RID HIJACKING:

Maintaining Access on Windows Machines.

Sebastián Castro

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@r4wd3r

r4wd3r

DerbyCon VIII

LOUISVILLE, KY-2018

```
C:\> net user r4wd3r

Username                   r4wd3r
Full User name             Sebastián Castro
Comment                    Infosec nerd, xpltdev, win
                           sec, opera singer
User's comment             Terrible at MS Paint :(
Country/region code        Colombia
Account active             No
First logon                1993/05/03  23:56


User profile               Technical & Research Lead
                           <at> CSL Labs
Work directory             https://csl.com.co
```

Agenda

0x01. Exposing the RID Hijacking Attack.

0x02. A Windows Logon Story.

0x03. Hijacking the RID.

0x04. Demo.

0x05. Conclusions.

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RID HIJACKING

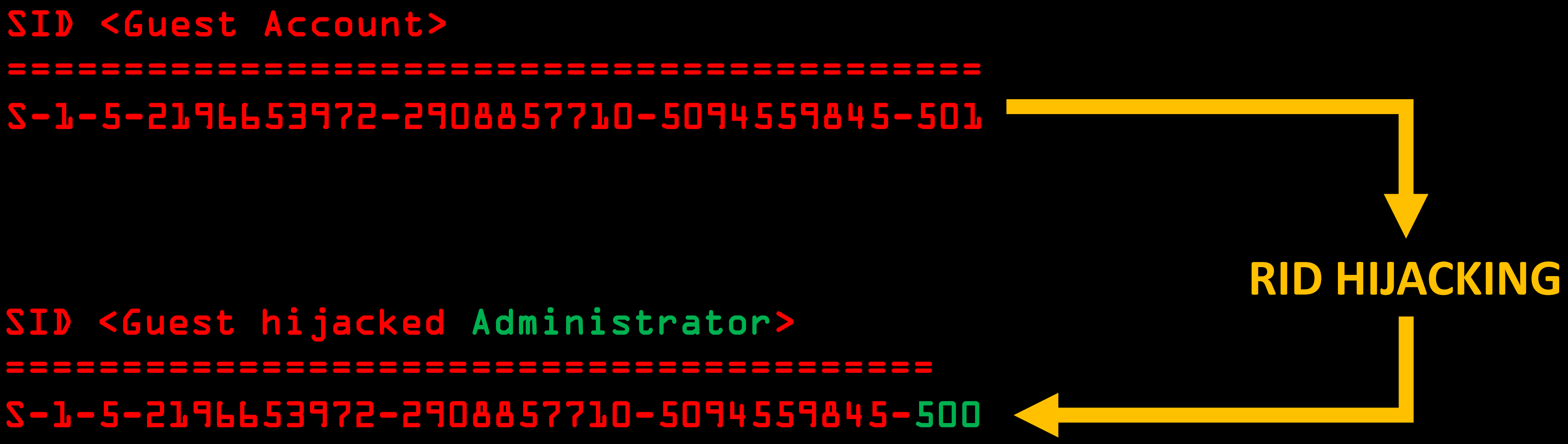
What is RID Hijacking?

- A new **persistence** technique that affects **ALL** Windows Systems since **NT**. (Haven’t tried this on Windows 95 nor Phone ☹).
- A stealthy way to maintain access by **only using OS resources.**
- A method which takes advantage of **important security issues** found at the Windows Security Architecture.

⚠ **Not reliable on Domain Controllers (yet).**

What does it do?

This technique **hijacks the RID** of any **existing user account** on the victim host and assigns it to **another one**.



```
SID <Guest Account>
==========================================
S-1-5-2196653972-2908857710-5094559845-501
```

RID HIJACKING

```
SID <Guest hijacked Administrator>
========================================
S-1-5-2196653972-2908857710-5094559845-500
```

RID HIJACKING

What does it do?

0x01. Assigns the privileges of the hijacked account to the hijacker one, even if the hijacked account is disabled.

0x02. Allows to authenticate with the **hijacker** account credentials (also remotely, depending on machine's configuration), and obtain authorized access as the **hijacked** user.

0x03. Permits to register any operation executed on the event log as the **hijacked** user, despite of being logged on as the **hijacker** one.

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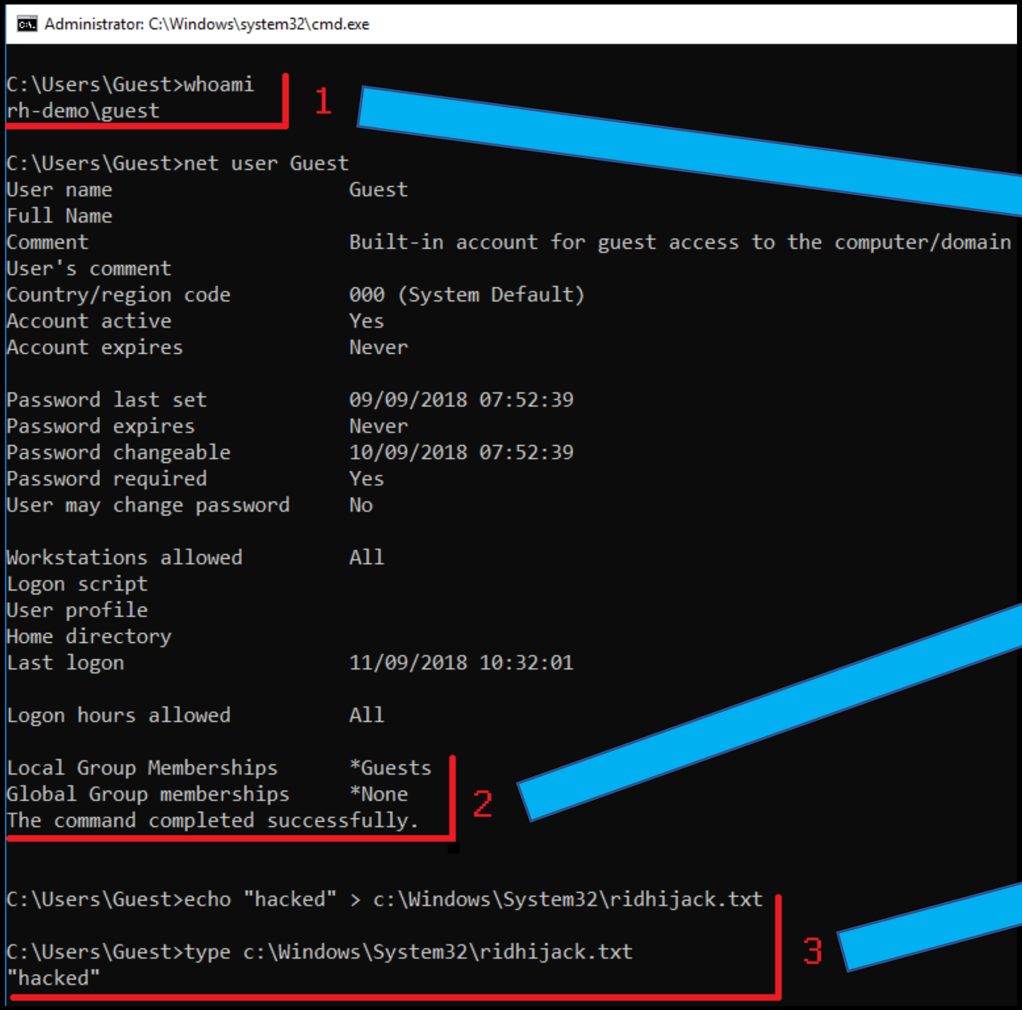
RID HIJACKING

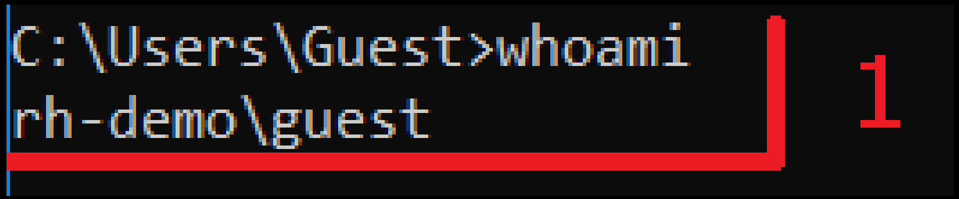
How does it look like?



