Analysis of Security Vulnerabilities in RUCKUS Implementations at Latin American Universities

Gabriel Minda
School of Information Systems Engineering, UIDE
Quito, Ecuador
gamindaca@uide.edu.ec

***Abstract*—Universities face growing cybersecurity challenges on their campus networks as they increasingly rely on large-scale wireless infrastructures, expanding the attack surface for both external and internal threat actors. Many higher education institutions in Latin America use RUCKUS network devices to provide campus-wide Wi-Fi connectivity, exposing them to critical vulnerabilities recently discovered in RUCKUS access points and management platforms. This academic report presents a comprehensive analysis of these technical vulnerabilities within the specific context of Latin American universities, with a focus on the Ecuadorian case.**

The document addresses the issue of cybersecurity in universities by establishing general and specific objectives and developing a theoretical framework based on the fundamentals of computer networks and cybersecurity in higher education environments. The methodology consists of a technical document analysis, utilizing reliable sources such as vulnerability databases, CERT/CC advisories, vendor bulletins, industry research, and local academic literature. The main findings and specific mitigation strategies are discussed, along with key performance indicators to measure the effectiveness of the implemented controls.

***Index Terms*—RUCKUS, Virtual SmartZone, Network Director, Higher Education, Vulnerability Management**

I. Introduction

A. Background

The rapid growth of online services and connected devices has created a heterogeneous environment that is difficult to protect. This diversity of systems, combined with strong dependence on technology, makes educational institutions attractive targets for cybercriminals who constantly refine their techniques [1], [2]. Recent cybersecurity reports show that the education sector is among the most frequently attacked worldwide and that ransomware, malware and phishing campaigns against higher education institutions continue to grow [1], [2]. These threats affect users and organizations across Latin America by taking advantage of weak security and technical vulnerabilities in institutional systems [1].

In Ecuador, cyber incidents in higher education are rarely disclosed, which keeps universities in a reactive stance, limits a clear understanding of their real level of risk and postpones the adoption of preventive and corrective measures [1], [2]. In this environment, vulnerabilities that affect the confidentiality, integrity and availability of network services can seriously erode the robustness of RUCKUS-based wireless deployments in Latin American universities [6], [7], [10]. In this context, universities become critical targets, both because they manage sensitive information and because they must guarantee the continuity of academic activities [1].

To meet these demands, many universities have deployed high-performance connectivity infrastructures that support large numbers of users while maintaining reliability and quality of service [9]. In this scenario, RUCKUS Networks has become a reference solution in smart cities, healthcare environments and university campuses, thanks to the scalability of its controllers and the performance of its access points [8], [9]. A representative case is Universidad de Especialidades Espíritu Santo in Ecuador, which renewed its wireless network by deploying Wi-Fi 6 access points managed through the RUCKUS Virtual SmartZone platform [9]. This upgrade increased the number of devices that each access point can support and improved service stability. As a result, RUCKUS is now positioned as one of the main wireless infrastructure solutions in the Ecuadorian university ecosystem [9].

As universities increase their dependence on RUCKUS-based network infrastructures, any weakness in these platforms can have an immediate impact on daily operations and on the overall security of institutional services [4], [6]. A single successful compromise of a Wi-Fi controller or centralized management platform can open the door to unauthorized access to internal resources, cause widespread service disruptions, enable data theft, and even support distributed denial-of-service (DDoS) attacks carried out through botnets of compromised devices [4], [5], [7].

In Latin America, this risk is intensified by structural constraints: many institutions work with limited budgets and have restricted access to specialized cybersecurity teams and tools [1]. In a considerable number of universities there are still no formal vulnerability management programs or advanced monitoring capabilities, which delays the timely detection and remediation of security flaws [1], [2]. Under these conditions, vulnerabilities that affect the confidentiality, integrity and availability of network services can seriously weaken RUCKUS wireless deployments in Latin American universities [6], [7], [10]. Identifying and mitigating these weaknesses is therefore a priority.

B. Objectives

General Objective: The general objective of this work is to evaluate critical security vulnerabilities in RUCKUS infrastructures deployed in Latin American universities, analyzing how

Table I
OSI LAYERS, TYPICAL THREATS AND CONTROLS IN UNIVERSITY WI-FI DEPLOYMENTS

Layer	Example in campus Wi-Fi	Typical threats / Controls
Physical (L1)	Wireless radio signals between APs and clients.	Jamming, signal interference, rogue antennas. *Controls:* power control, physical security of APs, RF monitoring.
Data Link (L2)	802.11 frames, VLAN tagging in access switches.	MAC spoofing, evil twin APs, weak WLAN configurations. *Controls:* WPA2/3-Enterprise, 802.1X, port security, dynamic VLANs.
Network (L3)	IP addressing and routing between campus subnets.	IP spoofing, misconfigured routing, pivoting between VLANs. *Controls:* ACLs, firewalls, network segmentation, VRFs.
Transport (L4)	TCP/UDP sessions for university services (LMS, email).	Port scanning, DoS on critical services. *Controls:* rate limiting, stateful firewalls, TLS, service hardening.
Application (L5–L7)	vSZ / RND web interfaces and APIs.	RCE, auth bypass, command injection, credential theft. *Controls:* strong authentication, RBAC, patching, WAF, secure coding.

they can be exploited and how they affect daily operations, in order to propose cost-effective mitigation strategies adapted to the region's limited resources.

