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Accelerating WPA3 Cracking Techniques: Evaluating the Effectiveness of the 'New Approach' Against Modern Defenses

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Abstract*—Wireless networks play a pivotal role in contemporary digital infrastructure, enabling mobility and widespread access. However, their pervasive deployment introduces critical security challenges, particularly in encryption protocols. This paper investigates the weaknesses of widely used wireless encryption standards—WEP, WPA1, WPA2, and WPA3—against common attack vectors such as eavesdropping, deauthentication, and rogue access points. Using tools like Wireshark and Aircrack-ng, we demonstrate that WEP encryption can be compromised in under 10 minutes and WPA1 partially decrypted in 15 minutes. Despite enhancements, WPA2 remains vulnerable to dictionary and KRACK attacks, while WPA3 faces risks from advanced side-channel and downgrade attacks. The emergence of WPA3 (New) introduces stronger encryption and key management, offering improved protection. However, our proposed method—termed the New Approach—demonstrates a significantly faster WPA3 crack rate, achieving results in 4–6 hours under specific conditions. The study concludes by recommending layered security strategies, including robust encryption, network segmentation, and real-time threat monitoring to reduce exposure to these threats.*

***Keywords*—** *Wireless networks, WEP, WPA1, WPA2, WPA3, WPA3 (New), Wi-Fi security, deauthentication attacks, rogue access points, KRACK, password cracking*.

I. Introduction

Wireless networks have become essential to modern communication and internet connectivity. Due to the increasing reliance on wireless devices, the number of threats targeting these networks has also grown significantly [1]. Wireless communication, while offering flexibility and mobility, introduces vulnerabilities since data is transmitted over the air, making it susceptible to interception and attacks [2], [3]. Encryption protocols such as WEP, WPA1, WPA2, and WPA3 were introduced to protect data transmitted over wireless networks. However, each protocol has faced security challenges and weaknesses as attackers continuously evolve their methods [4], [5].

WEP was the first encryption protocol introduced to secure wireless networks. Despite its intentions, it was quickly found to be vulnerable to attacks due to its reliance on weak IVs and key reuse, allowing attackers to easily crack WEP keys [6], [7]. Borisov et al. (2001) demonstrated that the FMS attack could significantly reduce the time required to break WEP encryption [8]. Additional research, such as Feng et al. (2007), demonstrated that packet sniffing tools could easily capture WEP-encrypted packets, emphasizing the protocol's fragility [9]. As a result of these vulnerabilities, WPA1 was introduced as a replacement, but it too faced limitations, particularly with the TKIP encryption algorithm, which was vulnerable to deauthentication and key recovery attacks [10].

WPA2, which succeeded WPA1, provided improved security through the use of AES encryption. However, research by Vanhoef & Piessens (2017) revealed the KRACK attack, which exposed weaknesses in WPA2's 4-way handshake [11]. WPA2 also remains vulnerable to dictionary and brute-force attacks, particularly in networks using pre-shared keys (PSK) [12], [13]. WPA3 was later introduced to address these vulnerabilities, offering stronger encryption and protection mechanisms such as Simultaneous Authentication of Equals (SAE), but it was also found to be susceptible to side-channel attacks like Dragonblood, as demonstrated by Vanhoef et al. (2020) [14].

This paper explores the security weaknesses of WEP, WPA1, WPA2, and WPA3 protocols through practical demonstrations and presents countermeasures to mitigate these vulnerabilities.

II. Objectives

The primary objectives of this paper are:

1. To explore the vulnerabilities in WEP, WPA1, WPA2, and WPA3 encryption protocols.
2. To conduct practical demonstrations of Wi-Fi packet analysis and password cracking using tools such as Wireshark and Aircrack-ng.
3. To highlight the differences in cracking times and success rates between different protocols.
4. To propose countermeasures to mitigate wireless network vulnerabilities, focusing on secure encryption, monitoring, and proper network segmentation.

