

# Data Comparison of NFC PN532 on Wemos D1 and MKR1000 Board through MQTT Protocol

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**Abstract**—This research focused on the comparison of data transfer process in NFC PN532 using two different transmission boards. Wemos D1 and MKR1000 used as the transmission board. The network built with MQTT protocol by using mosquitto message broker. NFC PN532, a transceiver module who works at 13,56MHz and supports several host interfaces used in this paper. SPI used as the interface between transmission board and NFC PN532. The testing mechanism is comparing the data received in server form NFC PN532 that transmitted through both MKR1000 and Wemos D1. The result showed that the use of one topic or two topics in MQTT protocol does not show big difference, but the data transmission using MKR1000 is quite better and more balance than Wemos D1.

**Keywords**—NFC PN532, Wemos D1, MKR1000, MQTT protocol

## I. INTRODUCTION

Nowadays Internet of Thing (IoT) used to connect the world, it able to connect things to the internet to retrieve information everywhere in any time [1]. IoT supports communication of machine-to-machine devices including embedded sensors and actuators through Radio Frequency (RF), Wi-Fi, data network, Long Term Evolution (LTE), Bluetooth, Zigbee, etc [2][1]. With the widely various ability of IoT, a lot of application built based on it. IT and networks, building, energy, consumer and home, health care and life science, industrial, transportation, retail, security, all various aspect can be built based on IoT [1] [3] [4] [5] [6].

Combining the IT, network, information system, and building aspect can produce classroom access control that integrated to academic information system, and lastly to build a smart campus. As an early research, this paper focusing on how NFC PN532 used as a reader that read user identity, whom able accessing a classroom and then the data saved to the server. It also comparing the capability of the transmission board based on the data read from NFC PN 532.

### A. NFC PN532

NFC is a technology that going to be a must in every mobile devices [7]. Its technology is an integration to Radio Frequency Identification (RFID) technology. Like RFID, NFC works in Radio Frequency, and for PN532 works in 13.56MHz [8]. Compare to RFID, Bluetooth, and IrDa [9], NFC used as the reader, because its ability to be used further in classroom access control that integrated to academic information system. This device support SPI, I2C and UART interfaces and in this paper uses SPI as the interface. In this paper, PN532 work to read the tag's ID that used as user identity.

### B. Wireless Development Board

Wireless development board is a device to bridge-embedded devices while implementing IoT. To transmit the data, there are various wireless development board that can be used, i.e. Arduino Wi-Fi Shield, Arduino Yun Shield, Arduino MKR1000, NodeMCU, ESP8266 and Onion Omega, etc [10]. This device make a possibility for embedded device to communicate each other wirelessly[10]. As stated before, the board used in this paper is Wemos D1 and MKR1000 because these devices able to transmit data via internet. As both of the board has ability to transmit the tag's ID read by NFC PN532. How the comparison of data transfer process in NFC PN532 using Wemos D1 and MKR1000 presented in this paper.

### C. MQTT Protocol

Message Queue Telemetry Transport (MQTT) is a simple data centric protocol using publish and subscribe mechanism, which can be scaled by single server to support up to thousands of clients [11]. This protocol allow machine-to-machine communication with minimum bandwidth, as the aspect of IoT, and it is suitable compare to HTTP in the term of sequence and QoS[12]. The data transmitted through the system is the tag's ID, so that MQTT chosen as the protocol used in this system. Publish and subscribe mechanism in MQTT protocol use alongside with topic to send the data between the publisher and the subscriber.

## II. RESEARCH METHOD

The method used in this research consist of four steps i.e. study literature, designing the system, implementation, testing and analysis. Study literature used as an early research and as a judgmental in choosing the devices used in the system. The result of this step is the functional and non-functional need used to build the system.

The functional needs of this system are the system able to transmit data from the NFC PN532 to server through MQTT protocol, the system able to compare the time stamp of the process between both in the transmission board through the server and the NFC PN532 through the main board. The non-functional needs of this system are Arduino UNO and Wemos D1 used as the main board with MKR1000, PN532 used as the NFC to identify the user's tag, mosquitto used as the message broker to build MQTT protocol, and SPI used as the interface between NFC PN532 and Arduino UNO.

