



# Tango Controls

An Open Source Scientific  
Control Systems toolkit  
made in Europe

Andy Götz (ESRF)

# TALK OUTLINE

- **Open Source Software**
- **What is Tango**
- **Instruments using Tango**
- **Tango for Industry**
- **Conclusion**

# WHAT IS OPEN SOURCE SOFTWARE?

- 1. Open Source Software is software with source code that anyone can inspect, modify, and enhance.**
- 2. Open Source Software does not have to be free of charge. A common business model is selling services on top of OSS.**
- 3. Open Source Software has inspired a lot of Open movements e.g. Open Science, Open Access, Open Data, Open Everything ...**

# STATE OF OPEN SOURCE SOFTWARE

You can't develop software anymore these days without doing open source."



Wolfgang Gehring, FOSS Ambassador // [Mercedes-Benz Tech Innovation](#)



94M

developers are on  
GitHub

<https://octoverse.github.com/>

90%

of companies use  
open source\*

<https://www.theopensourceway.org/>

# ESTEEM3 OPEN SOURCE SOFTWARE

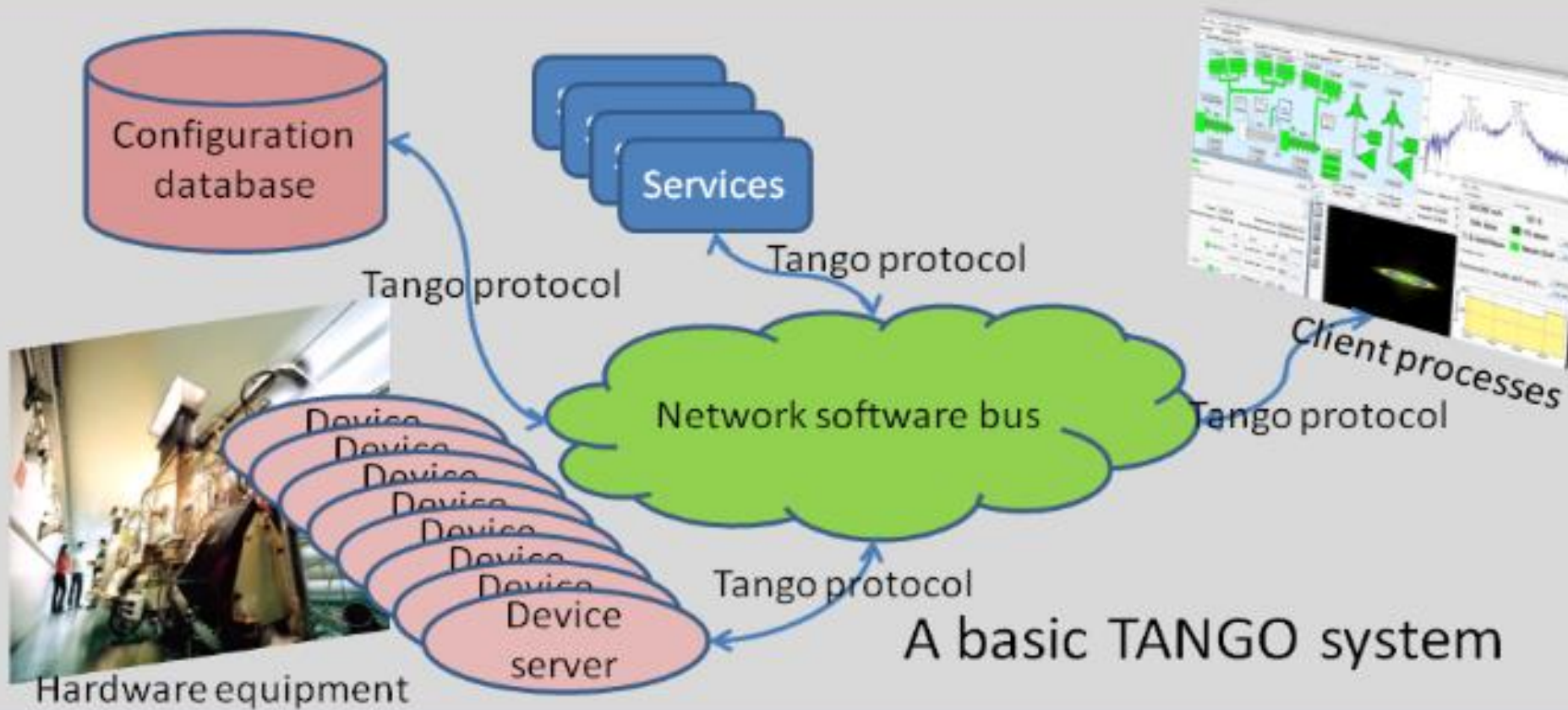
1. **Graptor 0.1** - <https://github.com/kbredies/graptor>
2. **HyperSpy** - <https://hyperspy.org/>
3. **Pyxem** - <https://github.com/pyxem/pyxem>
4. **LumiSpy** - <https://github.com/LumiSpy/lumispay>
5. **LiberTEM** - <https://libertem.github.io/LiberTEM/>
6. **Ptychography 4.0** - <https://ptychography-4-0.github.io/ptychography>

