



Tango Controls

An Open Source Scientific
Control Systems toolkit
made in Europe

Andy Götz (ESRF)

TALK OUTLINE

- **What is Tango**
- **Sites using Tango**
- **Domains adopting Tango**
- **Tango adoption in industry**
- **Important steps in developing Tango**
- **Sustaining Tango for the future**
- **Conclusion**

TANGO IN THE BEGINNING (1999)

TANGO - A OBJECT ORIENTED CONTROL SYSTEM BASED ON CORBA

A. Gotz, J. Meyer, E. Taurel, W-D. Klotz, (ESRF)

This paper will describe TANGO - the ESRF's latest generation object oriented control system base on CORBA. It will present the overall design, the database, the API and the device server model. It will discuss the use of CORBA as a network protocol for a control system. It will present how naming, signals, events and grouped calls have been solved in TANGO. It will show how TANGO has been deployed on frontends running Linux/m68k, Linux/x86 and Windows 95/98/NT.



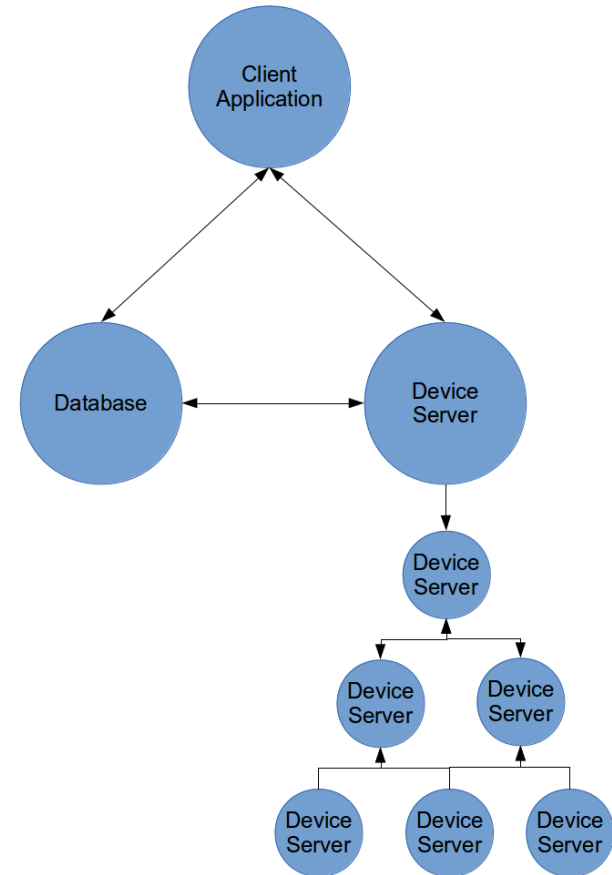
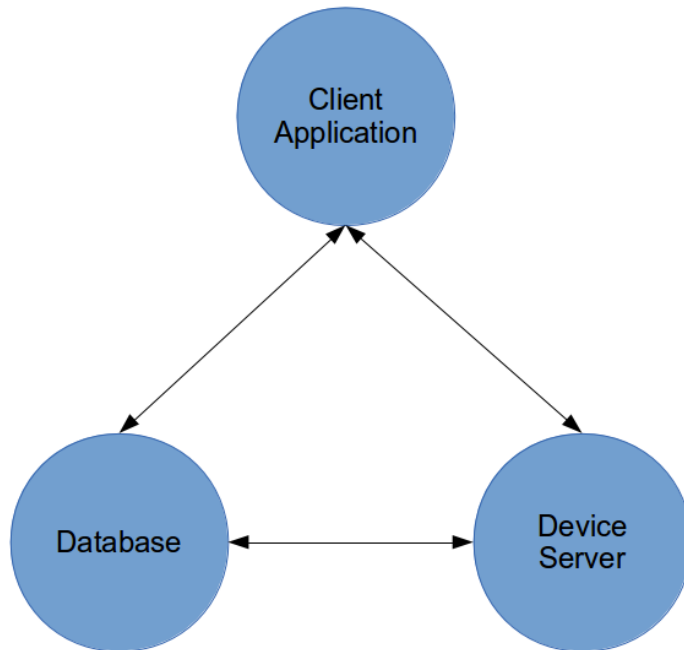
WHAT IS TANGO?

1. **An open source software toolkit for building scientific control systems**
2. **Hardware + Software objects are implemented as Devices**
3. **Hierarchies of Devices are supported**
4. **Devices are hosted in Device Servers**
5. **Devices are accessed via the network**
6. **A Tango control system can have 1 to 100 000 Devices**
7. **A generic set of applications are provided to manage, control, monitor and archive Devices**

