

OPTIMIZING HMI SCADA FOR MONITORING AND CONTROL COMMUNICATION RADIO REPEATER USING INTEK J65i-X GPRS MODEM

Bambang Winardi¹, Enda Wista Sinuraya², Agung Nugroho³, Erlin Dolphina⁴, Darjat⁵, Denis⁶, Sudjadi⁷, Hermawan⁸, Yuli Christyono⁹, Sukiswo¹⁰, Wahyudi¹¹, Susatyo Handoko¹²

^{1,2,3,5,6,7,8,9,10,11,12}Department of Electrical Engineering, Diponegoro University, Semarang Indonesia

⁴Faculty of Computer Science, Dian Nuswantoro University, Semarang Indonesia

Abstract: Radio communication at PT PLN (Persero) APD Central Java and DIY is still the main communication medium to coordinate work, both maintenance and handling of disturbances between units. In this case, the repeaters play an important role in the communication process between the PPE Dispatcher and field officers. In its operation the repeater may experience interference which can cause radio communication in the area covered by the repeater to be disrupted. There needs to be a device that can monitor the repeater's condition, which if The interference is detected at the source, supply or radio, PPE officers can immediately find out without having to come to the field. Utilization of the Intek J65i-X GPRS Modem allows taking the status of the repeater equipment which is not currently possible. By utilizing the digital input and digital output facilities on the modem, every condition of the repeater equipment circuit such as RX radio signal, TX radio signal, battery, charger and 220V supply can be detected. From the change in the existing supply voltage, it can be detected by the Intek J65i-X GPRS modem so that when there is a disturbance it can be monitored on the HMI SCADA in real time, so that in the future it is expected to be able to improve the performance of the SCADA system of PT PLN (Persero) APD Central Java and D.I. Yogyakarta.

Keywords: repeater, Intek J65i-X GPRS modem, auxiliary relay, monitoring and control, HMI SCADA

1. Introduction

In the distribution of electricity, coordination between units is very important. APD as a unit that regulates distribution, in this case the Central Java and DIY regions, must have a reliable communication system to assist the electricity distribution process. The communication media is usually used to coordinate work, maintain and handle disturbances between areas to the JTY PPE Dispatcher and the GI to the JTY APD Dispatcher. In this case, radio communication is the most important communication medium because apart from not requiring money, coordination through radio communication can be heard by all units and executives in the field.[1]

For Central Java and DIY, which have 71 substations and 11 areas, a radio communication system is needed which can cover all substations and areas. Because the contours of the DIY Central Java area are hilly, a repeater is needed to reach all areas. APD JTY has 3 main repeaters, namely the Telomoyo repeater, the Mt. Prau and Tawangmangu repeater.

Repeaters are a very important part of radio communication, for example the Telomoyo repeater which covers GIs in the Semarang, Kudus, Salatiga and Pekalongan areas as well as areas in these areas, when the repeater experiences interference, the impact is that JTY APD Dispatcher cannot communicate with GIs and Areas in the region so that it will experience difficulties in terms of coordination.[10]

The problem currently experienced by PLN APD JTY is that when there is a repeater disturbance, the PLN APD JTY officer cannot find out what is the cause of the disturbance other than conducting direct field investigations. Because there is no system for monitoring the devices contained in the repeater. The repeater has several equipment components such as RX radio, TX radio, battery, charger and 220V power supply.[11]

It is hoped that there will be a repeater monitoring and control system so that repeater reliability can be monitored through the HMI display which is integrated with the JTY APD SCADA system. The SCADA system is needed as the backbone of the operational system for monitoring the status and control of equipment in the field.

This device is made to increase the reliability of the repeater which is integrated with the SCADA system. With this system, it is hoped that it can increase SCADA operational service efforts that can be utilized by all PLN personnel, management of repeater interference handling, handled quickly and effectively so as to improve operational communication services between related PLN units.