Specific Objectives:

- Identify critical RUCKUS product vulnerabilities affecting university networks, detailing attack vectors.
- Assess risks to data confidentiality, system integrity, and service availability in the regional context.
- Propose cost-effective technical and organizational mitigation strategies.
- Define Key Performance Indicators (KPIs) to measure security control effectiveness.

II. THEORETICAL FRAMEWORK

A. Network Security and the OSI Model

Network security is commonly explained using layered reference models that organize how devices communicate. The most widely used is the Open Systems Interconnection (OSI) model, which divides communication into seven layers, from the physical medium up to the application layer [3]. This layered perspective makes it possible to analyze protocols in a structured way and to pinpoint where vulnerabilities arise, which in turn helps determine where security controls will be most effective [3]. In functional terms, the physical layer sends bits over the medium, the data link layer groups them into frames and handles basic error control, the network layer forwards packets, the transport layer guarantees end-to-end delivery, and the upper layers support the application layer, which is directly used by people and services [3].

From a cybersecurity standpoint, the OSI model is especially valuable because it clarifies that attacks do not occur at a single level of the stack but can be directed at different layers in different ways [3]. For example, a vulnerability in a Wi-Fi access point can affect the physical, data link and network layers, whereas a flaw in a SmartZone controller is mainly located at the application layer but can still compromise the underlying infrastructure [6], [7]. In practice, these layers are closely interconnected, so a weakness in one can quickly propagate to others.

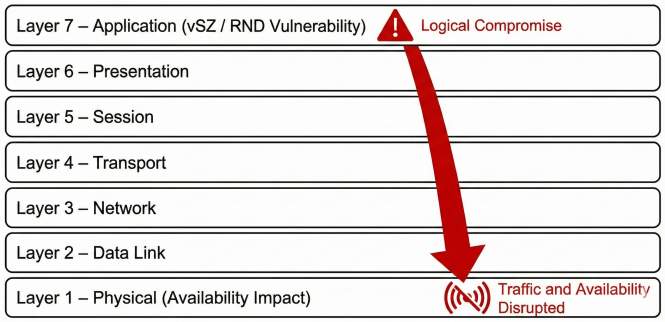

Figure 1. Conceptual mapping of an application-layer vulnerability in RUCKUS controllers onto the OSI model and its potential propagation toward lower layers and overall service availability [6], [7].

In Table I, specific security controls must be coordinated across multiple layers to effectively mitigate these risks in a university campus environment.

B. Cybersecurity in University Environments

Universities operate in increasingly complex technological ecosystems, with large and diverse user communities, many types of devices and relatively open access policies [1]. Together, these factors create a broad and constantly evolving attack surface, shaped by enrollment cycles, the launch of new academic programs and the continuous incorporation of digital services into teaching and administration [2]. In this

Table II
MAIN RUCKUS COMPONENTS IN CAMPUS DEPLOYMENTS AND ASSOCIATED RISKS

Component	Role in university network	Main security risks
Access Points (APs)	Provide Wi-Fi connectivity to students, staff and guests across campus buildings.	Exploitation of firmware vulnerabilities (e.g., CVE-2023-25717), use as DDoS bots, traffic interception, rogue AP replacement.
Virtual SmartZone (vSZ)	Central controller for AP configuration, policies and monitoring.	Single point of failure; RCE and privilege escalation (e.g., CVE-2025-44954); full visibility of SSIDs, keys and integration credentials.
Ruckus Network Director (RND)	Higher-level management for multiple SmartZone deployments.	Authentication bypass, compromise of multiple campuses or sites at once, tampering with global policies.
Management VLAN	Isolated segment for controller and administration interfaces.	Insufficient isolation, shared with other services, lateral movement if ACLs and firewalls are weak.
Logging Systems	Store logs from controllers, APs and firewalls.	Log tampering, loss of forensic data, lack of alerting on abuse of RUCKUS services.

context, maintaining academic openness while ensuring robust information security is particularly challenging and usually demands gradual adjustments in processes, institutional culture and governance structures [2].

Recent studies confirm that the education sector ranks among the most exposed globally to cybersecurity incidents, including ransomware, credential theft and attacks on network infrastructure [1], [2]. These events interrupt teaching, cause data loss, generate unforeseen costs and significantly damage institutional reputation [2]. Even so, there is a growing recognition of the importance of cybersecurity in higher education and a set of proposals that seek gradual and realistic improvements in this area [1], [2].

