Prototype radius server wifi koin (WIKO) at PT SIMS using the evolutionary prototype method

Muhammad Amrullah
Program Studi Teknologi Informasi, Fakultas Sains dan Teknologi, Universitas 'Aisyiyah Yogyakarta, Indonesia
*Email: 2111501036@student.unisayogya.ac.id

Abstract
PT Sarana Insan Muda Selaras (PT SIMS) is a company engaged in the technology sector, specifically in providing internet network services. One of the company's products is the WiFi Koin service, which allows users to access the internet based on a certain duration of time through a prepaid voucher system. PT SIMS faces obstacles in its WiFi Koin service due to the decentralized voucher management system, which requires users to purchase new vouchers at each location. The purpose of this research is to Create a RADIUS Server Prototype to centralize the management of WiFi Koin voucher data across all PT SIMS locations. The research method used is Evolutionary Prototype, by integrating Mikrotik Routers at each location as Network Access Servers (NAS) with a central server. This central server runs the User Manager package as a RADIUS Server and utilizes Point-to-Point Tunneling Protocol Virtual Private Network (VPN) technology to bridge secure communication between locations. The results of the research show that the developed Prototype successfully centralizes the Authentication, Authorization, and Accounting (AAA) functions, allowing users to use a single voucher across the entire WiFi Koin network. Functional testing proves that the system can handle user authentication.

Keywords: RADIUS Server; Mikrotik; WiFi Koin; VPN; Evolutionary Prototype

1. Introduction

PT Sarana Insan Muda Selaras (PT SIMS) is a company engaged in providing internet network services. One of its products is the WiFi Koin (WIKO) service, which allows users to access the internet for a specific duration using a prepaid voucher system. This service is available in various locations, designed to provide easy and affordable internet access to the public. However, the current voucher management system is decentralized, meaning each WiFi location generates its own voucher codes without synchronization to a central system. This forces users to purchase a new voucher every time they move to a different WIKO location. This management and authentication issue can be resolved with a centralized Remote Authentication Dial-In User Service (RADIUS) server (Anandika et al., 2023; Fauzi et al., 2020; Muftie et al., 2022; Subhiyanto, 2021) . This system integrates the concepts of Authentication, Authorization, and Accounting (AAA), enabling centralized user validation, access rights management, and activity logging (Gumelar, 2017; Marbatri Adis et al., 2022; Sembiring, 2022; Wadly et al., 2023) .

Previous research has demonstrated the effectiveness of RADIUS servers for user management in hotspot networks. Studies show that RADIUS allows for effective implementation of the AAA concept for enhanced network control and security (Gumelar, 2017) . The integration of Mikrotik's User Manager package as a RADIUS server has been proven to simplify administration and improve network security. Furthermore, a centralized RADIUS server provides a crucial accounting mechanism, allowing all user activities to be recorded in a single central location for monitoring and auditing purposes , a feature that directly addresses the fragmented data issue at PT SIMS (Marbatri Adis et al., 2022) . For users, this centralized system offers a seamless experience, allowing access across various locations with a single credential (Ardianto, 2019) . Technically, the integration of Mikrotik Routers as Network Access Servers (NAS) with a RADIUS server is well-established and reliable (Kuswanto et al., 2017) . This research builds upon these findings by applying a centralized RADIUS solution to the specific business model of a multi-location WiFi Koin service, using the Evolutionary Prototype method to ensure the developed solution meets the practical needs of the company and its users (Irnawati & Darwati, 2021). The objective of this study is to create a RADIUS server prototype to centralize the management of WiFi Koin voucher data across all PT SIMS locations using the Evolutionary Prototype method .

2. Method

The system development model used is the Evolutionary Prototype detailed in Figure 1, which allows for gradual system development through continuous evaluation and improvement based on direct user feedback (Bina et al., 2021). The process consists of four main stages:

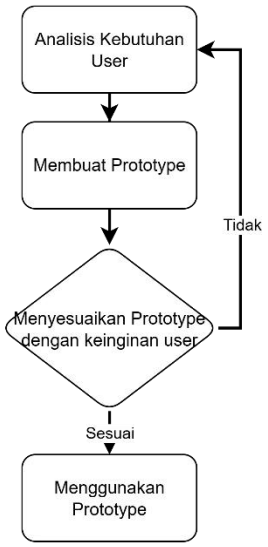

Figure 1. Evolutionary Prototype

As shown in Figure 1. explains the workflow of the Evolutionary Prototype method, starting from Needs Analysis, Prototype Creation, an iterative cycle of Prototype Adjustment and User Feedback, and the final Prototype Implementation.