2. Research Methods

a. MonRe block diagram

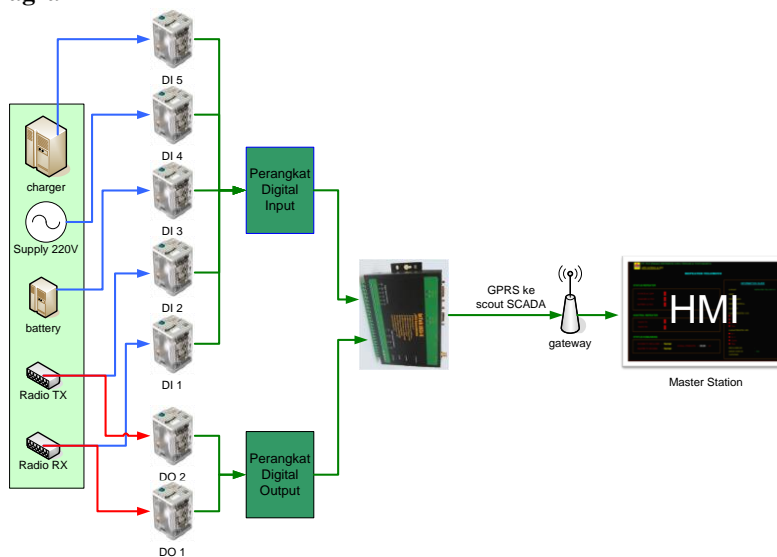


Figure 1. Block diagram of MonRe

How the MonRe System Works

Each auxiliary relay that is connected to the respective repeater equipment detects the presence of voltage or not around it. There are 5 indications of the supply voltage of the repeater equipment:

- *Supply 220V indication is green = 220V supply is missing*
- *Supply 220V indication is red = 220V supply is detected*
- *Charger indication is green = Charger OFF*
- *Charger indication is red = Charger is ON*
- *Battery indication is green = Battery OFF*
- *Battery indication is red = Battery ON*
- *Radio RX indication is green = Radio RX OFF*
- *Radio RX indication is red = Radio RX ON*
- *Radio TX indication is green = Radio TX OFF*
- *Radio TX indication is red = Radio TX ON*

- 1) If all indications such as 220V supply, charger, battery, RX and TX radio are all red or in a normal state (ON) but the repeater is not functioning, this indicates that the radio is hanging so it is necessary to control reset. Determination of red or green color based on SPLN Standard HMI Figure which explains that the red indication indicates close, while green indicates open on the device / network.

- 2) long with these changes, the aux relay will send an indication (in the form of a 12VDC voltage) in the form of a trigger to the DI (Digital Input) and DO (Digital Output) Intek J65i-X GPRS modem. If the aux relay does not get a supply voltage, the aux relay will forward its signal to the modem because the aux relay setting is NC (Normally Close).

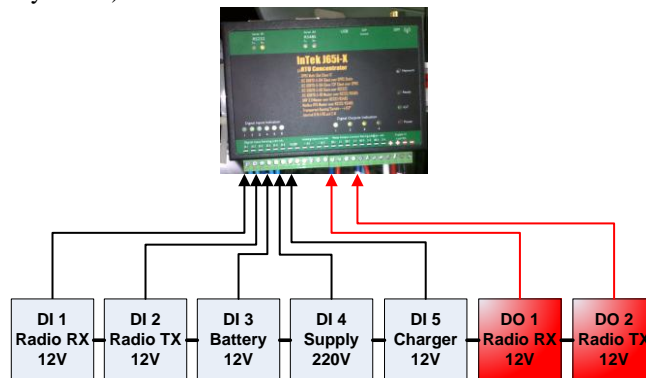


Figure 2. Schematic of aux relay voltage indication to modem

- 3) The GPRS modem will detect the change and will show the change in the value of the lamp indicator. For example, if there is interference on the RX radio, the DI indicator light will show a change in value by turning off the DI 1 (OFF) indicator lamp on the modem.
- 4) This change in value will become a GPRS modem database and will then be forwarded to the Yogyakarta area gateway, namely Gateway_Moxa_YGK3 through service providers (Telkomsel / Indosat) that have special and private APNs that can connect to the JTY APD SCADA Server via the ICON + network.
- 5) Then the data from the YGK3 gateway will be forwarded to the SCADA master station by mapping and commissioning to map and conduct tests to ensure that the device ID address at the location (modem) is connected and can communicate with the equipment ID at the master station.