C. RUCKUS Networks Ecosystem in Universities

RUCKUS Networks, a division of CommScope, provides high-performance connectivity solutions that are widely used on university campuses [9]. Its Wi-Fi access points and controllers support the centralized management of thousands of client devices, which simplifies configuration, monitoring and day-to-day operation of the wireless network [8]. The core elements of this ecosystem are the SmartZone and Virtual SmartZone controllers, which manage the access points, and the Ruckus Network Director platform, which coordinates multiple distributed controllers [6], [8]. This centralized architecture makes it easier to operate large-scale networks, but it also concentrates security risk in a small number of critical management systems [7].

In Table II, each component of this architecture plays a specific role but also introduces distinct security risks that attackers may exploit. Case studies such as the UEES deployment describe clear improvements in coverage, stability and capacity after the adoption of RUCKUS Virtual SmartZone and Wi-Fi 6 access points [9]. At the same time, the scale of these deployments means that a single vulnerability can translate into a large-scale risk: a successful attack on one controller can compromise hundreds of access points and thousands of users, which makes patch management and security hardening essential operational tasks [6], [7].

Under normal circumstances, the vendor publishes security bulletins and software updates whenever vulnerabilities are detected; however, the 2025 case exposed major shortcomings both in the disclosure process and in the speed of the vendor's response [6], [10]. In practice, this forces institutions to apply temporary mitigation measures while waiting for official fixes and reinforces the need to actively monitor threat-intelligence sources and specialized advisories when operating RUCKUS infrastructures [1], [7].

D. Summary

First, the OSI model provides a structured and systematic basis for locating and analyzing vulnerabilities at each layer of the network stack [3]. Second, universities operate in a high-risk, resource-constrained environment, where threats continue to increase and protection capabilities remain uneven [1], [2]. Finally, while the RUCKUS ecosystem offers substantial technical benefits for campus connectivity, it also introduces critical dependencies that must be managed with particular care from a security perspective [6], [9].

III. STATE OF THE ART

A. Management of Vulnerabilities in Network Infrastructures

In network infrastructures, vulnerability management is built around reference databases such as CVE and the National Vulnerability Database. These repositories store security defects with unique identities and severity scores, providing a standard language for describing and comparing risk across enterprises and technologies [4]. They are a core input for technical and management decisions in cybersecurity [4].

Along with these databases, coordinating groups such as CERT/CC publish vulnerability notes that aggregate linked concerns, and companies provide security bulletins that specify

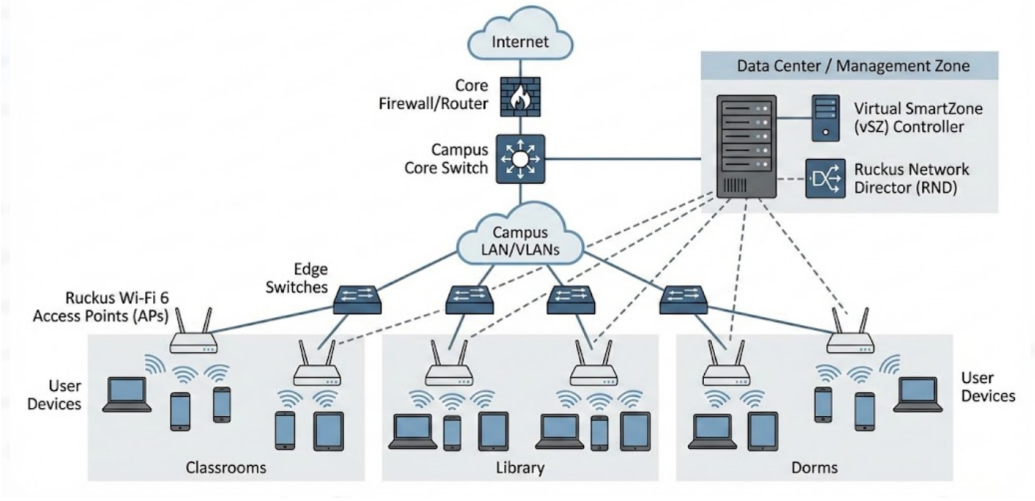

Figure 2. Typical RUCKUS centralized network architecture in a university campus, showing the connection between Access Points and the Virtual SmartZone controller.

Table III
REFERENCE SOURCES USED FOR VULNERABILITY MANAGEMENT IN THIS STUDY

Source	Information provided	Use in this work
NVD / CVE	Standardized identifiers, CVSS scores, technical summaries.	Identify critical RUCKUS vulnerabilities (e.g., CVE-2023-25717) and quantify their severity.
CERT/CC	Coordinated vulnerability notes, grouped CVEs, interim mitigations.	Understand systemic risks in vSZ and RND, follow disclosure timeline and temporary guidance.
Ruckus Bulletins	Vendor advisories, affected versions, fixed firmware releases.	Map vulnerabilities to product versions used by universities and derive patching requirements.
Industry Research	Campaign analysis, proof-of-concept exploits, attack chains.	Show real-world exploitation (e.g., AndoryuBot) and practical attack scenarios against RUCKUS devices.
Academic Studies	Context on Latin American universities, incident trends.	Adapt mitigation strategies and KPIs to the Ecuadorian and regional higher-education environment.

which product versions are impacted and which fixes should be deployed [6], [8]. Together, these records provide a critical layer of information that administrators may utilize to prioritize remedial action and organize updates in an orderly and verifiable manner [6], [8].