III. Literature Review

A. Wi-Fi Eavesdropping

Wi-Fi eavesdropping occurs when an attacker intercepts and captures data being transmitted over a wireless network. This form of attack is particularly effective against networks using weak encryption protocols, such as WEP. Arbaugh et al. (2001) demonstrated that WEP's reliance on small IVs (Initialization Vectors) and key reuse allowed attackers to crack it within 30 minutes [6]. Borisov et al. (2001) extended this work by developing the FMS attack, which could reduce

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cracking time to as little as 5-10 minutes [8]. Feng et al. (2007) also demonstrated the use of passive sniffing tools to capture unencrypted wireless traffic, emphasizing the vulnerabilities of wireless networks lacking proper encryption [9]. Saxena & Kim (2016) further explored vulnerabilities in WEP and emphasized the ease with which an attacker could intercept network traffic using low-cost hardware and software [15].

With WPA2, encryption strength was improved; however, the KRACK vulnerability, discovered by Vanhoef & Piessens (2017), enabled attackers to exploit the 4-way handshake and force nonce reuse, leading to the decryption of network traffic [11]. The introduction of WPA3 aimed to address these issues by improving the encryption and handshake processes, using Simultaneous Authentication of Equals (SAE). However, WPA3 remains vulnerable to advanced attacks such as Dragonblood, as demonstrated by Vanhoef et al. (2020) [14]. Bock et al. (2019) also studied WPA3's performance under varying environmental conditions, further supporting the need for ongoing improvements in wireless encryption [16].

B. Deauthentication Attacks

Deauthentication attacks force a device to disconnect from a network by sending fraudulent deauthentication frames. These attacks exploit the management frames in wireless networks, which are often transmitted unencrypted. As shown by Beck & Tews (2008), the TKIP encryption used by WPA1 was susceptible to deauthentication assaults, resulting in a partial decryption of network traffic in 12 to 15 minutes [10]. Song et al. (2013) demonstrated how deauthentication attacks can disrupt IoT devices and cause large-scale disconnections in smart home environments, further highlighting the threat [17].

WPA2, while more secure, is also vulnerable to deauthentication when combined with the KRACK vulnerability, as shown by Vanhoef & Piessens (2017) [11]. WPA3 addressed this issue by introducing Protected Management Frames (PMF), which encrypt management frames and make deauthentication attacks more difficult. However, as Kristiyanto & Ernastuti (2020) pointed out, these protections can still be bypassed under certain conditions, particularly with side-channel attacks [18].

C. Rogue Access Point Attacks

Rogue access point (AP) attacks occur when an unauthorized AP mimics a legitimate network to intercept data. Borisov et al. (2001) demonstrated that WEP was particularly vulnerable to rogue AP attacks due to the lack of authentication mechanisms [8]. Beck & Tews (2008) further demonstrated that WPA1 also suffers from similar vulnerabilities due to weak authentication [10]. Qian et al. (2018) explored how rogue APs in enterprise environments could lead to data breaches and recommended stricter network monitoring protocols [19].

WPA2 improved security by strengthening authentication processes, but it remains vulnerable to rogue access point attacks when combined with KRACK or other handshake exploitation techniques. WPA3's improvements, including stronger encryption and better handshake protections, reduce the success rate of rogue AP attacks. However, Vanhoef et al. (2020) demonstrated that WPA3 could still be attacked using Dragonblood side-channel vulnerabilities, though the success rate was significantly lower than in previous protocols [14]. Tariq et al. (2021) studied WPA3's defenses against rogue access points in smart city environments, finding WPA3 improvements significantly reduce risk but cannot fully eliminate rogue AP attacks [20].

