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Automation of Tests for Power Electronic Meters

Diego C. Maia Santos[1], Karla K. O. Silva[1], StephanieA. Braga [2], Vagner Henrique [2], Antônio A. C. Lima [1], Alaim Assis[3], Paulo Facó[3], Gabriel Habib[3], Jânio A. Oliveira[3], Henrique Innecco[3], Samir S. Ribeiro[2], Paulo R. C. Araújo [2], Rafael A. Freitas [1], Caio C. H. Cunha [1], Cilis A. Benevides[1]

[1] WDA Tecnologia da Informação; [2] Instituto Federal do Ceará; [3]Eletra Energy Solutions

E-mail: Cilis.benevides@gmail.com; caio.cunha@wdatecnologia.com.br

Resumo: A evolução da microeletrônica permitiu que os medidores eletrônicos de energia pudessem se comunicar com outros equipamentos. Essa comunicação possibilita que as grandezas desses equipamentos possam ser lidas ou alteradas em uma fase de validação, na indústria de medidores. Com a grande demanda na fase de validação devido ao aumento da comercialização de novos medidores eletrônicos, surgiu a necessidade de um procedimento de testes mais ágil. Essa necessidade fomentou a criação de um ambiente de testes automatizados que permite o teste de múltiplos e diferentes medidores eletrônicos instalados na bancada de testes de medidores da Eletra Energy Solutions.

Palavras-chave: Comunicação com medidores de energia; Testes automatizados; Plataforma multiprotocolo; Desenvolvimento real.

Abstract: The evolution of microelectronics allowed the power electronic meters to communicate with other equipment. This communication enables the quantities of such equipment to be read or changed in a validation stage, at the meter industry. With a big demand in the validation stage due to the increased commercialization of new electronic meters, the need for a more agile test procedure arose. This need fostered the creation of automated test environment that allows testing of multiple and different electronic meters installed on the test bench of Eletra Energy Solutions.

Keywords: Communication with power meters; Automated testing; Multiprotocol platform; Real development.

1. INTRODUCTION

Currently, the power electronic meters comprise microprocessors that allow their communication with other equipment. This communication can be wired or wireless, and can be performed via some important communication protocols, such as associaçãobrasileira de normastécnicas ABNT (NBR 14522) [1] and device language message specification (DLMS) [2]. Before the power meter industry markets its products, it must test them. With the advent of the smart metering [3, 4], modern power meters can communicate with other equipment via serial or wireless communication, and this fact allows the meters to be configured or their magnitudes read at the field or in a validation stage. With a big demand in the validation stage due to the increased commercialization of new electronic meters, the need for a more agile test procedure arose. Thus, an automated test environment for these meters becomes essential. For this reason, the following software were developed for the tests of several meters installed on the test bench of Eletra Energy Solution: automated testing software (ATS), bench communication interface (BCI), meter communication interface (MCI), and virtual meter (Vmeter). These software can test power meters of different types, such as THS (ABNT) and DLMS power meters, and validate some meters installed on the test bench in the same validation section without the intervention of a professional to follow these tests.

For the automated testing environment, a virtual meter (Vmeter) software was developed, which simulates a real power meter. Thus, this virtual meter calculates all the quantities of the real meter to be tested for further comparison in the testing phase.

Currently, the automated testing environment validates the following quantities of the THS and DLMS electronic meters: voltages of A, B and C phases; current of A, B and C phases; and active and reactive power of A, B and C phases.

Thus, summarizing the contributions of this study, we can relate: i)developmentofa multiprotocol test environment that will allow the manufacturers to validate their power meters at the testing department; ii) test environment that streamlines the meter testing procedure, reducing the test time and labor savings.

The rest of the paper is organised as follows. In Section 2, the materials and methods are presentedin detail. Section 3 describes the results. Finally, Section 4 concludes the paper.