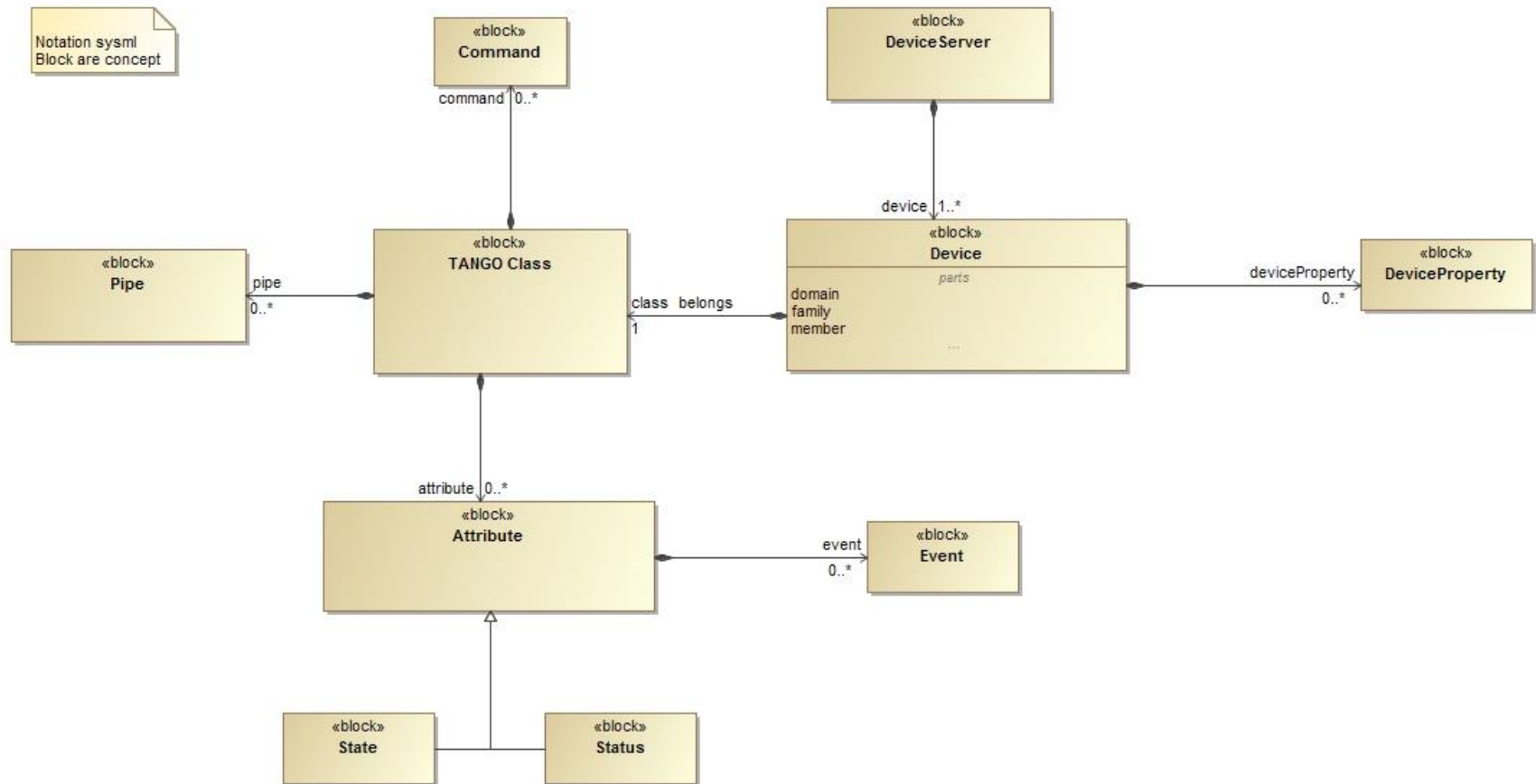
WHAT IS TANGO?



