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Wireless Communication on PLC Using Access Point TP-Link TL-WN722N

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Abstract – *Technological developments are a requirement for more practical system operation. One example is in data transmission. Wireless data communication is currently very popular. In today's revolution 4.0, of course, the use of cables in data transmission media is rarely used, but not every device supports wireless data communication. One of them is the PLC (Programable Logic Controller). As for additional extensions for PLCs to communicate wirelessly, they are sold separately and, of course, the price is quite expensive. Therefore, a solution for PLCs to communicate wirelessly using the TL-WN722N access point is widely available on the market. Measurements are made with the concept of point to point by looking at the results of modbus scans using Modscan32 on a PC server. The results show that the optimal maximum distance is 80 meters, with an average data transmission time of 1 second.*

Keywords: *Access Point, Modscan32, PLC, Wireless.*

I. Introduction

Data communication systems according to media are divided into two types, the first is cable-based communication media, and wireless (wireless) media. The use of wireless in terms of communication is more effective and efficient than using cables in certain conditions. For wireless-based communication media, digital data processing becomes the most important thing [1].

Wireless data communication is very popular, especially in the industrial revolution 4.0, systems that can be monitored and controlled at any time [2] [3]. Of course the use of cables in data transmission media is rarely used, the power requirements used in some wireless data communication topologies can increase energy efficiency [4]. The use of wireless communication media has been widely used, for example in several applications for sending sensor data using the WSN concept (Wireless Sensor Network) with processing devices using Node MCU or Arduino for the purposes of analyzing energy consumption on sensors [5], monitoring building lighting systems with RF modules XBee [6], and monitoring wind speed in the Tasikmalaya area using the S2B XBee pro module [4].

However, most of them in the industrial automation world still use cables in their transmission media, such as the use of ACII, RTU and TCP/IP modbus protocols [7]. Modbus is an industry standard protocol developed by Medicon in 1997 for PLC (Programable Logic Controller) applications. This protocol plays an important role in the industrial world for communication between PLCs and HMIs and PLCs between PLCs [8]. The modbus protocol has the potential to support the development of industry 4.0, especially the modbus TCP/IP type because it can provide open and broad communication access [9].

Research on the use of modbus communication in the application of the industrial world has been widely carried out, including by Sando Andre "The Modbus/TCP-LCU-based PID Water Level Control System and Industrial Field Control Node - RTU" [10] who concluded that two industrial-based technologies (LCU and Different RTUs) can be

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integrated with Modbus TCP communication, by implementing the SCADA system on the water level control system.

However, SCADA communication in the industrial world still uses wire in its data transmission because PLC (Programable Logic Controller) does not have wireless features and if these features are sold in separate extensions, the price is also very expensive. Whereas wireless transmission can be done, considering that data transmission using Modbus TCP has the potential to support the development of industry 4.0. As has been done by Hariyawan regarding the application of WSN on PLCs by utilizing the RS232 protocol on the PLC then processed by ATMEGA 128 and the processed data is transferred by the ZIG100 module wirelessly with a maximum range of 82 meters [11].

So in this study the concept of sending data wirelessly will be done using Access Point which are widely marketed so that wireless data transmission does not need to be processed again by additional microcontrollers to be able to communicate wirelessly. The use of access point is only a tool for data transmission media on wireless networks, of course in the process of transmitting data wirelessly, the PLC used must support the RS485 port by utilizing the basic data transmitted by the PLC in the form of Modbus TCP. In Table 1. The use of the access point type in this study uses the Tp-link series TL-WA701ND on the PLC side and the TL-WN722N type on the server side.

TABLE I
SPECIFICATIONS WIRELESS ADAPTER

No	Spesifikasi	TL-WN722N	TL-WA701ND
1.	Power Suplay	5V/0.5 A	9V/0.6 A
2.	Frekuensi	2.4Ghz	2.4 Ghz
3.	Antena	4 dbi	5 dbi
4.	Koneksi	USB 2.0	Ethernet
5.	Mode Oprasi	Client	Acces Point, Client,WDS,Bridge with AP.