2. MATERIALS AND METHODS

2.1. Components and development environment

The scenario used to validate the automated testing environment is the meter testing department of Eletra Energy Solutions. This department comprises a meter test bench of hexing manufacturer, capable of validating up to 6 meters simultaneously, a computer that runs Windows 8 OS, and the power electronic meters to be tested. In this environment, there are still portable test benches for the meter validation. This computer runs automated testing software (ATS), that is an important software for the meter testing. It is the coordinating software, which controls all the test actions such as the registration of the test scripts, test bench configuration, sending of read commands to the real and virtual meters, among others. Bench communication interface (BCI) is the software that allows ATS to communicate with the meter test bench in order to configure it or read the bench parameters. Meter communication interface (MCI) enables ATS to communicate with the virtual (Vmeter) and real meters. Finally, virtual meter (Vmeter) simulates a real power meter in order to calculate all the quantities of the real meter to be tested for further comparison in the testing stage.

All these software were developed in Java FX, and Eclipse is the integrated development environment (IDE) that was used to create all the Java methods and classes for this environment.

2.2. Methods

The automated testing environment has a modular architecture that comprises the following software: ATS, BCI, MCI, and Vmeter, and each of them performs the specific configuration and communication tasks.

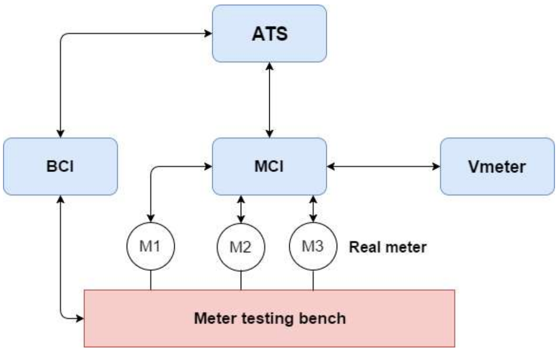

Figure 1. Modular architecture of the automated testing environment

In Figure 1, the automated testing environment architecture is presented. ATS was developed to represent the testing coordinator, which performs the following tasks. It sets, via BCI, the test bench parameters, such as the value of the electrical voltage and the load applied to the meters, as well as periodically monitors these parameters to correct any distortions.

MCI was created to allow the interface between ATS and the meters (real and virtual). After setting up the test bench, ATS sends, via MCI, a magnitude read command to the real and virtual meters. For this purpose, MCI converts a read command of ATS in an octet sequence, compatible with the ABNT or DLMS protocol, corresponding to this command.

Vmeter calculates the requested electrical quantities based on the model of the meter being tested. It receives the read command, identifies the electrical quantities to be calculated, calculates the quantities, and sends back these quantities to MCI. In Figure 2, a flow diagram shows the procedure for performing an automated test using the automated testing environment.

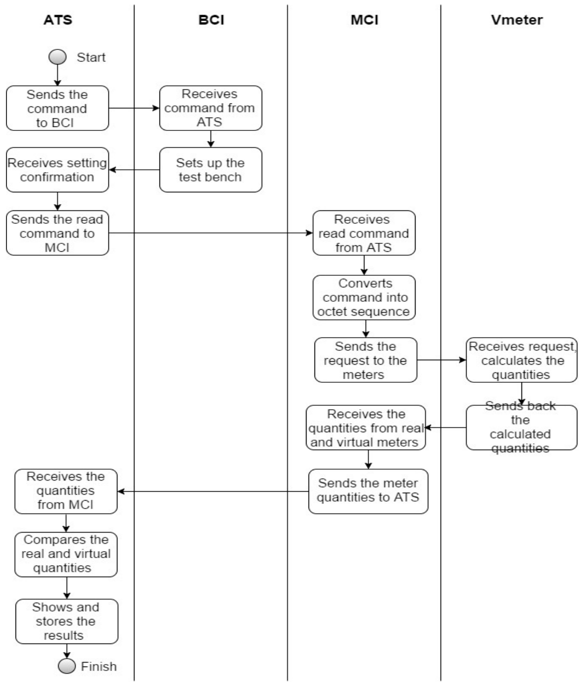

Figure 2. Flow diagram with the procedure for performing an automated test using the automated testing environment.