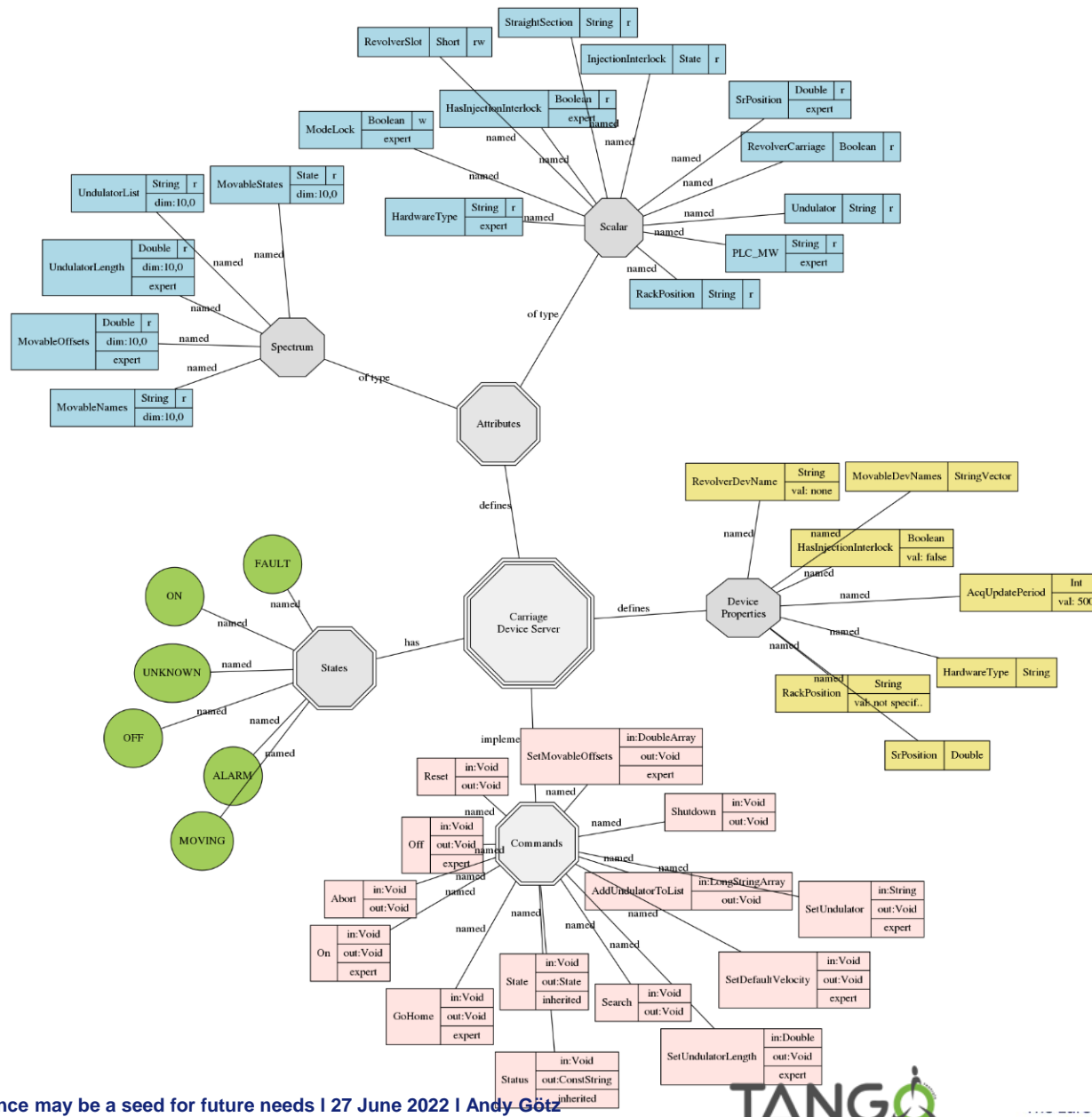
i.e. things = Devices



TANGO - SIMPLE DEVICE MODEL



TANGO CLASS FOR INSERTION DEVICE



EXAMPLE TANGO CONTROL SYSTEMS



TANGO IS OPEN SOURCE

Open Source Software is part of Open Science

OSI's Open Source Definition

- free redistribution
- source code availability
- derivatives allowed
- no limitations of who may use it or for what
- no additional license in place
- license must not depend on distribution format, technology, presence of other works

