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Karabo and Tango interoperability

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Device integration in the European XFEL Control System (Karabo)

The Karabo control system [1] [2] is used on photon systems at European XFEL (EuXFEL) to steer experiments and collect scientific data.

As a user-centered facility, EuXFEL deals with ever-changing requirements and often faces the need to integrate new instrumentation, or even to cope with user-provided hardware on relatively short notice. In 2023, a total 89 user experiments took place in the seven beamlines [3].

Karabo integration is mandatory for any device producing data used at EuXFEL, in order to have the data acquired and stored in the EuXFEL DAQ system. This ensures reliability, synchronization, and compliance with the data policy [4]. Additionally, Karabo integration is also convenient for devices whose main purpose is not data acquisition (e.g. motor positioners) to take advantage of the Karabo infrastructure like data logging, scans, distributed remote control, etc.

Tango devices at EuXFEL

Tango [5] is a well-established control system, and many hardware devices that are new in the EuXFEL context, have a Tango server available. For this reason, a Karabo device package has been implemented to provide a generic interface to any Tango server. This way the potential number of components that can be easily integrated at EuXFEL has been increased with a relatively small effort.

The TangoMirror device

The TangoMirror is a Karabo device that takes full advantage of the PyTango API [6]. It can be configured to connect to a Tango Server and expose any Tango attribute to the Karabo world. The Tango devices and parameters to be exposed are not hard coded, but can be entered by the user in the Karabo device configuration [Fig. 1], as well as the synchronization mode (polled, on a periodic event, or event-driven) [Fig. 2]. A nested view of the tango device and parameters is then injected at runtime in the Karabo device schema upon connection with the tango server. They can then be read or written just like any other Karabo parameter.

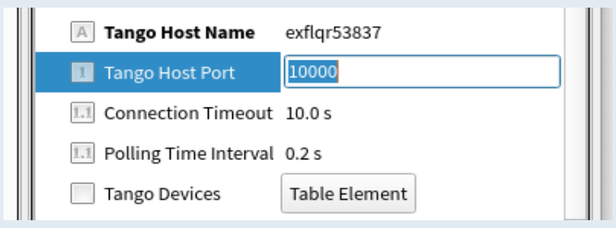

Figure 1 - The TangoMirror connection configuration

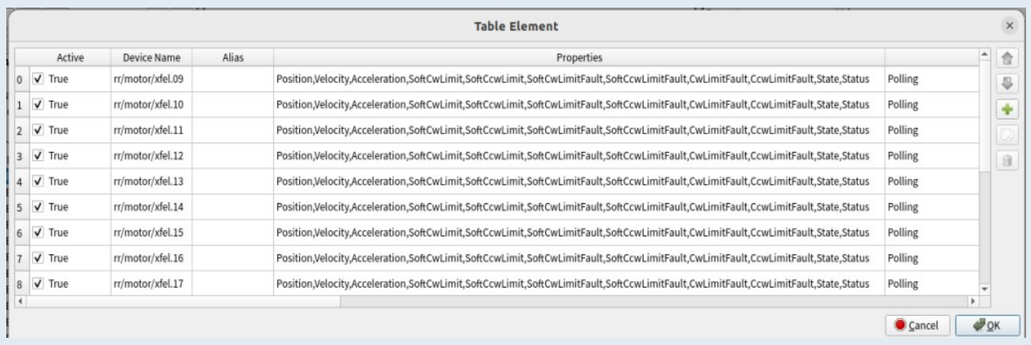

Figure 2 - The TangoMirror table for Tango devices and parameters configuration

The TangoMotor device

A more specific Karabo device has been implemented, to control motor controllers which come with a Tango server through Karabo: the TangoMotor. It implements the standardized Karabo motor interface, which makes the motor user interface more familiar to EuXFEL beamline scientists [Fig. 3].
More importantly, it also allows the motor controllers to be operated seamlessly by other Karabo software, the primary example being Karabacon, the Karabo scan tool [7].
The mapping of Tango motor parameters to the standard Karabo ones is user-configurable, as well as the mapping between state machine states [Fig. 4].

