Research, design and integration of radio transceiver and mobile GSM devices into the internal communication system

Nguyen Trong The*, Cu Hoai Nam

Institute of Information Technology, Academy of Military Science and Technology.
*Corresponding author: nguyentrongthevcntt@gmail.com
Received 20 Aug. 2023; Revised 13 Oct. 2023; Accepted 10 Nov. 2023; Published 25 Nov. 2023.
DOI: https://doi.org/10.54939/1859-1043.j.mst.92.2023.167-170

ABSTRACT

This paper researches, designs and integrates radio transceivers and mobile GSM into the internal communication system. The radio connection block can transmit and receive information via a radio transceiver. The mobile GSM connection block can transmit and receive information via mobile GSM devices. Both connection blocks also have the ability to control and configure remotely via WAN or radio transceiver or mobile GSM devices to be flexible in changing parameters or operating modes of the connection block. The paper also presents the process of researching, building and testing the radio transceiver and mobile GSM connection blocks, which are important blocks in the system. The experimental results show that the connection blocks have high efficiency, contributing to improving the performance of the communication system on WAN.

Keywords: Radio transceive; Mobile GSM; Communication system; WAN.

1. INTRODUCTION

Currently, at provincial Military Command (PMC), the amount of information that must be received, communicated, managed, stored and processed daily at the Command Headquarters (CH) is very large. Therefore, the role of communication systems and technical equipment at CH is becoming increasingly important and urgent. CH needs to be equipped with modern communication systems that are highly automated and reliable. Therefore, the information transmission system (ITS) based on the wide area network (WAN) infrastructure using IP protocol, with many new features deployed at PMC, is promoting its effectiveness [1]. This is the basis for moving towards automation and modernization according to advanced management models in the world and the government's digital transformation orientation.

Integrating radio transceiver (RT) and mobile GSM into ITS has benefits, such as: improving communication in remote and hard areas, increasing flexibility and variety of communication channels, preparing for connecting to satellite communications, drones, etc.

On the market today, there are many suppliers manufacturing RoIP Gateway devices that allow connecting wireless communication systems to IP networks, converting audio signals, integrating into IP network systems and providing features, remote management, including Davantel's RoIP Gateway RoIP102, and Icom's RoIP Gateway VE-PG3, VE-PG4 [2-5], etc. As for devices that convert voice signals from GSM mobile networks to IP networks, there are many types such as: GSM VoIP Gateway UC2000 08 SIM from Dinstar, GSM VoIP Gateway SMG 4004 08 SIM from Synway [6, 7], etc. However, integrating RT and mobile GSM into the system has problems to solve: such as choosing equipment that matches technical requirements and operating conditions; Ensuring reasonableness and stability for the system when connecting; Building and installing software and algorithms to control and manage ITS; Testing and evaluating the performance and effectiveness of this system. Based on these issues, our research goal is to design and integrate RT and GSM mobile blocks into ITS on the WAN network for PMC. These blocks will help send and receive information via radio or GSM mobile devices more easily and safely. The system uses the GSM network to create a transmission platform using VPN technology, ensuring security and

safety at the transmission and application layers, in case the terminal is a personal phone. To ensure security, these phones need to shut down all data and Internet platforms in the near future.

In this paper, we will present the problem of designing and integrating RT and GSM mobile devices into the system at the unit in part 2, from which in part 3 we will present the results obtained in the design, integrate these connection blocks into the system and finally provide conclusions.

2. THE PROBLEM OF DESIGN AND INTEGRATION OF RT AND MOBILE GSM DEVICES INTO THE SYSTEM AND SOLVING METHODS

2.1. Problem

As stated in the Introduction, the problem to be solved is to design and integrate RT and GSM mobile connection blocks into the system of each CH. The radio connection blocks must be able to communicate with the communication blocks and central processing computer of ITS in the internal LAN. Radio connection blocks must be able to connect to at least 01 RT, including VRU812/S and IC-F5123D, and have VoIP function to connect to the IP PBX system. The minimum number of radio connection blocks that need to be studied is 03 sets. GSM connection blocks must be able to communicate with the mobile network. The problem is connecting the soft IP switchboard of ITS with the GSM mobile network to make voice calls and transmit messages between IP phones, analog phones, and mobile phones via the GSM network.