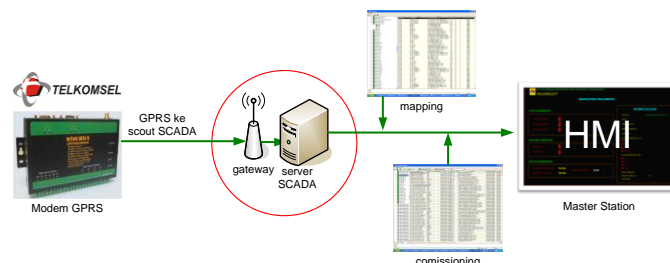


Figure 3. Configuring SCADA from Modem to HMI

- 6) On the SCADA master station side, variable data from MonRe will be entered in the master station database to be displayed in the SCADA HMI Single Line Diagram and alarm view for modem signal strength values, status of each equipment, radio reset control to comm indication. -failed between modem and repeater.
- 7) Meanwhile, the SIM Card communication travel path so that it can be read on the HMI SCADA, can be illustrated as in Figure 2.10. The SIM Card on the modem, sends data to the Telkomsel provider by using a special APN that has been set so that it can be connected to the SCADA APD JTY via the ICON + network. Telkomsel has a communication system via routing so that it can be connected to the ICON + network. Then the data is forwarded to the ICON + network as a link between the Telkomsel GPRS network and JTY's SCADA APD. Until finally the data can be read and communicate with each other from SCADA APD JTY.

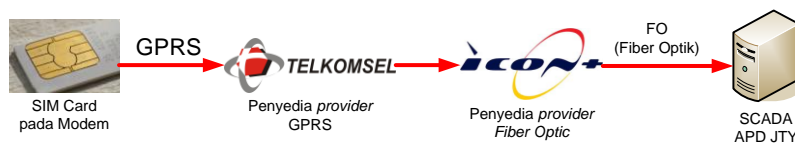


Figure 4. Configuration of the GPRS Sim Card to SCADA Communication Line

a. MonRe Mounting Design

Each aux relay will be connected to the voltage output points of each equipment, for example the RX radio output, TX radio, battery, charger, and 220V supply. The circuit will be placed on top of the charger panel box and it is enough to pull ten connecting cables to each repeater equipment.

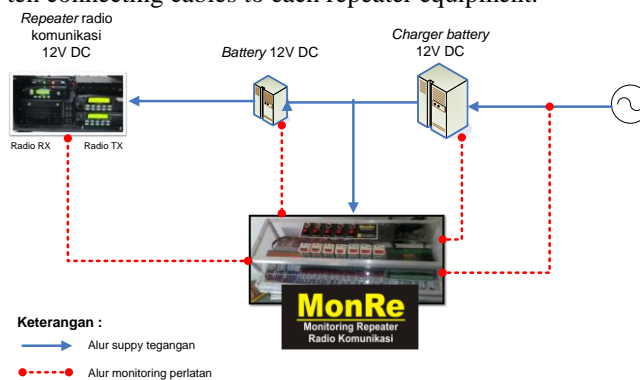


Figure 5. Block diagram of MonRe

3. Result and Analysis

Experiments were carried out using a MonRe (Repeater Monitoring and Control) simulator which had been set in such a way on the modem. Then mapping and commissioning are carried out to connect device communication with the PLN APD JTY master station computer. The ID attached to the master station must be the same as the ID on the modem.

a. Crash Data

This disturbance data was obtained from the observations of MonRe which was installed in the Telomoyo repeater which was installed on April 12, 2019. MonRe on the Telomoyo repeater had monitored several disturbances from the repeater equipment.

TIMESTAMP	MESSAGE
2013-05-08 20:38:59	Repeater-Telomoyo,Komunikasi Master ke Modem Fail test,Normal
2013-05-09 05:47:46	*Repeater-Telomoyo,Status Supply 220 V Repeater Telomoyo,Off
2013-05-09 05:47:47	Repeater-Telomoyo,Status Charger Repeater Telomoyo,Off
2013-05-09 08:49:07	*Repeater-Telomoyo,Status Supply 220 V Repeater Telomoyo,On
2013-05-09 08:49:08	*Repeater-Telomoyo,Status Charger Repeater Telomoyo,On
2013-05-09 17:45:07	Repeater-Telomoyo,Komunikasi Master ke Modem Fail test,Failed
2013-05-09 17:45:15	Repeater-Telomoyo,Komunikasi Master ke Modem Fail test,Normal
2013-05-10 19:18:27	Repeater-Telomoyo,Komunikasi Master ke Modem Fail test,Failed

Figure 6. Crash Data

b. Signal Strength Data

Meanwhile, to see how much signal is emitted from Telomoyo, it can be seen from the display below. A good signal scaling parameter is transmitted at > 20 dB. This parameter is determined based on work experience which concludes that with a signal strength below 20dB, the GPRS signal is prone to interference (signal disconnection).