To prevent disruptions to teaching and administrative activities, university network teams must promptly discover new vulnerabilities, analyze their impact on local installations and plan fixes [1]. Cases like CVE-2023-25717, which was rapidly added to CISA's Known Exploited Vulnerabilities (KEV) database, show why critical flaws exploited in real-world attacks demand immediate attention [4], [5].

In Table III, this research relies on a combination of vendor bulletins, vulnerability databases, and academic sources to provide a holistic view of the threat landscape.

B. Documented Attacks on RUCKUS Devices

FortiGuard Labs (Fortinet) found the AndoryuBot botnet, which scans the Internet for vulnerable RUCKUS access points and exploits them using CVE-2023-25717 [5]. Once a device is under the botnet's control, malicious code is executed and the access point is used in distributed denial-of-service (DDoS) campaigns, turning part of the wireless infrastructure itself into an attack tool [5].

This example shows that vulnerabilities in RUCKUS products are not abstract weaknesses but concrete attack vectors that adversaries are already exploiting in operational networks [4], [5]. The availability of malware that automates exploitation speeds up compromise, particularly when organizations delay patching or lack established vulnerability management processes [4].

In 2025, Claroty's Team82 identified eight serious vulnerabilities in Virtual SmartZone and Ruckus Network Director, which were later merged by CERT/CC into vulnerability notice VU#613753 [6], [7]. The flaws include hardcoded SSH keys, embedded secrets, authentication bypass, command injection and arbitrary file read, which can be chained to obtain full control over management platforms [7].

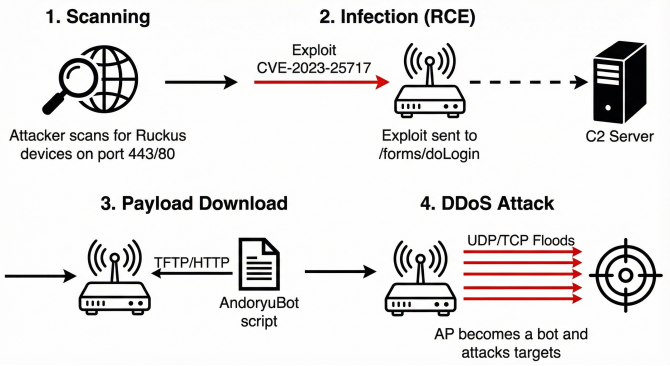

Figure 3. Operational lifecycle of the AndoryuBot botnet targeting Ruckus devices via CVE-2023-25717. The diagram shows the progression from scanning to DDoS execution [5].

A distinctive feature of this case was the initial absence of patches and the limited vendor response during the responsible disclosure process [6], [10]. In this context, CERT/CC issued temporary mitigation guidance, and the security community raised concerns about the systemic risk these issues posed in large-scale deployments [10].

C. Cybersecurity in Latin American Universities

Regional academic studies report a marked increase in cybersecurity incidents in the Ibero-American education sector, with a significant proportion of institutions indicating that they have experienced at least one event in the past year [2]. Detailed statistics on incidents in colleges are rarely made available, typically due to reputational or confidentiality issues.

Derenzin-Martínez's study in Ecuador evaluates university cyberattack preparation and highlights gaps in monitoring, incident response and risk management [1]. These studies emphasize the need to create an institutional security culture and explicitly integrate cybersecurity into strategic planning and governance procedures [1], [2].

Detailed statistics on events at universities are rarely made public for reputational or confidentiality reasons. However, data on phishing frequency place Ecuador among the most vulnerable countries in the region [1], [2]. This tendency shows that higher education institutions are extremely susceptible, underlining the need for more empirical research on attack dynamics and response capabilities [1].

D. Summary

The theoretical framework brings together three main ideas. First, the OSI model offers a clear structure for locating and analyzing vulnerabilities at each layer of the network stack [3]. Second, universities operate in a high-risk and resource-constrained environment, where threats continue to grow and protection capabilities remain uneven across institutions [1], [2]. Third, although the RUCKUS ecosystem provides important technical advantages for campus connectivity, it also creates critical dependencies whose security must be managed with particular care [6], [9]. These elements frame the state-of-the-art review and support the detailed analysis of specific vulnerabilities developed in the following sections [7].

Table IV
KEY RUCKUS VULNERABILITIES ANALYZED

ID / Ref	Component	Description	CVSS
CVE-2023-25717	Access Point	Unauth Remote Code Execution (RCE) via HTTP	9.8
VU#613753	vSZ & RND	Group of 8 vulnerabilities (e.g., hardcoded keys)	N/A*
CVE-2025-44954	vSZ	Root RCE via unauth SSH access	10.0
CVE-2025-44961	Network Director	Auth bypass via embedded secrets	9.8

*VU#613753 is a CERT/CC identifier grouping multiple CVEs.