By looking at how effective the data communication is by seeing how far it reaches and how long the data transmission process takes.

II. Research methods

PLC data communication system that is transmitted wirelessly using an access point is done point to point between the PLC and the PC Server, the placement of the PLC with the PC server is varied to see how far the wireless communication range can be. On the PC server, the Modscan32 application is installed to request modbus data on the PLC with the previously adjusted configuration as depicted in Fig 1. Wireless PLC communication with 802.15.4 protocol and 2.4 GHz frequency.

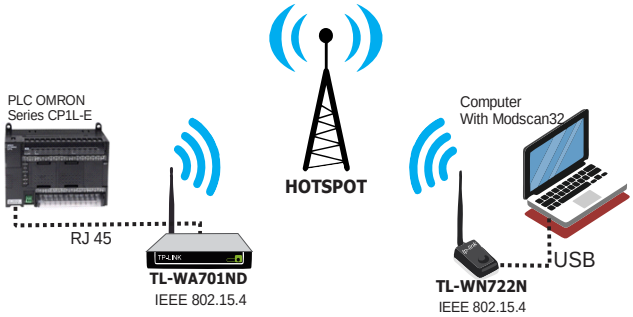

Fig. 1. Wireless PLC Remote Data Architecture

Data from the PLC is ModbusTCP data which is then transmitted via wireless with a network configuration as shown in Fig 2., where the PLC and PC are connected to the same network as the gateway 192.168.43.1. PC requests modbus data to PLC with destination IP 192.168.43.10 with Modscan 32 application and displays the data.

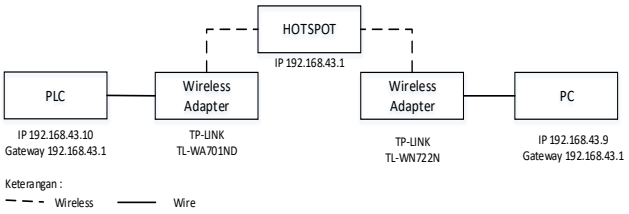

Fig. 2. Wireless PLC communication configuration.

III. Results

The results of the test for wireless data communication research on PLC using access point TP-LINK series TL-WA701ND was tested based on the ability to transfer data wirelessly by looking at the parameters of time, data length and maximum range that can be reached. For technical testing as shown in Figure 3, and for the location of the test site in the Siliwangi University Tasikmalaya campus as shown in Fig 4.

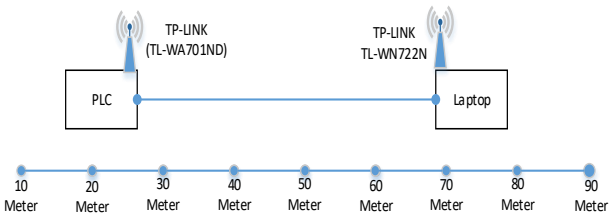

Fig. 3. Wireless Testing Techniques.

Fig. 4. Test Location (Satellite view)

The first test is to calculate the Round Trip Delay or Ping Time which is a method of measuring signal transmission between 2 points by calculating the signal time starting from requesting data (request) until receiving the requested data (response), testing is carried out based on the distance and size of the data packet. tested, it is obtained where the increase in the RTT value is influenced by the distance and width of the data being tested as shown in Fig 5.

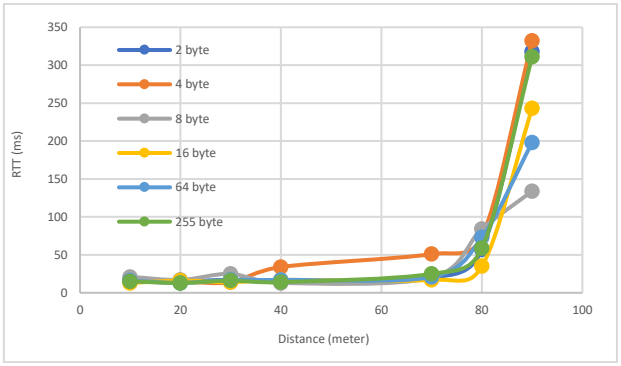

Fig. 5.Performance Testing Wireless data transfer.