Designing the system is the continuation of the previous step. Designing the system consist of designing the

hardware, the server, and the main software based on functional and the non-functional needs before. Implementation is the next step to apply the design to become a prototype that can be test.

The last step of this research is testing and analysis. The testing built to test the time of data received in server compare to the time data received in NFC PN532 by using eight schemes from the variation of transmission boards used in the system. The first and second is to test the time amount in Wemos D1 and MKR1000 as one topic. The third until fifth is to test the comparison between Wemos D1 and Wemos D1, MKR1000 and MKR1000, Wemos D1 and MKR1000 in one topic. The last is to test the comparison between Wemos D1 and Wemos D1, MKR1000 and MKR1000, Wemos D1 and MKR1000 in two topics. Each test in this paper taken in one second for five times. The comparison checked from the time stamp in database server compare to the time stamp got from RTC and seen in serial monitor.

### III. IMPLEMENTATION

Fig.1 shows the design of the system used in this research. As on the design, the research mainly focused in comparing the used of MKR1000 and Wemos D1 in transmitting NFC PN532 data to the server.

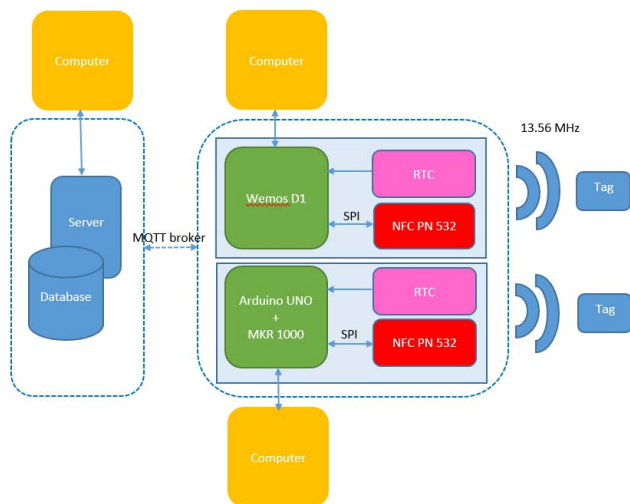


Fig. 1. System scheme.

The server consist of database used to save the data from NFC PN532. The table used in this paper consist of 5 columns i.e. id, class\_code, topic, time, nfc\_data. The time column uses time stamp type to indicate the time when the data saved on the database server. Fig. 2 shows the Wemos D1 and MKR1000 series used in this research.

The important thing that need to be concerned in this system is all parameter both in MKR1000 or in Wemos D1 must be the same, from the long of the wires used, the testing position, the type of the NFC used, and the environment of the testing. The comparison of the data transmission also checked by comparing transmitting the tag's id by using one topic and two topics of MQTT. Before the testing start, the RTC checked so that it works precisely without delay.

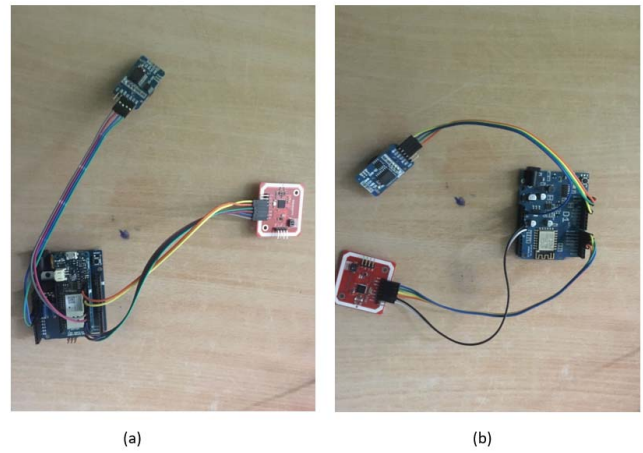


Fig. 2. (a) System implementation using MKR1000  
(b) System implementation using Wemos D1

### IV. RESULT AND ANALYSIS

#### A. Wemos D1

The testing for Wemos D1 done individually in one topic. Fig.3 shows the result for Wemos D1.