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

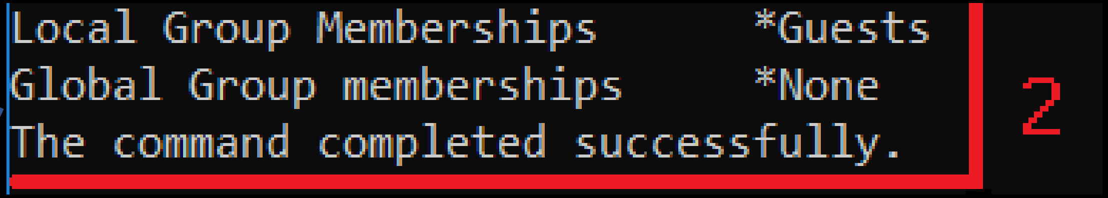
```
C:\Users\Guest>whoami
rh-demo\guest

C:\Users\Guest>net user Guest
User name                    Guest
Full Name
Comment                      Built-in account for guest access to the computer/domain
User's comment
Country/region code          000 (System Default)
Account active               Yes
Account expires              Never

Password last set            09/09/2018 07:52:39
Password expires             Never
Password changeable          10/09/2018 07:52:39
Password required            Yes
User may change password     No

Workstations allowed         All
Logon script
User profile
Home directory
Last logon                   11/09/2018 10:32:01

Logon hours allowed          All

Local Group Memberships      *Guests
