TANGO WEB ACCESS MODULES AND WEB CLIENTS FOR NICA CONTROL SYSTEM

Georgy Sergeevich Sedykh, Vladimir Gennadjevich Elkin, Evgeny V. Gorbachev, JINR, Dubna, Russia

Abstract

NICA (Nuclotron-based Ion Collider Facility) is a new accelerator complex designed at the Joint Institute for Nuclear Research (Dubna, Russia) to study properties of dense baryonic matter. The report describes Tango-modules designed at JINR to provide web-access to Tango-based control system. RestDS is a lightweight Tango REST service, developed in C++ with Boost and OpenSSL libraries. It implements Tango REST API and Tango JINR REST API; WebSocketDS is a lightweight Tango WebSocket service, developed in C++ with WebSocket++, Boost and OpenSSL libraries. It implements Tango attributes reading and command executing through WebSockets. The report also gives examples of web client applications for NICA control system, using these services.

INTRODUCTION

The Nuclotron-based Ion Collider fAcility is a new accelerator complex being constructed at JINR. It is aimed to study the properties of nuclear matter in the region of the maximum baryonic density. It includes injection complex, new superconducting booster synchrotron, the existing superconducting heavy ion synchrotron Nuclotron, collider having two new superconducting rings and new beam transfer channels [1]. NICA accelerator complex general scheme is shown in Fig 1.
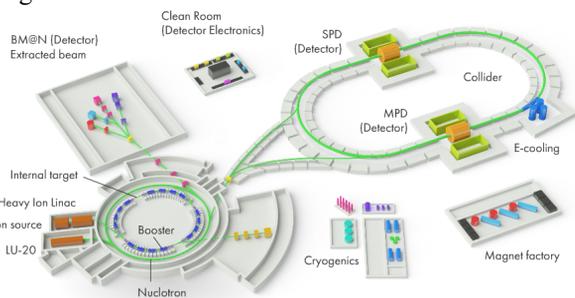

Figure 1: NICA accelerator complex general scheme [2].

NICA control system is based on Tango Controls framework - free open source device-oriented controls toolkit for controlling any kind of hardware or software and building SCADA systems [3]. The client applications are traditionally developed using LabView or Taurus frameworks.

In recent years, there has been a rapid development of web technologies. Now there is an opportunity to develop cross-platform, flexible, fast and convenient web applications. The idea to create web client applications for the control system seems to be promising. To achieve this goal universal tools for communication between Tango Controls and web clients are required. The most common data transmit technologies are WebSocket and REST.

WEBSOCKET

WebSocket is a computer communications protocol, providing full-duplex communication channels over a single TCP connection. It enables interaction between a browser and a web server with lower overheads, facilitating real-time data transfer from and to the server.

WebSocketDS [4] is lightweight tango module that is used to communicate tango devices to the outside world through the WebSocket. It was developed in C++ with Boost, OpenSSL and WebSocket++. Requests and responses are encoded in JSON.

WebSocketDS supports:
- Periodic attributes reading;
- Attributes reading on demand;
- Commands execution;
- Events subscription (change, periodic, archiving, user);

There are several modes of WebSocketDS operation. If the server mode is used, the server controls the information, being red from tango. The client mode means the user-defined data comes from server.

WebSocketDS is being operational in beam intensity measurement system at the Nuclotron, and also in injection complex diagnostic system. The WebSocketDS general operational diagram is shown in Fig 2.
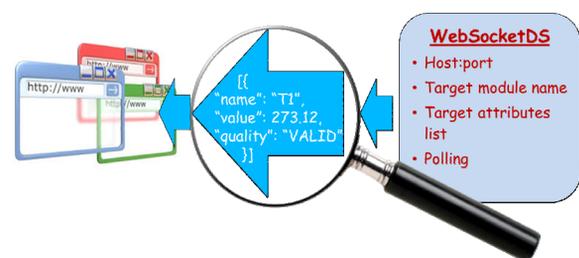

Figure 2: WebSocketDS general operational diagram.

REST

REpresentational State Transfer is set of architectural principles to design web services that focus on system's resources. Every resource is identified by its Unified Resource Locator (URL). URL is unique within controls system. REST-compliant Web services allow requesting systems to access and manipulate textual representations of Web resources using a uniform and predefined set of

stateless operations, defined in Hypertext Transfer Protocol (HTTP).

Tango REST Application Program Interface specification have been developed by Tango community [5]. The current version is RC4. It specifies attribute reading/writing, command executing, properties setting/getting, pipes reading/writing, using authentication, request and response format and error handling.

RestDS [6] is a lightweight Tango module, designed to provide access to Tango control system units through http requests. It was developed in C++ with Boost and OpenSSL. RestDS partially implements Tango REST API RC4. It supports plain (http) and secured (https) connections and basic authentication mechanism.

RestDS supports:

- To read/write single or multiple Tango attributes;
- To execute Tango commands with/without parameters;
- To get devices, attributes and commands info;
- To browse devices, attributes and commands within control system;
- Operations with Tango device properties and pipes are being developed and tested.