Tests are carried out starting from the data width of 2 bytes to 255 bytes. There is an increase in the RTT value for each distance tested, the farther the distance between the two points (master and slave) the greater the RTT value. However, all test results for RTT values ranging from 10 meters to 90 meters are all under 1 second. For the results of the average RTT value in each distance based on calculations from a data width of 2 bytes to 255 bytes as shown in Table 2.

TABLE 2
AVERAGE WIRELESS DATA TRANSFER PERFORMANCE TEST

Jarak (meter)	RTT (ms)
10	16
20	14.83
30	17.16
40	18.33
70	25.67
80	63.67
90	256

Second, testing modbus TCP data transfer using wireless based on distance and amount of data by looking for the maximum amount of data, lost data and RTO (Request Time Out) based on each distance tested, as shown in Figure 6 (a). The request is 123 data length / 246 bytes. More than 1 length of data alone cannot be redirected as shown in Figure 6 (b).

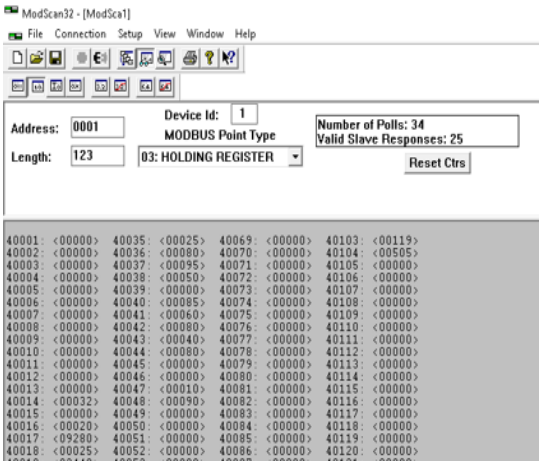

Fig. 6. Request 123 data length (successful)

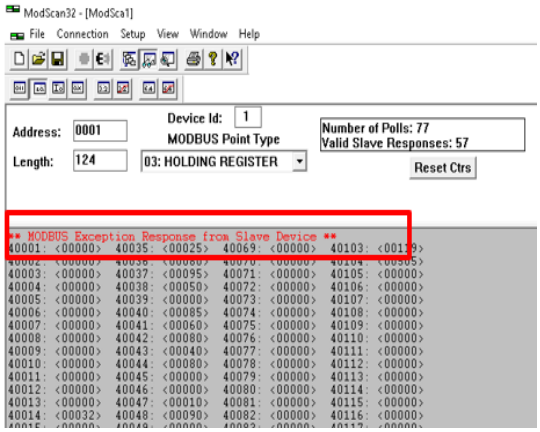

Fig. 7. Request 123 data length (failed)

According to Fig 6. and Fig 7., it is shown that the maximum data length that can be retrieved is 123 data lengths (246 bytes), with a maximum distance of less than 90 meters. As shown in Fig 8., based on the amount of data received and data loss, at a distance of 80 meters the data loss is said to be still good, only 4 data is missing from the 50 data sent or it can be said that only 8% data loss at a distance of 80 meters. But when the distance has reached 90 meters, the lost data increases by up to 28% which includes the classification of data transmission which is categorized as bad according to QoS (Quality of Services) [12].