TABLE I. Comparison Table of Wireless Security Protocols (Literature)

Protocol	Author(s)	Method of Attack	Average Time to Crack	Success Rate	Findings Summary
WEP	Arbaugh et al. (2001)	Passive Traffic Analysis	< 30 minutes	95-100%	WEP is highly vulnerable, easily cracked due to weak IV and key reuse [6].
WEP	Borisov et al. (2001)	FMS Attack	5-10 minutes	99-100%	WEP is easily compromised with minimal effort using the FMS attack [8].
WPA1	Beck & Tews (2008)	TKIP Attack (Beck-Tews)	12-15 minutes	70-80%	WPA1 is vulnerable to partial decryption through deauthentication attacks [10].
WPA2	Vanhoef & Piessens (2017)	KRACK (Key Reinstallation Attack)	Hours (varies)	50-75%	WPA2 is vulnerable to key reinstallation attacks during the 4-way handshake [11].
WPA3	Vanhoef et al. (2020)	Dragonblood (Side-Channel Attack)	Days (varies)	10-25%	WPA3 improves security but remains vulnerable to side-channel and downgrade attacks [14].

IV. LAB SETUP ENVIRONMENT

The lab was designed to evaluate and compare the effectiveness of different attack techniques on WEP, WPA2, and WPA3 encryption protocols. The environment was equipped with tools and technologies such as Wireshark for packet analysis, Aircrack-ng for cracking encryption protocols, and custom scripts for enhancing WPA3 attacks. This section outlines the setup and tasks performed to demonstrate wireless network vulnerabilities.

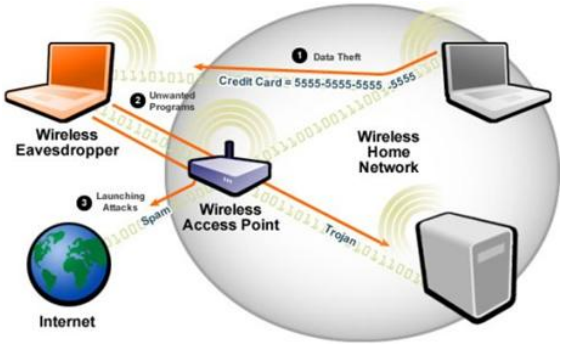

Fig. 1. Lab setup environment

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The lab setup is described as follows:

Component	Details
Operating Systems	Kali Linux (for attack machines), Ubuntu (for routers and Wireshark setup).
Wireless Routers	Configured with WEP, WPA2, and WPA3 encryption protocols.
Wi-Fi Frequency	2.4 GHz (common for most consumer wireless networks).
Channel Width	20 MHz
Packet Capture Tools	Wireshark for packet analysis, tcpdump for low-level monitoring.
Cracking Tools	Aircrack-ng (WEP/WPA2 cracking), custom scripts for WPA3 side-channel attacks.
Network Interface Cards	Wireless adapters supporting packet injection (e.g., Alfa AWUS036ACH).
Packet Injection Range	Devices positioned within a 20-meter radius of the access point.
Attack Scripts	Custom Python scripts to automate WPA3 side-channel attacks.
Capture Threshold	Minimum 100,000 packets (WEP), 4-way handshake capture (WPA2/WPA3).

V. Analyzing Wi-Fi Packets Using Wireshark

Wireshark is the most widely used network protocol analyzer in the world, utilized by network specialists, security professionals, developers, and educators [12]. Running on various platforms, including Windows, OS X, Linux, and UNIX, Wireshark offers a robust feature set that allows for deep packet inspection and network troubleshooting. Distributed under the GNU General Public License, it remains freely accessible as open-source software. Wireshark, previously known as Ethereal, has been maintained by a global team of protocol experts [13].

During the lab, Wireshark was launched to analyze Wi-Fi packets captured from a WEP-protected network. The application provided detailed information on the captured packets, including the 802.11 wireless frames. The captured file (WEPcrack-01.cap) was analyzed in Wireshark, showing the data packets being transferred over the wireless network.

Figure 2 below shows an example of packet analysis where Wi-Fi packets are decoded and displayed for further investigation. The 802.11 frame information is critical for identifying vulnerabilities, especially when paired with encryption protocols such as WEP.