Global Group memberships     *None
The command completed successfully.


C:\Users\Guest>echo "hacked" > c:\Windows\System32\ridhijack.txt

C:\Users\Guest>type c:\Windows\System32\ridhijack.txt
"hacked"
```

whoami



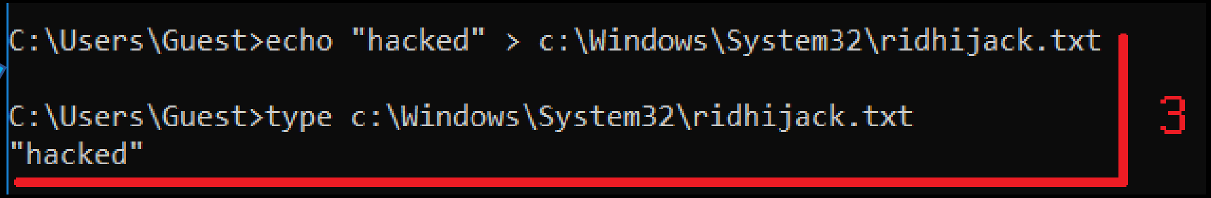
```
C:\Users\Guest>whoami
rh-demo\guest
```

net user Guest



```
Local Group Memberships      *Guests
Global Group memberships     *None
The command completed successfully.
```

writing on System32 folder



```
C:\Users\Guest>echo "hacked" > c:\Windows\System32\ridhijack.txt

C:\Users\Guest>type c:\Windows\System32\ridhijack.txt
"hacked"
```

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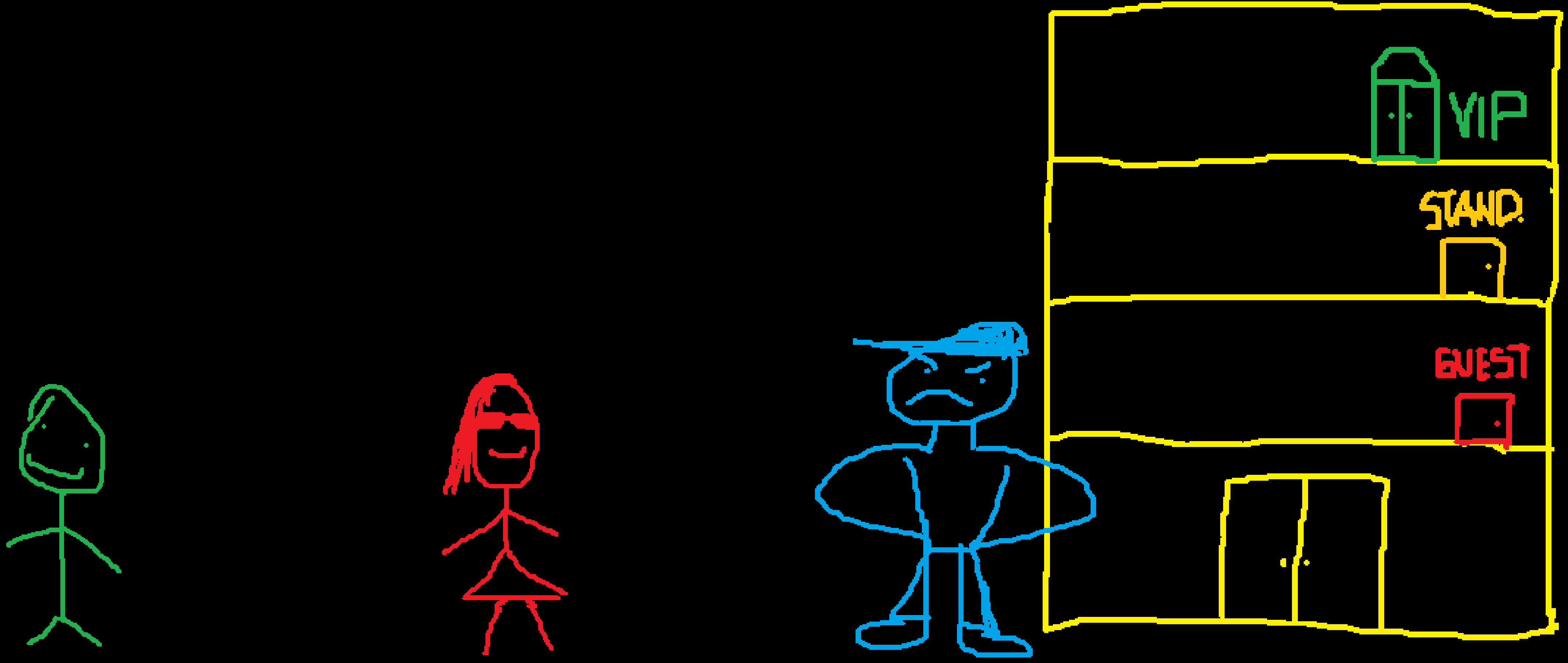
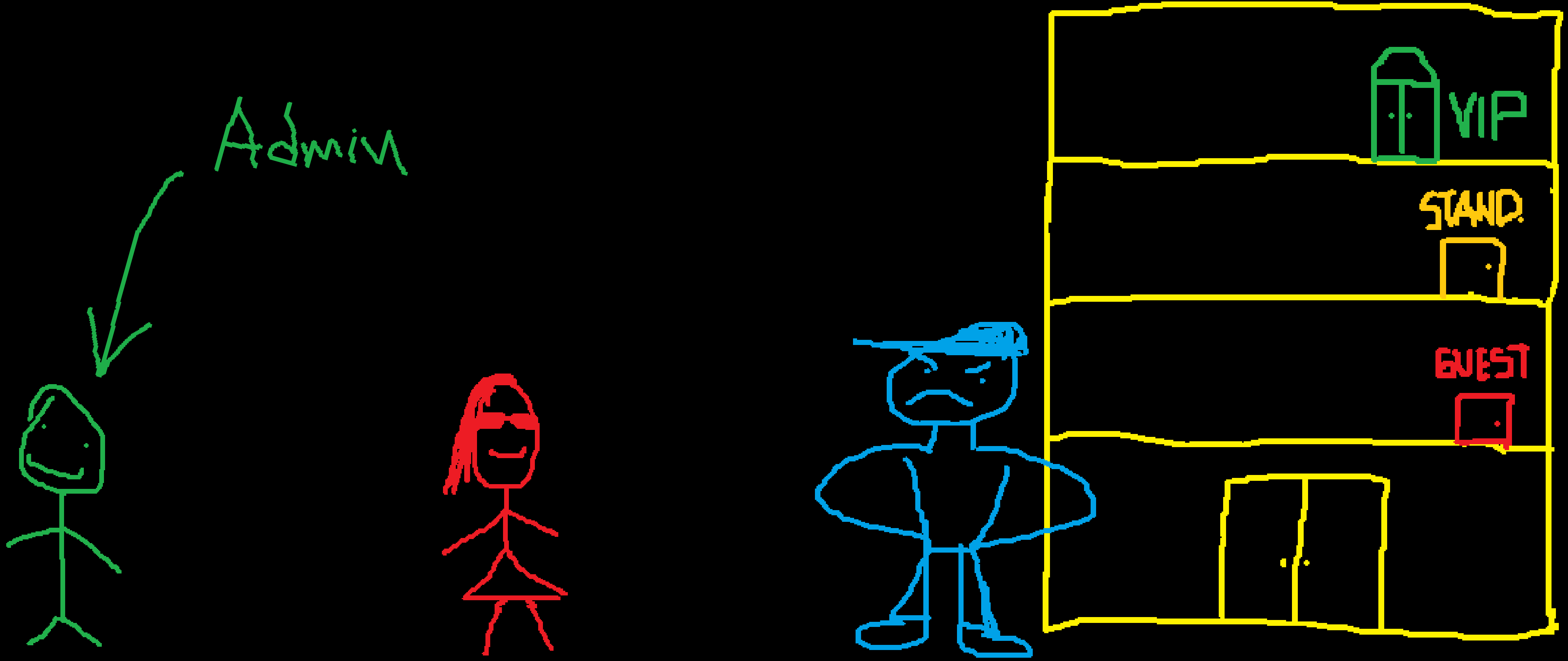
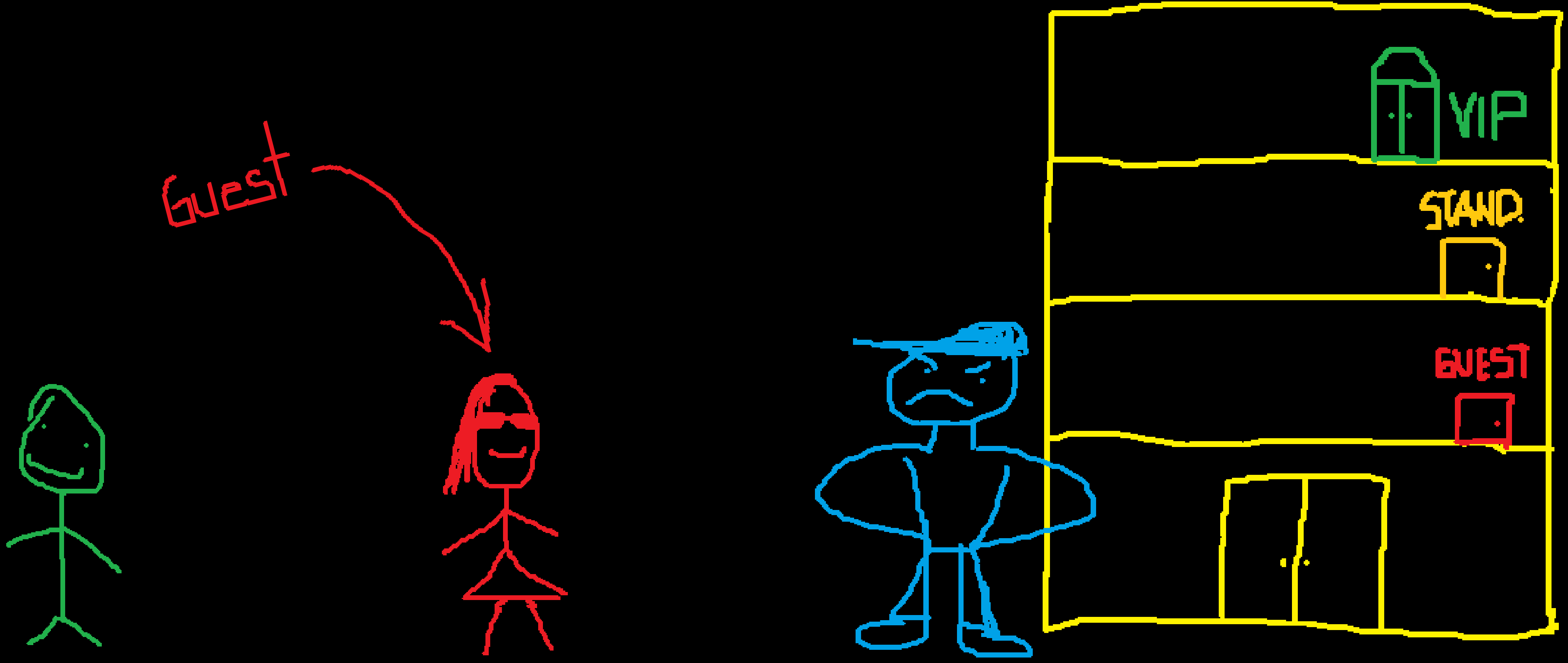
A Windows Logon Story…