RestDS is used in the control system of the NICA superconducting magnets cryogenic test bench and in beam diagnostic systems at the Nuclotron. The RestDS general operational diagram is shown in Fig 3.
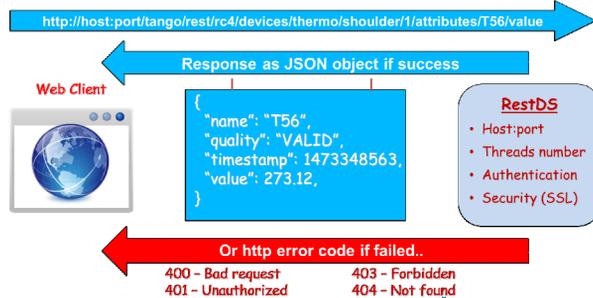

Figure 3: RestDS general operational diagram.

WEB ACCESS CONTROL

For security reasons the custom permission control system is used [7]. It implements the server-side role-based Tango access control system. It also serves for logging.

WEB CLIENT EXAMPLES

Web client applications are becoming widely distributed within the NICA Control System. There are simple JavaScript applications developed with help of jQuery [8] and HightCharts [9] libraries, and there are also complicated and flexible applications, developed with Sencha ExtJS framework [10]. It allows to create very flexible and powerful applications in the form of web desktop. Some web clients are in permanent operation for more than 3 years, and have been recommended as reliable and convenient applications.

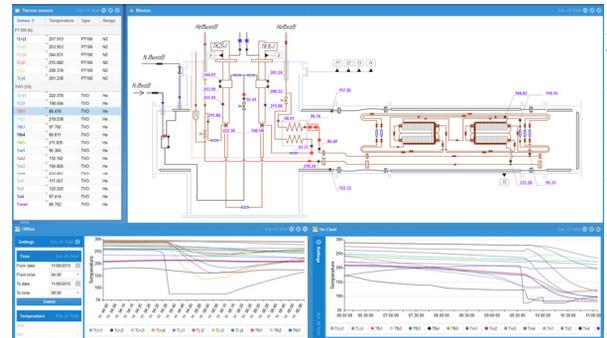The examples of NICA web client applications are shown in Fig 4, 5 and 6.

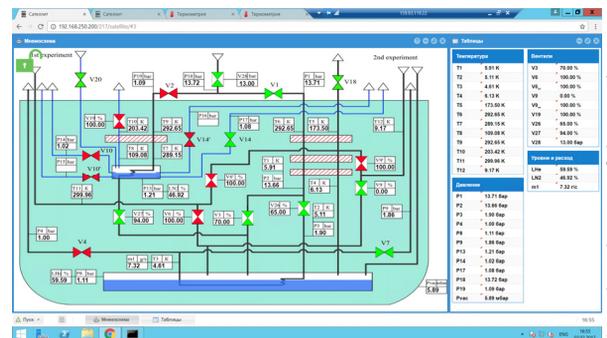Figure 4: Thermometry system web client application screenshot.

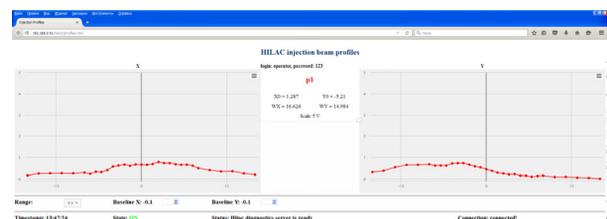Figure 5: Satellite refrigerator control system web **client** application screenshot.

Figure 6: Injection complex beam diagnostics web client application screenshot.

PLANS

- To implement the Tango REST API RC4 fully support to RestDS.
- To implement support of the industry-standard protocol for authorization OAuth 2.0.
- To develop the comprehensive documentation.
- To develop the generic data web browser for Tango. It should display historical data from HDB++ and live data from Tango attributes.
- To develop built-in lightweight generic Tango web client.

CONCLUSION

- Web client applications are cross-platform, well-looking and convenient;
- Web clients are widely distributed within the NICA Control system;
- Tango web access modules have been developed to provide universal way to communicate between web client and Tango-based control system.

REFERENCES

[1] G. Trubnikov, A. Sidorin *at al.*, "The NICA project at JINR", in *Proc. IPAC'16*, Busan, Korea, May 2016

[2] NICA accelerator complex official website, http://nica.jinr.ru/

[3] Tango Controls official website, http://www.tango-controls.org/

[4] WebSocketDS git repository, http://tangodevel.jinr.ru/git/elkinvg/WebSocketDS.git

[5] Tango REST API RC4 specification, http://tango-rest-api.readthedocs.io/en/latest/

[6] RestDS git repository, http://tangodevel.jinr.ru/git/tango/web/RestDS.git

[7] E. Gorbachev, "Development of NICA Control System: Access Control and Logging", in *Proc. ICALEPCS'17*, Barcelona, Spain, Oct. 2017, paper TUPHA171.

[8] jQuery library official web site, https://jquery.com/

[9] HighCharts library official web site, https://www.highcharts.com/

[10] Sencha ExtJS framework official web site, https://www.sencha.com/products/extjs/#overview