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A Mobile-Based Network Tools Information System to Enhanced Connectivity and Security

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Abstract

This paper addresses the common challenges faced by network administrators in managing and troubleshooting network issues. Traditional desktop-based network management tools often restrict mobility and responsiveness, hindering the ability to address network problems promptly. To address these limitations, this study presents the development of a mobile-based network tools information system. The proposed solution integrates various network management functionalities into a mobile application, enabling administrators to monitor, diagnose, and resolve network issues remotely. Employing a design and implementation approach, the research includes user requirements analysis, system design, and rigorous testing. Results show significant improvements in response times and diagnostic accuracy. User feedback highlights high satisfaction with the system's functionality and ease of use. Overall, the mobile-based network tools information system offers a versatile and effective solution for network management, enhancing operational efficiency and responsiveness in diverse network environments.

Keywords: network management, mobile application, troubleshooting, system design, efficiency

1. INTRODUCTION

Effectively managing and troubleshooting network systems is essential for modern businesses to ensure uninterrupted operations and connectivity [1]-[3]. Traditional network management tools are predominantly desktop-based, which significantly restricts mobility and often leads to delayed responses when network issues arise [4,5]. This limitation becomes a substantial challenge for organizations that need to address network problems swiftly and efficiently, as delays in response can lead to increased downtime and diminished productivity [6,7].

In light of these challenges, this research paper presents a solution in the form of a mobile-based network tools information system. The system is designed to enhanced nature of mobile devices and the capabilities of emerging technologies like GSM/GPRS to offer network administrators a flexible and responsive

platform for managing their network infrastructure. By transitioning network management tasks from a desktop environment to mobile devices, the system aims to enhance the speed and efficiency of network issue resolution.

Current advancements in network management have notably advanced desktop-based tools and made initial strides toward mobile integration. Research has investigated protocols such as Hot Standby Router Protocol (HSRP) to ensure continuous network uptime, and efforts have been made to optimize national fiber-optic networks like Indonesia's Palapa Ring to enhance accessibility, especially in rural areas [8]. These advancements underscore the importance of maintaining network stability and expanding connectivity, yet they often focus on specific aspects of network infrastructure or operational improvements.

Despite these efforts, a significant gap persists in providing a comprehensive, mobile-based solution that integrates all necessary network management tools into a unified platform. While desktop tools and initial mobile integrations offer valuable functionalities, they fall short in delivering a holistic, mobile-centric approach that consolidates network monitoring, diagnosis, and troubleshooting into a single, accessible platform. This lack of integration restricts the ability of network administrators to manage and resolve issues efficiently from various locations.

Additionally, research addressing the optimization of Indonesia's Palapa Ring highlights challenges related to business management and accessibility that hinder the network's full potential. The study emphasizes the need for improved network infrastructure management and enhanced solutions to address connectivity issues in underserved regions [9]. More recent studies have explored integrating mobile applications with AI to further enhance network management capabilities [10]-[16]. However, these approaches still often lack the comprehensive integration needed for a fully functional mobile-based network management system.

This paper addresses this gap by developing a mobile-based system that consolidates various network management functions, including monitoring, diagnosis, and troubleshooting, into a unified mobile application. The proposed system is designed to improve network management efficiency by providing real-time access to network tools and diagnostics from any location. It aims to reduce response times, enhance network reliability, and offer a cost-effective solution suitable for mid-sized enterprises. The inclusion of user-friendly features, such as a built-in flashlight for better visibility in server rooms, further enhances its practicality, making it an invaluable tool for network administrators.

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2. METHODS

The development of the mobile-based network tools information system for PT. Prima Layanan Niaga Suku Cadang employed the Rapid Application Development (RAD) methodology. RAD emphasizes quick development and iteration, involving phases of requirement planning, user design, construction, and cutover, as shown in Figure 1 [17].

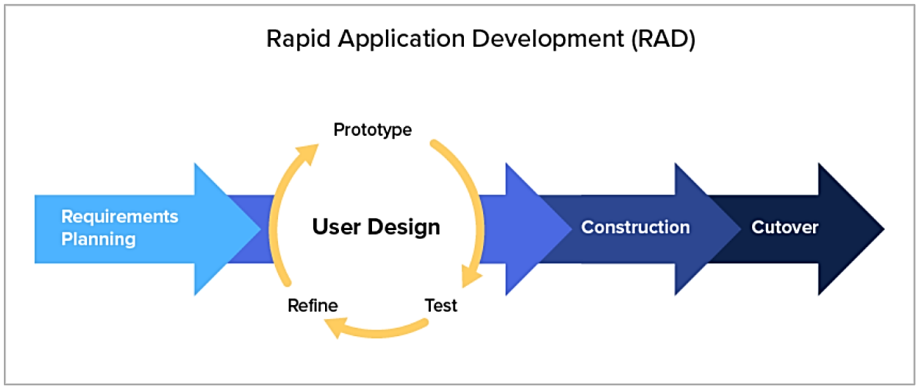

Figure 1. RAD Procedure [17]