<https://www.esteem3.eu/Software>

# WHAT IS TANGO?

1. An **open source software toolkit** for building scientific and industrial **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 (TSS) can have 1 to 100 000 Devices
7. A generic set of applications are provided to manage, control, monitor and archive TSS

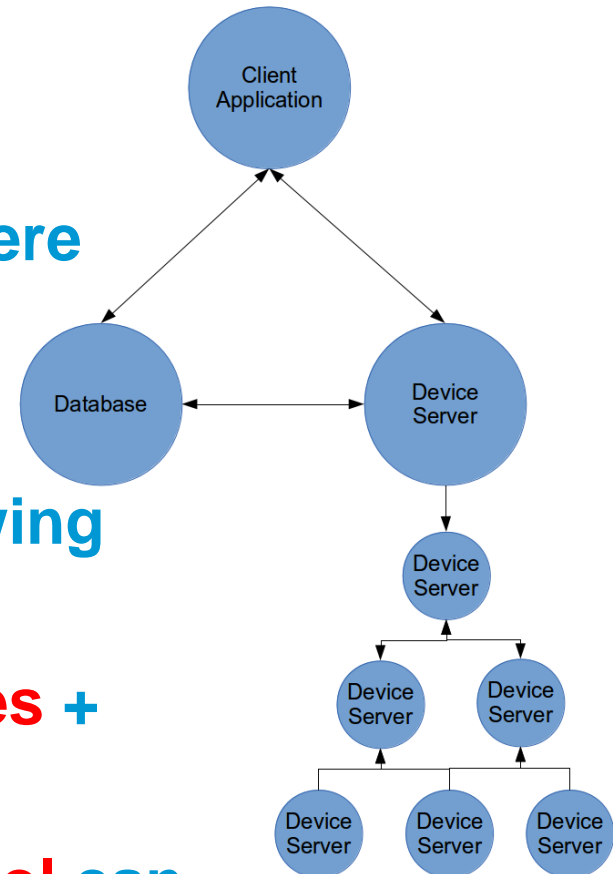
# TANGO ARCHITECTURE



# THE ADVANTAGES OF TANGO



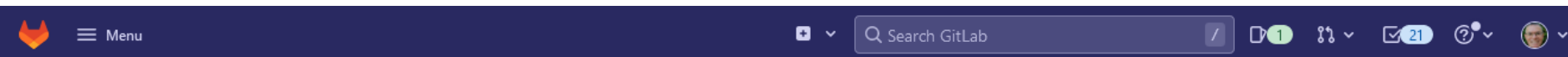
1. Tango can connect to anything where the Thing is called a **Device**
2. Devices can be **simple** or complex
3. Device **hierarchies** supported allowing complex hardware to be controlled
4. Devices are implemented by **classes + state machine** and have a **state**
5. The efficient Tango **network protocol** can control hundreds of thousands of Devices due to its **peer-2-peer** architecture





# TANGO GITLAB DASHBOARD

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



## Projects












New project

Your projects 120 Starred projects 0 Explore projects Explore topics Pending deletion

Filter by name...

Updated date

All Personal

C	tango-controls / <b>cppTango</b>  Owner TANGO kernel c++ implementation	 ★ 16 🍴 19 🐞 30 📄 126	Updated 1 day ago
T	tango-controls / Web / <b>Taranta</b>  Owner A React client to interface with Tango	 ★ 10 🍴 10 🐞 7 📄 23	Updated 1 day ago
	tango-controls / <b>pytango</b>  Owner Python binding to <a href="#">Tango C++</a>	 ★ 14 🍴 20 🐞 11 📄 69	Updated 1 day ago
R	tango-controls / <b>rfc</b>  Owner The Tango RFC project aims at define the Tango Controls kernel specification.	 ★ 0 🍴 6 🐞 0 📄 30	Updated 2 days ago
F	tango-controls / <b>fandango</b>  Owner Functional tools for PyTango / Tango Control System <a href="http://www.tango-controls.org/resources/howto/how-fanda...">http://www.tango-controls.org/resources/howto/how-fanda...</a>	 ★ 1 🍴 2 🐞 5 📄 28	Updated 2 days ago

*Anyone can download, re-use, modify or redistribute the code under the licence (LGPL)*

