communication

- Synchronous



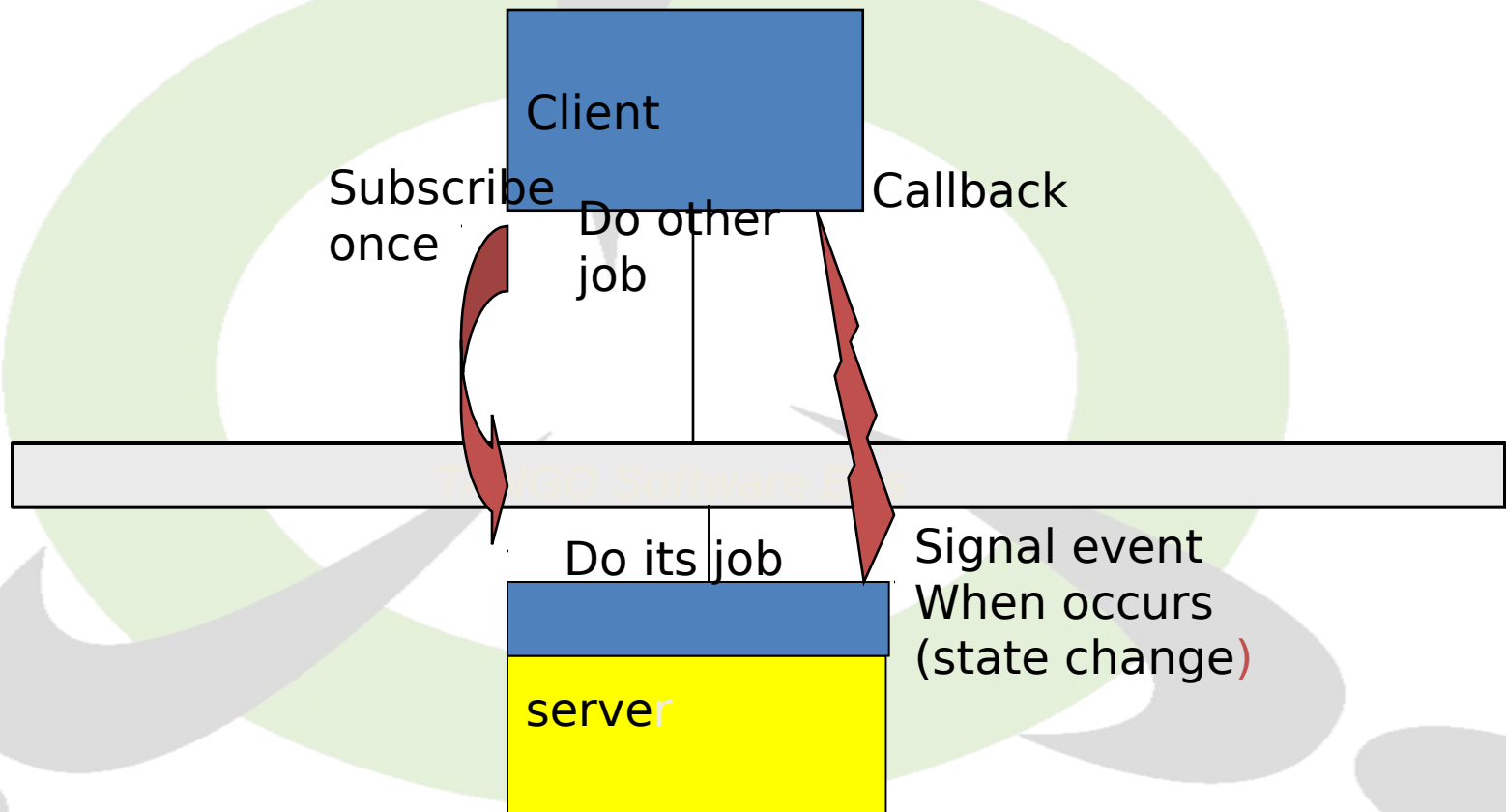
TANGO Communication

- Asynchronous



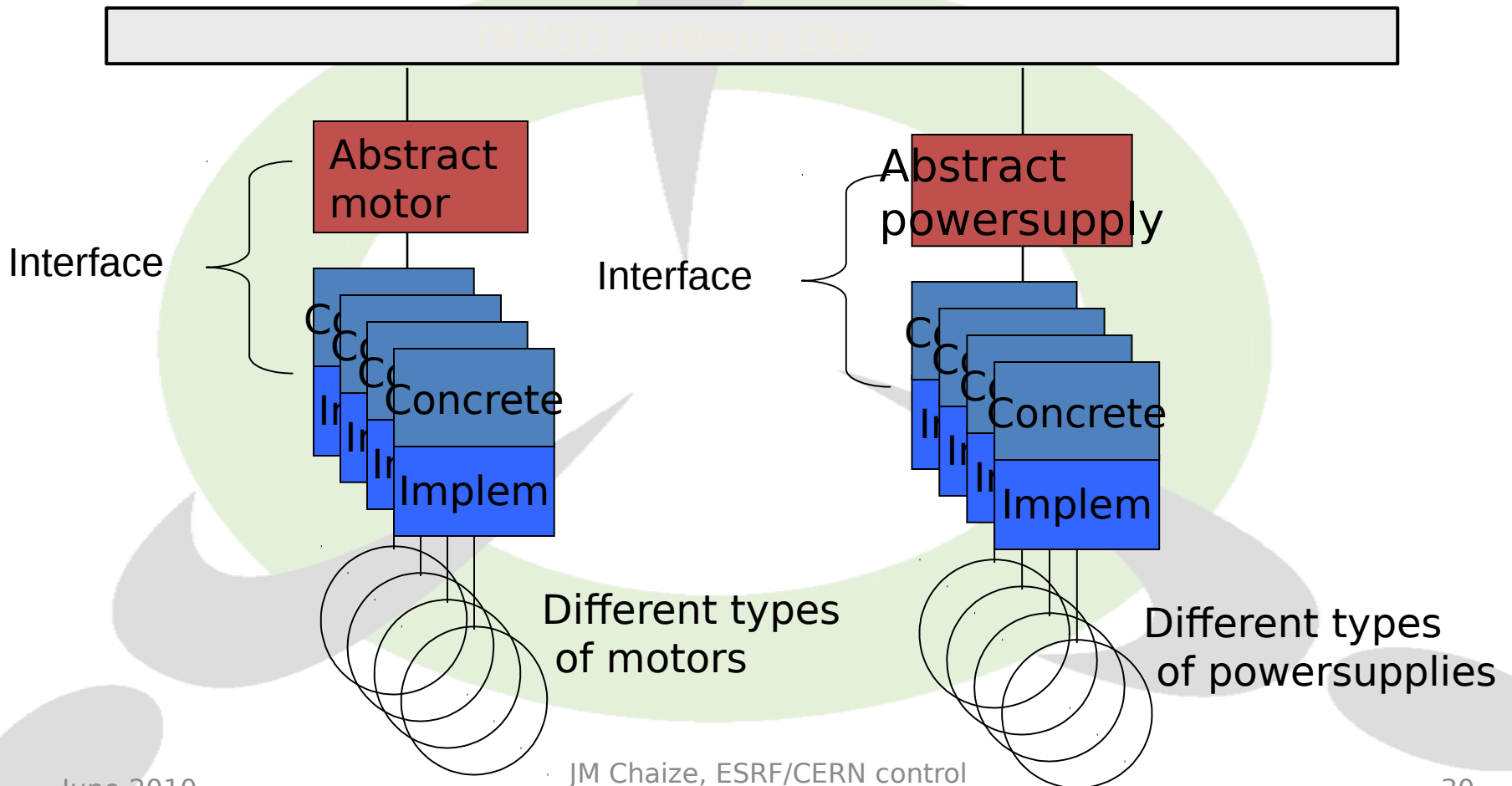
TANGO Communication

- Event Driven



Abstract interface classes

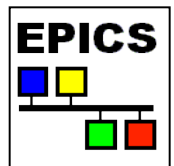
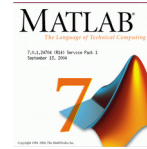
Standardise interfaces of equipment of the same types