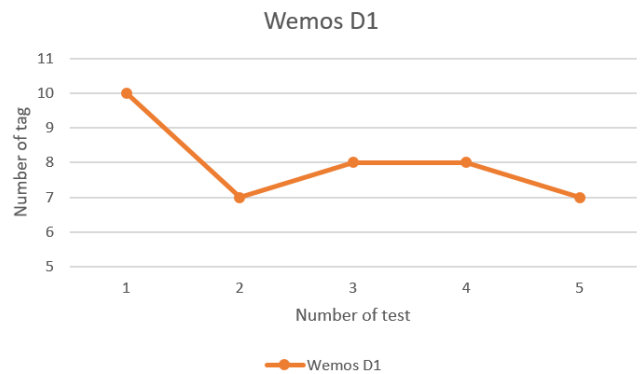


Fig. 3. Wemos D1 result.

Based on the test, the average number of number of tags is 8. The RTC did not worked properly as the design. RTC only able to show the time stamp for the first reading. The time stamp comparison between the serial monitor and the database server showed the time difference is 4 minutes and 36 seconds delay. All of the data transmitted fully to the server

#### B. MKR1000

The testing for MKR1000 done individually in one topic. Fig. 4 shows the result for MKR1000. Based on the test, the average number of number of tags is 11. The RTC worked properly as the design. The time stamp comparison between the serial monitor and the database server showed the time difference is 5 minutes and 1 second delay. All of the data transmitted fully to the server.

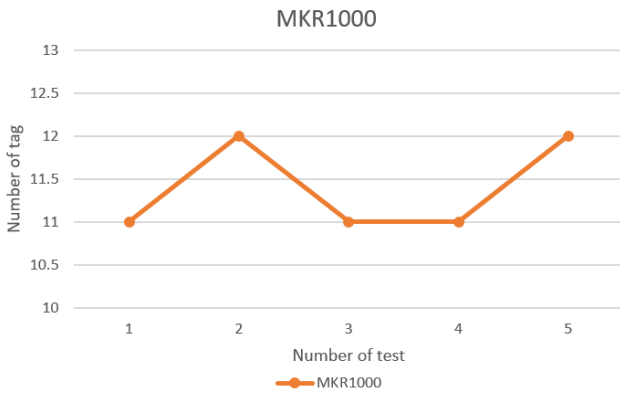


Fig. 4. MKR1000 result.

### C. Wemos D1 compare to Wemos D1

The testing comparison between Wemos D1 done in one topic and two topics. Fig. 5 shows the result for Wemos D1 comparison in one topic while Fig. 6 shows the result for Wemos D1 comparison in two topics.

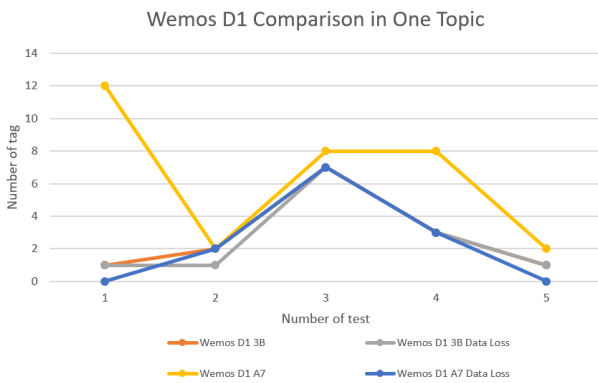


Fig. 5. Wemos D1 comparison using one topic.

Based on the test for one topic, the average number of number of tags in Wemos D1 3B is 2 with average data loss 2. The average number of number of tags in Wemos D1 A7 is 6 with average data loss 2. The test showed that the chance of connection between the nodes is not balanced.