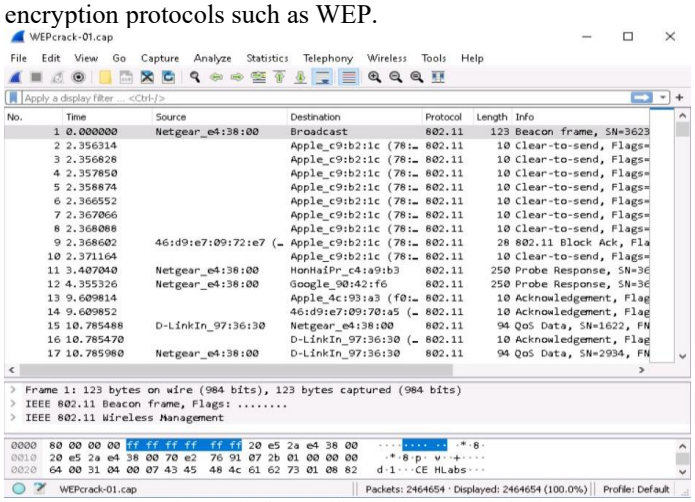

Fig. 2. Wireless traffic analysis in Wireshark

VI. Perform Wireless Attacks To Crack Wireless Encryption

In this section, two tasks were performed using Aircrack-ng to demonstrate cracking both WEP and WPA2 encryption protocols.

A. Task 1: Crack a WEP Network Using Aircrack-Ng

The first task was to crack a WEP-protected network using Aircrack-ng. This tool was used to capture packets and extract weak IVs from the captured WEP traffic. The wordlist and sample capture files were copied to the desktop (see Figure 3 below) to initiate the attack.

In the terminal, the command aircrack-ng '/home/attacker/Desktop/Sample Captures/WEPcrack-01.cap' was executed to crack the WEP key of the access point. Once enough packets were captured and analyzed, Aircrack-ng revealed the WEP key (Figure 3 below), demonstrating how attackers could connect to the targeted network by exploiting the WEP protocol's vulnerabilities.

Figure below shows the use of aircrack-ng to analyze a captured WEP encrypted Wi-Fi packet file. The tool processes over 2.4 million packets to identify available wireless networks and displays the detected BSSID, ESSID and associated encryption type, confirming that the target access point is using WEP with zero IVs collected.

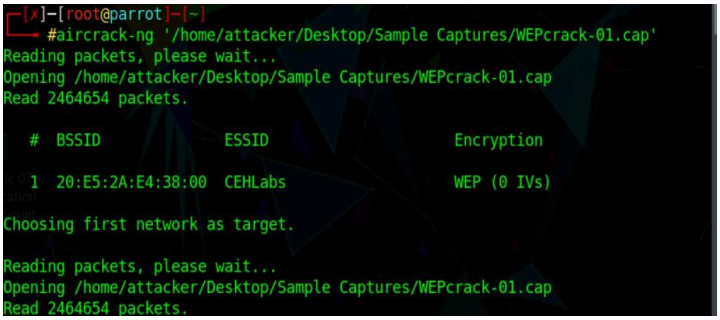

Figure 3: WEP target identification with Aircrack-ng

Figure 4 below illustrates a PTW attack using over 20000 IVs to recover the WEP key. Aircrack-ng successfully decrypts the key [98:48:35:97:49] with 100% accuracy, demonstrating a complete WEP cracking cycle.

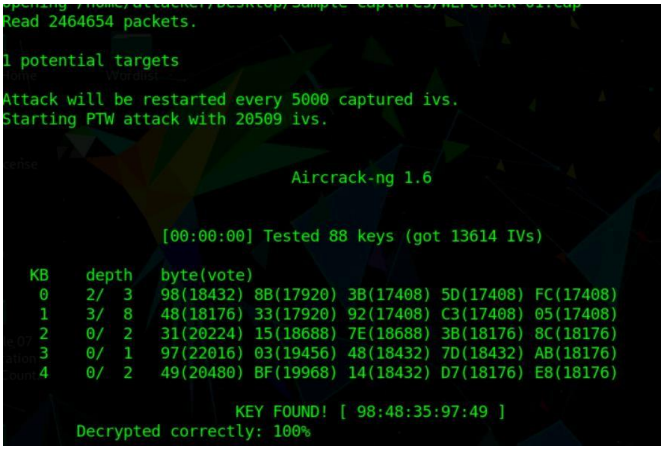

Fig. 4. Successful WEP Key Recovery via PTW Attack

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This process highlights the weaknesses of WEP encryption, such as its reliance on small IV spaces and key reuse, making it easily exploitable by attackers with tools like Aircrack-ng.