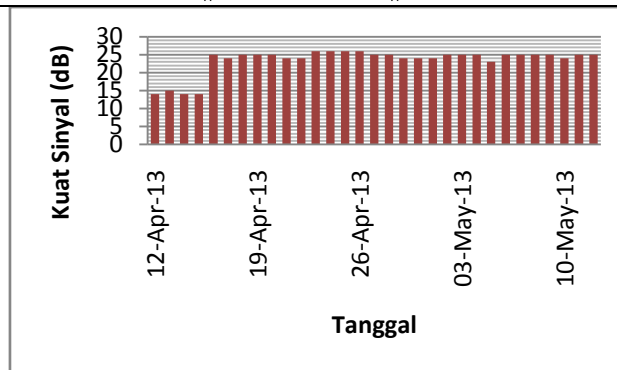


Figure 7. Signal Strength Data

The data above is obtained from the results of the data recap per day conducted by officers. This data is taken from the display as shown below.

Name	Description	Value
RP_VGR.51136-36_Signal	Signal value RP.VGR.51136-36	22.00
RP_VGR.51121C2_Signal	Signal value RP.VGR.51121C2	0.000000
Repeater Prau Sinyal - Repeater	Signal value Repeater Prau	25.00
RP_VGR.51118-2_Signal	Signal value RP.VGR.51118-2	22.00

Figure 8. Data recapitulation per day

c. Discussion

1. Repeater Equipment Status Indicator Marking

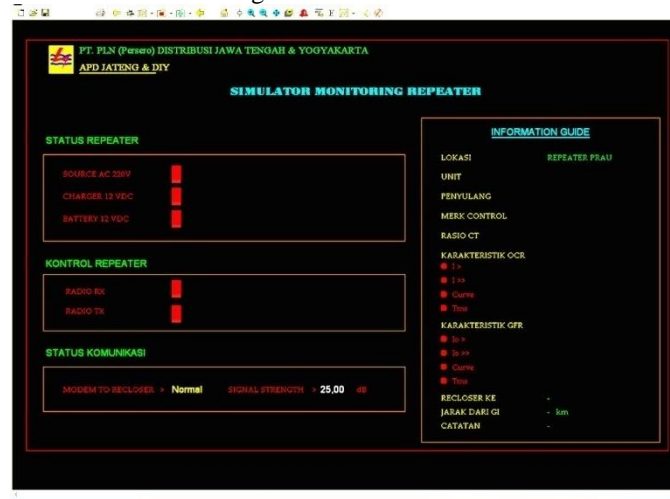


Figure 9. Status of Repeater Equipment

The status of the 220V source is red, this indicates that the 220V supply to repeater equipment is normal. If the 220V source is green, the supply voltage is lost, it means the repeater equipment is not getting 220V supply. Determination of red or green color based on SPLN Standard HMI Figure which explains that the red indication indicates close, while green indicates open on the device / network.

2. RX and TX Radio Reset Control

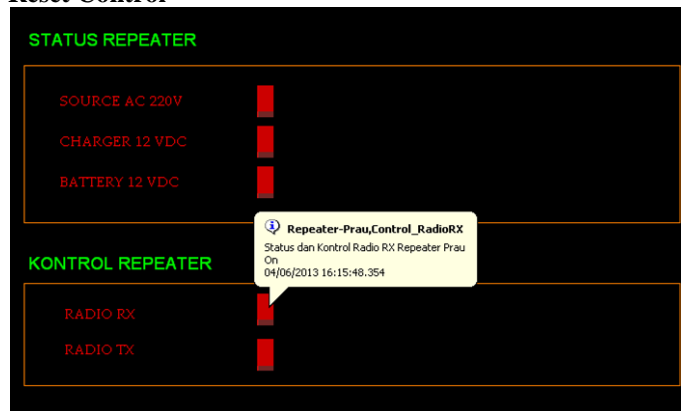


Figure 10. Repeater Control

To perform a control reset on the TX and RX radios, first make sure all the equipment is ON (red block).

Click on the red block button of the RX radio (the radio to be controlled), then the display will appear as follows.

