

TANGO ACTIVITIES IN BINP

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Abstract

Several years of experience using TANGO Control system are discussed in this paper.

Construction of Linear Induction Accelerator (LIA-20) was the driving force for introduction of TANGO in Budker Institute. In the frame of this project, significant number of TANGO Classes for different types of hardware were developed and basic program infrastructure was provided. This progress made it feasible to apply TANGO to other facilities. Therefore, it was used in some subsystems at VEPP-2000 and vacuum stand. This paper presents overview of construction of TANGO based control system. The problems, which arise during its introduction to existing control system, are discussed as well.

INTRODUCTION

In 2015, construction of Linear Induction Accelerator (LIA-20) was started. It will provide electron beam with energy 20 MeV, current up to 2kA and lateral size after focusing on the target less than 1 mm. Channels number and types presented in Table 1. For this project, it was decided to develop new hardware and new control system [1].

Table 1: Number of Channels

Type	Channel Number
Fast (<10 us)	594
Slow (> 10 us)	1485
Timing	1485
Interlock	1485
Technological control	1000
Total	6000

The expected lifetime of this facility is longer than 10 years, so it is necessary to pay attention to overall control system design and to selection of components. The experience gained during construction and operation of other facilities, such as VEPP-2000 and LIA-2, enable us to formulate general and technical requirement.

General requirements:

- Maintainability.
- Extensibility. Extension of system should not result in complete redesign of CS.

- Reusability. It should be possible to apply some solutions to other facilities.
- The use of outdated technologies should be avoided.

Technical requirement:

- It should be distributed control system.
- Ecosystem. Utilities, scripting, archive system and tools for rapid user interface (UI) development should be available.

TANGO satisfies these requirement. It is developed by consortium which consists of more than 10 scientific organization, such as ESRF, ALBA, MAX IV, SOLEIL, SKA, etc. Therefore, the risk of being abandoned in nearest future is significantly reduced. Moreover, large user community increases chance to find and to correct errors on early stages. It is worth to mention that TANGO was chosen at “Nuclotron-based Ion Collider fAcility” (NICA)[2].

TANGO has a rich ecosystem:

- Core libraries in C/C++, Python, Java
- Bunch of utilities for development and monitoring (Pogo, Jive, Astor)
- UI library: Taurus, ATK
- HDB++ archiving system

TANGO AT LIA-20

Creation of CS was started in the late 2015. Tight schedule of facility construction demanded to provide a test stand for accelerating modules and pulsed power supplies as soon as possible. So it was decided to divide development into two stages. At first stage, all hardware was provided with Tango Class and client program. These programs form minimum viable control system and serves as building blocks for software of the second stage. The second stage involves creation of high-level programs that operate in terms of entire facility.

The test stand was equipped with prototype of software at the end of first quarter of 2016. One year later, in first quarter of 2017, 5 MeV version of LIA-20 was put in operation. By that time, almost all VME [3] and CANBus devices were supported and the first stage accomplished.

The second stage was aimed at providing software that will facilitate operation of the facility. Work was started with Time Editor [4]. This program provides a way to define all delays and sequence of events as set of equations.

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Another important direction was oscillograms viewer. For this purpose unified Waveform Viewer was developed. It allows to combine oscillograms from different sources and provides oscilloscope like user interface (Fig. 1).

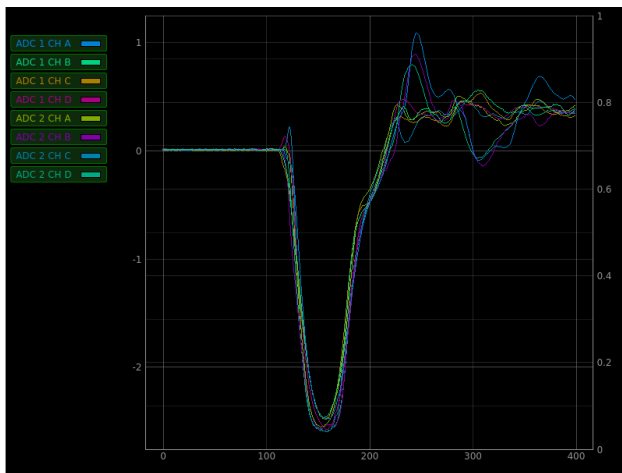


Figure 1: Waveform Viewer.

With growing experience, it became evident that some solution could be useful for whole TANGO community and should be shared. This activity has started with patch to HDB++ viewer and continued by publishing PostgreSQL backend for HDB++.

As it expected that Python 2 will not be maintained after 2019, it was decided to assist with porting Taurus to Python3.

TANGO COURSES

From the very beginning, it was clear that relying only on TANGO community is not enough, and it is necessary to grow a user group at BINP. To involve more developers and users in activities the training course was held in June 2017.

