

# Write-up: Advent of CTF 2025 - Image Security

**Score:** 85/100 (Passed) **Platform:** Windows 11 Image (Aeacus Scoring Engine)

You can view the original challenge here: [Advent of CTF 2025 - Image Security](#).

## I. Forensics (Digital Forensics Investigation)

Question 1: Decrypt the intercepted message

- **Ciphertext:** Xyeb1 V czkhijj klue go l qmueji'w tal? Tsmm ijk dshe yogcdg ssu qerr tpkhemjfki
- **Methodology:**
  1. Based on the hint "very old cipher" and the text structure, I identified this as a **Vigenère Cipher**.
  2. Utilized **CyberChef** (or dcode.fr) for analysis. You can view the full decoding recipe here: [CyberChef Solution](#).
  3. Key identified: **FREQANALYSIS** (Hinting at Frequency Analysis).
  4. Decoded the text, revealing a quote from Shakespeare's Sonnet 18.
- **Answer:** Shall I compare thee to a summer's day? Thou art more lovely and more temperate

Question 2: Startup Script Identification

- **Methodology:**
  1. Inspected **Task Manager** → **Startup Apps** tab.
  2. Identified a suspicious executable named **jokehaha.exe** enabled at startup.
  3. Verified the execution path via the **Details** tab (enabled Command Line column).
- **Answer:** **jokehaha.exe**

Question 3: Reverse Engineering Encrypt Tool

- **Artifact:** **encrypt.exe** found on the Desktop.
- **Analysis:**
  1. **Identification:** Identified the file as a **PyInstaller** packed executable using **Detect It Easy (DiE)** and string analysis.
  2. **Extraction:** Used **pyinstxtractor.py** to extract the contents and retrieved the bytecode file **encrypt.pyc**.
  3. **Decompilation:** Used **pycdc.exe (Decompile++)** to decompile the **.pyc** file back to the original Python source code.

### Decompiled Code Result:

```
# Source Generated with Decompile++
# File: encrypt.pyc (Python 3.11)
import base64
```

```

def e(t):
    p = [2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61,
67, 71, 73, 79, 83, 89, 97]
    k = 165
    b = []
    for i, c in enumerate(t):
        a = ord(c)
        m = p[i % len(p)]
        x = a * m ^ k # Encryption Logic
        b.append(x.to_bytes(2, 'big'))
    return base64.b64encode(b''.join(b)).decode('utf-8')

```

#### 4. Decryption Logic:

- Encryption Algorithm:  $x = (\text{ASCII} * \text{Prime}) \text{ XOR Key}$ .
- Decryption Algorithm (Inverse):  $\text{ASCII} = (\text{Encoded_Value XOR Key}) / \text{Prime}$ .
- I wrote a Python script to reverse the process and retrieve the flag.

► **Click to view Solver Script (Python)**

```

import base64

# Encrypted string from the challenge
encoded_str = "AEUBzgKoA6cEVAVBBtQIoQkRC9QNaw9kE8QQ0xIuFvkZMB7GsobGRwhHnk="

# Constants extracted from decompiled code
p = [2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67,
71, 73, 79, 83, 89, 97]
k = 165

# Step 1: Decode Base64 to bytes
data_bytes = base64.b64decode(encoded_str)

ans = ""

# Step 2: Iterate through every 2 bytes (Big Endian format)
for i in range(0, len(data_bytes), 2):
    chunk = data_bytes[i:i+2]

    # Convert bytes to integer
    x = int.from_bytes(chunk, 'big')

    # Calculate index to find the corresponding prime number
    char_index = i // 2
    m = p[char_index % len(p)]

    # Inverse logic:
    # Original:  $x = (a * m) ^ k$ 
    # Reverse:  $a = (x ^ k) // m$ 
    val_after_xor = x ^ k
    ascii_val = val_after_xor // m

    ans += chr(ascii_val)

```

```
print("Decoded message:", ans)
```

- **Answer:** pyinstallermybeloveddd

## II. User & Group Management

**Objective:** Ensure only authorized users (per README) have system access, remove unauthorized accounts, and enforce the Principle of Least Privilege.

### Remediation Steps:

#### 1. Remove Unauthorized User

- **Finding:** Identified user **Grinch**, who was not listed in the "Authorized Users" or "Administrators" section of the README.
- **Action:**
  - Executed command via CMD (Admin):

```
net user Grinch /delete
```

- (Alternative: **Lusrmgr.msc** → **Users** → Right-click **Grinch** → **Delete**).

#### 2. Disable Built-in Administrator

- **Rationale:** The default **Administrator** account has a well-known SID and is a primary target for brute-force attacks. The **Santa** and **Elf** accounts are designated for administration.
- **Action:**
  - Executed command via CMD (Admin):

```
net user Administrator /active:no
```

- Verified that the account is disabled.