A Windows Logon Story…



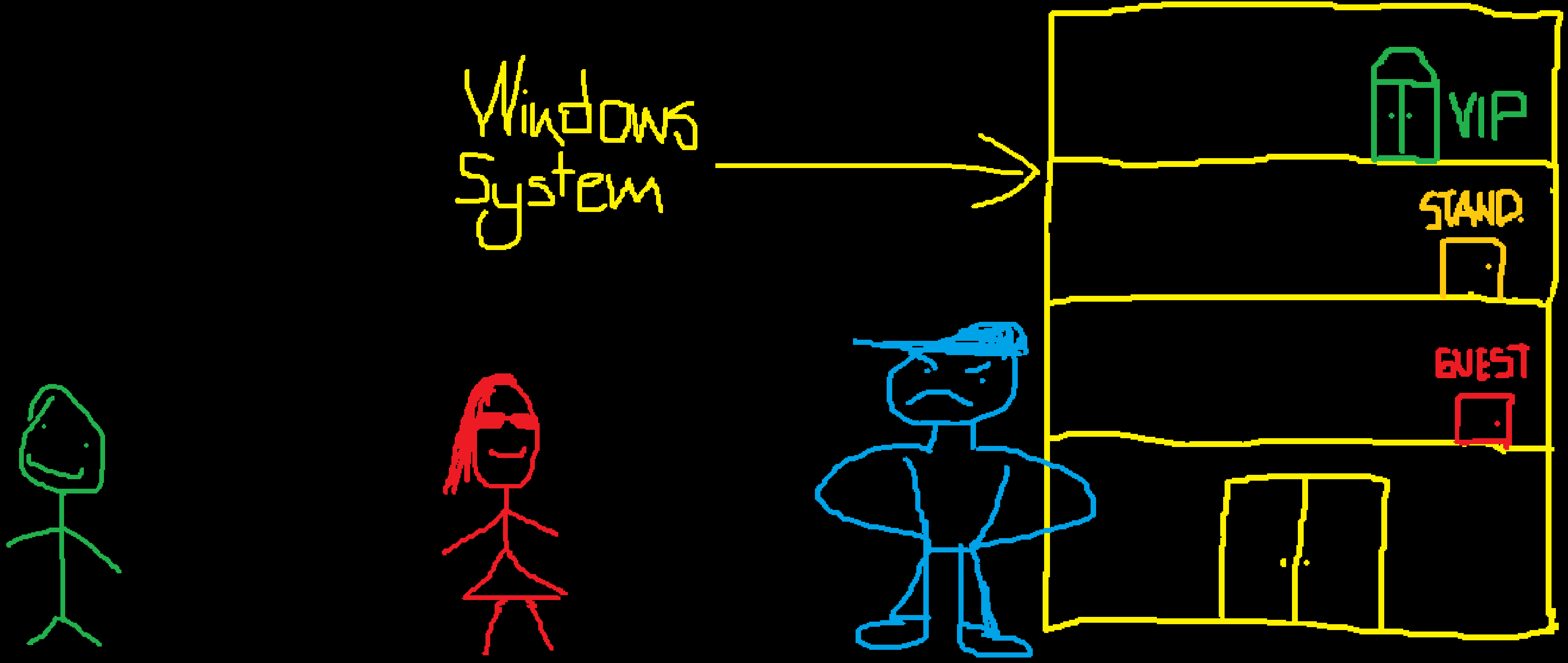
A Windows Logon Story…



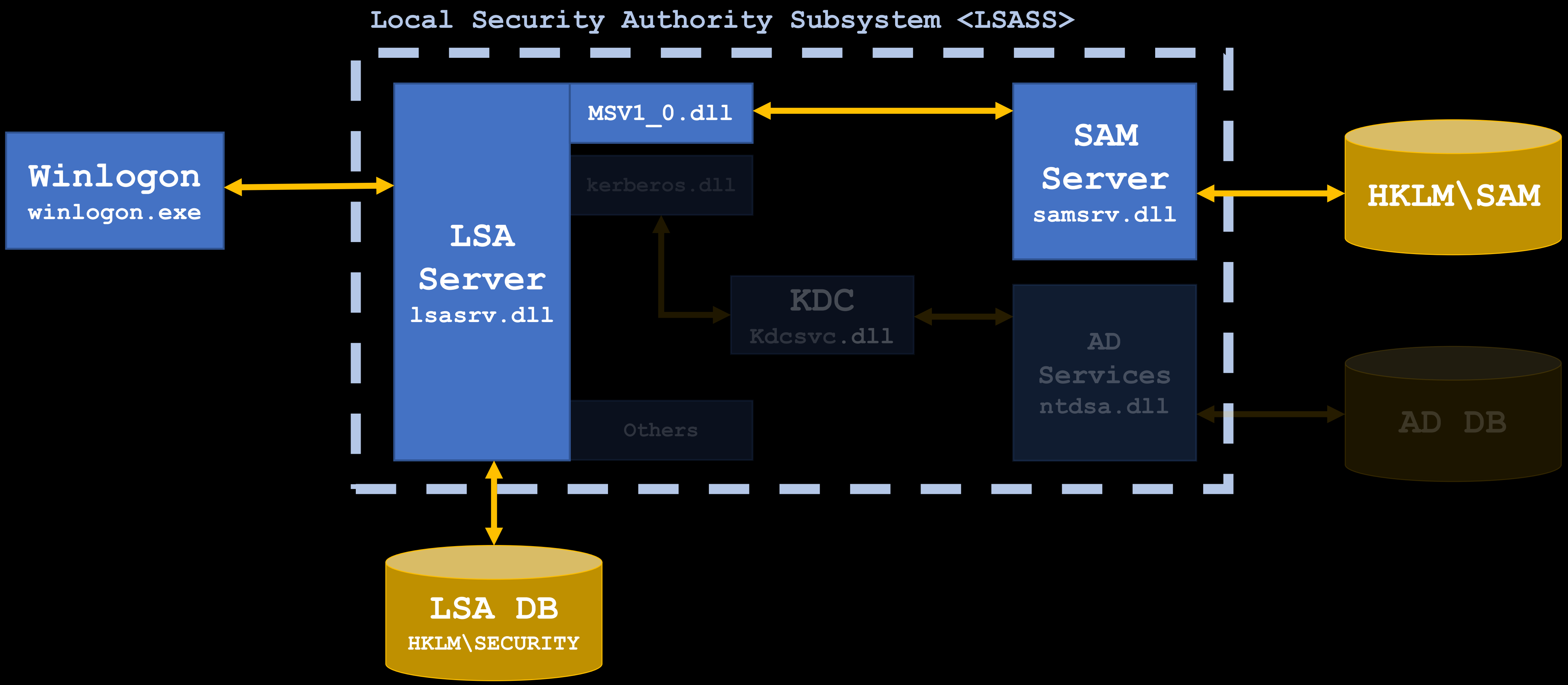
A Windows Logon Story…

Windows
"Security"
VIP
STAND.
GUEST

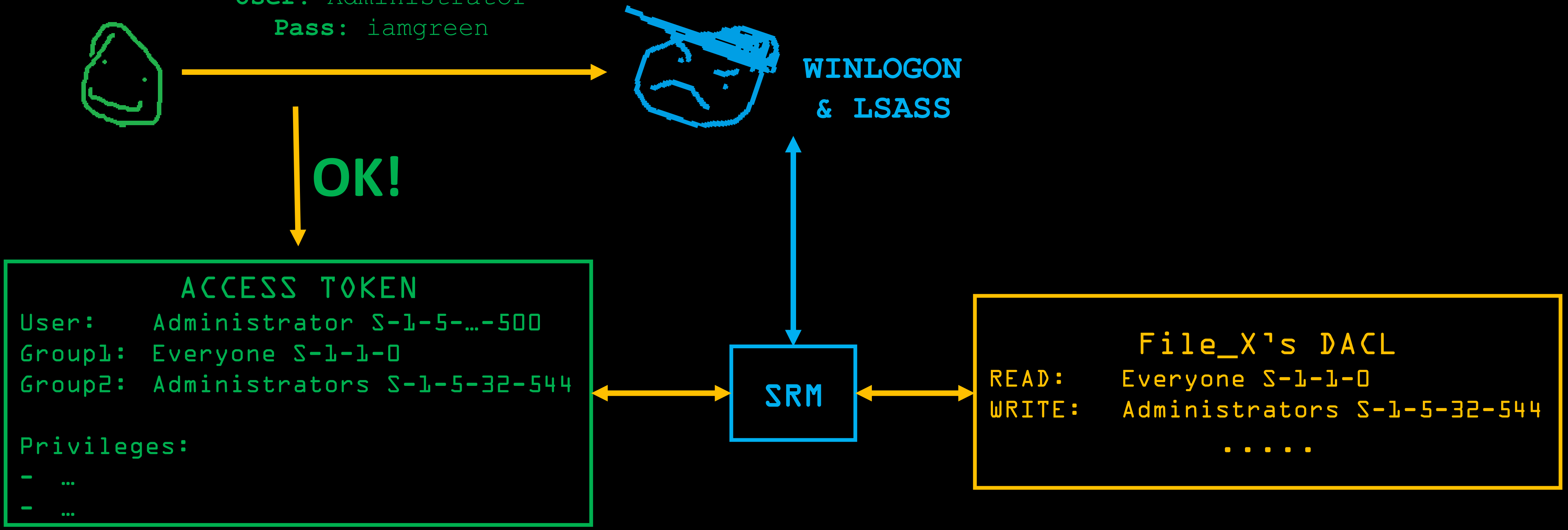
A Windows Logon Story…



Windows Security Architecture



Quick Logon Overview



User: Administrator
Pass: iamgreen

WINLOGON & LSASS

OK!

SRM

ACCESS TOKEN

User:	Administrator S-1-5-…-500
Group1:	Everyone S-1-1-0
Group2:	Administrators S-1-5-32-544

Privileges:

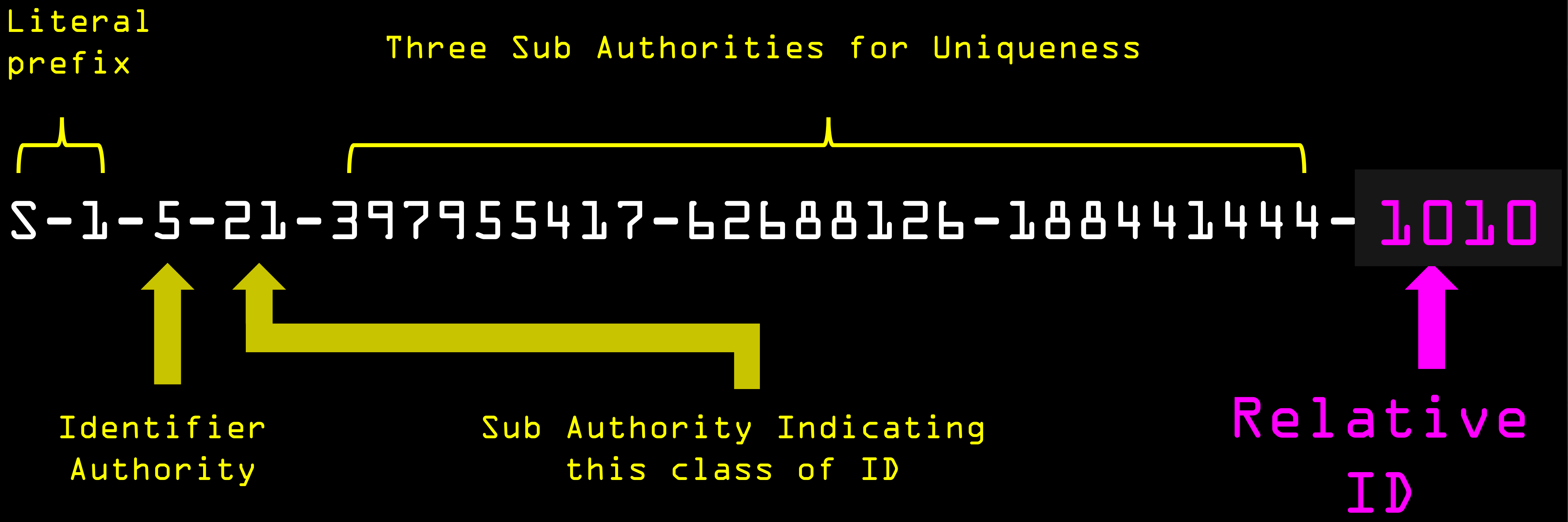
- …
- …

File_X's DACL

READ:	Everyone S-1-1-0
WRITE:	Administrators S-1-5-32-544

.....