Much more than a software bus

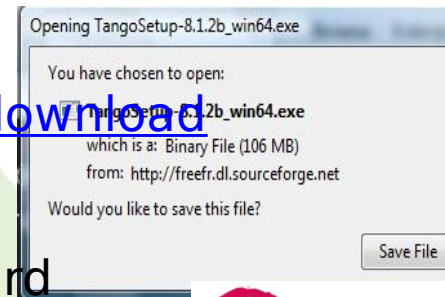
- Code generator for C++, Java, python
- Configuration tool
- Administration tool
- Archiving service
- Access control service
- Logging service
- Scan service
- GUI Toolkit for Java,QT, Python
- Synopsis animation tool
- Alarm service
- Web interface
- Android support
- Tutorials

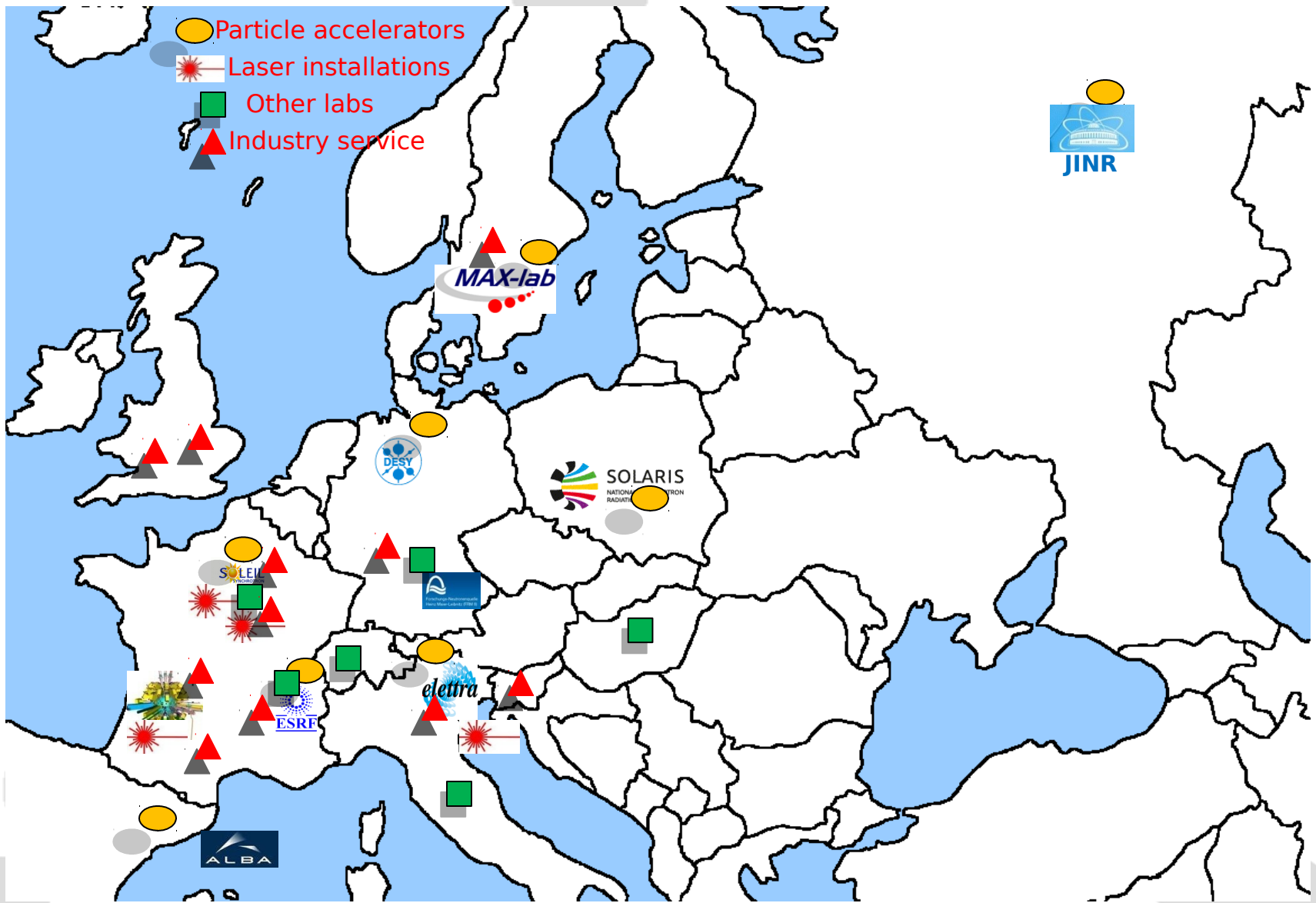
- Bindings
- Many utility classes
- Hardware access class catalog
- Mailing list support



How to try it?