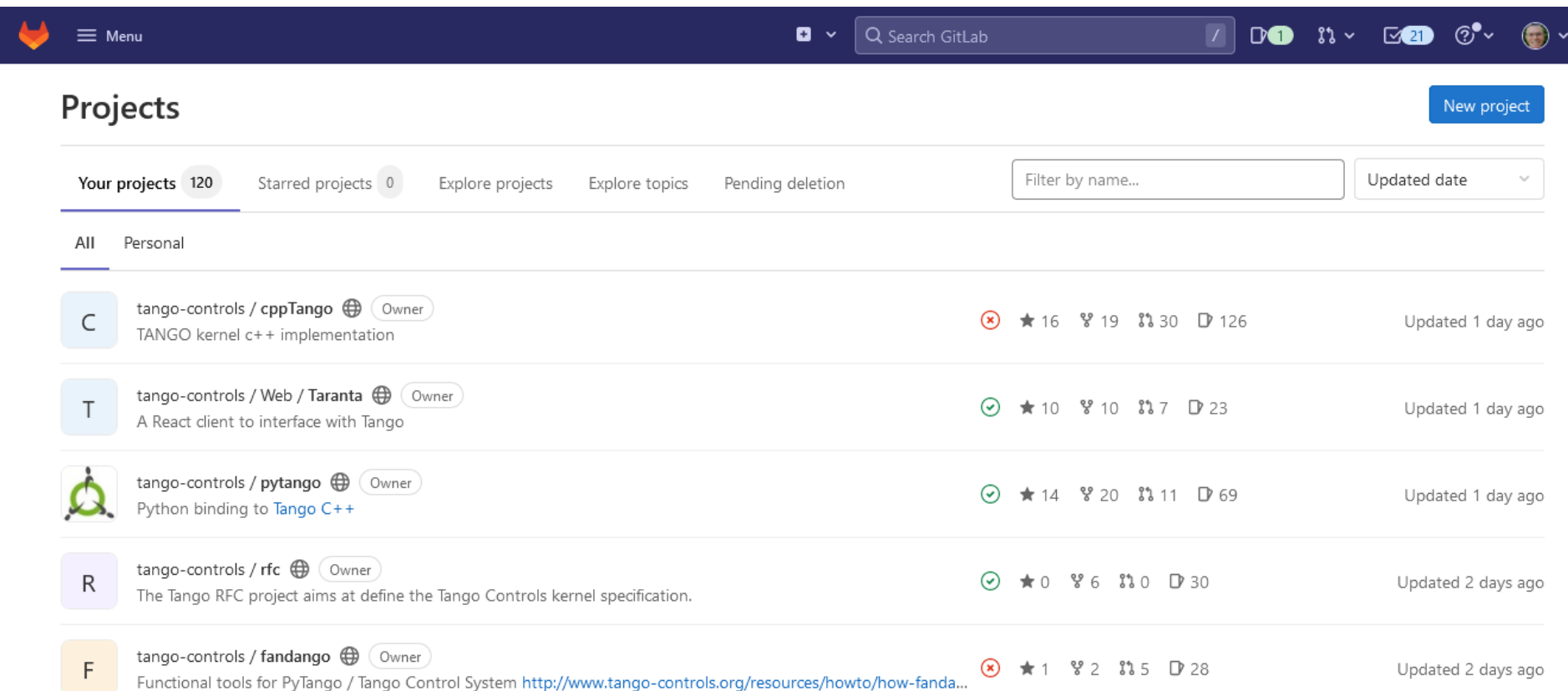


open source
initiative[®]

"free as in speech, not as in beer"

TANGO GITLAB DASHBOARD

<https://gitlab.com/tango-controls>



The screenshot shows the GitLab dashboard for the 'tango-controls' organization. The top navigation bar includes the GitLab logo, a menu icon, a search bar, and various utility icons. The main section is titled 'Projects' and features a 'New project' button. Below this, there are tabs for 'Your projects' (120), 'Starred projects' (0), 'Explore projects', 'Explore topics', and 'Pending deletion'. A filter bar allows searching by name and sorting by updated date. The project list includes:

- tango-controls / cppTango** (Owner): TANGO kernel c++ implementation. Status: Red X. Stars: 16, Forks: 19, Issues: 30, Milestones: 126. Updated 1 day ago.
- tango-controls / Web / Taranta** (Owner): A React client to interface with Tango. Status: Green Check. Stars: 10, Forks: 10, Issues: 7, Milestones: 23. Updated 1 day ago.
- tango-controls / pytango** (Owner): Python binding to Tango C++. Status: Green Check. Stars: 14, Forks: 20, Issues: 11, Milestones: 69. Updated 1 day ago.
- tango-controls / rfc** (Owner): The Tango RFC project aims at define the Tango Controls kernel specification. Status: Green Check. Stars: 0, Forks: 6, Issues: 0, Milestones: 30. Updated 2 days ago.
- tango-controls / fandango** (Owner): Functional tools for PyTango / Tango Control System. Status: Red X. Stars: 1, Forks: 2, Issues: 5, Milestones: 28. Updated 2 days ago.

Anyone can download, re-use, modify or redistribute the code as long as they respect the licence (LGPL)

TANGO CONTROLS – MADE IN EUROPE ?

Developed in

- ***France***
- ***Italy***
- ***Spain***
- ***Germany***
- ***Sweden***
- ***Poland***
- ***South Africa***
- ***United Kingdom***



Used in

- ***Czech***
- ***Hungary***
- ***Romania***
- ***India***
- ***Australia***
- ***Finland***
- ***China***
- ***...***

SCIENTIFIC SITES USING TANGO

Synchrotrons

ESRF, SOLEIL, ELETTRA, ALBA, PETRA-3, MAX-IV, SOLARIS

Lasers

LMJ, APOLLON, IN2P3, ThomX (France), ELI (Czech, Hungary, Roumania), CALA, MBI (Germany)

Telescopes

SKA (South Africa), GMRT (India), LOFAR 2.0, DISTURB (Netherlands), ExTRA (Chile)

Others

ONERA (France), FRM-II, KIT (Germany), Betulium (Finland)

EXTRA TELESCOPES USE TANGO

ExTRA telescopes are searching for earth-like exoplanets



SKA + TELESCOPES USE TANGO

SKA is building the world's largest radio telescope to study the Cosmic Dawn in the beginning of the universe



LOFAR 2.0 TELESCOPES USE TANGO

LOFAR low frequency telescope spanning Europe has revolutionized low frequency astronomy



MOVING TO INDUSTRY

Two examples: #2 – furniture industry

Reconfigure line
quickly

Packaging line



Existing process:

- Easy tasks already automated
- Manual packaging
- Low productivity on manual line
- Low flexibility on auto line

New process:

- On-demand automation
- Easy to reprogram
- Flexible, productive hybrid line



Pascale Betinelli-Deck
Anay Gotz



THALES LASERS USE TANGO

Thales is using Tango for high powered lasers across the globe e.g. world's most powerful laser – 10 PW @ ELI-NP