Security Identifiers <SID>



Literal prefix

Three Sub Authorities for Uniqueness

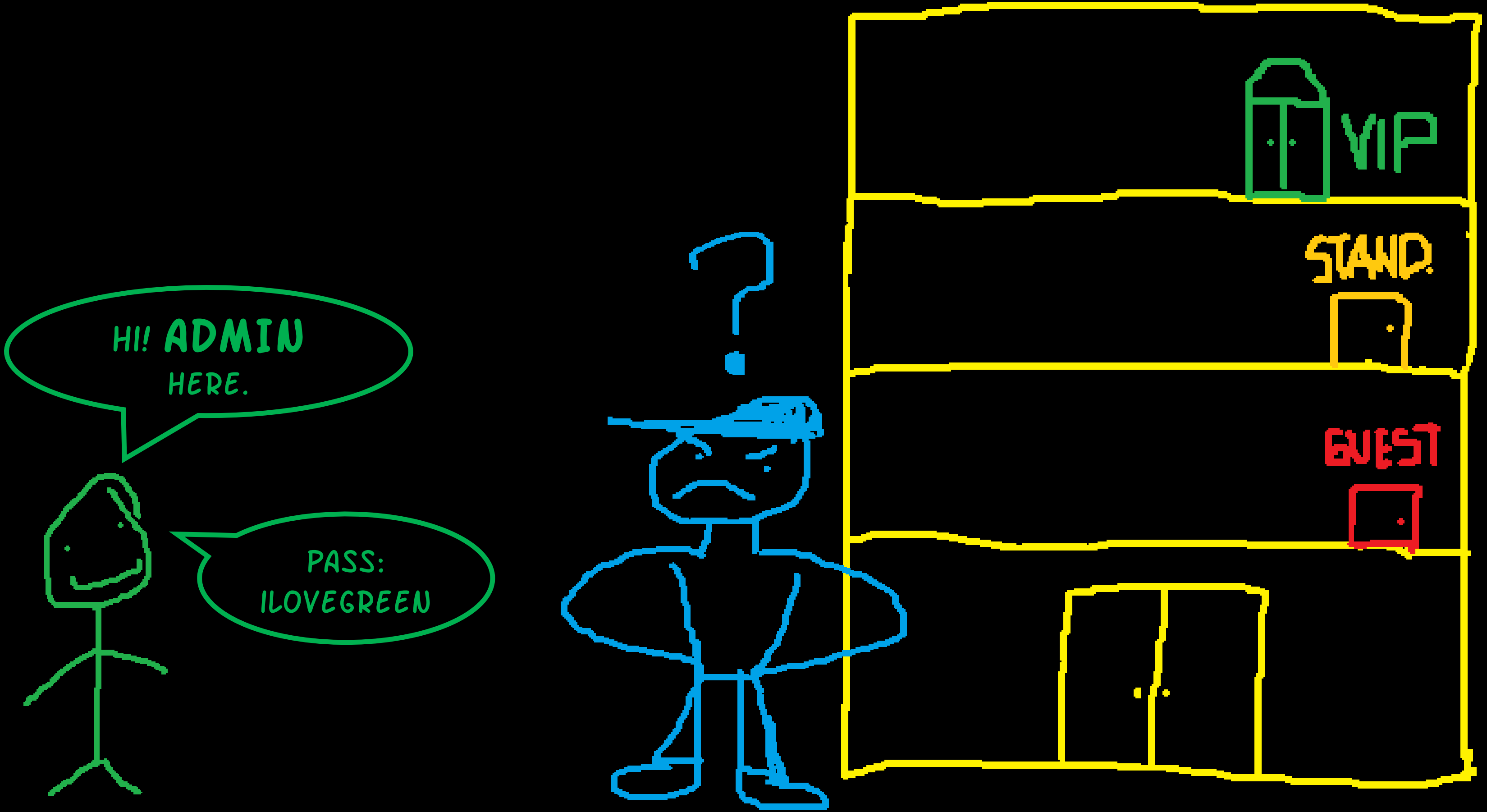
S-1-5-21-397955417-62688126-188441444-1010

Identifier Authority

Sub Authority Indicating this class of ID

Relative ID

Authentication



Authentication Steps

0x01. WINLOGON Initialization.

0x02. WINLOGON calls LOGONUI (using CPs).

0x03. WINLOGON creates an unique LOGON SID.

0x04. WINLOGON calls LSASS and prepares a handle for an Authentication Package.

Authentication Steps

0x05. WINLOGON sends logon info to the MSV1_0 calling LsaLogonUser.

Logon Info:

Username/Password.

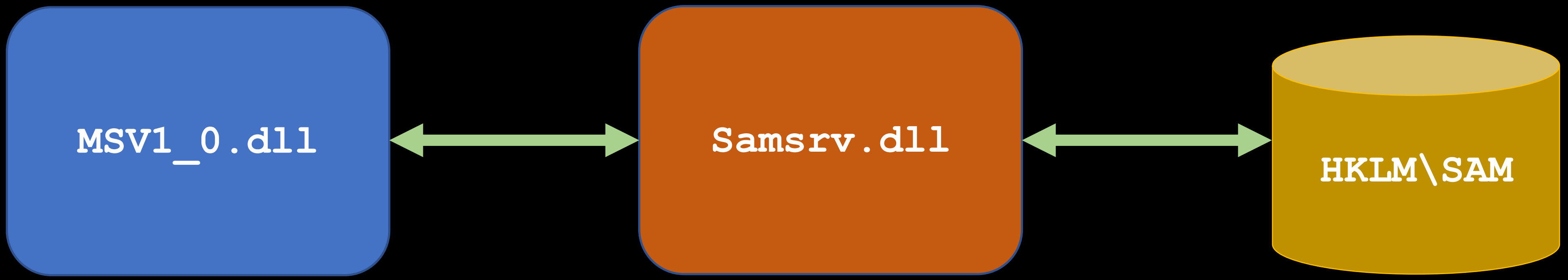
LOGON SID.

⚠ MSV1_0 is also used on domain-member computers when are disconnected of the network.

Authentication Steps

0x06. MSV1_0 sends username and hashed password to the SAMSRV.

0x07. SAMSRV queries on the SAM database with the logon data, retrieving some security info.



Authentication Steps

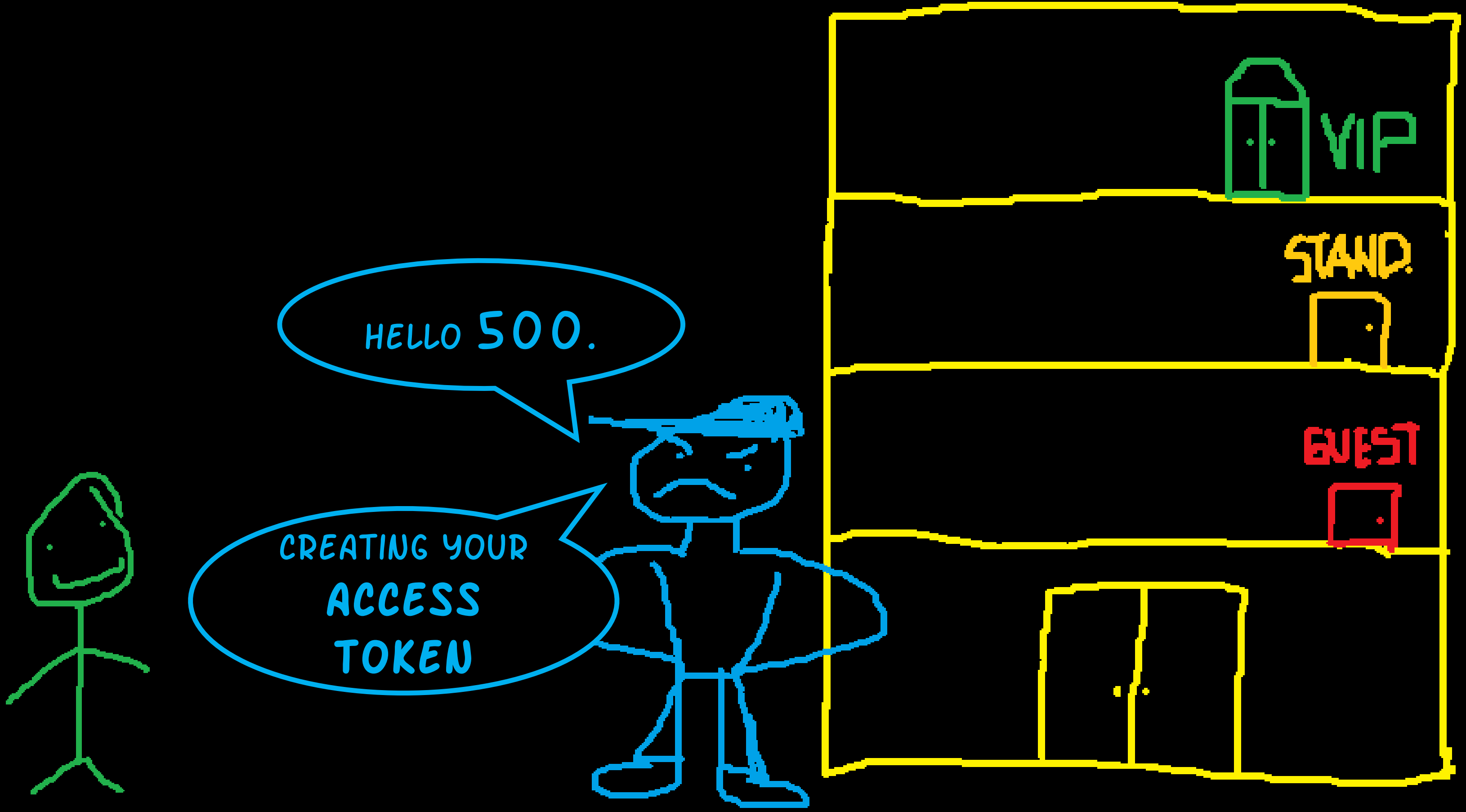
0x08. MSV1_0 checks the information obtained from the SAMSRV response.

0x09. If OK, MSV1_0 generates a LUID for the session.

0x0A. MSV1_0 sends the login information (including LUID) to LSASS.

All the data sent will be used for the further access token creation.

Authorization



Access Token

Object used by the SRM to identify the security context of a process.

LSASS creates an initial access token for every user which logs on.

Child processes inherit a copy of the token of their creator.

Processes in a user's session will be executed using the same access token.

Token source
Impersonation type
Token ID
Authentication ID
Modified ID
Expiration Time
Session ID
Flags
Logon session
Mandatory Policy
Default primary group
Default DACL
User account SID
Group 1 SID
…
Group n SID
Restricted SID 1
…
Restricted SID n
Privilege 1
…
Privilege n

Authorization Steps

0x0B. LSASS checks the LSA database for the user's allowed access.