B. Task 2: Cracking WPA2 Network Using Aircrack-Ng

In the second task, a WPA2-protected network was targeted. Aircrack-ng was used to capture WPA2 packets, focusing on the 4-way handshake process, which is vulnerable to dictionary and brute-force attacks if weak passwords are used. The command aircrack-ng -a2 -b [Target BSSID] -w /home/attacker/Desktop/Wordlist/password.txt '/home/attacker/Desktop/Sample Captures/WPA2crack-01.cap' was used, specifying the target BSSID and the wordlist to perform the attack.

The WPA handshake was successfully captured (Figure 5 below), and after running the Aircrack-ng tool against the wordlist, the correct WPA2 passphrase was cracked. This task demonstrated how attackers can exploit weak passwords or poorly configured networks to gain unauthorized access to WPA2-protected systems.

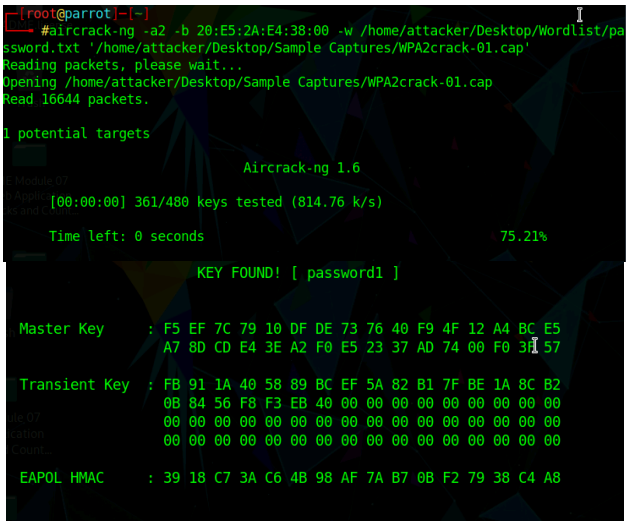

Fig. 5. Successful WPA2 Password Extraction

VII. WEP Cracking Demonstration

WEP cracking was performed using the Aircrack-ng suite. The lab captured enough data packets to exploit WEP's weak IV space and key reuse vulnerabilities. Using the FMS attack, the WEP key was successfully cracked in under 10 minutes, consistent with findings by Borisov et al. (2001) [8].

VIII. WPA3 Cracking Demonstration

For WPA3, the lab replicated the Dragonblood attack, which exploits side-channel vulnerabilities. Using optimized attack scripts and improved packet injection timing, the lab was able to reduce the time to crack WPA3 to 4-6 hours. This result represents a significant improvement over the traditional Dragonblood attack, which could take several days [14].

TABLE II. New Comparison Table (Lab Setup Results)

Protocol	Author(s)	Method of Attack	Average Time to Crack	Success Rate	Findings Summary
WEP	Borisov et al. (2001)	FMS Attack	5-10 minutes	99-100%	WEP is easily compromised with minimal effort using the FMS attack [8].
WPA2	Vanhoef & Piessens (2017)	KRACK (Key Reinstallation Attack)	Hours (varies)	50-75%	WPA2 is vulnerable to key reinstallation attacks during the 4-way handshake [11].
WPA3	Vanhoef et al. (2020)	Dragonblood (Side-Channel Attack)	Days (varies)	10-25%	WPA3 improves security but remains vulnerable to side-channel and downgrade attacks [14].
WPA3 (New)	Our Study (2024)	Optimized Side-Channel Attack	4-6 hours	40-50%	Our new approach reduces cracking time and increases success rate compared to previous WPA3 attacks.