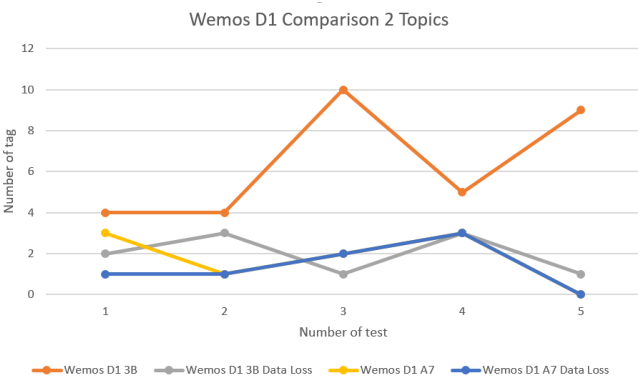


Fig. 6. Wemos D1 comparison using two topics.

Based on the test for two topics, the average number of number of tags in Wemos D1 3B is 6 with average data loss 2. The average number of number of tags in Wemos D1 A7 is 1 with average data loss 1. The test showed that the

chance of connection between the nodes is not balanced. It showed that in the comparison of Wemos D1 using two topic does not really had any difference to Wemos D1 using one topic.

### D. MKR1000 compare to MKR1000

The testing comparison between MKR1000 done in one topic and two topics. Fig. 7 shows the result for MKR1000 comparison in one topic while Fig. 8 shows the result for MKR1000 comparison in two topics.

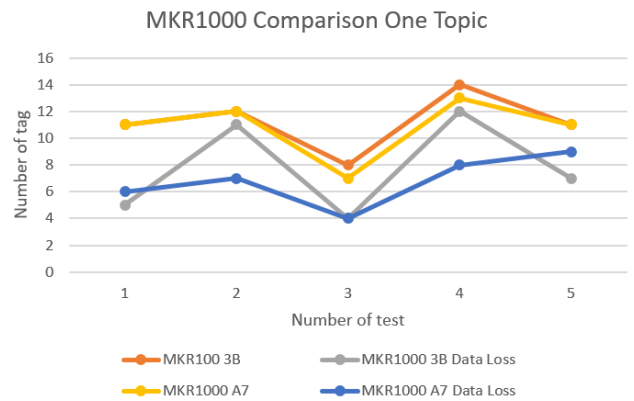


Fig. 7. MKR1000 comparison using one topic.

Based on the test for one topic, the average number of number of tags in MKR1000 3B is 11 with average data loss 7. The average number of number of tags in MKR1000 A7 is 10 with average data loss 6. The test showed that the chance of connection between the nodes is balanced.

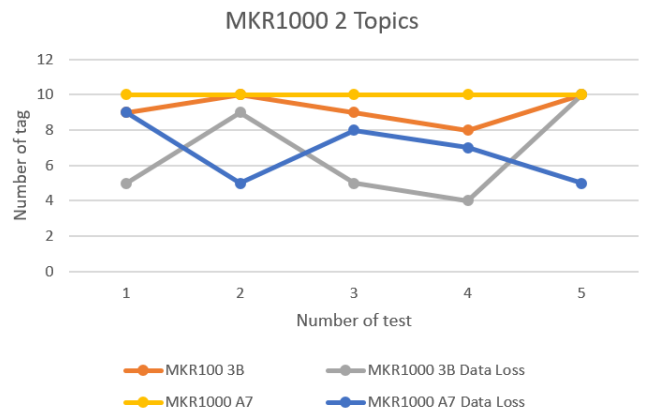


Fig. 8. MKR1000 comparison using two topics.

Based on the test for two topics, the average number of number of tags in MKR1000 3B is 9 with average data loss 6. The average number of number of tags in MKR1000 A7 is 10 with average data loss 6. The test showed that the chance of connection between the nodes is balanced. It showed that in the comparison of MKR1000 using two topic does not really had any difference to MKR1000 using one topic.

### E. MKR1000 compare to Wemos D1

The testing comparison between MKR1000 done in one topic and two topics. Fig. 9 shows the result for MKR100 comparison in one topic while Fig. 10 shows the result for Wemos D1 comparison in two topics.