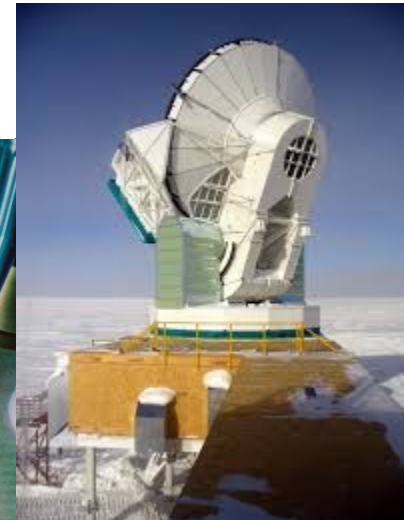
- TANGO is available free of charge
- Source code distribution
- Downloadable on <http://www.tango-controls.org/download>
- Binary Packages
 - Available for Ubuntu + Debian Linux in the standard distributions
- **`sudo apt-get install tango-common tango-db python-pytango`**
 - Available for Windows on <http://www.tango-controls.org/download>
- The Tango Box
 - An Ubuntu virtual machine with Tango installed and configured for easy testing
 - Runs on VMware and Virtualbox





Use cases

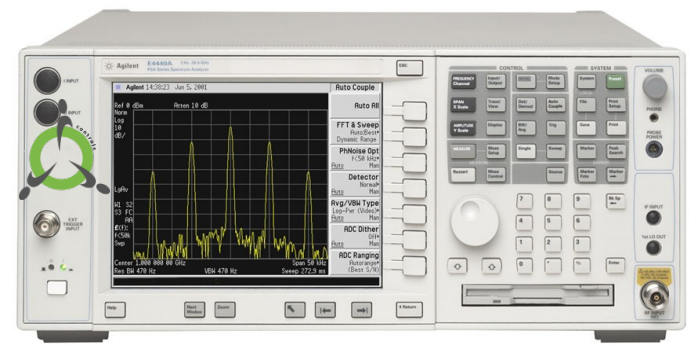
- TANGO was born in particle accelerator world, however ...
- TANGO is a generic solution for any collection of objects
- Used also in other scientific domains like
- Wind tunnels e.g. ONERA
- Neutron source experiments (FRM2, Institut Laue-Langevin)
- Large laser installation
 - LMJ, PETAL, APOLLON
 - Free Electron Laser (Fermi)
- Small instruments
 - Thomx (art and medicine)
- Small installations
 - Embedded systems
 - Industrial supervision



TANGO - Generating economical activity

Instrumentation hardware market

- Tango compatible hardware
 - Supplier provides and guaranty The TANGO interface to their product
- Advantage for the supplier :
 - Sales argument for addressing TANGO community
 - Provide remote control of device
 - Profit for free from TANGO framework
- Advantage for the community/client/user
 - Easier integration
 - Better matching of the hardware features



Recent projects started with TANGO

ONERA

THE FRENCH AEROSPACE LAB



東北大学
TOHOKU UNIVERSITY



The Italian Mars Society

Think beyond your planet...



Jdraw: Generic Synoptic animation

The image displays the Jdraw software interface, which is used for generic synoptic animation. The main window shows a detailed schematic of the BM22 Infrared Station. The diagram includes the following components:

- Storage ring**: Located at the top left, connected to the Movable Mirror.
- Movable Mirror**: A green component that reflects light from the storage ring.
- Absorber**: A component at the bottom left that receives light from the Movable Mirror.
- BM22 Infrared Station**: The central part of the diagram, featuring a **Tunnel Roof** and several mirrors labeled **M2**, **M3**, **M4**, and **M5**.
- Diamond**: A component located between mirrors M5 and M6.
- Microscope**: A large component at the bottom right that receives light from mirror M6.