The system development process consists of four main stages. It begins with the User Needs Analysis phase, where initial discussions between developers and PT SIMS are held to identify key problems, such as decentralized voucher management, and to gather both functional and non-functional requirements. Following this analysis, the Creating the Prototype stage involves the development of an initial working model, which includes designing the network architecture and topology, determining hardware needs, and performing the initial configuration of the Mikrotik devices and the RADIUS server. This prototype then enters the Adjusting the Prototype stage, an iterative cycle where end-users test the system and provide feedback, allowing the developer to make necessary revisions to better align the system with user needs. Finally, once the prototype is approved, the process concludes with the Using and Implementing the Prototype stage, where the final system is deployed in the actual operational environment and undergoes a comprehensive evaluation to ensure its reliability, ease of use, and stability.

The system architecture utilizes a Mikrotik RB750r2 as the central server, running the User Manager package (RADIUS) and a VPN server. At each WIKO location, a Mikrotik RB941-2nD serves as the hotspot access point. All devices are connected via a PPTP VPN tunnel, which creates a secure communication path between each WIKO location and the central server for centralized user management. The hardware and software used are detailed in Table 1, and the network architecture is depicted in Figure 2.

Table 1. Hardware and Software

Category	Device Name	Specifications/Version	Function
Hardware	Mikrotik Server WIKO	RB750r2 (hEX-Lite)	The central router that manages WIKO devices, VPN servers, and runs the RADIUS Server (UserManager).
	Device WIKO	RB941-2nD (hAP-Lite)	As an Access Point Hotspot at the

			user's location.
	Client Device	Laptop, Smartphone	For connection and access testing.
	RADIUS Server	Mikrotik User Manager	Mikrotik's default RADIUS Server package.
Software	VPN	PPTP (Point-to-Point Tunneling Protocol)	For secure connection between location and central server.
	RouterOS	v6.48 or later	Operating system on all physical Mikrotik devices.

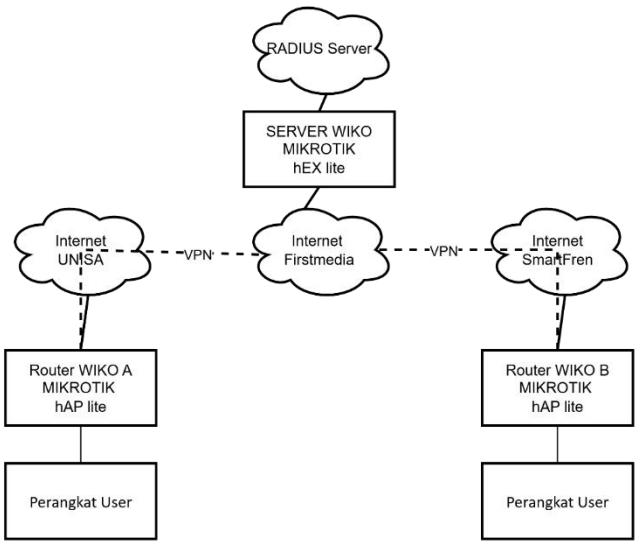

Figure 2. WIKO RADIUS Server Prototype Architecture

As shown in Figure 2, WIKO A and WIKO B locations establish a VPN tunnel connection over the internet to a central server (RB750r2). This central server functions as both a VPN Server to accept connections and a RADIUS Server (UserManager) to process all authentication requests. With this architecture, when a user connects to a hotspot at any WIKO location, the login process is securely tunneled and directed to the central server.

3. Results and Discussion

The initial prototype was built based on the needs analysis by following several key configuration steps to create a functional system for testing. First, the Central RADIUS Server Configuration was established by setting up a Mikrotik RB750r2 at a central location with a static public IP and installing the User Manager software package to enable its function as a RADIUS Server. To bridge communication with remote locations, a VPN Configuration was established, where the central router was set as a PPTP Server, and unique VPN accounts were created for each WIKO router. Once connected via a secure tunnel, each WIKO router received a private IP address, integrating it into the virtual private network. Concurrently, the Hotspot Configuration on each WIKO router was activated, and the authentication method was changed to "Use RADIUS" to ensure all login requests were forwarded centrally. The crucial RADIUS and Hotspot Integration was then completed by configuring a two-way trust relationship using a shared secret password, where each WIKO router was pointed to the server's private VPN IP, and the central server was configured to recognize each WIKO router as a

trusted Network Access Server (NAS). Finally, for initial testing, Profile and User Creation was performed in User Manager to define access limitations (like duration and speed) and to generate several voucher accounts.