Token source
Impersonation type
Token ID
Authentication ID
Modified ID
Expiration Time
Session ID
Flags
Logon session
Mandatory Policy
Default primary group
Default DACL
User account SID

Authorization Steps

0x0B. LSASS checks the LSA database for the user's allowed access.

0x0C. LSASS adds the Groups, SIDs and privileges to the access token.

Token source
Impersonation type
Token ID
Authentication ID
Modified ID
Expiration Time
Session ID
Flags
Logon session
Mandatory Policy
Default primary group
Default DACL
User account SID
Group 1 SID
…
Group n SID
Restricted SID 1
…
Restricted SID n
Privilege 1
…
Privilege n

Authorization Steps

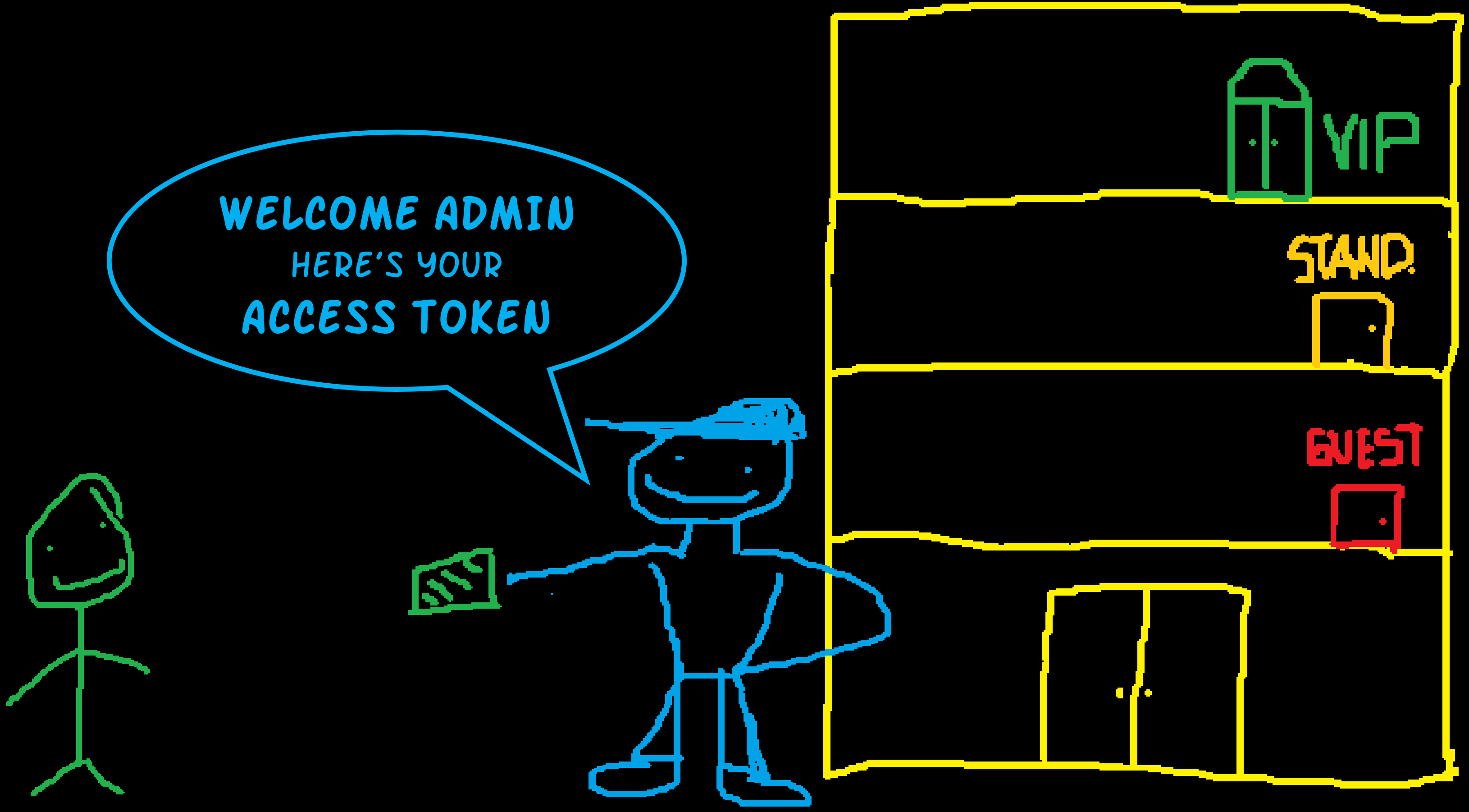
0x0B. LSASS checks the LSA database for the user's allowed access.

0x0C. LSASS adds the Groups, SIDs and privileges to the access token.

0x0D. LSASS formally creates a primary access token.

Token source
Impersonation type
Token ID
Authentication ID
Modified ID
Expiration Time
Session ID
Flags
Logon session
Mandatory Policy
Default primary group
Default DACL
User account SID
Group 1 SID
…
Group n SID
Restricted SID 1
…
Restricted SID n
Privilege 1
…
Privilege n

Authorization



Authorization

ACCESS GRANTED

TOKEN

RID: 500
VIP
STAND.
GUEST

Agenda

0x01. Exposing the RID Hijacking Attack.

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Understanding the attack

How is the user identified by the system after being successfully authenticated?

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S-1-5-2196653972-2908857710-5094559845-500

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How does the system associate an username with his SID?

Understanding the attack

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S-1-5-2196653972-2908857710-5094559845-500

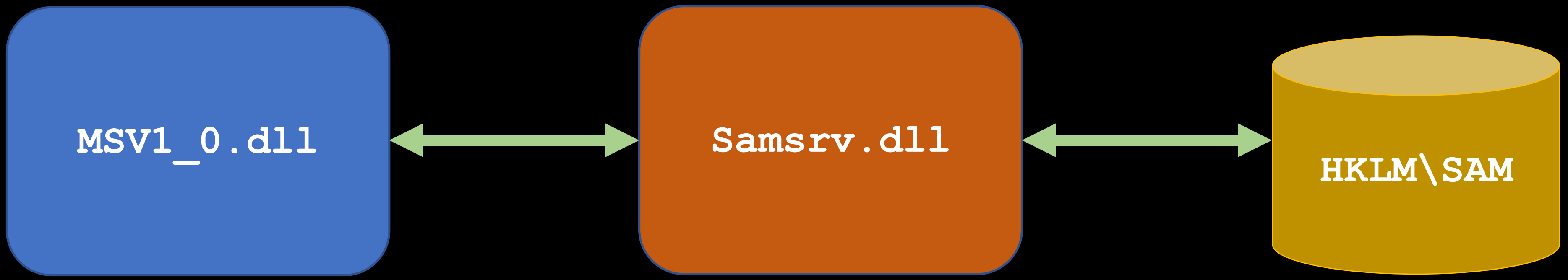
How does the system associate an username with his SID?

Using the Samsrv.dll black magic :)

Remembering…

0x06. MSV1_0 sents username and hashed password to the SAMSRV.

0x07. SAMSRV queries on the SAM database with the logon data, retrieving some security info.



RID HIJACKING

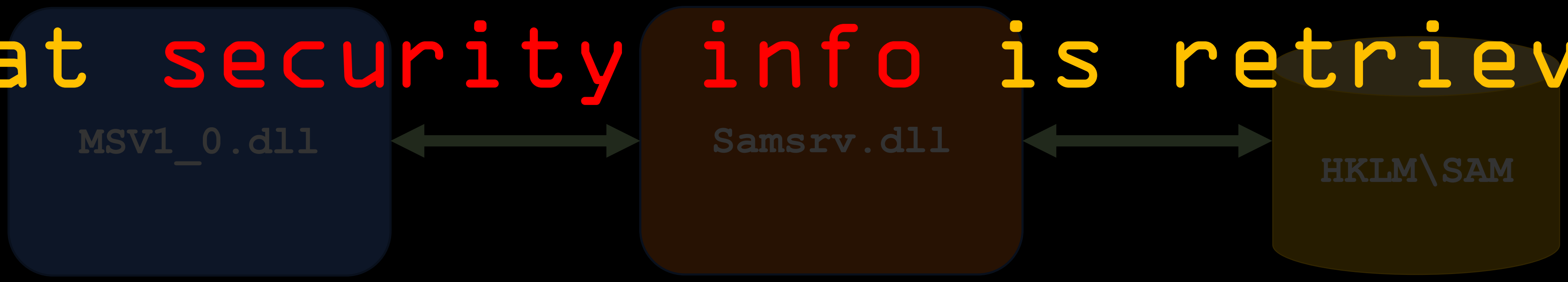
Remembering...

0x06. MSV1_0 sents username and hashed password to the SAMSRV.

0x07. SAMSRV queries on the SAM database with the logon data, retrieving some security info.

How is the username associated with the SID?