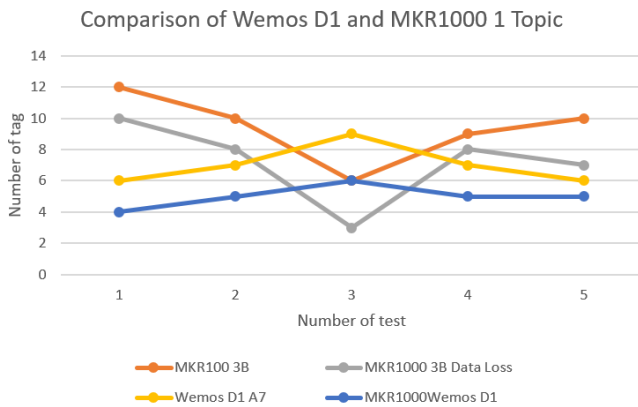


Fig. 9. MKR1000 and Wemos D1 comparison using two topics.

Based on the test for one topic, the average number of number of tags in MKR1000 3B is 9 with average data loss 7. The average number of number of tags in Wemos D1 A7 is 7 with average data loss 5. The test showed that the chance of connection between the nodes is not balanced. MKR1000 has better change but because of it the number of data loss is also bigger.

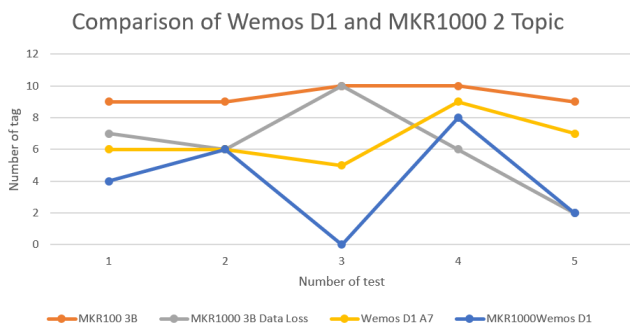


Fig. 10. MKR1000 and Wemos D1 comparison using two topics.

Based on the test for two topics, the average number of number of tags in MKR1000 3B is 9 with average data loss 6. The average number of number of tags in Wemos D1 A7 is 6 with average data loss 4. The test showed that the chance of connection between the nodes is not balanced. MKR1000 has better change but because of it the number of data loss is also bigger, the use of two topics is not as good as the one topic.

Table 1. shows the summary of data transmission acceptance from NFC\_N532 through server. Based on the eight tests mechanism, the use of one topic or two topics in MQTT protocol does not show big difference, but the data transmission using MKR1000 is quite better and more balance than Wemos D1.

TABLE I. COMPARISON TABLE

Board		Data Comparison (number of data/second)	
		Average Data Received	Average Data Loss
Wemos D1		8	0
MKR1000		11	0
Wemos D1 comparison 1 Topic	Wemos D1 3B	2	2
	Wemos D1 A7	6	2
Wemos D1 comparison 2 topics	Wemos D1 3B	6	2
	Wemos D1 A7	1	1
MKR1000 comparison 1 Topic	MKR1000 3B	11	7
	MKR1000 A7	10	6
MKR1000 comparison 2 topics	MKR1000 3B	9	6
	MKR1000 A7	10	6
Wemos D1 and MKR1000 comparison 1 Topic	MKR1000 3B	9	7
	Wemos D1 A7	7	5
Wemos D1 and MKR1000 comparison 2 topics	MKR1000 3B	9	6
	Wemos D1 A7	6	4

### V. CONCLUSION

The result for individual transmission board testing shows MKR1000 transmit data three more than Wemos D1 but with 25 seconds delay longer. Wemos D1 comparison in 1 topic and 2 topics shows unbalance data transmission. The used of different topic does not show great difference. MKR1000 comparison in 1 topic and 2 topics shows balance data transmission. The used of different topic does not show great difference. MKR1000 and Wemos D1 comparison in 1 topic and 2 topics shows an almost balance data transmission. The used of different topic does not show great difference. The use of one topic or two topics in MQTT protocol does not show big difference, but the data transmission using MKR1000 is quite better and more balance than Wemos D1.

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