# EXAMPLE TANGO CONTROL SYSTEMS



**ESRF-EBS world's brightest x-ray source**



**ELI-NP 10 PW world's most powerful laser**

**THALES**

## 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, Julich (TEM), KIT (Germany), Betulium (Finland)*

# TEM USING TANGO

## TEM at Julich is using Tango to control multiple devices from a Jupyterlab notebook

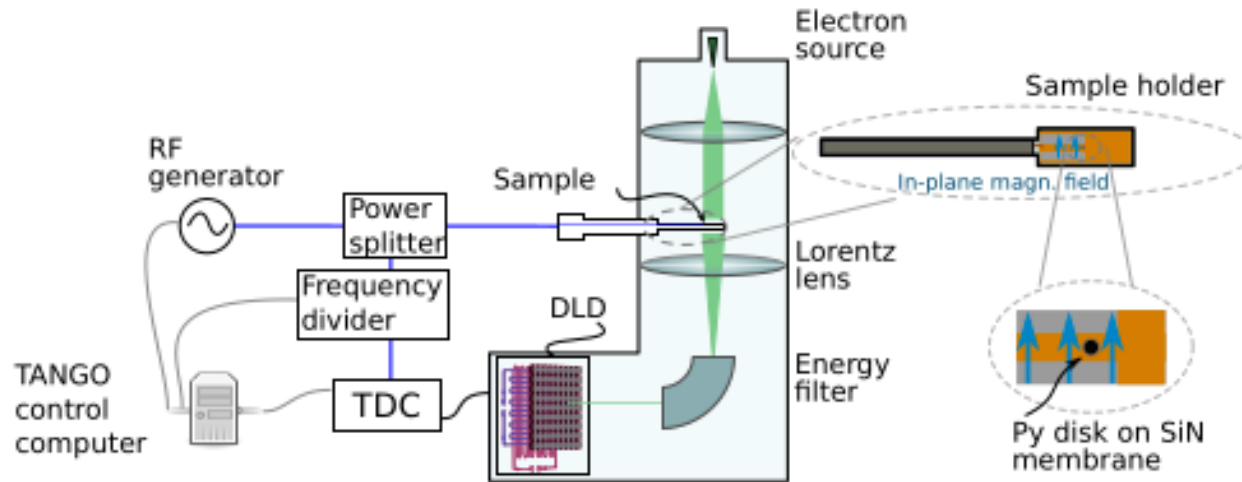


FIGURE 2.9: The basic setup of the TEM measurement. A RF generator generates the 0.1 to 2.5 GHz signal. This is split to reach the sample and the time-to-digital converter (TDC). The signal for the TDC has to be divided, as the GHz signal is a too high frequency for the TDC, which therefore requires a frequency divider. The electron beam passes the sample, which is excited by the RF signal. The beam is then filtered by energy and passes to the DLD. The data from the TDC is transferred to the control computer with the TANGO system. The control computer also allows for controlling the RF generator and frequency divider. (Adapted from [75])

## “Towards Ultrafast Electron Microscopy” by Simon Däster

<https://doi.org/10.3929/ethz-b-000521399>

# LARGE TANGO CONTROL SYSTEMS

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



# 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

The image is a screenshot of the Marvel Fusion website. The main visual is a 3D rendering of a fusion reactor's interior, featuring a central laser beam and numerous spherical components. The website layout includes a navigation menu in the top right, a main heading, a sub-heading, a descriptive paragraph, and a 'Learn more' button. On the right side, there are callout boxes for 'TONG system' and 'MISSION'. At the bottom, there are two ovals labeled '32 Workstations' and '2 servers workstation', and a 'THALES' logo.

Marvel Fusion

## A revolutionary carbon-free energy technology

Leveraging the latest breakthroughs in laser & nanoscience for the ultimate commercial fusion power plant.

[Learn more](#)

TONG system

MISSION

32 Workstations

2 servers workstation

THALES

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# KEY FACTORS TO SUCCESS

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

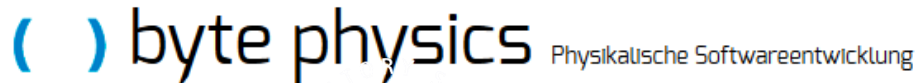
# COMPANIES CONTRIBUTING TO TANGO

## Companies providing TANGO support

• **S2 Innovation**



• **Byte Physics**



• **Observatory Sciences**



## Companies using TANGO

- Thales
- Prevac
- Jyse
- Bertin,
- Codra
- Softwareschneiderei, ...



Softwareschneiderei





TANGO  has the potential to be the de-facto **industrial control systems** similar to **Linux** is for **cloud computing**



Prodigy -- Linux advertisement by IBM

# 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 (TEM) and industry at the same time**
3. **The Tango Controls Collaboration has been essential to sustaining TANGO**
4. **Research Institutes are incubators of innovative Open Source Software**
5. **Tango could become a de facto standard for TEM in EU if a large company decided to use it**