1. Introduction

Measurement instruments calibration is a significant part of the metrology activities. The recent development of information technologies allows implementing the calibration procedures on the basis of automated measuring instruments and computers interaction via the Internet.

Remote calibration is performed for devices installed on sites other than its permanent calibration facility, normally by the common method associated with relevant instruments and exchanging information related to the calibration with its customers, without personnel of the accredited laboratory being present [1].

Usually, remote calibration system provides such functions as:

- remote control and monitoring the measuring equipment;
- measurements which are performed at a customer location but controlled remotely by the calibration facility;
- transmitting data, relating to calibration and environmental conditions, to the customer, if necessary; and
- access to measurement and calibration history and other related data of each instrument [2, 3].

Remote calibration allows to carry out measurements faster and more efficient, especially in cases when the calibration of some instruments is more expensive than instruments cost. Besides, sometimes equipment that needs to be calibrated is inaccessible for people because of the hard usage environmental conditions.

This paper presents remote calibration system, which is realized using the LabView virtual instruments (VIs) technology.

2. General description of the remote calibration system

In the paper the remote calibration system which has been developed in the Department of computer-aided measurement systems and metrology in TPU is considered.

The remote calibration system is executed on a client-server architecture. Program for remote calibration consists of two VIs: client-VI and server-VI.

Server-VI is opened and run on the computer directly connected to the test equipment. The needed software such as LabView with the set of specific instrument drivers must be installed on the servers’ computer. Test equipment is connected with the server computer via GPIB interface. Client-VI can be run on every remote computer that has Internet connection. Client computer does not require any additional software installation.

Server-VI receives the commands from the client-VI and sends them to the test equipment via the selected interface. It reads the measurement data from the instruments and transmits this information to the client-VI over the Internet connection. In this system, the server-VI has to be run first, and the client-VI will then connect to it using information about the IP-address and the port number of the computer.

Front panels of the client-VI and server-VI, which are intended for digital multimeter NI PXI-4072 remote calibration in AC Voltage mode, are shown in Fig. 1 and Fig.2 appropriately. Test equipment includes multifunctional calibrator Fluke 5520A and digital multimeter NI PXI-4072 as a device to be calibrated. Connection between client-VI and server-VI is implemented using TCP/IP technology.

![Remote calibration system](image)

**Fig.1.** Client-VI front panel of the remote calibration system

After connecting test equipment to computer and running both server-VI and client-VI, user specifies the IP-addresses and ports numbers of the remote and local computers. On the client-VI front panel, user selects calibrator output function (e.g., “Volts AC or volts DC with 0 Hz” to measure AC voltage) and enters the desired calibrator output values.
The calibration protocol includes the following information:
1) Rated value;
2) Fundamental frequency;
3) Measured value;
4) Range;
5) Absolute error;
6) Related error;
7) Permissible error.

To check whether the instrument passed the calibration, system compares the measurement error with the passport error values. If one of the absolute errors exceeds the permissible error value, the led opposite the exceeded value will become red. AC accuracy specifications of the digital multimeter have the following form. The 2 year accuracy of the meter is ±(% of reading + % of range) at the operating temperatures (23 ± 10 °C). Based on the above specifications, the uncertainty at AC voltage reading can be found. For example, for AC voltage reading of 3.0000 V with a frequency of 100 Hz (measured at 5.0000 V range) the uncertainty is ±(3.000×0.0005 + 5.0000×0.0002) V = ±(0.0015 + 0.001) V = ± 0.0025 V (or 0.083%) [4].

3. Conclusion
Remote calibration system provides remote execution of the calibration procedure, automatic acquisition and rapid calibration results processing. The main advantage of remote calibration is that calibration procedure is automated, and it is required just minimum human’s involvement. Remote calibration system based on virtual instrument technology has client-server architecture that allows to send commands and to receive data remotely via the TCP/IP protocol. Today remote calibration technology is urgent for implementing in large companies, which have a lot of branches distributed all over the world, and it is necessary to provide intensive equipment calibration schedule.

References