

Back to the future with the Recovery Portal: a tool to restore control system components at European XFEL

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Introduction

The stable and continuous operation of large-scale distributed control systems is based on well-established configuration management and data logging. During service interruptions control system components may lose crucial configurations and restoring these to a working condition may take time, resulting in reduced operation hours. To avoid fixing system components one by one an overall recovery procedure and tools can be used. In this contribution a software solution for restoring control system components to an arbitrary point in the past at the European XFEL is presented.

Use case

Typically large scale distributed control systems consist of a large amount of sensors, actuators, motors, cameras and other hardware components. Configuration and operational parameters of these devices are either stored directly on the hardware or hosted at PCs connected to them. This critical information might be lost due to:

- Unplanned service interruptions like power cuts, hardware misuse and failures, or network outages.
- Planned maintenance actions like software and service updates, hardware upgrades and replacements, scheduled facility shut downs.
- Cyber attacks and misuse of centralized IT services.

Therefore it is crucial to have a safe and reliable configuration management system capable to restore device configuration and working condition in a short time.

Karabo control system at European XFEL

Karabo is an event driven distributed control system, developed and in use at European XFEL [1]. Based on a central AMQP broker, it provides Python and C++ APIs for hardware integration. It performs extensive data logging by means of Influx DB [2]. Software components providing access to hardware and user oriented higher level controls are organized in services and so called Karabo devices. A Karabo device provides read/write attributes and slots, that can be used to trigger a command on a device and are grouped in projects [Fig. 1].