Overlaid on the right side of the main window is the **AtkPanel** control interface for the station. The panel title is "AtkPanel : sr/d-irm/id22". It includes a menu bar with "File", "View", "Preferences", and "Help". Below the menu bar, there is a status section with the following text:

Status
The IR Mirror is ON. It's position is controlled by a closed loop.
The IR Mirror is in slotted mode

Below the status section, there is a table of parameters:

HM average T	48.96 deg C	...
SM Upper average Temp	52.18 deg C	...
SM Lower average Temp	52.70 deg C	...
SM Temp diff	-0.52 deg C	...
Mirror position	-49150. um	-0049150 ...

At the bottom of the AtkPanel, there is a **Scalar** control element.

Jive

Database browser and Test Device Launcher

The screenshot displays the Jive 3.7 software interface, which is a database browser and test device launcher. The main window is titled "Jive 3.7 [orion:11000,orion:10000]" and features a menu bar with "File", "Edit", and "Tools".

The left pane shows a hierarchical tree of devices under the "Server" tab. The tree includes nodes such as "LiberadbControl", "Linac", "LinacCooling", "LinacGun", "LinacGunAux", "LinacGunHVPS", "LinacHVPS", "linac", "SAdc150", "SDac712", "LinacHVPS", "elin/mod1/hv", "elin/mod2/hv", "LinacModAux", "LinacModulator", "LinacRF", "LinacSequence", "logconsumer", "MachstatWrap", and "MBFeedback". A context menu is open over the "elin/mod2/hv" node, listing actions: Copy, Paste, Rename, Delete, Monitor device, Test device, Define device alias, Go to device node, Restart device, and Device wizard.

The central pane displays "Device Info" for the selected device "elin/mod2/hv". The information includes:

- Device: elin/mod2/hv
- type_id: IDL:Tango/Device_3:1.0
- iiop_version: 1.2
- host: 1-pinj-2 (160.103.72.52)
- port: 33237
- Server: LinacHVPS/linac
- Server PID: 3711
- Exported: true

Below the device info, the "Polling Status" section shows the results of recent commands:

- Polled command name = State
- Polling period (mS) = 2000
- Polling ring buffer depth = 10
- Time needed for the last command reading (mS) = 0.678
- Data not updated since 1 S and 472 mS
- Delta between last records (in mS) = 2000, 2000, 2000,

A "Refresh" button is located at the bottom of the device info pane.

The right pane is titled "Device Panel [elin/mod2/hv]" and has tabs for "Commands", "Attributes", and "Admin". The "Attributes" tab is active, showing a table of device attributes:

Attribute	Name	Status
HighVoltage		
HVDac	Label	Status
State	Writable	READ
Status	Data format	Scalar
	Data type	DevString
	Max Dim X	1
	Max Dim Y	0

Buttons for "Read", "Write", and "Plot" are located below the table. The "Attributes" pane also displays the results of polling commands:

- Attribute: elin/mod2/hv/HVDac
- Duration: 0 msec
- measure date: 25/09/2006 16:31:12 + 724ms
- quality: VALID
- Read: 0.0

- Attribute: elin/mod2/hv/State
- Duration: 0 msec
- measure date: 25/09/2006 16:31:19 + 562ms
- quality: VALID
- DISABLE

- Attribute: elin/mod2/hv/Status
- Duration: 0 msec
- measure date: 25/09/2006 16:31:27 + 961ms
- quality: VALID
- Read: Can't be switch on while :
Modulators are not warm
Bad focus current 1 in klystron 2
Bad focus current 2 in klystron 2
Bad focus current 3 in klystron 2
Modulator 2 HV relay closed

"Clear history" and "Dismiss" buttons are located at the bottom of the device panel.

POGO Device Server Code Generator

The image displays the POGO software interface with several key components highlighted:

- Main Window:** The top menu bar includes File, Edit, and Help. The File menu is open, showing options like New Class, Open, Import, Generate Source, **Generate Doc** (circled in purple), and Exit. The status bar at the bottom shows "Language Generated: C++ Java".
- Tree View:** A tree view on the left lists various attributes and states. The "Attributes" section is expanded, showing "Current", "Voltage", "Frequency", and "CurrentSetPoint". The "States" section is also expanded, showing "Tango::ON", "Tango::OFF", "Tango::FAULT", and "Tango::STANDBY".
- Command Window:** A window titled "Command Window" displays metadata for the selected attribute: "Inherited from: PowerSupply", "Revision: Release_1_0", "Author:", and "Repository: ESRF".
- Edit Attribute Window:** A dialog box titled "Edit Attribute Window" is open, showing configuration for the "current" attribute. It includes fields for Attribute name, Attribute Type (SCALAR), Data Type (Tango::DEV_DOUBLE), and Read/Write Type (Tango::READ_WRITE). It also has radio buttons for "Expert Only" and "Polled". A "Default Attribute Properties" section contains fields for Label, Unit, Standard Unit, Display Unit, Display Format, Max. Value, Min. Value, Max. Alarm, and Min. Alarm. A red box highlights the text "C++ or Java" in the dialog.