THALES TANGO / Panorama Supervisions in the world

GERMANY

ALA ATLAS3000
90 J Laser System



25 devices

2 servers
1 workstation

CHINA

JIAOTONG
200 TW Laser System



ROMANIA

eli ELI-NP
2 x 10 PW Laser System



ISRAEL

WEIZMANN
2 x 100 TW Laser System

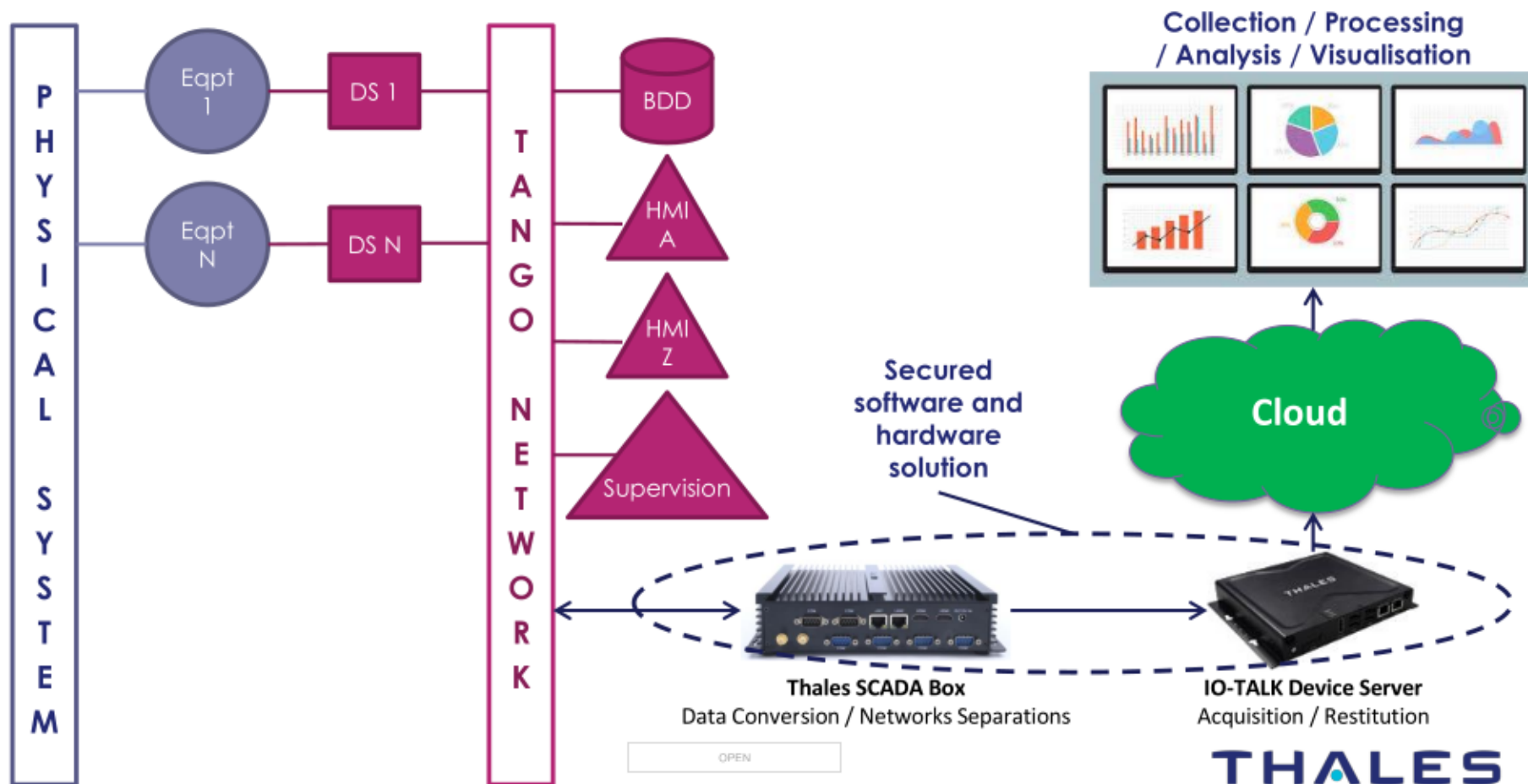


THALES

OPEN

THALES LASERS USE TANGO

Thales developed Tango SCADA Box for monitoring HUMS and Predictive Maintenance



PREVAC – DEPOSITION SYSTEMS

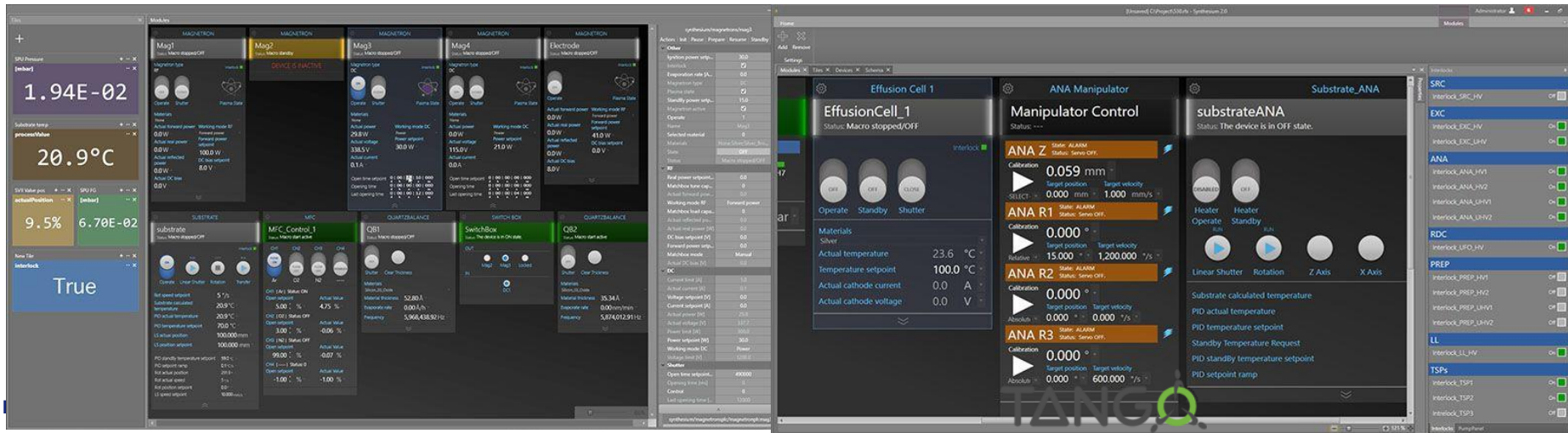