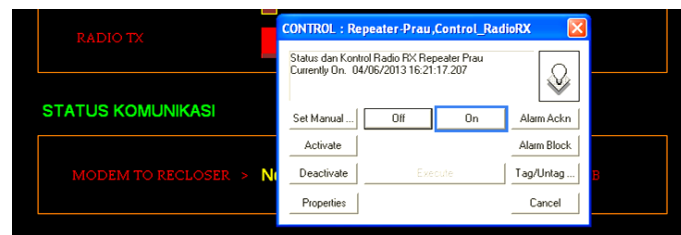


Figure 11. The window display for performing control reset

Click OFF to reset the radio, then click Execute

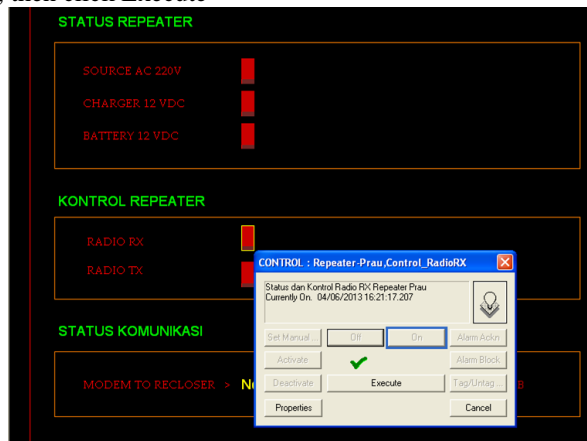


Figure 12. Display Window to execute control reset result

So automatically, the RX or TX radio equipment which is simulated to be an LED, will be reset so that the lamp simulator indicator will OFF then ON again. The following shows the results of the reset control on the Alarm View.



Figure 13. Results of Control Reset on Alarm View HMI SCADA

3. Comparison of After Install Repeater Monitoring and Control

Functionally, MonRe is very helpful in preventing loss of damage on the communication side caused by interference from repeater equipment. This tool will work as an early warning system as well as a standard automation and can be connected to the SCADA system.

If this tool is installed in the repeater as part of a monitoring device for repeater equipment consisting of RX and TX radios, battery, charger and 220V supply, interference handling will be faster and more precise because the communication of the equipment with SCADA is real time and the alarm view will be provide information from the repeater side.

Comm-failed repeater due to equipment disruption due to damage to one of the repeater equipment is something that can be suppressed if there is early detection. Since there are no operators on duty at the repeater location, it is not always necessary to monitor the condition of the equipment. With this equipment, the condition of each repeater equipment can be monitored remotely via SCADA. Here are the benefits in the MonRe installation application and the comparison with not installed.

Table 1. Comparison Before and After MonRe Installed

Condition	Not Using Equipment	By Using Equipment
as a precautionary measure before the comm-failed repeater occurred	No action unless there is a report or scheduled maintenance	Data can be used as material for analysis in order to carry out maintenance / investigations as quickly as possible
Knowing the condition of each equipment in detail	Yes, manually via the guard who is not always on standby, not routine.	Real Time Monitoring, Data Logging, On-Line SCADA
Knowing the condition of RX and TX radio equipment	Through the officer, it can only be known when testing communication between radio base stations	<i>Contact source enters Digital Input and monitored SCADA, if radio hangs can be controlled reset via Remote Control</i>

4. Conclusion

From the observations of technology implementation works that discuss the optimization of HMI SCADA for monitoring and control of radio communication repeaters using the Intek J65i-X GPRS modem, several conclusions can be drawn:

1. MonRe (Repeater Monitoring and Control) has been successfully installed on the Telomoyo repeater and has been functioning properly as a disturbance monitoring tool and reset control for repeater equipment such as RX radio, TX radio, battery, charger, 220V supply and can be monitored in real time on HMI SCADA APD Central Java and DIY. In the future it will also be installed on the Mt. Prau to optimize radio communication throughout Central Java and D.I. Yogyakarta.
2. With the creation of MonRe, employees no longer need to rely on reports from repeater guards, dispatchers and master stations can find out in real time which equipment is experiencing interference by looking at the HMI SCADA. So that it can be monitored if there is interference with the source, supply or radio repeater.
4. When the RX and TX radios hang on their equipment, they can directly control the ON / OFF reset from the master station without having to go to the location of the interference. So that it can save time and effort because if you come to a location that is far away and takes a long time.
5. MonRe can help analyze the causes of repeater disturbances, so that when it is required to handle it on site, officers already know the cause of the disturbance and have prepared spare equipment and equipment for restoring the fault. This can help speed up interruption recovery so that the interruption time is not too long.
6. The installation of MonRe radio communications on the Telomoyo repeater and Mt. Prau is a new alternative that is reliable and efficient so that it can be a solution to existing problems.

Reference

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