POGO Device Server Code Generator

```
Hazemeyer.cpp - /mntdirect/_segfs/tango/tools/pogo/test/cpp,
File Edit Search Preferences Shell Macro Windows Help
gfs/tango/tools/pogo/test/cpp/Hazemeyer/Hazemeyer.cpp DOS line 186, col 0, 8255 bytes
//+-----+
// method :      Hazemeyer::write_Current
// description :  Write Current attribute values to hardware.
//+-----+
void Hazemeyer::write_Current(Tango::WAttribute &attr)
{
    DEBUG_STREAM << "Hazemeyer::write_Current(Tango::WAttribute &attr) entering.
}
//+-----+
//+-----+
Hazemeyer.cpp - /mntdirect/_segfs/tango/tools/pogo/test/cpp,
File Edit Search Preferences Shell Macro Windows Help
gfs/tango/tools/pogo/test/cpp/Hazemeyer/Hazemeyer.cpp DOS line 238, col 0, 8255 bytes
//+-----+
void Hazemeyer::off()
{
    DEBUG_STREAM << "Hazemeyer::off(): entering... !" << endl;
    // Add your own code to control device here
}
//+-----+
//+-----+
* method: Hazemeyer::on
* description:  method to execute "On"
* Set the power supply ON
*
*/
//+-----+
void Hazemeyer::on()
{
    DEBUG_STREAM << "Hazemeyer::on(): entering... !" << endl;
    // Add your own code to control device here
}
//+-----+
```

Tango Device Server User's Guide - Mozilla Firefox

File:///Y:/tango/tools/pogo/test/cpp/Hazemeyer/doc_html/DevC

Tango Device Server User's Guide

ESRF *elettra* SOLEIL SYNCHROTRON ALBA TANGO Device Server

Device Attributes Description

Hazemeyer Class

Revision: Release_1_0 - Author:

Scalar Attributes			
Attribute name	Data Type	R/W Type	Expert
Current: Current measured on this power supply.	DEV_DOUBLE	READ_WRITE	No
Voltage	DEV_DOUBLE	READ	No
Frequency: AC Current Frequency measured on PS.	DEV_DOUBLE	READ	Yes
CurrentSetPoint: The current set value as stored in the powersupply.	DEV_DOUBLE	READ	No

Rechercher : mca Occurrence suivante Occurrence précédente Signifier tout Respecter la casse

http://www.synchrotron-soleil.fr

ATKpanel a generic client

The image displays the ATKpanel software interface. A central dialog box titled "Attribute property editor" is open, showing the following configuration for a "dc" attribute:

- Device: sy/ps-sext/defocusing
- Attribute: dc
- Value: 9.55 Amp (highlighted in green)
- Label: dc
- Minimum value: 0, Maximum value: 20
- Minimum alarm: 9, Maximum alarm: 10
- Format: %4.2f, Unit: Amp
- Description: Actual DC current in the defocussing sextupole