#### 3. Password Management

Based on the *Authorized Administrators* and *Authorized Users* list in the README:

- **A. Restore Administrator Passwords (Santa & Elves):**
  - **Rationale:** The README warned that authorized passwords might have been changed. Resetting them ensures authorized access control.
  - **Action:** Reset passwords for **Santa**, **Elf1**, **Elf2**, **Elf3**, and **Elf4** to the specific values provided in the README.

```

net user Santa "Chr157m45C4r015!"
net user Elf1 "M3rryChr157m45"
net user Elf2 "w0rk1ngH4rd."
net user Elf3 "Santa1"
net user Elf4 "1ts_71M333!"
```

- **B. Enforce Strong Passwords for Standard Users:**

- **Rationale:** Standard users (**Buddy**, **Kevin**, **Frosty**) had weak or unknown passwords.
- **Action:** Set new, complex passwords (Length > 10, utilizing uppercase, lowercase, numbers, and special characters).

```

net user Buddy "P@ssw0rd123!"
net user Kevin "P@ssw0rd123!"
net user Frosty "P@ssw0rd123!"
```

- (*Note: P@ssw0rd123! is used here as an example of a compliant, complex password.*)

#### 4. Audit Administrators Group

- **Rationale:** Enforce Least Privilege. Standard users must not have administrative rights.
  - **Action:**
    - Navigated to **lusrmgr.msc** → **Groups** → **Administrators**.
    - **Removed:** **Administrator**, **Guest**, and any standard users (e.g., **Kevin**, **Buddy**) found in the group.
    - **Retained:** Only **Santa**, **Elf1**, **Elf2**, **Elf3**, and **Elf4**.
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### III. Password & Account Lockout Policy

**Objective:** Enforce strict password requirements and automated lockout mechanisms to mitigate brute-force and dictionary attacks.

**Tool:** **secpol.msc** (Local Security Policy) → **Account Policies**.

#### 1. Password Policy

- **Maximum password age:** Set to **42** or **90** days.
  - *Rationale:* Ensures periodic password rotation; limits the window of opportunity for compromised credentials.
- **Minimum password age:** Set to **1** day.
  - *Rationale:* Prevents users from cycling through passwords immediately to reuse old ones.
- **Minimum password length:** Set to **10 - 12** characters.
  - *Rationale:* Increases the complexity for password cracking tools exponentially.
- **Enforce password history:** Set to **5** passwords remembered.
  - *Rationale:* Prevents password reuse.
- **Password must meet complexity requirements:** **Enabled**.

- *Rationale:* Mandates the use of complex character combinations (Uppercase, Lowercase, Numbers, Symbols). 

## 2. Account Lockout Policy

- **Account lockout threshold:** Set to **5** invalid logon attempts.
  - *Rationale:* Locks the account after 5 failures, stopping automated brute-force attacks effectively.
- **Account lockout duration:** Set to **30** minutes.
  - *Rationale:* Forces attackers to wait, significantly slowing down the attack.
- **Reset account lockout counter after:** Set to **30** minutes.
  - *Rationale:* The counter resets after 30 minutes if no further failed attempts occur. 

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## IV. Audit Policy

**Objective:** Enable logging for critical system events (logons, policy changes, account management) to facilitate security monitoring and incident response (Digital Forensics).

**Tool:** `secpol.msc` → **Local Policies** → **Audit Policy**.

### Detailed Configuration:

- **Audit account logon events:**
  - *Configuration:* **Success, Failure.**
  - *Rationale:* Logs each time a user account is authenticated by this computer (crucial for detecting **Brute-force attacks**).
- **Audit account management:**
  - *Configuration:* **Success, Failure.**
  - *Rationale:* Logs user creation, deletion, password changes, or group membership modifications (detects unauthorized account manipulation).
- **Audit logon events:**
  - *Configuration:* **Success, Failure.**
  - *Rationale:* Logs when a user logs on or logs off the system directly.
- **Audit policy change:**
  - *Configuration:* **Success, Failure.**
  - *Rationale:* Alerts if security policies are intentionally modified (e.g., disabling Audit logging or weakening Password Policy).
- **Audit object access:**
  - *Configuration:* **Success, Failure.**
  - *Rationale:* Tracks access to critical files, folders, or registry keys (requires SACL configuration on specific objects).



## V. Local Policies & Security Options

**Objective:** Harden system security settings to prevent Man-in-the-Middle (MitM) attacks, credential dumping, and information disclosure.

**Tool:** `secpol.msc` → **Local Policies** → **Security Options**.

### 1. Hardening Network Communications - SMB Signing

- **Configuration:**
  - Microsoft network client: Digitally sign communications (always) → **Enabled**.
  - Microsoft network server: Digitally sign communications (always) → **Enabled**.
- **Technical Explanation:**
  - Enforces packet signing for all SMB traffic.
  - Prevents **SMB Relay** and **Man-in-the-Middle** attacks.

### 2. Hardening Logon Process - Hide Last User Information

- **Configuration:**
  - Interactive logon: Don't display last signed-in → **Enabled**.
- **Technical Explanation:**
  - Prevents Windows from displaying the username of the last logged-in user.
  - Attackers with physical access must guess both the **Username** and **Password**.

