**A PROJECT PHASE-I REPORT**

**ON**

**OPTICAL PORT DATA COMMUNICATION USING DLMS COSEM**

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

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**OF**

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**IN**

**ELECTRONICS AND TELECOMMUNICATION**

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**2020– 2021**

**CERTIFICATE**

This is to certify that the project phase-I report entitled

“**OPTICAL PORT DATA COMMUNICATION USING DLMS COSEM**”

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is a bonafide work carried out by them under the supervision of Prof. P. G. Chilveri and it is approved for the partial fulfillment of the requirement of Savitribai Phule Pune University for the award of the Degree of Bachelor of Engineering (Electronics and Telecommunication Engineering)

This project Phase-I report has not been earlier submitted to any other Institute or University for the award of any degree or diploma.

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1. **INTRODUCTION**
   1. **BACKGROUND**

Energy meters are used for commercial purpose i.e. to record consumption of energy by consumer and correspondingly billing the consumer. In these days in every sector, there are number of customers which use the electricity but they are not satisfied with the services provided by power distribution companies. Electricity authority & the government realizes problems occurring in the existing transmission network, such as increasing cost due to poor operational efficiency, environmental impacts and an ongoing demand for energy. The idea of remote metering was born in the 1960s. Initially, remote pulse transmission was used, but this has gradually been replaced by using various protocols and communication media. Today’s energy meters are data loggers. Now-a-days, meters with complex functionality are based on the latest electronic technology, using digital signal processing, with most functions being implemented in firmware. They give much more than just energy readings. Meters have a large amount of data, which is not practical to read using the given display and can be better read electronically.

* 1. **RELEVANCE**

One of the major components of operational cost in an electrical utility system is the cost of acquiring data on consumption of the thousands of consumers, spread over a large geographical area, connected to the system. Typically, acquiring data on energy consumption is accomplished by making a meter reader visit the premises of each and every consumer and record data manually. Time and again loss of revenue to the utility occurs because of human errors in acquiring data on the consumption of individual consumers. Automating the entire process of acquiring data and billing will reduce the cost by eliminating human intervention in meter reading. The task of collecting data on electricity consumption without human intervention is popularly known as automatic meter reading (AMR). To facilitate automatic data collection, the metering systems should be networked. The earlier Common Meter Reader Instrument (CMRI) had a hardware/ software that used different communication protocols as provided by various manufacturers to download data from the meters of respective manufacturers, all of which were generally supplied with their own data exchange formats or protocols. To ensure interoperability of energy meters, implementing open protocol was the only true solution. Today for Indian power sector “IEC 62056 Electricity metering – Data exchange for meter reading, tariff and load control” (DLMS COSEM) is adopted for implementation in meters as the open protocol for meter data exchange. This series of IEC standards are supported by the Indian Companion Specification as IS 15959. This project aims to enhance the homogeneity in different makes of meters by developing a common meter reading instrument that follows DLMS COSEM protocol and reads any meter data accurately and efficiently.

* 1. **PROJECT UNDERTAKEN**

* + 1. **PROBLEM STATEMENT**

To Implement optical port data communication on any microcontroller as per IS 15959 which serves on DLMS COSEM protocol.

* + 1. **OBJECTIVES**
* To study DLMS COSEM object model.
* To study IS 15959 of the DLMS COSEM protocol.
* To design a client for a typical energy meter.
* To develop a reader using Arduino with optical port.
* To develop a method for establishing association between the client and the server to communicate data optically.

1. **LITERATURE SURVEY**

**[1] F. Drăgan, R. Holonec and R. Copîndean, "Local Monitoring / Recording and Display Device for Power Electricity Meter, using IEC 62056–21 Local AMR application device, hardware solution, for DLMS-COSEM based Power Meters," 2019 8th International Conference on Modern Power Systems (MPS), Cluj Napoca, Romania, 2019**

* 1. The RS232 serial interface is used to connect the device with the power meter using an appropriate physical layer communication protocol, like IEC 62056-21.
  2. Parameters are identified using short OBIS codes, each value being followed by its measure unit.
  3. A simple message exchange consists of pairs of “queries”, “acknowledgements” and “responses”.

**[2] Hiren R. Zala, Viranchi C. Pandya,”Energy Meter Data Acquisition System with Wireless Communication for Smart Metering Application” International Journal of Engineering Research & Technology (IJERT) , Vol. 3 Issue 11, November-2014**

* 1. A GSM module has to be connected with each Energy meter which will increase the overall cost of the system.
  2. The most effective technology of MSP430G microcontroller and CC2500 RF transceiver save the power very much.
  3. The message collection of the meter readings at the utility office is done with the use of one SIM300 based GSM module same used in the center node and data collector software Ozeking.

**[3] Subrata Biswas, Mubinul Haque, Arafat Kabir, Md. Iftekhar Alam, Avijeet Banik, “PC Based Low Cost Energy Meter Billing System for Home and Commercial Buildings” International Journal of Scientific & Engineering Research, Volume 5, Issue 2, February-2014**

* 1. PC based energy meters can gather data for remote reporting.
  2. Radio frequency used in this PC based power monitoring system can take many forms. The more common ones are handheld, mobile, satellite and fixed network solutions.
  3. The software is written in C-sharp because C# language is intended to be a simple, modern, general-purpose, object-oriented programming language and it can be modified.