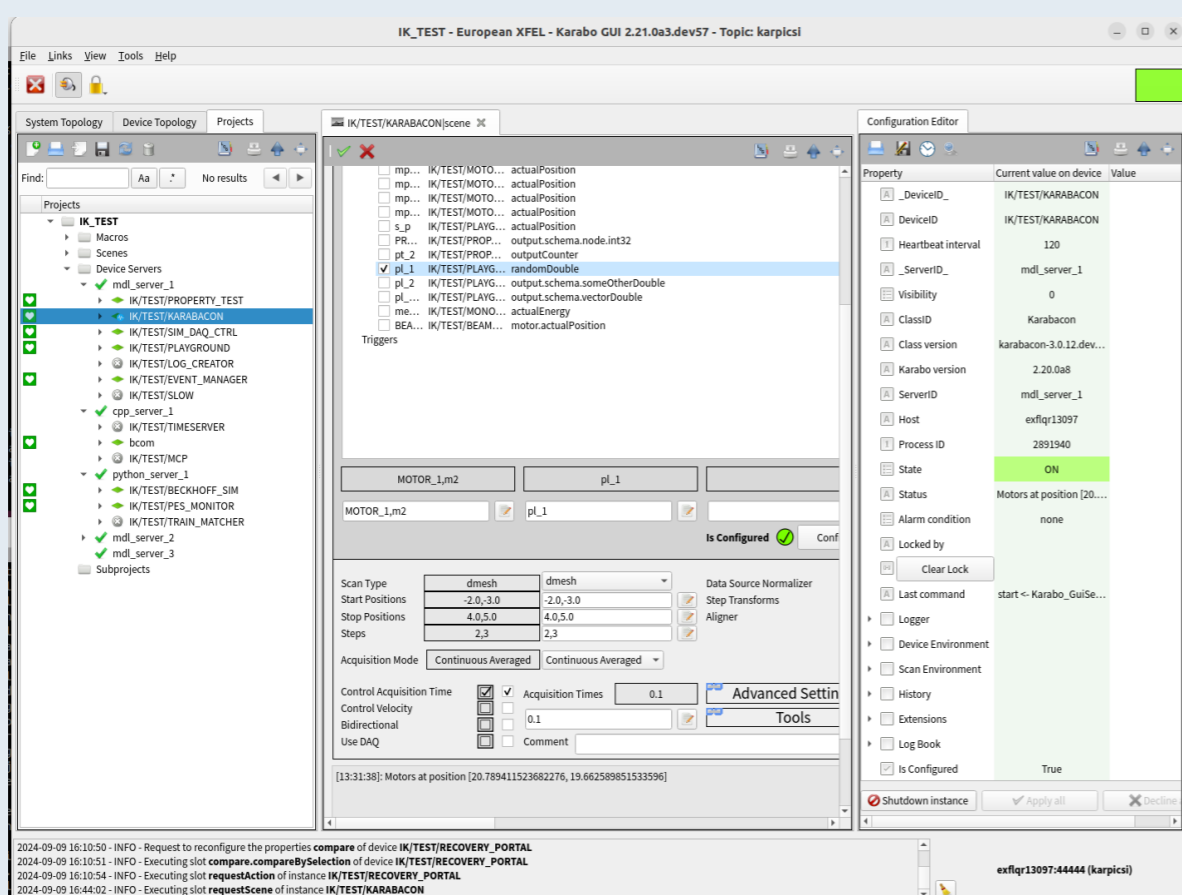


Fig. 1. Karabo GUI displaying project with device servers and devices as a tree on the left, device or project provided scene in the center and device configuration (attributes and slots) on the left.

Typically, Karabo devices are instantiated manually by clicking on the device or device server name and issuing "Instantiate Device" action. Karabo ecosystems at EuXFEL are organized into topics, that are reflected in several projects. An instrument may have several projects, device servers and devices (counted in thousands) and in the case of central deployment or topic-wide startup manual bring up of devices is tedious and error prone. Therefore a new device, called the Recovery Portal for automatic bring up and reconfiguration has been developed.

Recovery portal

Recovery portal is a Karabo device written in Python and provides two main functions:

- To avoid manual start of Karabo devices, recovery portal provides a step-by-step device bring up and condition recovery procedure (Fig.2):
 1. User has to select a time point in the past.
 2. If necessary filter devices by type or name.
 3. Retrieve historical information of the selected devices.
 4. Instantiate selected devices.

After the bring up procedure a summary table is populated and the user can inspect action results, compare device attributes and apply historical configurations.

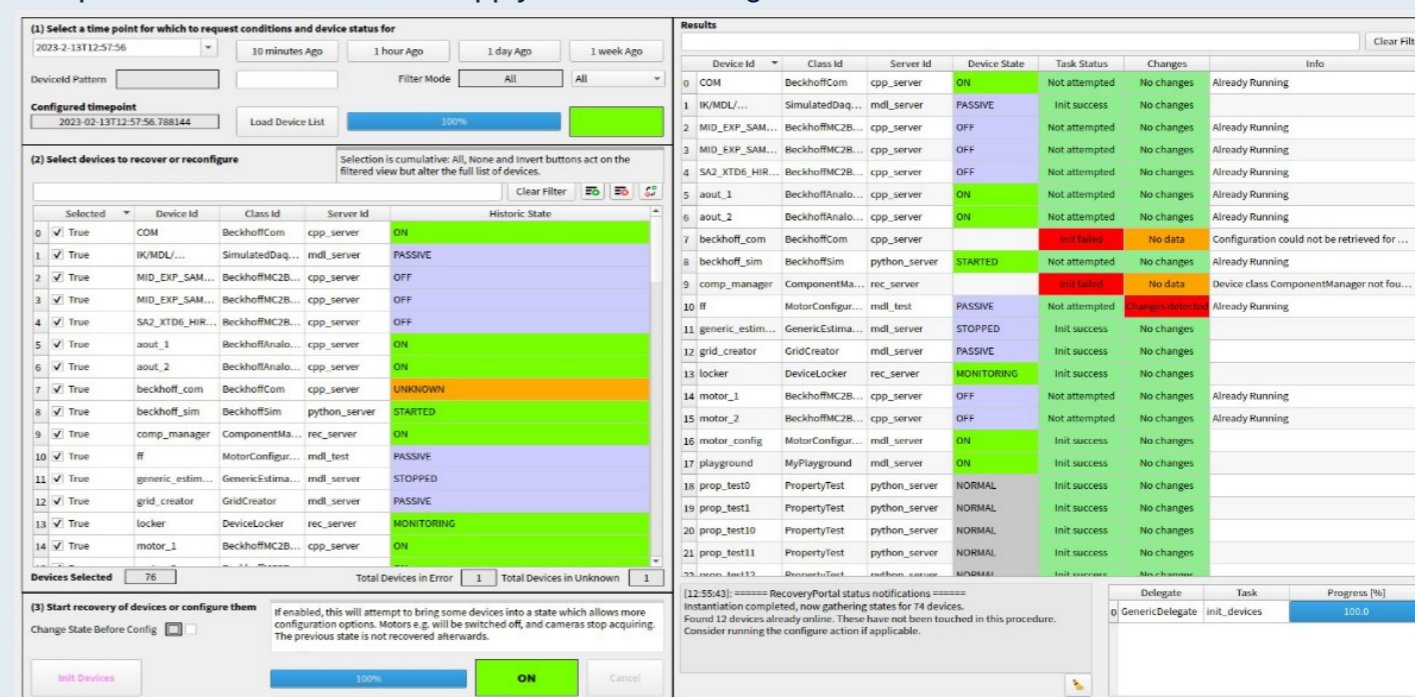


Fig. 2. Recovery portal scene to instantiate and reconfigure devices.