Energy Materials In-situ Laboratory Berlin
(EMIL)

“Synthesium software is based on **Tango technology** and is extremely easy to extend with new hardware.

All recipes and new hardware modifications can be done by using open-source tools or in Python script.”

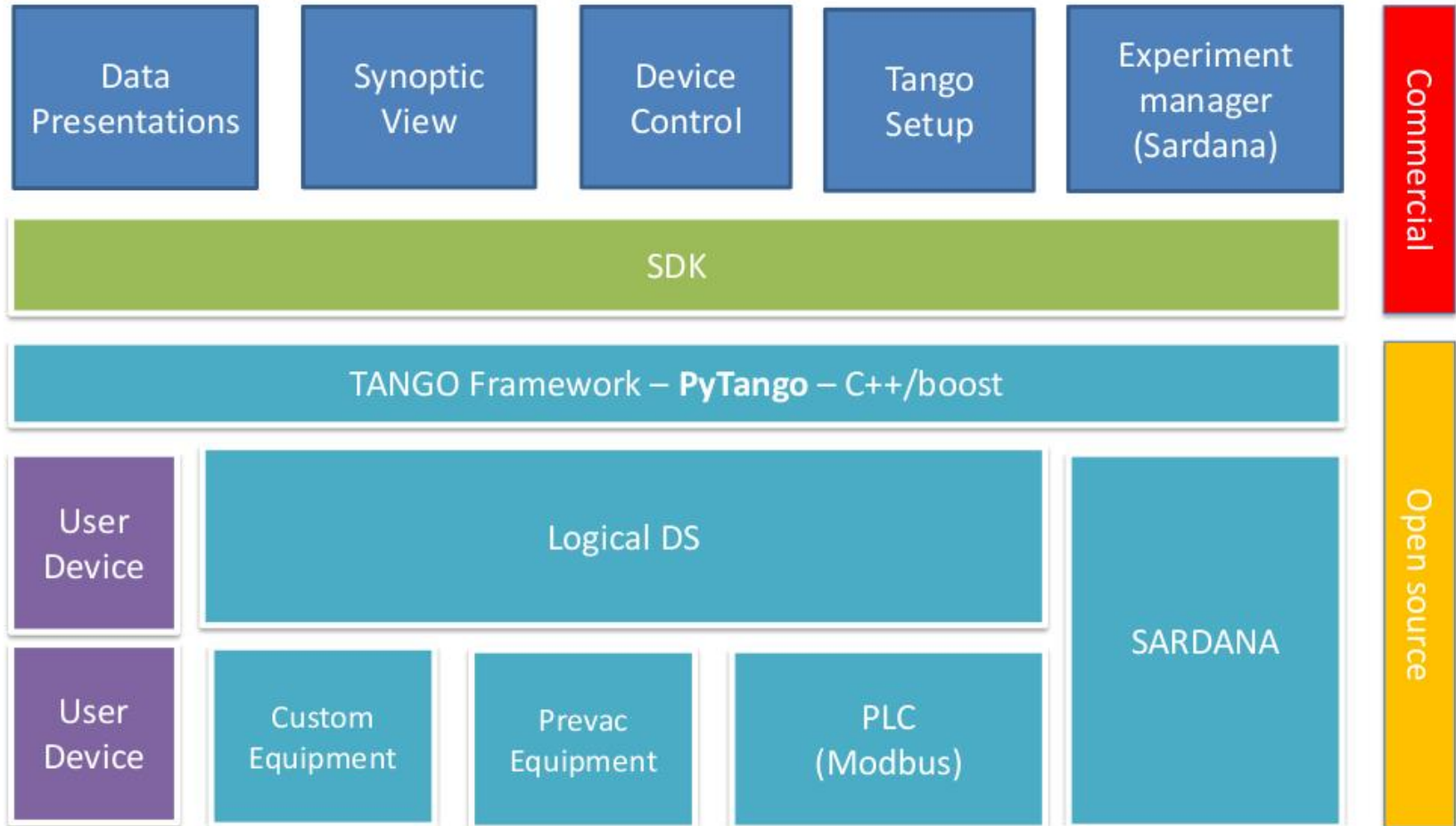
TANGO
Connecting things together



PREVAC USES TANGO



RAPID FX TOOLSET



ENERGY LAB 2.0 USES TANGO

Energy Lab 2.0 are finding efficient ways to provide energy to houses (project by KIT in Karlsruhe)