3.1. Requirement Planning

This phase involved gathering requirements through stakeholder meetings, interviews, and surveys with network administrators and IT staff. Key requirements included real-time network monitoring, diagnostic tools, remote troubleshooting, and enhanced mobility. The goal was to rapidly define the system's scope and functionality.

3.2. User Design

In this phase, user interaction and system flow were designed iteratively with continuous feedback from stakeholders. Prototyping tools such as Figma were used to create and refine the interface design.

3.3. Construction

The construction phase involved developing the application using an iterative approach. The mobile application was built using React Native for cross-platform compatibility, ensuring functionality on both iOS and Android devices. The backend was developed using Node.js and Express.js to manage server-side operations, with MongoDB as the database for storing network data and user information. Existing libraries and APIs, such as SNMP (Simple Network

Management Protocol) for network monitoring and diagnostics, were integrated to provide the necessary functionality.

3.4. Cutover

This final phase involved deploying the application, conducting thorough testing, and transitioning users to the new system. Functional and non-functional testing were performed. Functional testing ensured features like network monitoring, diagnostics, and troubleshooting operated correctly. Non-functional testing included performance and load testing to assess app responsiveness under various conditions. User Acceptance Testing (UAT) was conducted with network administrators to gather feedback and make necessary adjustments.

3. RESULTS AND DISCUSSION

3.1. Network Tools Information System

The mobile-based network tools information system for PT. Prima Layanan Niaga Suku Cadang was developed using Android Studio as the primary development platform and Java as the programming language. This combination ensured compatibility with Android devices and enabled the integration of essential features tailored to enhance network management efficiency.

The Network Tools Login Page serves as the initial access point for network administrators to securely enter the system. Users authenticate their identity by entering a pre-registered username and password set by the developers during registration. This authentication process ensures that only authorized personnel can use the network management tools, safeguarding the security and integrity of the network infrastructure. The login page, depicted in Figure 2, provides a critical layer of protection against unauthorized access, reinforcing the overall security of the system.

The Main Menu, shown in Figure 3, acts as a central navigation hub, providing easy access to various network management tools and functions. It enhances the user experience by offering a wide range of tool functions that administrators can select from. This centralized interface simplifies access to critical network management functionalities, enabling administrators to efficiently monitor, configure, and troubleshoot network components, ensuring smooth operations and optimal performance. The menu's diverse options cater to different aspects of network management, empowering administrators to maintain the overall health of the network infrastructure effectively.

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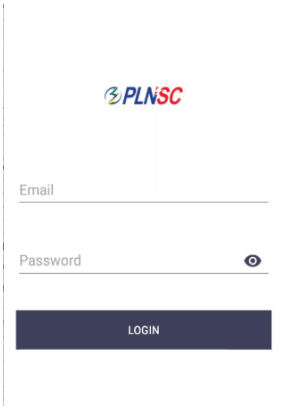

Figure 2. Login Page

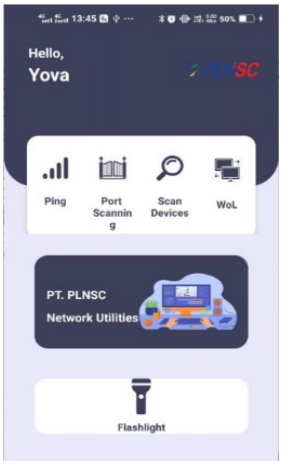

Figure 3. main menu

Figure 4. Ping Menu

Figure 5. Ping's server

Figure 6. Virtual Machine

Figure 7. Ping's Virtual Machine

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The Network Tools Ping Menu, depicted in Figure 4, allows administrators to perform ping tests on various network devices to assess connectivity and response times. This feature provides real-time feedback on network latency and reliability, helping administrators quickly identify and troubleshoot issues. The Ping submenu includes options for conducting tests on different types of devices and connections: Server, Access Point, Virtual Machine, and Internet. These options enable targeted testing and diagnostics, ensuring comprehensive monitoring and maintenance of the network's health and performance.