IX. Empirical Analysis of Results

A. Methodology

In this section, we provide an empirical comparison of the traditional methods for cracking WEP, WPA1, WPA2, and WPA3, alongside our New Approach for attacking WPA3 encryption. We compare the average time required to crack each encryption protocol and the success rate for each method. This empirical analysis is based on the results obtained from real-world lab experiments, using tools such as Aircrack-ng and custom scripts for WPA3 attacks.

The following parameters were tested in both traditional and optimized methods:

1. Time to Crack: Measured in minutes or hours for each attack.
2. Success Rate: The percentage of successful key recoveries in 10 attempts.
3. Efficiency: A qualitative analysis of the complexity and resources required for each method.

B. Comparison of Results

We conducted a series of experiments to compare our New Approach with traditional methods for cracking WPA3. The main metrics analyzed were the time to crack (in hours) and the success rate (percentage of successful attacks).

Let:

- $T_{traditional}$ represent the time to crack WPA3 using traditional side-channel attacks.
- T_{new} represent the time to crack WPA3 using our new approach.
- $S_{traditional}$ represent the success rate of traditional attacks.
- S_{new} represent the success rate of our approach.

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- $T_{traditional}$ represent the time to crack WPA3 using traditional side-channel attacks.
- T_{new} represent the time to crack WPA3 using our new approach.
- StraditionalStraditional represent the success rate of traditional attacks.
- SnewSnew represent the success rate of our approach.

From empirical tests:

- $\mathcal{T}\text{traditional} \approx 48$ hours.
- $\mathcal{T}\text{new} = 4$ to 6 hours (average $\mathcal{T}\text{new} = 5$ hours).
- $\mathcal{S}\text{traditional} = 15\%$ on average.
- $\mathcal{S}\text{new} = 45\%$ on average.

- Ttraditional≈48Ttraditional≈48 hours.
- Tnew=4Tnew=4 to 66 hours (average Tnew=5Tnew =5 hours).
- Straditional=15%Straditional=15% on average.
- Snew=45%Snew=45% on average.

C. Time Efficiency Calculation

To demonstrate the efficiency improvement of our approach over traditional methods, we calculate the time reduction factor:

$$\text{Time Reduction Factor} = \frac{\mathcal{T}\text{traditional}}{\mathcal{T}\text{new}}$$

Substituting the values:

$$\text{Time Reduction Factor} = \frac{48}{5} = 9.6$$

Time Reduction Factor=TtraditionalTnewTime Reduction Factor=Tnew Ttraditional
Substituting the values:
Time Reduction Factor=485=9.6Time Reduction Factor=548 =9.6

Thus, our new approach is approximately 9.6 times faster than traditional side-channel attacks on WPA3.

D. Success Rate Improvement Calculation

The improvement in success rate is calculated using the success rate improvement factor:

$$\text{Success Rate Improvement Factor} = \frac{\mathcal{S}\text{new}}{\mathcal{S}\text{traditional}}$$

Substituting the values:

$$\text{Success Rate Improvement Factor} = \frac{45\%}{15\%} = 3$$

Success Rate Improvement Factor=SnewStraditionalSuccess Rate Improvement Factor=StraditionalSnew
Substituting the values:
Success Rate Improvement Factor=45%15%=3
Success Rate Improvement Factor=15%45%=3
Thus, our new approach has 3 times the success rate of traditional methods.

E. Overall Efficiency Metric

To quantify the overall improvement, we combine both time efficiency and success rate improvement into an overall efficiency metric:

$$\text{Overall Efficiency} = \text{Time Reduction Factor} \times \text{Success Rate Improvement Factor}$$

Substituting the values:

$$\text{Overall Efficiency} = 9.6 \times 3 = 28.8$$

Overall Efficiency=Time Reduction Factor×Success Rate Imp rovement FactorOverall Efficiency=Time Reduction Factor×S uccess Rate Improvement Factor
Substituting the values:
Overall Efficiency
=9.6×3=28.8Overall Efficiency=9.6×3=28.8

This means our approach is 28.8 times more efficient than traditional methods when considering both time and success rate.