IV. RESULTS AND DISCUSSION

As summarized in Table IV, this study focuses on four critical vulnerability identifiers that represent the highest risk to university infrastructures.

A. Vulnerability Analysis in RUCKUS Implementations

1) CVE-2023-25717 – Unauthenticated Remote Code Execution: In the web management interface of RUCKUS access points with firmware 10.4, a critical vulnerability was found, identified by the acronym CVE-2023-25717 [4]. This vulnerability allows an attacker to execute illegal commands with elevated privileges by sending an HTTP request, without the need for valid credentials [4].

This exploit works via command injection in the endpoint `/forms/doLogin`, where injected strings are interpreted as operating system commands [4], [5]. Once these commands are injected, the attacker is able to remotely download and execute code on the device, as well as install persistent malware [5].

This vulnerability is rated with a score of 9.8 according to CVSS v3, categorized as critical due to its ease of exploitation; it requires no authentication and completely affects the confidentiality, integrity, and availability of the affected device [4]. Shortly after its public disclosure, FortiGuard Labs reported that the AndoryuBot botnet was actively exploiting CVE-2023-25717 to compromise RUCKUS access points and incorporate them into DDoS campaigns [5].

In response to this attack, RUCKUS published a security bulletin and a software update, recommending that customers update the firmware and restrict access to the management interface [8]. Furthermore, it was recommended to isolate the management interface in a dedicated VLAN, ensuring it is not exposed to the Internet [8]. CISA added vulnerability CVE-2023-25717 to the Known Exploited Vulnerabilities (KEV) catalog and urged organizations to remediate it within short

Table V
COMPARISON BETWEEN 2023 AP AND 2025 CONTROLLER VULNERABILITIES

Aspect	2023 AP vuln.	2025 controller vulns.
Affected component	Standalone Ruckus Access Points (AP firmware 10.4).	Virtual SmartZone (vSZ) and Ruckus Network Director (RND).
Attack surface	HTTP management interface exposed on the AP.	SSH, web interfaces and internal services on centralized controllers.
Exploit type	Unauthenticated command injection leading to RCE.	Hardcoded SSH keys, embedded secrets, auth bypass, command injection.
Privilege level	Control over a single AP.	Potential full root control over management plane.
Operational impact	Use of APs in DDoS campaigns, local outages.	Large-scale compromise, mass outage risk, extraction of credentials.
Patch issues	Relatively prompt vendor patching.	Initial absence of patches; strong reliance on temporary mitigations.

deadlines [4]. For universities, this highlights the importance of having agile patch management processes.

2) 2025 Vulnerabilities in RUCKUS SmartZone and Network Director (VU#613753): In July 2025, CERT/CC published vulnerability note VU#613753, which describes eight critical vulnerabilities in RUCKUS Virtual SmartZone (vSZ) and Ruckus Network Director (RND) [6]. These vulnerabilities, discovered by Noam Moshe of Claroty Team82, directly affect the centralized management components of the wireless network [7].

The vulnerabilities include hardcoded SSH keys, embedded secrets, authentication bypass, command injection, and arbitrary file reads [6], [7]. Taken together, they allow for privilege escalation up to full control of the wireless management systems [7], [10]. One of the most severe issues was the vulnerability identified as CVE-2025-44954, which corresponds to unauthenticated remote access via a default SSH key in vSZ [7]. This allows an attacker to obtain root privileges on the controller and has a highly critical CVSS score of 10.0 [7]. Other vulnerabilities, such as CVE-2025-44957 and CVE-2025-44963, involve embedded secrets and JWT keys that allow authentication to be bypassed [6].

Together, these flaws enable attack chains in which an attacker with access to the management network gains full control over vSZ and RND [6]. From there, the attacker can deploy backdoors, extract configurations and credentials, and invade other university systems [7], [10]. When this flaw was publicly disclosed, no patches were available, and the vendor had not yet provided an official response [6]. CERT/CC recommended network isolation and strict access control to management interfaces as temporary mitigations [6], [10]. Subsequently, Ruckus Networks published Security Bulletin 20250710, acknowledging the flaws and announcing fixed software versions for SmartZone and RND [8]. The company also published a hardening guide and best practices for secure deployments, influenced in part by pressure from the security community [7], [8].

As compared in Table V, the evolution of vulnerabilities from 2023 to 2025 shows a shift from simple AP exploitation to more sophisticated attacks against central management controllers.

B. Impact Analysis in University Environments

The impact of exploiting these vulnerabilities in the university landscape can be examined using the Confidentiality, Integrity, and Availability (CIA) triad [3], [4]. From a confidentiality perspective, an attacker who compromises a vSZ or RND controller can access configurations containing Wi-Fi credentials, pre-shared keys, and integration data with directory services [6]. The attacker could also monitor or manipulate user traffic passing through controlled access points [7].

