

TANGO MODULE FOR WEBSOCKET CONNECTION

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WebSocket is a computer communications protocol, providing full-duplex communication channels over a single TCP connection. This module allows carrying out both monitoring and management of TANGO devices. The module also has several modes of operation. Depending on the selected mode, you can control one or more of required tango devices. The exchange of messages between the client and the server is in JSON format.

Keywords: TANGO, WebSocket

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1. Introduction

TANGO Controls is an object oriented control system based on CORBA for Windows, Linux and Unix. It is a free open source controls toolkit for controlling any kind of hardware or software and building SCADA systems. This system is used for controlling various kinds of lasers, synchrotrons, physics experiments [1]. It is being actively developed by a consortium of research institutes including JINR.

TANGO Controls is based on the concept of Device Servers. Devices implement service oriented and object oriented approaches to software architecture. At the moment, TANGO is actively used by the Nuclotron control system.

In TANGO, there are various tools for creating client applications. It's TangoATK (JAVA), QTango (C++), Taurus (Python) also LV bindings (LabView). They all use the standard TANGO protocol (CORBA) for data exchange.

For greater versatility, a TANGO module that provides communication via the standard WebSocket protocol was developed.

2. HTML5 WebSocket protocol

WebSocket [2] is a revolutionary new communication feature in the HTML5 specification, which defines a full-duplex communication channel that operates over the Web through a single socket. WebSocket is not just another incremental enhancement to conventional HTTP communications; it represents a major advance, especially for real-time, event-driven web applications.

To establish a WebSocket connection, the client and server upgrade from the HTTP protocol to the WebSocket protocol during their initial handshake.

The WebSocket protocol is currently supported in most major browsers including Google Chrome, Microsoft Edge, Internet Explorer, Firefox, Safari and Opera. WebSocket also requires web applications on the server to support it.

3. WebSocketDS TANGO module for WebSocket connection

This TANGO module is used to connect TANGO devices with the outside world using the WebSocket protocol. It supports automatic retrieval of updated data, acquisition of data on demand, and execution of commands. The TANGO-protocol's possibility of communication can be limited by a firewall. However, the WebSocket allows one to connect to standard ports (http:80 or https:443).

The WebSocketDS TANGO module supports the following features:

- periodic attributes reading;
- attributes reading on demand;
- commands execution;
- TANGO events subscription (change, periodic, archiving, user).

There are several application modes, which are a combination of the client and server modes, or only the server mode or only the client mode.

In the server mode, it is allowed to read TANGO attributes and pipes, as well as execute commands for the TANGO device (group) specified in the properties for the module.

If the client mode is used, the client can manage the updated data. The client manages both the value of the update period and the content of the data (the list of TANGO attributes and pipes). Single execution of a TANGO command, as well as reading data from TANGO attributes and pipes, is also possible.

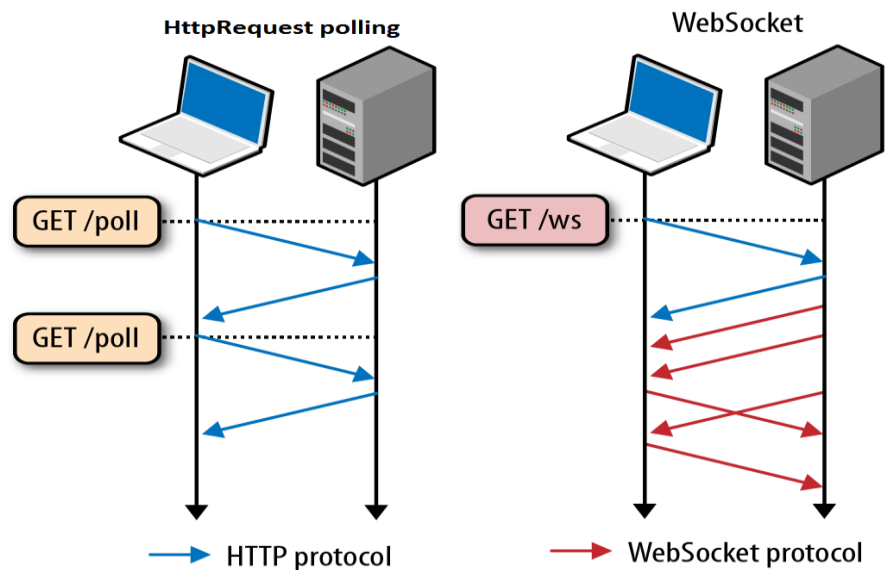


Figure 1. How WebSocket works

Access to TANGO devices can be easily provided by using one or more WebSocketDS devices. Several WebSocketDS devices with different modes can be used for tasks separation. A client application can retrieve the data from any subscribed TANGO device or execute a command on it by sending a request in JSON format.