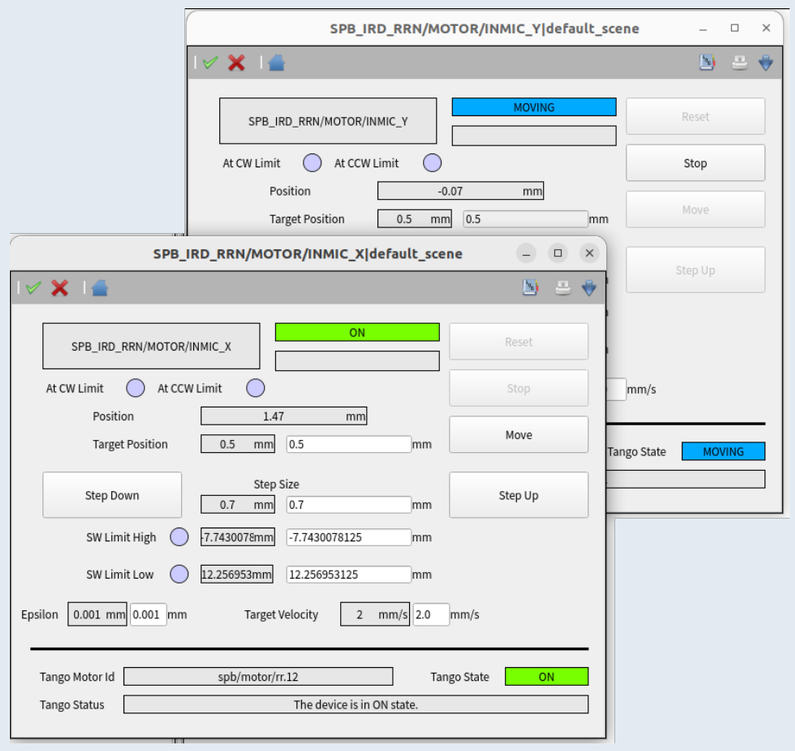

Figure 3 - The TangoMotor user interface

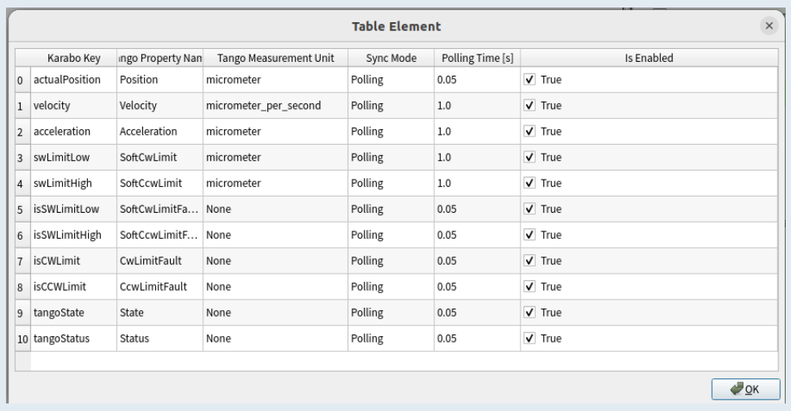

Figure 4 - The TangoMotor parameter mapping table

Exposing Karabo devices to other control systems

For the inverse process, i.e. exposing Karabo software devices to other control systems, including Tango, the Karabo Proxy is available [8]. It exposes Karabo device properties by means of a REST API and can be configured to provide read-only or read-write access.
An EpicsMirror device has been recently developed as well, to provide a similar interface with the EPICS control system [9].

References

[1]: 10.1107/s1600577519006696
[2]: www.karabo.eu
[3]: European XFEL Annual Report 2023
[4]: https://www.xfel.eu/users/policies/index_eng.html
[5]: www.tango-controls.org
[6]: pytango.readthedocs.io/en/stable
[7]: https://indico.psi.ch/event/12738/contributions/38938
[8]: https://github.com/European-XFEL/karabo_proxy
[9]: epics-controls.org

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