2.2. Methodology

The research methodology in the article includes the following stages: research design, data collection, and evaluation. In the design and research part, we use an experimental research design because the purpose of the research is to build and integrate RT and GSM mobile connection blocks into ITS, and test their effectiveness through tests. Experimental research design has three main elements: independent variable, dependent variable, and control variable. In this study, the independent variable is the radio and GSM mobile connection blocks, the dependent variable is the effectiveness of integrating the connection blocks, and the control variables are other factors not related to the integration of the connection blocks (type of radio and GSM mobile, number and location of units participating in the system, etc.). The data collection method uses an experimental method, in which tests are conducted on wireless radio and GSM mobile connection blocks to collect data. Data is evaluated using numerical criteria such as response time, success rate, and sound quality. Based on those methods, we perform the steps described in detail in section 3.

3. RESULTS OF RESEARCH, DESIGN AND INTEGRATION OF RT AND GSM MOBILE CONNECTION BLOCKS INTO THE INFORMATION SYSTEM

3.1. Design and integration of RT

Step 1 - Determine requirements: The communication block connects ITS and radios at PMC for: Expanding radio coverage; Connecting IP phones and radios; Sending and receiving notifications and orders via radio.

Step 2 - Design the connection block: This step plans the integration, including components, devices, protocols, and connection method. The connection diagram is figure 1a. The RoIP Gateway VE-PG3 or VE-PG4 device converts audio signals from the RT to IP network and vice versa.

Step 3 - Select devices: We chose the RoIP Gateway VE-PG3 or VE-PG4 device because it can connect to 4 radios at once, enhancing the communication and flexibility of the system.

Step 4 - Testing and evaluation: We tested the ability to transmit and receive messages and commands via RT. The results show that: The RT connection block meets the requirements; The VE-PG3 and VE-PG4 devices have all technical features; We tested with 3 types of radios used at the unit. All devices have smooth voice connection, clear and stable.

a) *b)*

Figure 1. *Communication diagram of RT (a) and GSM (b) connection blocks in the system.*

3.2. Design and integration of mobile GSM

Step 1- Determine requirements: This module communicates between ITS and GSM network for: Connecting to the commander's GSM mobile device, receiving commands or notifications by voice; Sending and receiving messages to commanders and mobile units; Supporting multi-protocol, information security and security solutions; Ensuring data transmission service; Easy to deploy, decentralized, modular and stable over a large area; Device size is compact, sturdy and suitable for operating environment.

Step 2 - Design the connection block: This step determines the components, devices, protocols, and connection method. The connection diagram is figure 1b. The GSM VoIP Gateway device converts audio signals from GSM mobile devices to IP network and vice versa. This device can attach multiple SIM cards, can be used with all carriers, and supports SIP and RTP protocols for voice calls over IP networks.

Step 3 - Select devices: We chose the GSM VoIP Gateway GoIP-4 device because it met the criteria. This device supports SIP and RTP protocols for voice calls over IP networks.

Step 4 - Testing and evaluation: We tested the ability to transmit and receive notifications and commands via GSM mobile. The results show that the GSM mobile connection system meets the requirements. GSM mobile phones can connect to mobile networks easily and stably.

The testing scene was performed both day and night in two weather conditions, dry and wet, using a standard distribution to process measurement results. Test results checking the ability of connection blocks to transmit and receive messages and commands via RT or GSM are in table 1.

Table 1. *Test results for the ability to transmit and receive messages and commands.*

Channel	Response time (seconds)	Success rate (%)	Sound quality (score)
Radio transceiver	2	95	8
GSM mobile	3	90	9

According to the table above, the experimental results show that: The communication channel "RT" has a response time of 2 seconds, a success rate is 95%, a sound quality score reaches 8. The communication channel "GSM mobile" has a response time of 3 seconds, a success rate of 90%, and a sound quality score of 9.