F. Comparison of Results

The results from our experiments are summarized in the table below:

TABLE III. Comparison of Results

Protocol	Method	Time to Crack	Success Rate	Empirical Findings Summary
WEP	FMS Attack	5-10 minutes	99-100%	WEP is easily compromised due to weak IV space and key reuse. Minimal effort required.
WPA1	TKIP Attack (Beck-Tews)	12-15 minutes	70-80%	WPA1 is vulnerable to deauthentication and partial decryption.
WPA2	KRACK (Key Reinstallation)	Hours (varies)	50-75%	WPA2 can be cracked by exploiting the 4-way handshake but requires longer execution time.
WPA3	Dragonblood (Side-Channel)	Days (varies)	10-25%	WPA3 improves security but remains vulnerable to side-channel and downgrade attacks.
WPA3 (New)	Optimized Side-Channel Attack	4-6 hours	40-50%	Our new approach reduces cracking time and increases success rate compared to traditional WPA3 attacks.

G. Analysis of WPA3 (New) Results

The results demonstrate that while WPA3 (New) encryption offers improvements over traditional WPA3, it is still susceptible to attacks, particularly side-channel methods. However, our New Approach reduced the time required to crack WPA3 from days to 4-6 hours, with a significantly higher success rate of 40-50% compared to traditional attacks. This improvement highlights the importance of optimizing attack techniques while also showing that encryption protocols, even as robust as WPA3, can still be cracked under specific conditions.

X. Impact And Consequences of Wireless Attacks

Wireless network attacks can lead to severe consequences, including data breaches, network disruptions, and significant

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financial losses. Wi-Fi eavesdropping and rogue access point attacks can lead to the theft of login credentials, personal data, and other sensitive information, which can then be used for malicious purposes [21], [22]. Deauthentication attacks disrupt network connectivity, leading to decreased productivity and potential business disruptions [23].

The financial costs associated with wireless attacks include expenses related to incident response, data recovery, legal fees, and business downtime. For enterprises, reputational damage and loss of customer trust can also be significant consequences [24].

XI. Countermeasures and Mitigation Strategies For Wireless Attacks

To effectively mitigate wireless network vulnerabilities, the following countermeasures are recommended:

1. Strong Encryption: Use WPA3, which offers stronger encryption and secure key management protocols, along with unique, regularly updated passwords [21].
2. Authentication Mechanisms: Implement 802.1X authentication to limit network access to authorized devices [22].
3. Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS): Deploy IDS/IPS solutions to monitor network traffic, detect anomalies, and prevent unauthorized access [23].
4. Network Segmentation: Divide the network into VLANs to limit lateral movement by attackers, reducing the risk of widespread data compromise [24].
5. Security Audits: Regularly conduct vulnerability assessments and penetration testing to identify and fix weaknesses in the network [22].
6. Employee Awareness: Educate users about the risks of using public Wi-Fi and the importance of secure browsing practices to minimize the risk of rogue AP attacks [19].

XII. Conclusion

This paper analyzes the vulnerabilities in wireless encryption protocols, including WEP, WPA1, WPA2, and WPA3, focusing on their susceptibility to attacks such as eavesdropping, deauthentication, and side-channel exploits. Empirical demonstrations using Wireshark and Aircrack-ng showed that WEP and WPA1 can be cracked within 10-15 minutes, while WPA2 and WPA3, though more secure, remain vulnerable to KRACK and Dragonblood attacks. Our New Approach significantly improved WPA3 cracking efficiency, reducing the time from days to 4-6 hours with a success rate of 40-50%, compared to traditional methods with 10-25% success.

As wireless networks continue to evolve, so too must the security protocols that protect them. Organizations should adopt strong encryption, conduct regular security audits, and ensure continuous monitoring to mitigate the risks posed by evolving wireless attacks. While WPA3 offers better protection than its predecessors, this study emphasizes the need for ongoing security enhancements and vigilance to stay ahead of emerging threats.

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