Compared to other protocols, such as REST (http), the ability to subscribe to events allows a significant reduction in network traffic. Once the connection is upgraded to WebSocket, messages can flow from the server to the browser the moment they arrive (see Figure 1).

Client programs can be written in any programming language supporting WebSocket. At the present time, support is available in almost all languages. Browser applications (with a special Javascript object created) and desktop applications can be used as clients. To create desktop applications, there are libraries for almost all modern environments: QT, C#, boost, python and others. JSON format is used for requests and responses.

4. Connection security

Various methods are used to protect the connection when executing commands. Different authentication methods can be used. In case of the standard method, a login and password are sent in URL. For example, `ws://host?login=login&password=pass`.

There are several implementations that use the random identifier method. Instead of a password, two values are sent to the server. The first one is the word sent by the server (can be sent by any method). The second is the response from the client, calculated from the first one by the method known to the server. Authentication is carried out in several stages. The implementation depends on the server responsible for authentication. For example:

- The client sends a message requesting a random number.
- The server generates a random number, stores and sends it to the client.
- The client calculates (depending on the requirements of the authorization module) the required response, and sends it to the server.
- The server sends a response. (OK or not)

5. WebSocketDS module usage

WebsocketDS TANGO module is actively used in the control system of LHEP JINR LU-20 linear accelerator (Figure 2).

There are two TANGO devices for monitoring the temperature of the cooling system. There are TANGO devices for controlling the power sources of the hard focus magnetic lens. The client applications are using WebSocketDS to communicate with these TANGO devices. It's also planned to use this module for future client applications.

The module is also used in the Nuclotron beam slow Extraction web client [5].

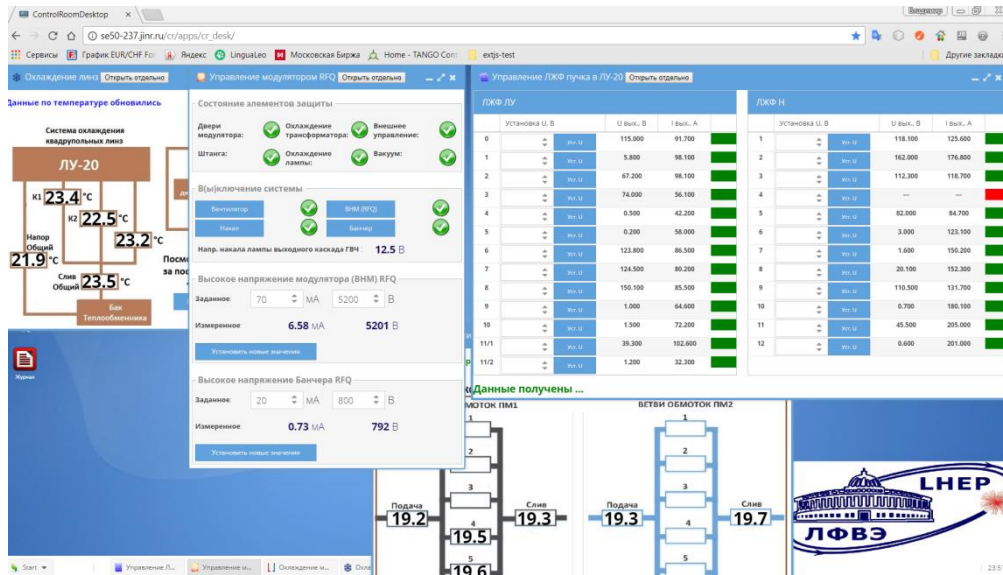


Figure 2. Web clients for control system of LU-20

Access to the WebSocketDS source code is provided via TANGO community web site [6], and Git repository at tangodevel.jinr.ru [3].

6. Conclusions

The WebSocketDS Tango device server has been developed. It provides access to TANGO control system components via WebSocket protocol and allows communications between TANGO devices and Web or desktop client applications. The WebSocketDS module is successfully used in the control system of the LU-20 linear accelerator (LHEP JINR).

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