Regarding integrity, full control over the wireless infrastructure allows an attacker to alter critical configurations, change network parameters, or install modified firmware with persistent backdoors [5], [7]. These changes can degrade the user experience, facilitate targeted phishing via fake portals, and foster distrust in academic platforms and services [1].

In the availability dimension, an attacker could disable access points at scale or reconfigure controllers to disconnect entire zones of the campus [6]. Compromised access points can also be used as DDoS nodes, saturating the university's Internet links and causing widespread interruptions [5]. Given that many academic and administrative activities depend heavily on Wi-Fi connectivity, a denial-of-service attack scenario could severely disrupt institutional operations [1], [2]. Compromising the wireless network is often just the first step in a broader attack chain, especially when network segmentation is weak or incomplete [2].

C. Mitigation Proposals and Best Practices

1) Short-Term and Low-Cost Measures: Short-term measures focus on rapidly reducing the attack surface through low-cost, high-impact actions [6]. The main priority is to apply urgent firmware updates to all affected RUCKUS devices, using versions that address vulnerabilities CVE-2023-25717 and the 2025 vulnerabilities [8].

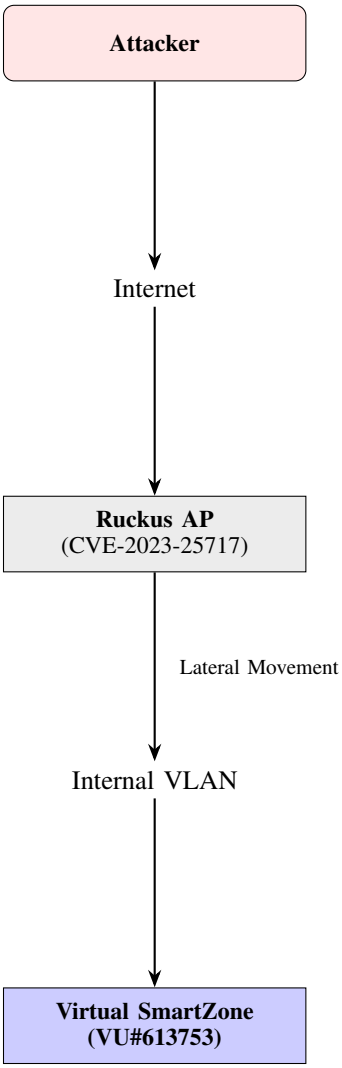

Figure 4. Attack chain demonstrating the escalation from a compromised Access Point to the core Management Controller. This figure illustrates the potential path from external threats to internal core compromise.

Management interfaces for vSZ and RND must be located in dedicated management VLANs, and access must be restricted to authorized administration IP addresses using ACLs or firewalls [6]. Default credentials must be changed, and SSH keys regenerated whenever possible [7], [8]. Reinforcement of these measures includes disabling unnecessary services and strengthening security parameters on the controllers [8]. Universities should also monitor vulnerability indicators related to AndoryuBot, reviewing logs, processes, and network connections for suspicious patterns, and flashing old or suspicious devices with clean firmware when necessary [5].

2) Medium-Term and Medium-Cost Strategies: In the medium term, universities can move towards a more robust security architecture through the implementation of a basic Security Operations Center (SOC) [1], [2]. An academic SOC, created with open-source tools, can monitor wireless and management network traffic in near real-time [1]. Advanced

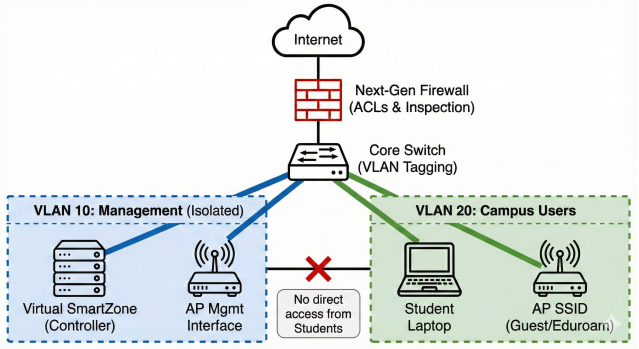

Figure 5. Proposed secure network topology. The Management VLAN (blue) is isolated from the Campus User VLAN (green) by a Firewall to prevent lateral movement.

network segmentation, combined with Network Access Control (NAC), helps limit lateral movement and isolate sensitive segments [6]. Separating traffic from students, faculty, laboratories, and administration will reduce the individual impact of vulnerabilities [2]. Specific incident response plans for the Wi-Fi infrastructure must be developed and tested, including drills and coordination with entities such as EcuCERT [1], [2].

3) Long-Term Initiatives: In the long term, initiatives should focus on continuous IT staff training, the development of a strong cybersecurity culture, and technology diversification [1]. Regular training in network security, vulnerability management, and incident response increases operational maturity and reduces configuration errors [2]. Inter-university collaboration and joint work with EcuCERT to share alerts, experiences, and best practices also contribute to greater resilience [1], [2].