### 3. Hardening Credential Protection - Disable Credential Caching

- **Configuration:**
    - Network access: Do not allow storage of passwords and credentials for network authentication → **Enabled**.
  - **Technical Explanation:**
    - Prevents the OS from caching network credentials.
    - Mitigates credential dumping attacks (e.g., via tools like Mimikatz).
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## VI. Service Auditing

**Objective:** Reduce the Attack Surface by disabling unnecessary, risky, or legacy services.

**Remediation Steps:**

### 1. Disable Microsoft FTP Service (Critical)

- **Finding:** Service `ftpsvc` was Running.
- **Risk:** FTP uses clear-text transmission, exposing credentials and data.
- **Action:**
  - **Method 1 (GUI):** `services.msc` → Microsoft FTP Service → Stop → Startup Type: **Disabled**.
  - **Method 2 (PowerShell Admin):**

```
Stop-Service "ftpsvc" -Force  
Set-Service "ftpsvc" -StartupType Disabled
```

## 2. Disable Print Spooler

- **Finding:** Service **Spooler** was Running.
- **Risk:** The Print Spooler is vulnerable to exploits (e.g., PrintNightmare) and is unnecessary on a non-print server.
- **Action:** Stopped and set Startup Type to **Disabled**.

## 3. Verify Other Risky Services

- **Action:** Verified the following services were disabled:
  - **SSDP Discovery (SSDPSRV):** Disabled (UPnP risk).
  - **Remote Registry (RemoteRegistry):** Disabled (Remote modification risk).
  - **Telnet (T1ntSvr):** Not installed.

## 4. Disable File and Printer Sharing

- **Finding:** The **LanmanServer** service was running, allowing SMB file sharing.
- **Action:**
  - **GUI:** Disabled "File and printer sharing" in *Advanced sharing settings*. 
  - **Service Level:** Navigated to **services.msc**, stopped and **Disabled** the **Server (LanmanServer)** service to completely prevent the machine from acting as a file server.

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## VII. Software Audit

### 1. Unwanted Software Removal

- **Action:** Identified and uninstalled prohibited applications found on the system.
  - **Removed:** **Wireshark** (Network protocol analyzer - Classified as a "hacking tool").
  - **Removed:** **Discord** (Non-business communication application).

### 2. Software Updates

- **Requirement:** The README explicitly stated that critical applications must be kept up to date.
- **Action:** Checked current versions and updated **Notepad++** and **7-Zip** to the latest stable releases to patch known vulnerabilities and ensure software integrity.

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## VIII. Application Security & Hardening

### 1. Remote Desktop (RDP) and Remote Assistance Configuration

**Objective:** Enable the RDP service (Critical Service) to ensure availability, but enforce the highest security standard (NLA) and disable the Remote Assistance feature to reduce the attack surface.

**Remediation Steps:**

## 1. Open Remote Configuration:

- Press **Windows + R** to open the Run dialog.
- Type command: **sysdm.cpl** and press **Enter**.
- In the *System Properties* window that appears, select the **Remote** tab.

## 2. Disable Remote Assistance:

- In the *Remote Assistance* section (top), **UNCHECK** the box: "**Allow Remote Assistance connections to this computer**".
- *Rationale:* This feature is often exploited by attackers to gain control or for Social Engineering attacks, so it should be disabled if not in use.

## 3. Enable and Configure Remote Desktop (RDP):

- In the *Remote Desktop* section (bottom):
- Select the radio button: "**Allow remote connections to this computer**" (To enable the service).
- **IMPORTANT:** Check the box immediately below: "**Allow connections only from computers running Remote Desktop with Network Level Authentication (recommended)**".
- *Rationale:* **NLA (Network Level Authentication)** mandates user authentication before the RDP session is established, helping to prevent Man-in-the-Middle attacks and reducing server load.



## 2. Windows Features

- Disabled **SMB 1.0/CIFS** (Legacy protocol vulnerability).
- Disabled **Telnet Client, TFTP Client**.
- Disabled **Media Features** (Windows Media Player).

## 3. Defensive Countermeasures

- Enabled **Windows Defender Real-time Protection**.
- Enabled **SmartScreen** (Reputation-based protection) and **PUA** (Potentially Unwanted Apps) blocking.

## 4. Remediating Malicious Antivirus Exclusions

- **Finding:** Malicious exclusions were configured in Windows Defender (excluding **.exe** extensions and the **C:\** drive).
- **Risk:** This allowed malware to bypass AV scans.
- **Action:** Removed all malicious exclusions. Retained only the exclusion for the Scoring Engine (**C:\aeacus**).

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## IX. Malware Removal & Prohibited Files

### 1. Malware Eradication

- **Startup Malware:** Removed **jokehaha.exe** and **fake-flag-child.ps1** from startup items.
- **Hidden Malware:**
  - Identified and removed malicious files via Virus & Threat Protection Scan.

- Identified and removed **Seatbelt.exe** (Reconnaissance tool) in **C:\Windows\Temp**. 
- Purged all contents of **C:\Windows\Temp**.
- Identified and removed **winloader.exe** (Backdoor) in **C:\Windows\System32**. 

## 2. Prohibited File Removal

- Located and removed unauthorized archives (**.zip**) containing hacking tools and games in the **Downloads** folders of users **Elf1** and **Elf2**. 
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