- The comparison of device parameters allows to inspect and compare historical and actual device attributes (Fig. 3). Similar to bring up procedure, the user can select a time point in the past and filter devices by type. The device selection contains "Critical Parameter Devices" that will list devices with predefined critical parameters important for the stable operation of instruments. Double clicking on the device row opens a dialog displaying device attributes with different past and present values.

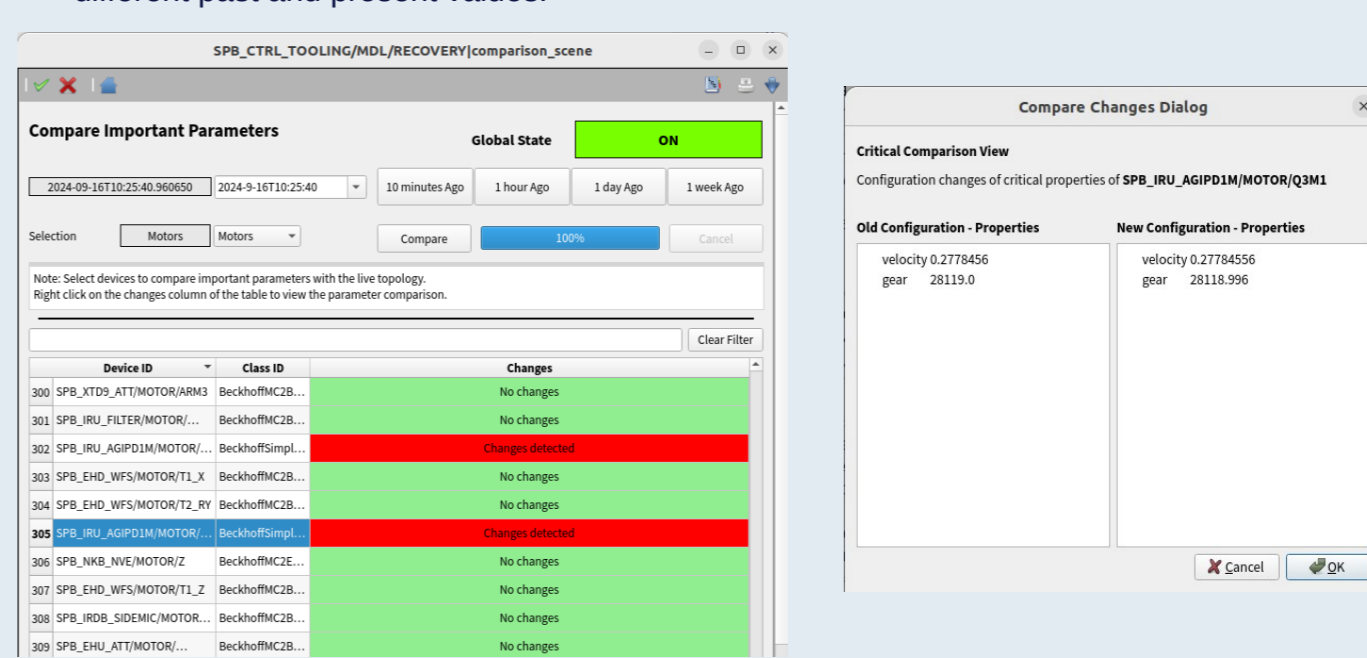


Fig. 3. Comparison of historical and actual device parameters.

Summary

- The Recovery Portal provides a uniformed tool to bring up Karabo devices and retrieve and apply their configuration from past.
- Recovery Portal simplifies bring up of Karabo control system components and reduces the down time of the control system.

References

- [1] Hauf, Steffen, et al. "The Karabo distributed control system." Journal of synchrotron radiation 26.5 (2019): 1448-1461.
- [2] Fluke Gero, et al. "Experiences with Datalogging to InfluxDB at the European XFEL". NoBugs conference 2022.