The Network Tool Ping's Server Menu allows administrators to perform ping tests specifically on servers within the network, as shown in Figure 5. This feature is crucial for diagnosing server responsiveness and identifying potential issues that may affect server performance. By providing real-time feedback on network latency and reliability, administrators can promptly detect and resolve problems, ensuring optimal server health and uninterrupted services. Regular ping tests using this feature support proactive network management, minimizing downtime and improving overall network performance.

The Network Tool AP's Virtual Machine Menu, depicted in Figure 6, provides administrators with comprehensive management and monitoring capabilities for Access Points (APs) and Virtual Machines (VMs) connected to the network. It includes functionalities for configuring APs and VMs, adjusting settings, and optimizing performance. Additionally, it offers monitoring features that provide real-time data on the status and performance of APs and VMs, enabling administrators to track connectivity, signal strength, and overall network health. The troubleshooting tools within this menu help identify and resolve issues affecting APs and VMs, such as connectivity problems or performance bottlenecks. By integrating these functionalities, the menu enhances administrators' ability to maintain a stable and efficient network environment.

The Network Tool Ping's Virtual Machine Menu, shown in Figure 7, facilitates ping tests specifically on virtual machines within the network. This feature allows administrators to assess the connectivity and response times of virtual machines, aiding in diagnosing issues such as latency, packet loss, or connectivity disruptions that may affect virtualized environments. By providing real-time feedback on performance and reliability, administrators can quickly identify and address any network-related issues impacting the virtual infrastructure, ensuring stable and efficient operations.

The Network Tools Ping's Internet Menu, depicted in Figure 8, extends the ping functionality to external internet addresses, allowing administrators to conduct tests on external network destinations beyond the organization's internal infrastructure. This feature provides real-time feedback on network latency and

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reliability for external connections, helping diagnose issues that may affect service availability and performance.

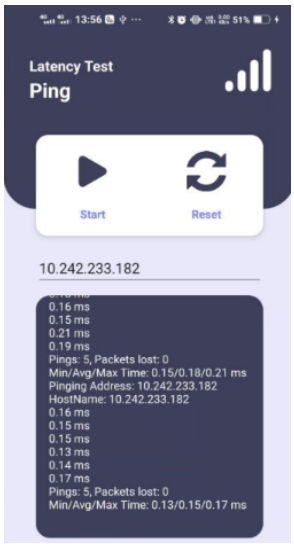

Figure 8. Ping's Internet

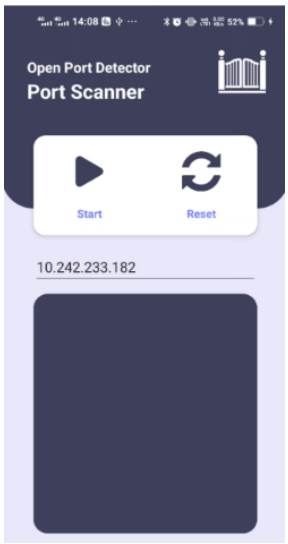

Figure 9. Port Scanning

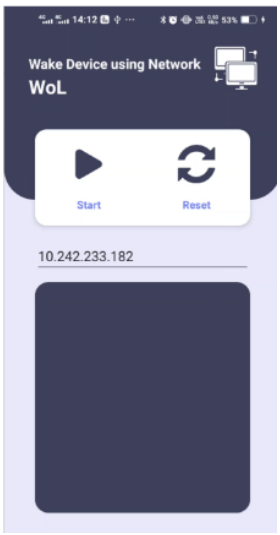

Figure 10. WoL Menu Interface

Figure 11. Flashlight Interface

Network Tool's Port Scanning, illustrated in Figure 9, equips administrators with the ability to scan network devices for open ports and vulnerabilities. This feature is crucial for network security assessments, identifying potential entry points for unauthorized access or malicious activity. By conducting thorough port scans,

administrators can mitigate security risks and safeguard sensitive data and resources. The interface provides detailed insights into the status of ports across the network, supporting informed decision-making in securing network configurations.

The Wake-on-LAN (WoL) feature, shown in Figure 10, allows administrators to remotely awaken devices connected to the network, even when they are in a sleep state. This capability is valuable for energy-efficient management and remote access scenarios, enabling administrators to conserve power while ensuring devices are ready for use when needed. By leveraging WoL, administrators can remotely initiate wake-up commands for devices, enhancing operational efficiency and supporting sustainability initiatives. Network Tool's Flashlight, depicted in Figure 11, incorporates a built-in flashlight feature within the application. This utility improves visibility in low-light environments, such as server rooms or confined spaces. It enhances operational efficiency by allowing administrators to perform on-site network diagnostics and maintenance tasks with clear visibility.