**[4] Gordan Štruklec, Joško Marši,” Implementing DLMS/COSEM in Smart Meters”, 8th International Conference on the European Energy MarkeT (EEM), 25-27 May 2011**

* 1. DLMS/COSEM covers all the AMR/AMI application fields and supports all the communication media (except maybe wireless mesh networks).
  2. The lack of the PC client application which includes all (or most of) DLMS features and which is able to interpret data in a user-friendly way makes the integration process more difficult and more time-consuming.
  3. Main function of an Automatic Meter Reading (AMR) system is gathering meter data for billing in an automated way. Various standard-based techniques enable local or remote connections to meters, e.g. IEC62056-21, IEC62056-31, M-bus, GSM, GPRS, PSTN, Internet, PLC.

**[5] Blue Book Edition 12.2 : COSEM Interface Classes and OBIS Object Identification System, DLMS User Association, 19th Jan 2017.**

The DLMS/COSEM specification specifies a data model and communication protocols for data exchange metering equipment. It follows a three step approach.

Step 1: Modelling

Step 2: Messaging

Step 3: Transporting

Step 1 is specified in this document.

Step 1, Modelling: This covers the data model of metering equipment as well as rules for data identification. The data model provides a view of the functionality of the meter, as it is available as interface(s). It uses generic building blocks to model this functionality. The model does not cover internal, implementation specific issues.

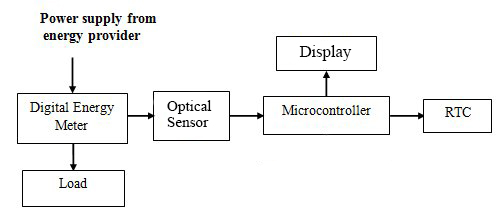
**[6] Green Book Edition 9 : Companion Specification for Energy Metering DLMS/COSEM Architecture and Protocols, DLMS User Association, 5th August 2019.**

Step 2 and 3 are specified in this Technical Report.

Step 2, Messaging: This covers the services for mapping the interface model to protocol data units (APDU) and the encoding of this APDUs.

Step 3, Transporting: This covers the transportation of the messages through the communication channel.

1. **DESIGN AND DESCRIPTION**
   1. **SYSTEM BLOCK DIAGRAM**

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The above block diagram describes the system that we are introducing in this project.

This system broadly consists of a meter which acts as a server while the reader device is the client.

1. Microcontroller
   1. Heart of project
   2. Establishes association with the server (meter)
   3. Interprets the data received from the meter
2. Optical Sensor
   1. Acts as a communication Channel between Meter and Reader
   2. Collects Data through the Optical port present on Meter
3. Real Time Clock (RTC)
   1. RTC keeps track of time in real mode
4. Display (Laptop/PC)
   1. Displays the data acquired from the meter for better understanding.
5. **SYSTEM REQUIREMENTS**
6. Hardware Specification
   1. Micro-controller – Arduino Uno (ATMEGA 328P)
   2. Common Optical Probe with Optical band width 900 to 1000 Nano meters
   3. DS3231 RTC Module
   4. Display- Laptop/PC
7. Software Specification
   1. Visual Studio Code
   2. Python 3.7
      1. Python is a general-purpose object-oriented programming language with high-level programming capabilities. It has become famous because of its apparent and easily understandable syntax, portability and easy to learn. Python is a programming language that includes features of C and Java. It provides the style of writing an elegant code like C, and for object-oriented programming, it offers classes and objects like Java.
      2. Python is derived from programming languages such as ABC, Modula 3, small talk, Algol-68.
      3. Python page is a file with a .py extension that contains could be the combination of HTML Tags and Python scripts.
   3. Arduino IDE 1.8.13

**7. ADVANTAGES, DISADVANTAGES AND APPLICATIONS**

* 1. **ADVANTAGES**
  2. Data is read electronically. Hence, human errors eliminated.
  3. Can read meters by different manufacturers accurately.
  4. Capable to communicate with static energy meters or computers.
  5. Interoperability is brought about by the implementation of DLMS COSEM.
  6. **DISADVANTAGES**

1. Cannot eliminate the need of human involvement.
2. Base Computer Software (BCS) are needed for data interpretation of complex electrical parameters.
   1. **APPLICATIONS**
3. Used for data reading from various makes of meters.

**8. CONCLUSION**

There are many communication technologies used today for meter reading applications, but lack the properties of interoperability and homogeneity. Device described in this project is a solution for meter reading system with capabilities of local display of electrical parameters. In advancement, wireless modules can be used along with other technologies and result can be further improved.

**9.** **REFERENCES**

[1] Subrata Biswas, Mubinul Haque, Arafat Kabir, Md. Iftekhar Alam, Avijeet Banik, “PC Based Low Cost Energy Meter Billing System for Home and Commercial Buildings” International Journal of Scientific & Engineering Research, Volume 5, Issue 2, February-2014

[2] F. Drăgan, R. Holonec and R. Copîndean, "Local Monitoring / Recording and Display Device for Power Electricity Meter, using IEC 62056–21 Local AMR application device, hardware solution, for DLMS-COSEM based Power Meters," 2019 8th International Conference on Modern Power Systems (MPS), Cluj Napoca, Romania, 2019

[3] Hiren R. Zala, Viranchi C. Pandya,” Energy Meter Data Acquisition System with Wireless Communication for Smart Metering Application” International Journal of Engineering Research & Technology (IJERT) , Vol. 3 Issue 11, November-2014

[4] “Functional Requirements for Common Meter Reading Instrument” by Central Electricity Authority and Central Power Research Institute, December 2011

[5] Excerpt – “COSEM Interface Classes and OBIS Object Identification System”, Edition 12.2, DLMS User Association, January 2017

[6] Excerpt – “DLMS/COSEM Architecture and Protocols”, Edition 9, DLMS User Association, May 2019