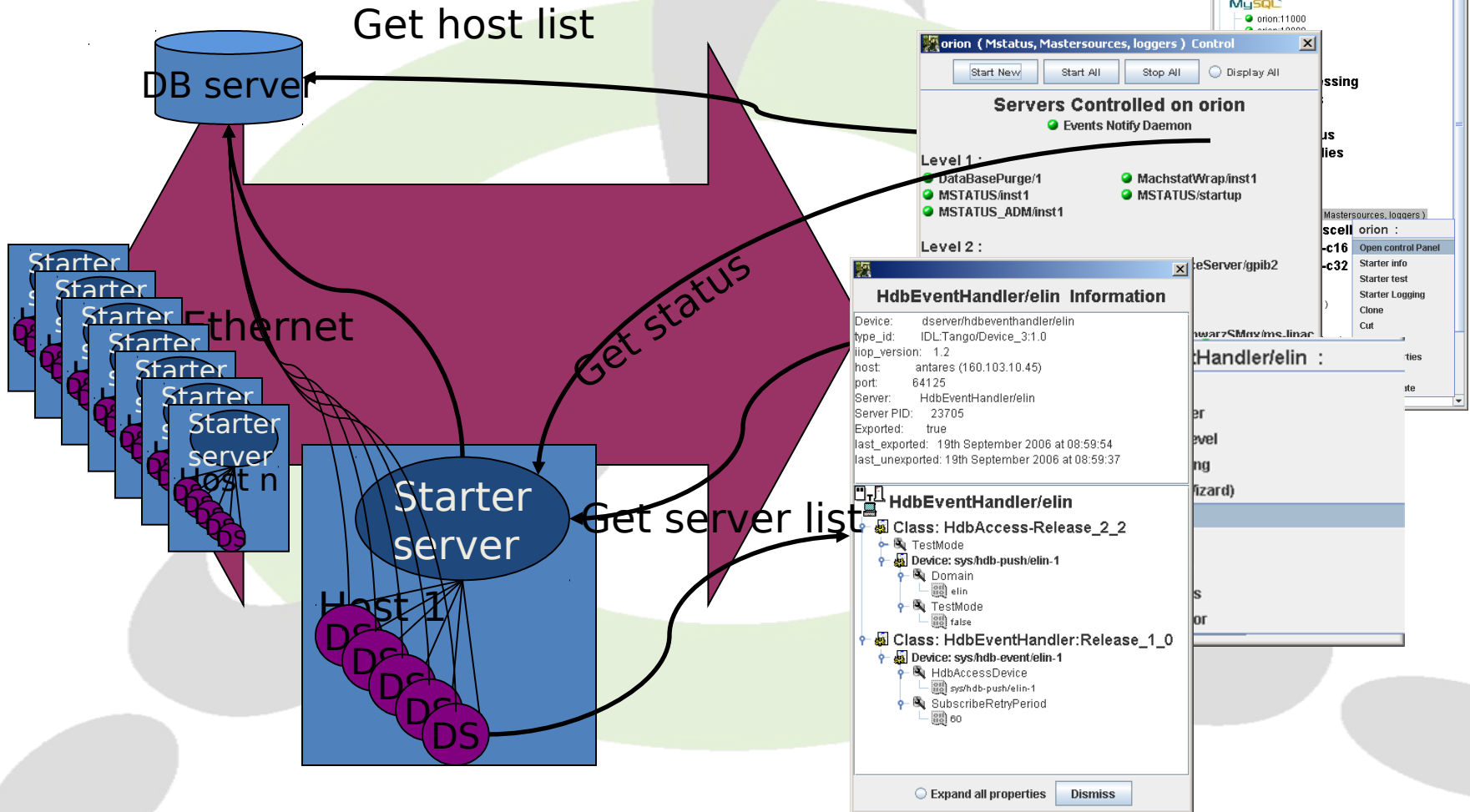
The background interface includes a status panel with "Alim DC fault" and a table of parameters:

Parameter	Value	Unit
bpsst0	100299	us
dc voltage	17.88	Volt
dc current	0.02	Amp
rms voltage	0.08	Volt
rms current	0.01	Amp
dc	9.40	Amp
rms	6.25	Amp
phase	0	us
ac 1	100.00	%
ac 2	0.00	%
ac 3	0.00	%
ac 4	0.00	%

A graph titled "voltage_wave" shows a red signal fluctuating between approximately 363.0 and 364.0 over a time range of 0.0 to 250.0. The graph is labeled "sy/ps-sext/defocusing/voltage_wave (Y1)".

Astor/Starter

Tango Control System Manager



A stylized human figure in grey is centered at the top. Below it, a large green ring is partially visible. The text 'Thank you for your attention' is overlaid on the green ring. Below the text, there are two bullet points. At the bottom, there are three grey ovals: one on the left, one in the center, and one on the right.

Thank you for your attention

- WWW sites for TANGO
 - Common site **<http://tango-controls.org>**
- **<http://sourceforge.net/projects/tango-cs>**