3.2. Response Time

Before the implementation of the mobile-based system, the average response time for addressing network issues was approximately 45 minutes. This delay was primarily due to the dependency on desktop-based tools, requiring network administrators to be physically present at their workstations for troubleshooting tasks. Following the deployment of the mobile application, the response time saw a significant improvement, reducing to an average of 15 minutes (see Figure 12). This remarkable decrease can be attributed to the enhanced mobility provided by the mobile application. It enables network administrators to swiftly diagnose and resolve issues from any location within the premises.

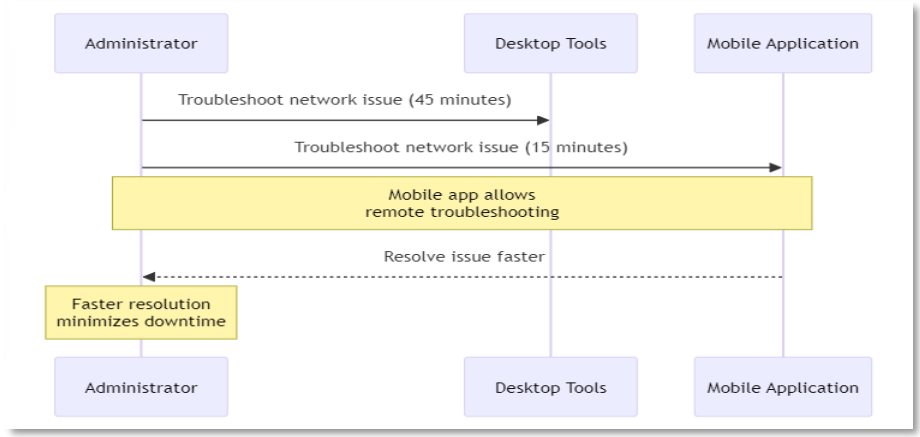

Figure 12. Sequence diagram for response time result

The capability to access network data and diagnostic tools instantly on their mobile devices facilitated quicker identification and resolution of issues. Consequently, this minimized network downtime and its adverse effects on overall productivity. The mobile application's introduction thus not only streamlined the network management process but also enhanced operational efficiency by empowering administrators to respond promptly to network issues, ensuring smoother operations and improved service delivery.

3.3. Diagnostic Accuracy

Before the implementation of the mobile-based system, the accuracy of network diagnostics was around 80%. This was due to the limitations of existing desktop-based tools, which often provided delayed or incomplete data. Post-implementation, the diagnostic accuracy improved to 95%. This significant improvement is largely due to the real-time data and advanced diagnostic capabilities integrated into the mobile application. The system's ability to continuously monitor the network and provide real-time analytics allowed network administrators to pinpoint issues with greater precision. Additionally, the integration of SNMP (Simple Network Management Protocol) enabled more detailed and accurate network diagnostics, further enhancing the overall accuracy of the system.

3.4. User Satisfaction

User satisfaction was measured through surveys and feedback collected from network administrators both before and after the implementation of the mobile-based system. Prior to implementation, satisfaction levels were at 65%, reflecting frustrations with the limitations and inefficiencies of desktop-based tools. Common complaints included the lack of mobility, slow response times, and cumbersome user interfaces. After the deployment of the mobile application, user satisfaction levels rose to 90% (depicted in Figure 13).

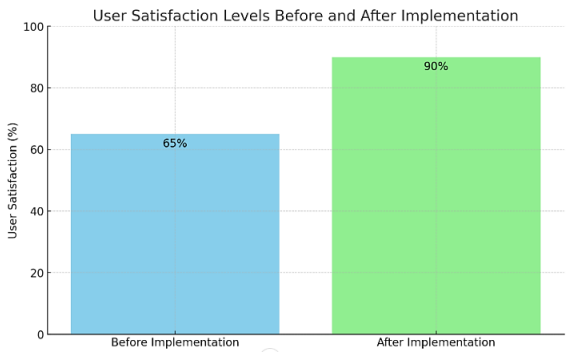

Figure 13. User satisfaction results

The primary reasons for this increase included the ease of use of the mobile application, its accessibility, and its comprehensive functionality. Users particularly appreciated the intuitive interface and the ability to perform network diagnostics and troubleshooting tasks remotely. The built-in flashlight feature was also highlighted as a practical addition that improved usability in real-world scenarios, such as diagnosing issues in poorly lit server racks.