As summarized in Table VI, these measures are categorized by implementation timeframe and cost to facilitate planning by university IT departments.

D. Key Performance Indicators (KPIs)

To transition from a reactive to a data-driven security posture, this study proposes a CISO Dashboard composed of five strategic grids, as visualized in Fig. 6. These metrics allow university administration to monitor the effectiveness of the implemented controls in real-time.

The dashboard provides a granular view of the security status through the following indicators, corresponding to the grids shown in Fig. 6:

1) **KPI 1: Firmware Patch Compliance.** As shown in the top-left grid of Fig. 6, this metric tracks the percentage of devices running the latest secure firmware. The current status shows **98% compliance** (490 out of 500 devices), approaching the target of 100% within 30 days. This is critical to mitigating vulnerabilities like CVE-2023-25717.
2) **KPI 2: Mean Time to Patch (MTTP).** The top-center grid illustrates the speed of the IT team's response. The data indicates a significant improvement, dropping from 14 days to a **current MTTP of 4.5 days**, which successfully meets the target of keeping exposure under 7 days for critical vulnerabilities.

Table VI
SUMMARY OF MITIGATION MEASURES BY TIMEFRAME AND COST/EFFORT

Timeframe	Cost	Recommended Measures
Short-Term	Low	Apply urgent firmware updates (CVE-2023-25717, VU#613753); isolate vSZ/RND in dedicated VLANs; restrict access via ACLs; rotate SSH keys; monitor for AndoryuBot indicators [6], [8].
Medium-Term	Medium	Deploy an academic SOC using open-source tools; implement network segmentation and NAC; develop and test incident response plans; coordinate with EcuCERT [1], [2].
Long-Term	High	Establish continuous IT staff training programs; build institutional cybersecurity culture; diversify network technologies; align governance with standards [1].

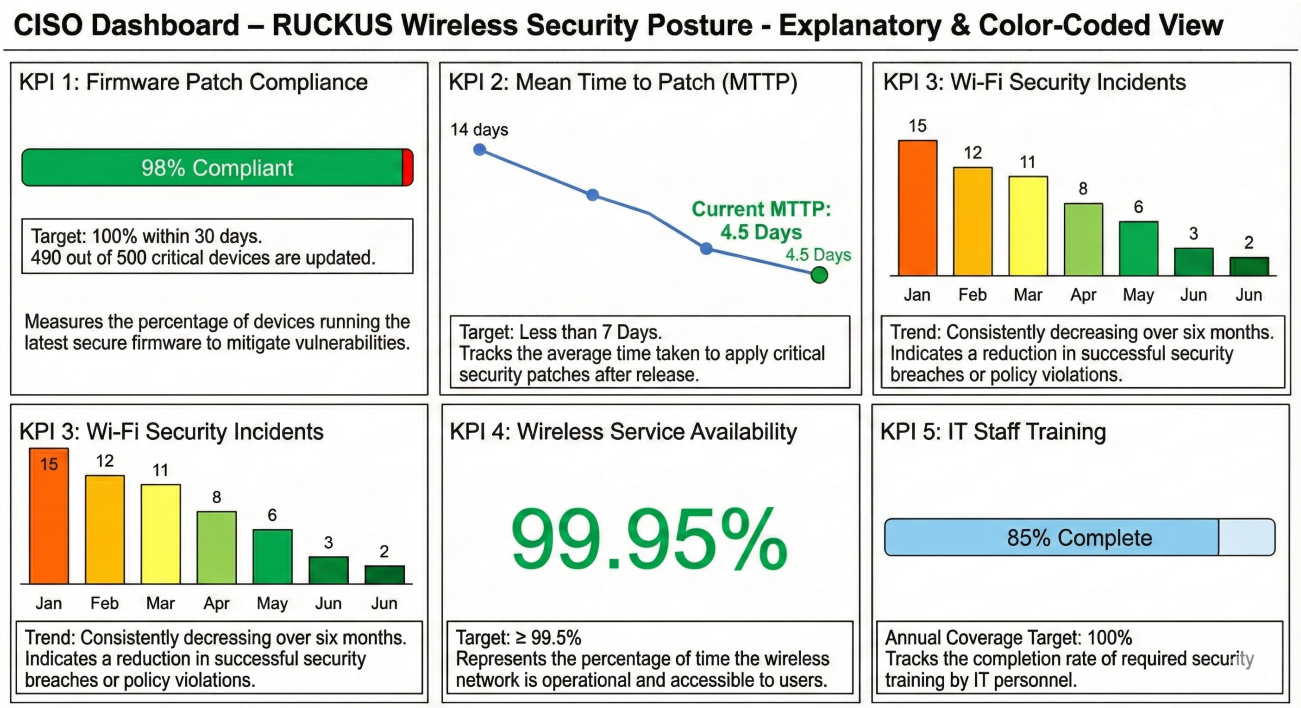

Figure 6. Proposed CISO Dashboard for RUCKUS Wireless Security Posture. The visualization is divided into five logical grids: (1) Firmware Compliance, (2) Patching Speed, (3) Incident Trends, (4) Service Availability, and (5) Staff Training.