3.1. Evaluation and Testing Results

After the initial prototype was demonstrated, it was evaluated by PT SIMS. The prototype was deemed to have fully met all functional and operational requirements, successfully addressing the core problem of centralized voucher management. As a result, no further revision cycles were necessary, and the initial prototype was approved as the final system for comprehensive testing. Functional testing of the final system showed a 100% success rate across all scenarios, as summarized in Table 2.

Table 2. Final System Functional Testing Results

No.	Testing Scenario	Expected results	Status
1	The user logs in at one of the locations (WIKO A or WIKO B).	Login successful, session recorded on central server.	**100%**
2	User changes Location (WIKO A or WIKO B).	Can continue session from (WIKO A or WIKO B).	**100%**

3.2. Discussion

The designed prototype of a centralized RADIUS server successfully resolved the primary challenges faced by PT SIMS. The effectiveness of the Evolutionary Prototype method was demonstrated, as the initial prototype precisely captured and fulfilled all requirements from the outset, eliminating the need for further development cycles.

The system's robustness was confirmed through testing across diverse network environments. The central server used a Firstmedia internet connection, WIKO A used the Universitas 'Aisyiyah Yogyakarta network, and WIKO B used a Smartfren cellular network. The successful implementation of a PPTP VPN tunnel proved effective in bridging these different network infrastructures, overcoming challenges such as the lack of a public IP at the branch locations. This confirms the solution is not only theoretically valid but also practical for real-world deployment. As shown in Figure 2, the User Manager's active sessions table displays users connected simultaneously from different WIKO locations, proving the system's capability to handle authentications from multiple network sources. Figure 3 and Figure 4 show a user successfully logging in at WIKO A and then seamlessly continuing their session after moving to WIKO B, highlighting the system's core functionality.

4. Conclusion

Based on the research results, it is concluded that the prototype of a centralized RADIUS Server system, utilizing Mikrotik User Manager and a VPN connection, successfully resolved the decentralized voucher management problem at PT SIMS's WiFi Koin service with 100% effectiveness. The developed system enables the use of a single voucher across the entire network, improving operational efficiency for administrators and providing a better experience for users. The Evolutionary Prototype method proved highly successful; the initial prototype managed to capture and meet user needs without requiring additional revision cycles, thereby accelerating the system development process.

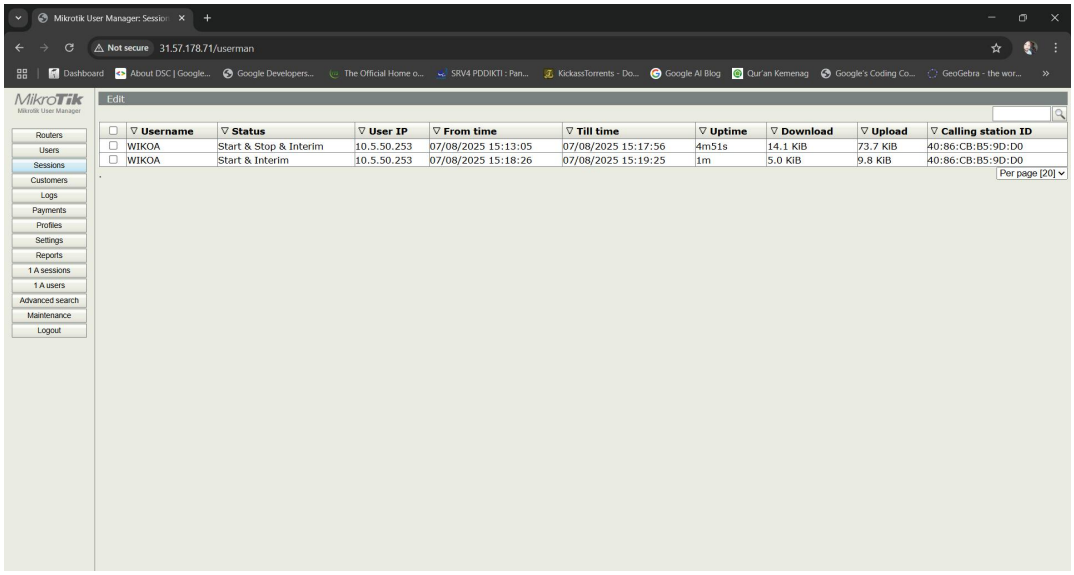

Figure 3. Active Sessions from Various Locations in User Manager

As shown in Figure 3. Showing a screenshot of the Mikrotik User Manager web interface on the central server. The "Active Sessions" table shows at least two users currently online. One user is connected via WIKO-A (from the 'Aisyiyah University Yogyakarta network) and the same user is also connected via WIKO-B (from the Smartfren network), proving that the system can handle authentication from multiple network sources simultaneously.