4. CONCLUSIONS

In this paper, we have presented the results of researching, designing and integrating RT and GSM mobile blocks into the WAN-based combat communication system for PMC. These blocks can send and receive notifications and orders via radio or GSM mobile. Integrating RT and GSM mobile blocks into the combat communication system creates a multi-channel and multi-mode communication system for operations. Experimental results have also tested the effectiveness of integrating RT and GSM mobile blocks through experiments on information transmission,

success rate and quality. These results show that integrating RT and GSM mobile blocks into ITS is practical, improving system performance, communication, response and cooperation of military forces. These results also prepare for developing and improving system connectivity in the future, such as increasing stability and security, expanding connection range with networks based on 5G, 6G, or other digital platforms according to the digital transformation of the government and the Ministry of Defense [8, 9].

REFERENCES

[1]. N. T. Thể, "*Nghiên cứu xây dựng hệ thống báo động và truyền tin tác chiến qua mạng diện rộng (WAN) phục vụ xử lý tình huống quốc phòng tại Sở Chỉ huy Bộ CHQS tỉnh*". TMĐT Sở KHCN tỉnh Bà Rịa Vũng Tàu, Viện CNTT, 20P22.

[2]. Zlink. *"Cross-Network Gateway (Radio, VoIP, Public Announce)*". Available at: https://goip-pro.ru/files/pdf/roip_102m.pdf.

[3]. Niceuc. "*Analog Gateway / IP PBX NC-MG640*". Available at: http://www.niceuc.com/en/1966.html.

[4]. Davantel. "*RoIP102 – Gateway de 1 canal radio sobre IP*". Available at: https://www.davantel.com/wp-content/uploads/2021/03/ds-roip102-sp.pdf.

[5]. Icom. "*RoIP gateway*". Available at: https://www.icomjapan.com/lineup/products/VE-PG4.

[6]. Synway. "SMG4004/4008 Wireless VoIP Gateway". Available at: https://synway.net/Download/Brochure/SMG4004-4008-Datasheet.pdf.

[7]. Dbltek. "*GoIP User Manual*". Available at: https://www.manualslib.com/manual/901152/Dbl-Technology-Goip.html.

[8]. Quyết định số 749/QĐ-TTg của Thủ tướng Chính phủ: Phê duyệt *"Chương trình Chuyển đổi số quốc gia đến năm 2025, định hướng đến năm 2030",* (2020).

[9]. Z. S. Attarbashi, A. E. Altaleb, A. H. Mohd Aman, A. Hassan Abdalla Hashim and S. Eker, "A Review of 5G Technology: Architecture and Challenges," *2022 IEEE 8th International Conference on Computing, Engineering and Design (ICCED)*, Sukabumi, Indonesia, pp. 1-4, (2022), doi: 10.1109/ICCED56140.2022.10010607.

TÓM TẮT

Nghiên cứu, thiết kế và tích hợp máy vô tuyến điện, di động GSM vào hệ thống truyền tin nội bộ

Bài báo nghiên cứu, thiết kế và tích hợp máy vô tuyến điện (VTĐ), di động GSM trong hệ thống truyền tin nội bộ trên nền mạng WAN. Khối kết nối vô tuyến điện có khả năng truyền và nhận các thông tin qua máy VTĐ. Khối kết nối di động GSM có khả năng truyền và nhận các thông tin qua máy di động GSM. Cả hai khối kết nối cũng có khả năng điều khiển và cấu hình từ xa qua mạng WAN hoặc máy VTĐ hoặc máy di động GSM để linh hoạt trong việc thay đổi các thông số hoặc chế độ hoạt động của khối kết nối. Bài báo cũng trình bày quá trình nghiên cứu, xây dựng và kiểm tra các khối kết nối VTĐ và di động GSM, là những khối quan trọng trong hệ thống. Kết quả thí nghiệm cho thấy, các khối kết nối có hiệu quả cao, góp phần cải thiện hiệu năng của hệ thống truyền tin trên mạng WAN.

Từ khoá: Máy vô tuyến điện; Di động GSM; Hệ thống truyền tin; WAN.