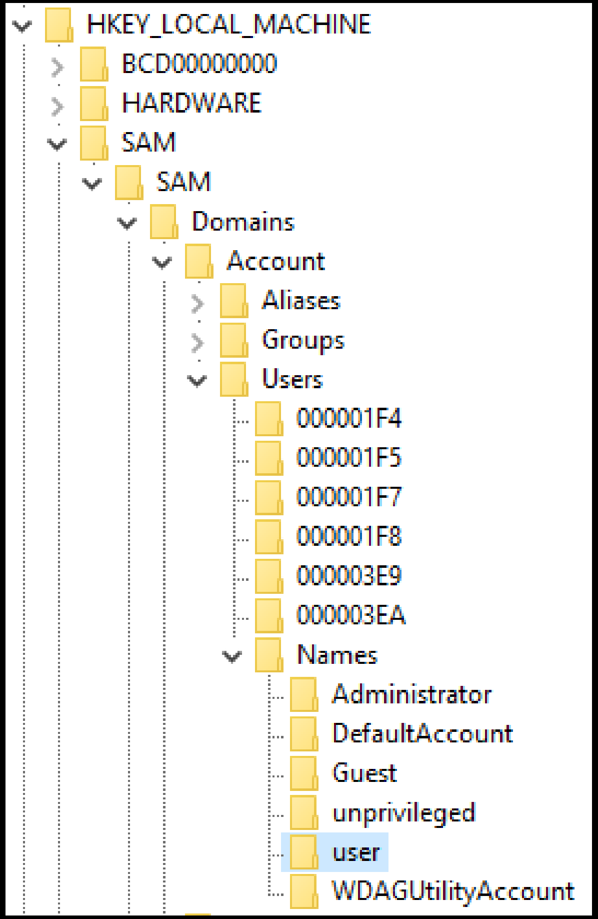
What security info is retrieved?



Samsrv.dll and SAM

SAMSRV looks for the username at the SAM database.

HKLM\SAM\SAM\Domains\Account\Users\Names



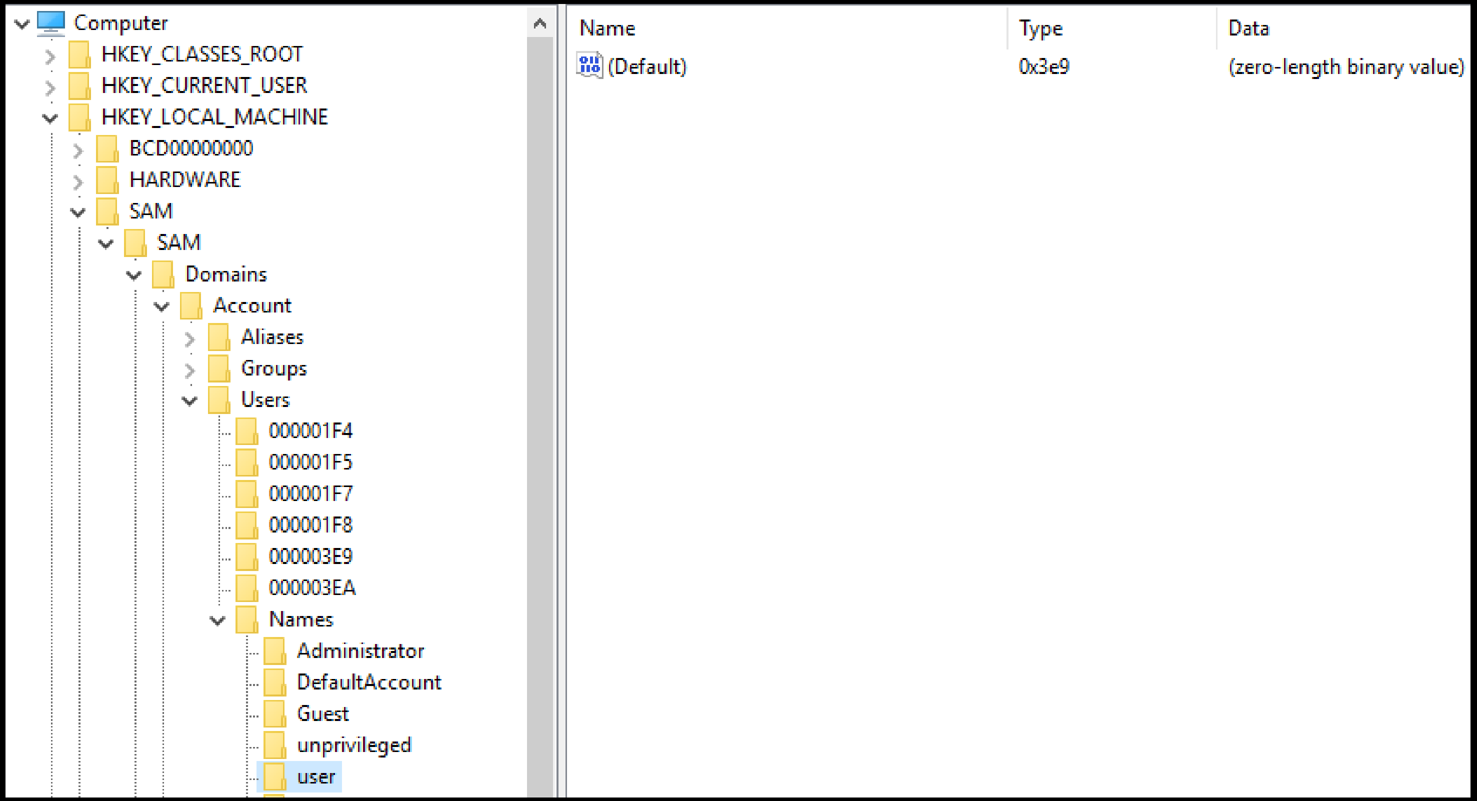
```
HKEY_LOCAL_MACHINE
  BCD00000000
  HARDWARE
  SAM
    SAM
      Domains
        Account
          Aliases
          Groups
          Users
            000001F4
            000001F5
            000001F7
            000001F8
            000003E9
            000003EA
            Names
              Administrator
              DefaultAccount
              Guest
              unprivileged
              user
              WDAGUtilityAccount
```

Samsrv.dll and SAM

SAMSRV looks for the username at the SAM database.

Each key contains a REG_BINARY value.

HKLM\SAM\SAM\Domains\Account\Users\Names



```
Computer
  HKEY_CLASSES_ROOT
  HKEY_CURRENT_USER
  HKEY_LOCAL_MACHINE
    BCD00000000
    HARDWARE
    SAM
      SAM
        Domains
          Account
            Aliases
            Groups
            Users
              000001F4
              000001F5
              000001F7
              000001F8
              000003E9
              000003EA
              Names
                Administrator
                DefaultAccount
                Guest
                unprivileged
                user
```

Name	Type	Data
(Default)	0x3e9	(zero-length binary value)