KEY FACTORS TO SUCCESS

1. **TANGO builds on proven concepts**
2. **Management supported Open Sourcing TANGO**
3. **A collaboration developed TANGO (ESRF, SOLEIL, ELETTRA, ALBA and DESY)**
4. **GRAVIT INNOVATION incubator helped a lot to improve TANGO branding and web site**
5. **A collaboration contract with 11 members helps finances key developments**
6. **The COMMUNITY was key to developing the software, writing documentation, packaging + organizing events**

- **GRAVIT INNOVATION helped improve the marketing and communication of TANGO but also some technical aspects:**
 - ✓ Defining the mission and scope of Tango
 - ✓ Designed a new logo and branding
 - ✓ Redesigned the web site with local company (Webu)
 - ✓ Registered Tango Controls as a trademark
 - ✓ Did a complete review of the code by INRIA
 - ✓ Explored collaboration with commercial companies

A GOOD WEBSITE IS IMPORTANT



[About us](#) [Community](#) [Developers](#) [Partners](#) [Contact](#)

[D mo](#)

[Documentation](#)

[Download](#)



Connecting things together

What is Tango Controls ?

A free open source device-oriented controls toolkit for controlling any kind of hardware or software and building **SCADA** systems...

[Read more](#)

Why choose Tango Controls ?

Because it is easy to use, flexible, and highly scalable. It provides a complete set of features for controlling equipment and lot of services for managing systems.

[Read more](#)

How to use Tango Controls ?

Just download it and install it. Then reuse or write a device server, deploy and marvel at how it works!

[Read more](#)

2800+ registered users

FORUM IS THE MOST USED FEATURE


🏠 > [Community](#) > [Forum](#)

FORUM


Members

There are more than 520 members in the Tango Community Forum.








To see the list of forum members and to find out from which affiliation and from which counties they are coming from, visit [Members page](#).

 [Last updates in topics](#) [Mark all forums as read](#) [Subscribe to all forums](#)

Development

Forum	Topics	Posts	Last posts
 Python	149	727	21 May, 2022 14:48

Recent activities In the forums

-  [Import class from catalogue - Tutorials available ?](#)
23/06/2022 by [nelmerich](#)
-  [How to protect attribute write value with critical section?](#)
23/06/2022 by [zreszela](#)
-  [Compatibility Tango 9, Tango 8](#)
21/06/2022 by [gdi-franco](#)
-  [Compiling libhdbpp-extraction-cpp](#)
20/06/2022 by [aglas](#)
-  [Tango and software to track hardware modification](#)
10/06/2022 by [sblanchet](#)
-  [easy way to count attributes on jive?](#)
03/06/2022 by [gauron](#)
-  [Configure fixed ports for device servers from Astor/Jive/Starter](#)
...

TANGO COMMUNITY - ORGANISATION

1. Tango Controls Collaboration Contract
2. GitLab 120 repositories + issues + CI
3. Forum + Mailing list
4. Write-the-Doc Camps
5. Annual Meetings
6. Kernel Meetings



Kernel + Write-the-doc camp @ Grenoble (2017)



RFC – SPECIFYING THE FUTURE



TANGO RFC Writing workshop in
Zamek Korzkiew (Poland) June 2022

RFC – SPECIFYING THE FUTURE

Mission
Contribution
RFCs
1/Tango
2/Device Model
3/Command
4/Attribute
5/Property
6/Database
7/The Tango Pipe specification
8/Device Server Model
9/Data types
10/Request Reply
12/Publisher-Subscriber protocol
14/The Tango Logging Service
15/The Dynamic Attribute and Command
16/Tango Resource Locator (TRL)
Read the Docs v: latest

Tango Request For Comments (RFC)

This repository is the home of all Tango Open Specification.

It is rendered on the readthedocs.io: docs passing

Mission

The goal of this RFC project is to provide a formal specification of the current (V9) Tango Controls system. This specification shall include:

1. Concepts,
2. Terminology,
3. Protocol behaviour,
4. Conventions,

each on a sufficient level for future evolution of Tango Controls and/or implementation in other languages. In that respect, concepts are more important than implementation details.

Contribution

The process to add or change an RFC is the following:

<https://tango-controls.readthedocs.io/projects/rfc/en/latest/>

TANGO COLLABORATION CONTRACT

- **11 RIs signed a collaboration contract for 5 years with the ESRF to contribute financially to the maintenance and further development of TANGO**
- **Each RI pays 11 keuros / year**
- **If possible RIs contribute manpower**
- **Members vote on the budget**
- **ESRF places orders and follows up**
- **Started in 2015, renewed in 2021**

<https://www.tango-controls.org/about-us/#steering%20committee>

COMPANIES CONTRIBUTING TO TANGO

- S2 Innovation



- Byte Physics

() byte physics Physikalische Softwareentwicklung

- Observatory Sciences



Companies using TANGO



- Thales
- Prevac
- Jyse
- Bertin,
- Codra

THALES



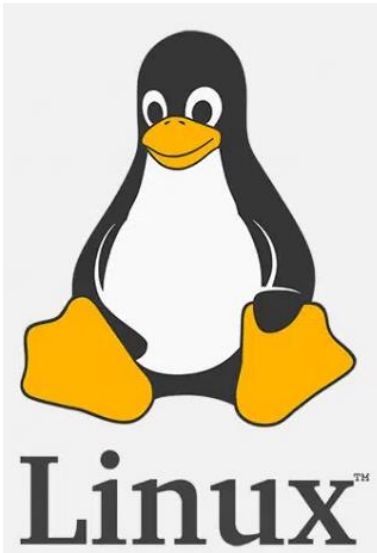
- Softwareschneiderei, ... Softwareschneiderei