The course was based on Tango 8, PyTango, Taurus and Tango Class for NI-PXI-6251. The Tango Class was provided by NICA team.

The course was divided into three sections:

TANGO overview. In this section structure and basic components are discussed.

User section. It covers interaction with device server using PyTango and creation of user interface with Taurus. The aim is to provide skill necessary for obtaining data from control system or prototyping user client program.

Developer section. This section is for experienced users and developers. includes writing device servers in Python and C++.

PROMOTION IN BINP

VEPP-2000 Integration

Next important step is introducing to existing facilities with subsequent replacement whenever possible. The col-

lider VEPP-2000 became the first one. Since VEPP-2000 is in operation, modernization of entire control system at one go is impossible. Therefore, it was decide to make small isolated changes that could not cause significant impact on whole system. Two approaches are used Adapter and Gateway (see Fig. 2).

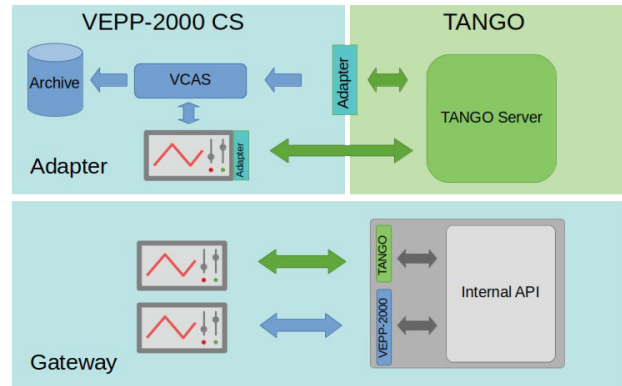


Figure 2: Integration approaches.

Adapter approach is used when access to TANGO-based subsystem is needed. The common use-cases are plotting, transferring data to archive system.

Gateway approach, whereas, in contrast, is used when particular service are tightly coupled with entire system. To facilitate future migration TANGO is provided as secondary interface to inter API, so that it could be use with the old one in parallel. This approach will be used for modernization control software of pulse subsystem.

The first subsystem that was integrated is a beamline for vacuum experiment for LHC-HL [5]. It is independent experiment and uses adapter for transferring data to archiving system. The second one is BeamShaker [6]. It communicate both VEPP-2000 CS and TANGO.

The beamline and Beamshaker use Tango Classes developed for LIA-20: Stepper Motor Controller and general purpose DAC.

Supported hardware

Traditionally, most of hardware used at BINP facilities is in-house. Therefore, successful depends on number of devices supported.

Nomenclature of existing devices is so large that providing support for all of them is impossible. And it was decided to divided into three groups:

- **Modern.** All devices that were developed during last 5-10 years. These devices already provided with Tango Class or will be provided soon. It is CANBus and new VME devices.
- **Possible.** It is widespread devices, that in use but not recommended for new project. Tango Device could be developed on demand.
- **Legacy.** These devices will not be supported.

Figure 3 shows status of devices. Supported devices marked with green colour, unsupported with grey colour and that will supported soon with yellow.

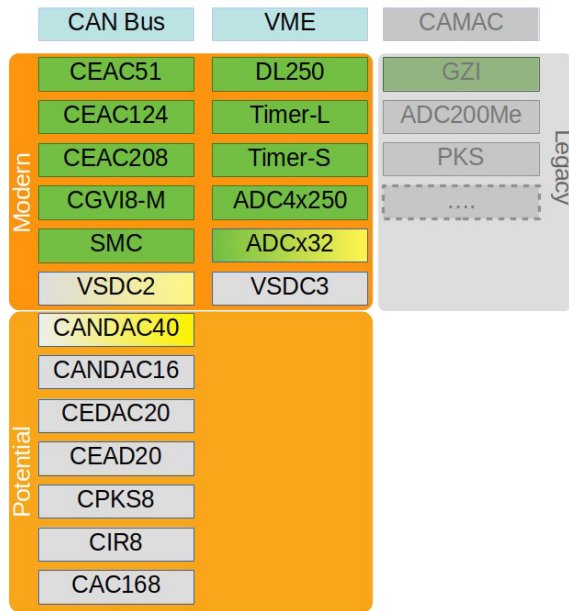


Figure 3: Supported devices.

FURTHER WORK

During last years several new facilities were proposed: Super-Charm-Tau factory (SCT) and Synchrotron Radiation Source “SKIF”. The experience gained during last few years makes it reasonable to consider TANGO for control systems of these facilities. However, it is expected that beamlines at the “SKIF” will use TANGO. Prototyping was started at the beamline at the VEPP-4.

Besides, mentioned facilities TANGO will be used for electron-cooling system for NICA. Construction of this system is starting soon.

In a view of these projects, it is necessary to keep involving people to TANGO activities. Therefore, it was decide to organize training course.

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