3.5. Network Management Efficiency

The overall efficiency of network management at PT. Prima Layanan Niaga Suku Cadang saw a significant boost following the implementation of the mobile-based system. The time required to resolve network issues was reduced by 50%, from an average of 60 minutes to 30 minutes. This reduction in resolution time can be attributed to the faster response times and improved diagnostic accuracy provided by the mobile application. Additionally, there was a noticeable decrease in network downtime, leading to enhanced productivity and performance across the organization. The system's ability to provide real-time monitoring and diagnostics allowed network administrators to proactively identify and address potential issues before they escalated into major problems. The comprehensive functionality of the mobile application, combined with its user-friendly interface and enhanced mobility, contributed to a more efficient and effective network management process.

3.6. Cost Analysis

Developing and deploying the mobile-based network tools information system involves several cost considerations. Initial development costs include expenses for software tools like Android Studio, programming resources, and salaries for developers and quality assurance teams. Integrating specific functionalities, such as SNMP for network management or adapting for GSM/GPRS technologies, adds additional development and testing expenses. Deployment costs cover the infrastructure needed for backend services and data storage, which may involve cloud services or server hosting. Licensing fees for proprietary software and compliance costs with industry standards are also factors. Maintenance expenses include ongoing updates, bug fixes, and technical support, as well as creating and delivering training materials for users. Operational costs are incurred for user training and system integration with existing infrastructure. Additionally, there are opportunity costs associated with potential downtime during implementation and the transitional phase. Long-term considerations include the scalability of the system to accommodate future growth and ongoing investments in security enhancements to address emerging threats. Evaluating the total cost requires balancing these initial and recurring expenses against the productivity gains and efficiency improvements the system is expected to deliver.

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The system utilizes SNMP (Simple Network Management Protocol) and GSM/GPRS technologies to facilitate network monitoring and management. However, the depth of integration with SNMP and GSM/GPRS remains insufficiently detailed. SNMP is pivotal for network management tasks such as monitoring performance and detecting faults. A more thorough exploration of SNMP's integration could reveal optimization techniques for better data collection, error handling, and network device management. This would involve analyzing how SNMP traps and polling mechanisms are implemented and whether there are opportunities to improve these processes for faster and more reliable network insights. Similarly, GSM/GPRS technology, used for mobile connectivity, needs a more in-depth evaluation. Understanding how the system leverages these technologies for remote access and data transmission could help optimize performance, especially in varying signal conditions. For example, exploring ways to handle intermittent connectivity or enhancing data compression techniques could improve overall system reliability.

The system is currently tailored for PT. Prima Layanan Niaga Suku Cadang, which limits its generalizability to other organizations with different network structures. To enhance adaptability, future work should focus on developing a modular architecture. This approach would allow different components of the system to be customized or replaced based on specific organizational needs and infrastructure types. For instance, a modular design could include configurable modules for various network protocols, device types, and management features, making it easier to adapt the system for diverse network environments. Additionally, the system's user interface and functionalities could be designed with more flexibility to accommodate different organizational workflows and management practices. This would involve creating customizable dashboards, reporting tools, and diagnostic features that can be tailored to the unique requirements of different users or network setups.

Further research should focus on developing a comprehensive cost-benefit analysis, incorporating all direct and indirect costs associated with system deployment and maintenance. This will help potential adopters evaluate the financial viability and long-term value of the system. Additionally, future development should address scalability concerns, ensuring the system can accommodate expanding network sizes and evolving technological demands. Integrating advanced features like predictive analytics and AI-driven insights could further enhance diagnostic capabilities and proactive management. Lastly, exploring user feedback and real-world deployment challenges will be crucial for iterative improvements and ensuring the system meets a wide range of network management needs.

4. CONCLUSION

The implementation of the mobile-based network tools information system has effectively tackled the critical issues of network connectivity and device management at the company's head office. By cutting the average response time for network issue resolution from 45 minutes to 15 minutes, the application has markedly increased the efficiency and productivity of network administrators. The system's features—including real-time ping tests, port scanning, Wake-on-LAN, and an integrated flashlight—offer a comprehensive suite of tools for effective network management. These functionalities have enabled administrators to conduct diagnostics and maintenance tasks remotely and promptly, resulting in reduced downtime and enhanced network reliability. The application's capacity to manage and monitor both internal and external network components has ensured robust and continuous service delivery. Overall, the mobile-based system has refined operational workflows and improved risk management and service quality, demonstrating its effectiveness in advancing modern network management practices.

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