OPEN SOURCE BOOSTS INNOVATION

Let's Share What We Know



World Wide Web



- Linux
- Firefox
- Gimp
- Python
- LibreOffice
- GNU compiler
- Blender, Shotcut
- Apache web server
- Wordpress, PHP, ...



https://youtu.be/Y_MnuvHDjOY?t=2

« De notre côté, on va coupler le saxs avec la synthèse chimie (réacteurs, injection, ...) pour avoir une boucle de rétroaction. Grace à Tango, cela ne semble pas si compliqué. Je passe pour un magicien auprès des collègues. »

Olivier Taché (CEA Paris-Saclay)



https://youtu.be/Y_MnuvHDjOY?t=2

« On our side, we will couple the sax with the chemical synthesis (reactors, injection, ...) to have a feedback loop. Thanks to Tango, it doesn't seem so complicated. I look like a magician to my colleagues. »

Olivier Taché (CEA Paris-Saclay)

CONCLUSIONS

1. **TANGO is a successful control systems toolkit started in Europe and now developed and used by an international community**
2. **TANGO has the potential to be a controls platform for both research and industry at the same time**
3. **The challenge for the TANGO community is to be sustainable and continue being modern for (at least) the next 20 years**
4. **The Tango Controls Collaboration has been essential to sustaining TANGO**
5. **Research Institutes are incubators of innovative Open Source Software**
6. **Tango could become a de facto standard in Europe**

Could TANGO become
the Linux of control
systems?

ICALEPCS 1999 - TRIESTE

Software: Distributed Computing Software

Oral Presentations

WA2I01 (285) [TANGO - a object oriented control system based on CORBA](#)

A. Gotz, Esrf; J. Meyer, Esrf; E. Taurel, Esrf; W-D. Klotz, Esrf



WA2O02 (280) [CDEV Generic Servers for RHIC Commissioning and Operations](#)

J. Van Zeijts, BNL/RHIC

WA2O03 (148) [Accessing Remote Equipment as Distributed Remote Objects through the Computer Network using Java Remote Method Invocation](#)

N. Kanaya, Institute Of Particle And Nuclear Studies Kek; Y. Yasu, High Energy Accelerator Research Organization Kek

WA2O04 (124) [Web-based distributed systems for collaborative Remote experiments.](#)

E. Garcia, TCPSI; J.A. Rodriguez, TCPSI; J. Rejas, TCPSI; M.A. Duran, TCPSI

FA1I01 (289) [TECHNICAL PREPARATIONS FOR REMOTE PARTICIPATION AT JET](#)

V. Schmidt, Jet Joint Undertaking; L. Villard, Ecole Polytechnique Federale

FA1O02 (121) [Generic repository and search engine for LHC equipment tests data](#)

M. Peryt, CERN; F. Momal, CERN

FA1O03 (195) [EPICS Directions to Accomodate Large Projects and Incorporate New Technology](#)

L. Dalesio, Lanl; J. Hill, Lanl; M. Kraimer, Anl; R. Chestnut, Slac; H. Shoaee, Slac

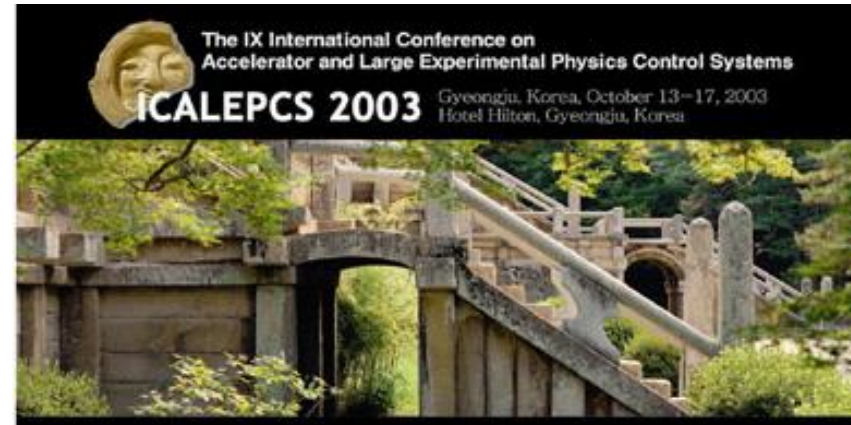


FA1O04 (50) [An architecture and A Framework for the Design and Implementation of Large Control Systems](#)

C. Gaspar, CERN; Ph. Charpentier, CERN; B. Franek, Rutherford Appleton Laboratory



LEGO ROBOT DANCING TANGO (2003)



TANGO – FULL DEVICE MODEL

IoT frameworks are simple

They do not handle complex systems

This is the Strength of TANGO