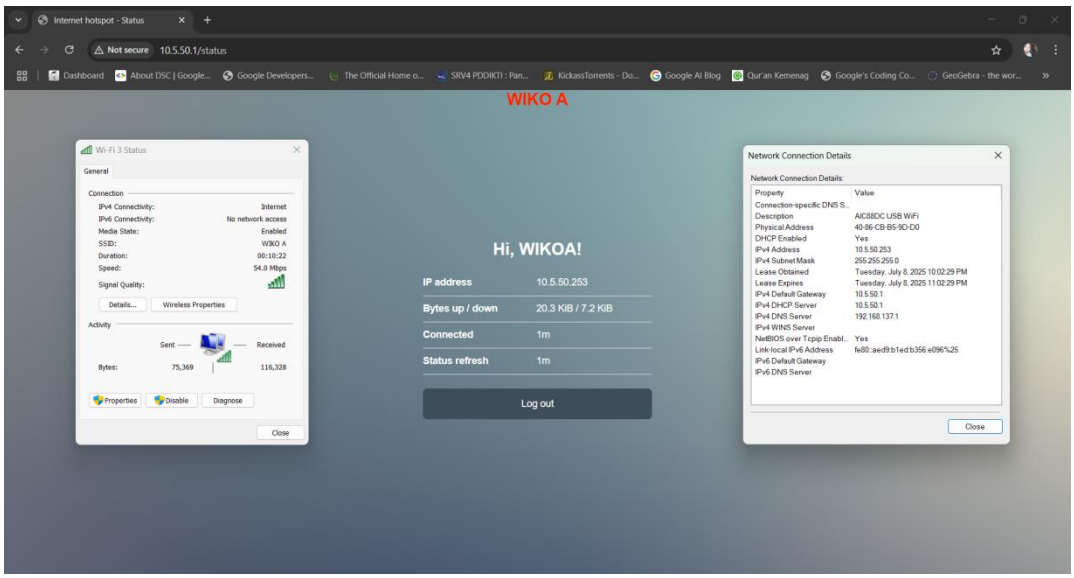

Figure 4. Hotspot Login Page on WIKO A Device

As shown in Figure 4. shows the login page (captive portal) display on the user's website when connected to the WIKO A Hotspot

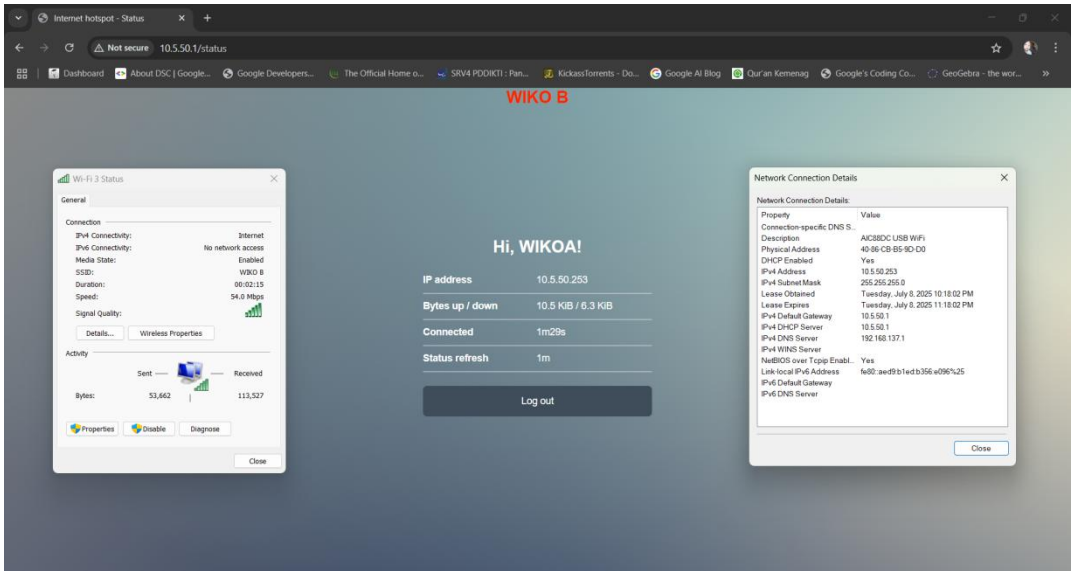

Figure 5. User Session Moving from WIKO A to WIKO B.

As shown in Figure 5. shows the login page (captive portal) display on the user's website when connected to the WIKO B Hotspot by moving from WIKO A

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