3) **KPI 3: Wi-Fi Security Incidents.** Displayed in the top-right grid, this bar chart tracks successful breaches or policy violations over six months. The trend is consistently decreasing, falling from 15 incidents in January to just 2 in June, demonstrating the effectiveness of the new mitigation strategies.
4) **KPI 4: Wireless Service Availability.** The bottom-center grid highlights the operational stability of the network. The current availability is **99.95%**, meeting the high-availability requirement ($\geq 99.5\%$) essential for academic continuity during exam periods and enrollment.
5) **KPI 5: IT Staff Training.** The bottom-right grid tracks the completion rate of required security training by IT personnel. Currently at **85% complete**, it highlights a gap towards the 100% annual coverage target, indicating an area for immediate administrative reinforcement.

By monitoring these five specific grids, the university can quantitatively assess whether the RUCKUS infrastructure is becoming more resilient over time.

Table VII
PROPOSED KEY PERFORMANCE INDICATORS (KPIS)

KPI	Metric Description	Target
KPI 1	% of devices on secure firmware	100% (30 days)
KPI 2	Mean Time to Patch (Critical Vulns)	< 7 days
KPI 3	Trend of successful Wi-Fi incidents	Downward
KPI 4	Wireless Service Availability	$\geq 99.5\%$
KPI 5	IT Staff Security Training Coverage	100% Annually

As defined in Table VII, monitoring these indicators allows institutions to quantitatively assess the effectiveness of their

security posture over time. Together, these indicators provide a structured way to evaluate the effectiveness of controls and justify security investments to senior management.

E. Discussion

The analysis shows that the combination of vulnerabilities in access points (CVE-2023-25717) and management controllers (vSZ and RND, VU#613753) creates a high-risk scenario for universities relying on RUCKUS solutions [4], [6], [7]. The active exploitation of these vulnerabilities by botnets like AndoryuBot confirms that the threats are real and not merely theoretical [5].

The specific characteristics of Latin American universities (limited resources, emerging regulatory frameworks, and high exposure to phishing and other threats) make the adoption of the proposed measures particularly urgent [1], [2]. Relying solely on vendor patches is not sufficient; vulnerability management and secure architecture must be considered strategic functions within institutional governance [6]. Defining KPIs contributes to making cybersecurity management more systematic and measurable [4]. In this sense, the proposed combination of technical controls, organizational measures, and performance indicators offers a realistic roadmap for strengthening wireless security in Latin American university environments.

V. Conclusions and Future Work

A. Conclusions

This research has shown that RUCKUS implementations in Latin American universities are potentially exposed to critical vulnerabilities that can lead to complete compromise of wireless infrastructures [4], [6], [7]. These vulnerabilities affect the confidentiality, integrity and availability of services essential for higher education [1], [2].

Key findings include CVE-2023-25717, exploited by botnets such as AndoryuBot, and the set of 2025 vulnerabilities in vSZ and RND that enable privilege escalation to root access via hardcoded SSH keys and authentication flaws [5], [7], [10]. These cases illustrate the impact of weaknesses in centralized management components. For universities, the identified vulnerabilities pose significant threats to personal and academic data, network configuration integrity and Wi-Fi availability [1], [2]. The analysis indicates that responses cannot be limited to ad hoc patching, but must be part of a broader strategy encompassing vulnerability management, secure architecture and institutional strengthening [4], [6].

The work has met its objectives by identifying and describing RUCKUS vulnerabilities relevant to Latin American universities, contextualizing their impact in local environments, proposing phased mitigation measures and defining indicators to assess security posture improvements [1], [6]. Overall, the results reinforce the notion that cybersecurity must be treated as a strategic priority supported by university leadership [2].

B. Future Work

Several lines of future work arise from this study. First, empirical research collecting data on real incidents in universities in Ecuador and the region is needed [1]. Surveys and interviews with IT departments can help characterize attack types, response times and the effectiveness of adopted measures.

Second, penetration testing labs using RUCKUS vSZ and APs should be implemented to replicate exploits such as CVE-2023-25717 and CVE-2025-44954 in a controlled environment [5], [7]. These labs would serve both research and practical training for students and IT staff [1].

Third, anomaly detection techniques based on artificial intelligence and machine learning applied to university network traffic should be explored [2], [4]. These techniques can complement signature-based detection and enhance the ability to identify zero-day attacks or new variants [7].

Finally, future research could assess the cost–benefit of diversifying network infrastructure vendors and developing higher-education-specific cybersecurity compliance frameworks [2], [4]. Adapting controls inspired by standards such as ISO 27001 or NIST guidelines to the Latin American university context will help elevate security levels to international benchmarks [1], [6].

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