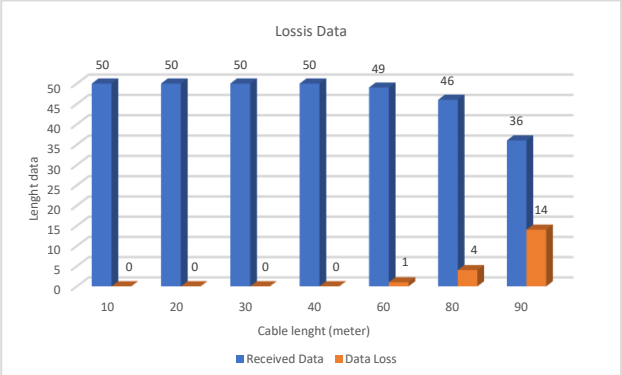

Fig. 8. MTCP Wireless Communication Test

In Figure 9, testing the TCP modbus data by looking at the length of time it takes for the data transmission process. The average delivery time is below 1 second for each distance tested based on the amount of data of 244 bytes.

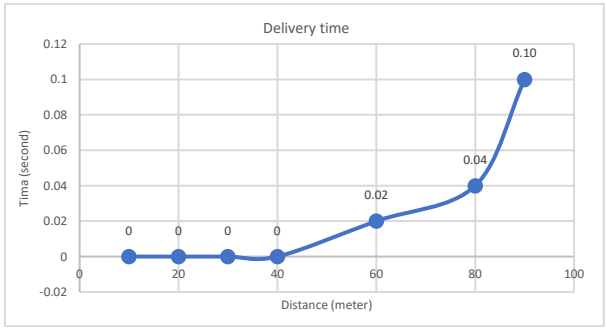

Fig. 9. Testing data delivery time pengiriman

can be seen from a distance of 10 meters to 40 meters there is no delay in the delivery time because all the sample data, totaling 50 data sent, all reached the master in less than 1 second so that the data sent time was the same as the time it received, for more details, it can be seen in Table 3.

TABLE 3
AVERAGE TIME DIFFERENCE BETWEEN SEND AND RECEIVE

Distance (meter)	Data samples	Difference between send and receive time(s)	Average (s)
10	50	0	0
20	50	0	0
30	50	0	0
40	50	0	0
60	50	1	0.02
80	50	2	0.04
90	50	5	0.10

IV. Conclusion

Sending data wirelessly to the PLC can work properly using the Access Point series TL-WA701ND with the Modbus TCP communication protocol. The test results show that the farthest wireless range is up to 90 meters, but this range is not recommended because data loss reaches 28%, because according to Q0S (Quality of Service) data loss above 26% is a bad classification. Therefore, the most recommended distance for wireless communication on PLC using the TL-WA701ND access point is 80 meters with data loss of only 8% and is included in the good classification according to QoS.

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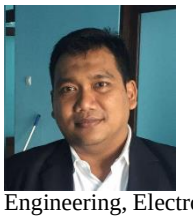
Authors' information

Rendi Priyatna , place of birth Ciamis, April 06, 1998 graduated from Electrical Engineering, University of Siliwangi Tasikmalaya, West Java, Indonesia, Graduated in 2021 with a concentration in Control Systems. Very fond of automation, instrumentation and control,
Previously published journals in the field of Water Treatment Plan automation using a PLC controlled wirelessly and also a new design discovery in the field of automation, namely increasing the analog input pin channel on the PLC, and now a research result that I previously made a separate journal on transfer performance Modbus TCP data on the PLC which is transmitted wirelessly.



Asep Andang, master of Engineering at the Bandung Institute of Technology (ITB) currently works at Electrical Engineering at Siliwangi University as a lecturer and head of the lab, and is continuing his doctoral studies at Udayana University, Bali. Asep conducts research in Instrumentation Engineering, Electronic Engineering and Electrical Engineering. Their current project is a 'hybrid active power filter.

Firmansyah Maulana Sugiartana Nursuwars, currently works at Siliwangi University. Their current project is 'API (currently works at Siliwangi University. Their current project is 'API (application programing interface) mikrotik untuk otentikasi sistem akademik Universitas Siliwangi'.) mikrotik untuk otentikasi sistem akademik universitas siliwangi'.