3. RESULTS

The automated testing environment has been usedto test the ABNT standard meters in the testing department of Eletra Energy Solutions.To present the most important result, a screenshot, displayed in Figure 3,showsthe functionalities of the automated testing environment.

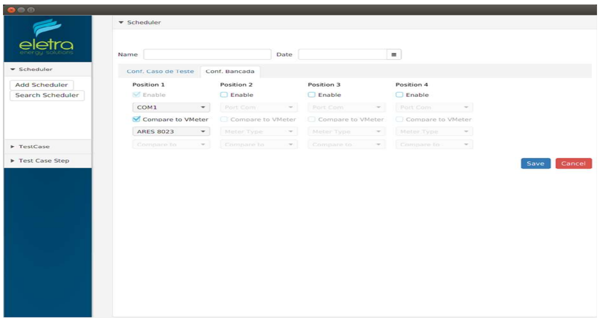

Figure 3. The screenshot with the functionalities of the automated testing environment

At the left side of the screen, the scheduler, testcase, and testcase step functionalities are shown. The scheduler option allows you to configure the test case and the bench, and enables the real meters to be communicated with the ATS. The testcase option allows you to name and set up the test case, set parameters of the test, and start and stop the bench. Finally, the test case step enables the user to configure the interval of the test step, and what the steps will be taken from a test case.

The time saved in the testing stage is another result that has been observed. To prove it, the following scenario was proposed: four electronic meters (Cronos 7023) were installed on the bench; the tester (user) set up manually the bench; the tester read the electrical quantities of the meters; and, finally, calculated and compared the values. The tester performed this procedure 15 times and recorded their execution times. The same procedure was performed by automated testing environment, when the modules ATS, Vmeter, BCI and MCI modules were run to automatically test the fours electronic meters on the bench. This software was used to perform 15 iterations, and on each iteration the software configured the bench, read the electrical quantities of the meters, and, finally, calculated and compared the values. The execution times of these 15 iterations were recorded and are presented in Figure 4, along with the execution times of the manually test.

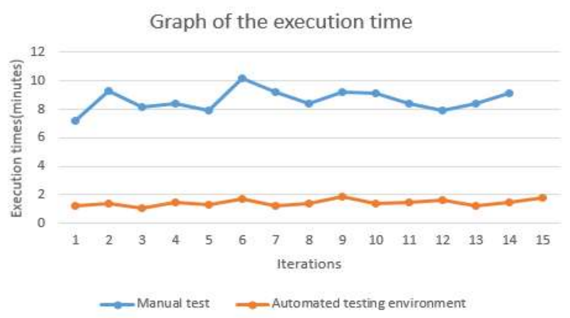

Figure 4. Graph of the execution times related to the manually and automated tests

Based on the graph presented in Figure 4, the automated tests reduced the testing time about 8 times.

4. CONCLUSION

The study presented in this paper resulted in a test environment that reduces the participation of a professional tester in the testing stage of the electronic power meters. This environment, that comprises the software ATS, BCI, MCI and Vmeter, allows a testing stage more reliable and faster. Automated test is more reliable because it reduces the failures or errors through fatigue, or inattentiveness of a professional tester.

Another advantage of this environment is the cost reduction. In this case, the company will pay less worked hours to the professional tester.As presented in the Results section, the time saved in the testing stage with this environment was about 8 times.

5. REFERENCES

[1] Associação Brasileira de Normas Técnicas. 2008. Intercâmbio de informações para sistemas de medição de energia elétrica. http://www.abntcatalogo.com.br/norma.aspx?ID=822

[2] Device Language Message Specification. DLMS – device language message specification. http://www.dlms.com/index2.php, 2014.

[3] Zhao Li, Zhenyuan Wang, Jean-charlesTournier, William Peterson, Wenping Li, Yi Wang. A unified solution for advanced metering infrastructure integration with a distribution management system. *First IEEE International Conference on Smart Grid Communications (SmartGridComm),* 2010.

[4] Mak, Sioe T. Smart meters serving as synchro-sensors for Smart Distribution Grid applications. *IEEE Power and Energy Society General Meeting,* 2011.