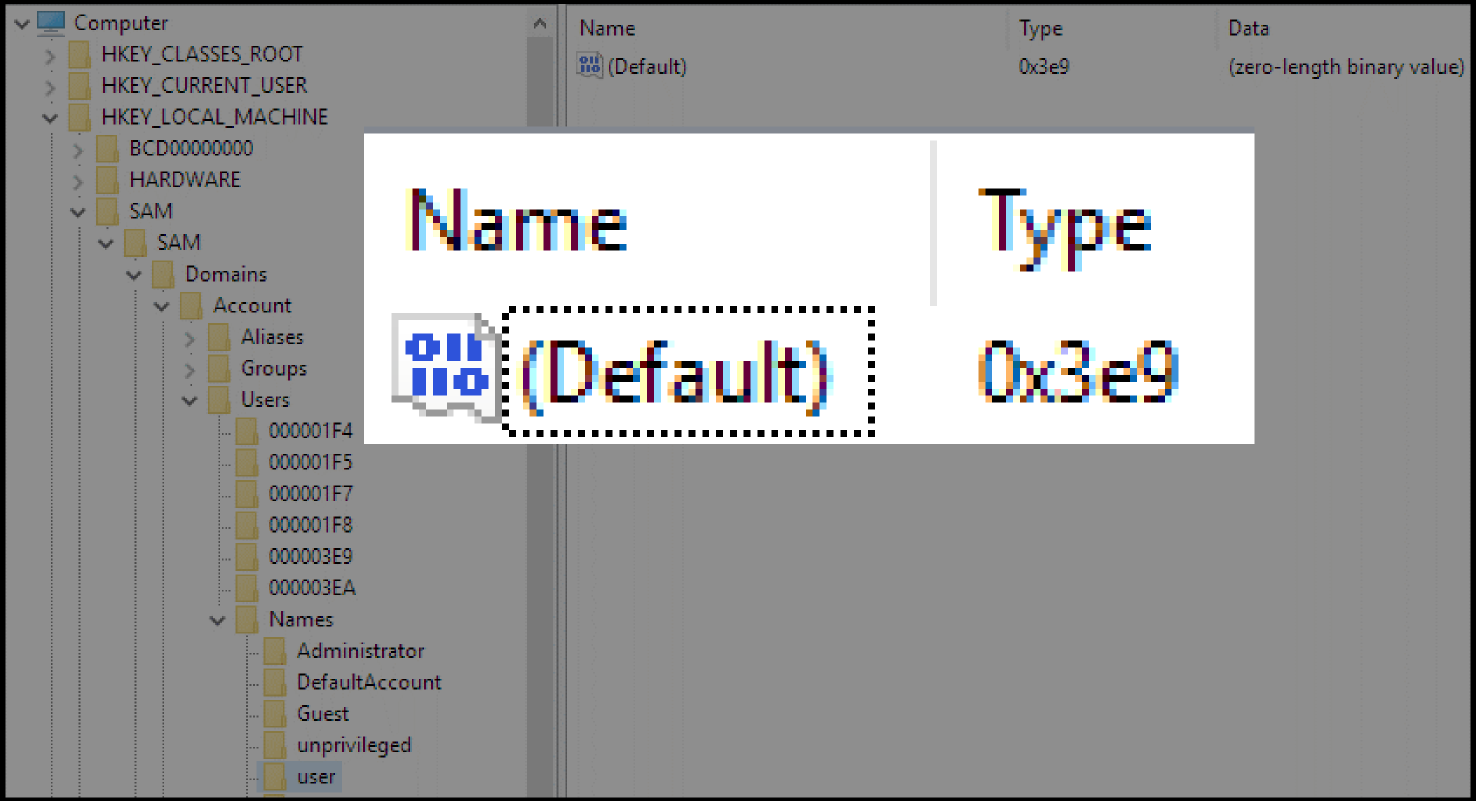
Samsrv.dll and SAM

SAMSRV looks for the username at the SAM database.

Each key contains a REG_BINARY value.

The REG_BINARY has as Type the RID of the account.

HKLM\SAM\SAM\Domains\Account\Users\Names



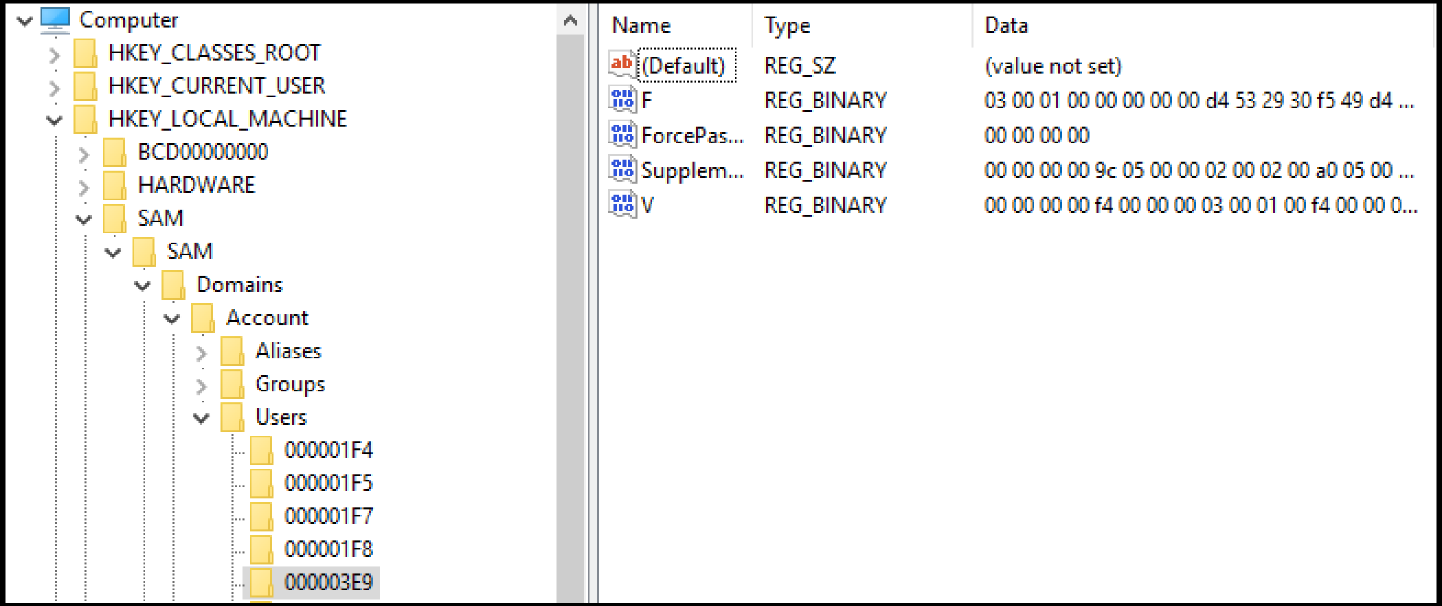
Name	Type	Data
(Default)	0x3e9	(zero-length binary value)

Name	Type
(Default)	0x3e9

Samsrv.dll and MSV1_0.dll

SAMSRV looks for the key associated with the RID.

HKLM\SAM\SAM\Domains\Account\Users



```
Computer
  HKEY_CLASSES_ROOT
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  HKEY_LOCAL_MACHINE
    BCD00000000
    HARDWARE
    SAM
      SAM
        Domains
          Account
            Aliases
            Groups
            Users
              000001F4
              000001F5
              000001F7
              000001F8
              000003E9
```

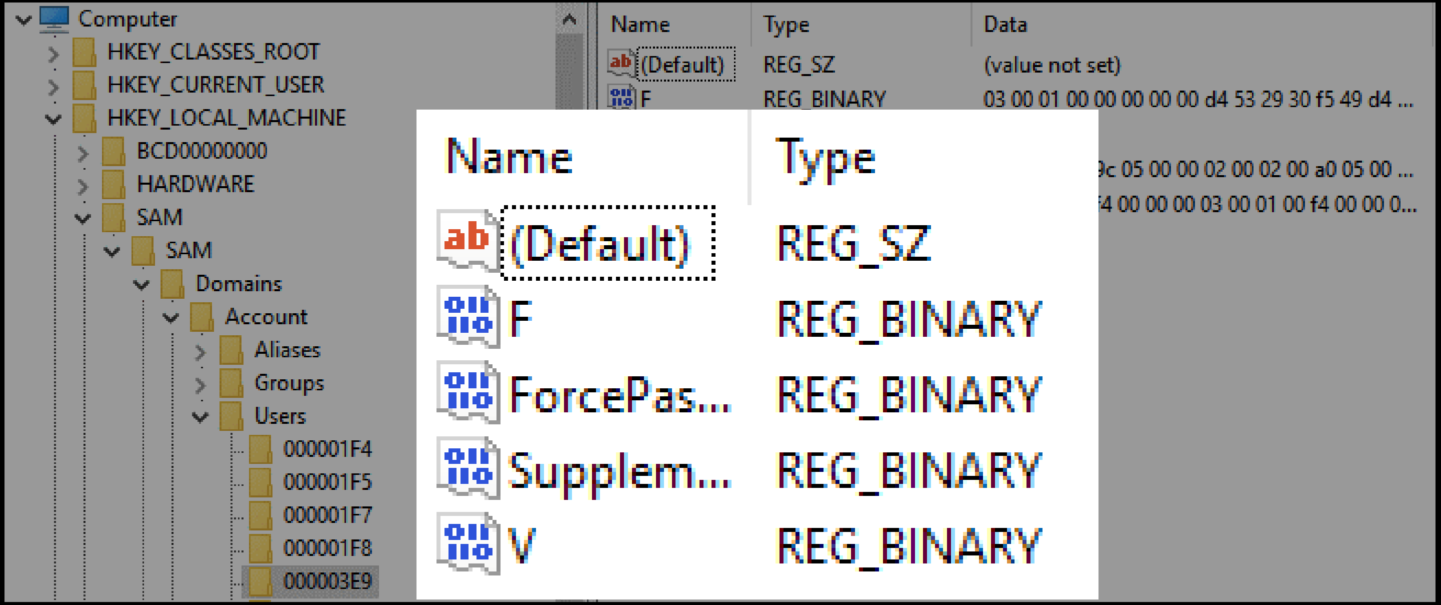
Name	Type	Data
(Default)	REG_SZ	(value not set)
F	REG_BINARY	03 00 01 00 00 00 00 00 d4 53 29 30 f5 49 d4 ...
ForcePas...	REG_BINARY	00 00 00 00
Supplem...	REG_BINARY	00 00 00 00 9c 05 00 00 02 00 02 00 a0 05 00 ...
V	REG_BINARY	00 00 00 00 f4 00 00 00 03 00 01 00 f4 00 00 0...

Samsrv.dll and MSV1_0.dll

SAMSRV looks for the key associated with the RID.

SAMSRV grabs all the data stored in the referenced key.

HKLM\SAM\SAM\Domains\Account\Users



```
Computer
  HKEY_CLASSES_ROOT
  HKEY_CURRENT_USER
  HKEY_LOCAL_MACHINE
    BCD00000000
    HARDWARE
    SAM
      SAM
        Domains
          Account
            Aliases
            Groups
            Users
              000001F4
              000001F5
              000001F7
              000001F8
              000003E9
```

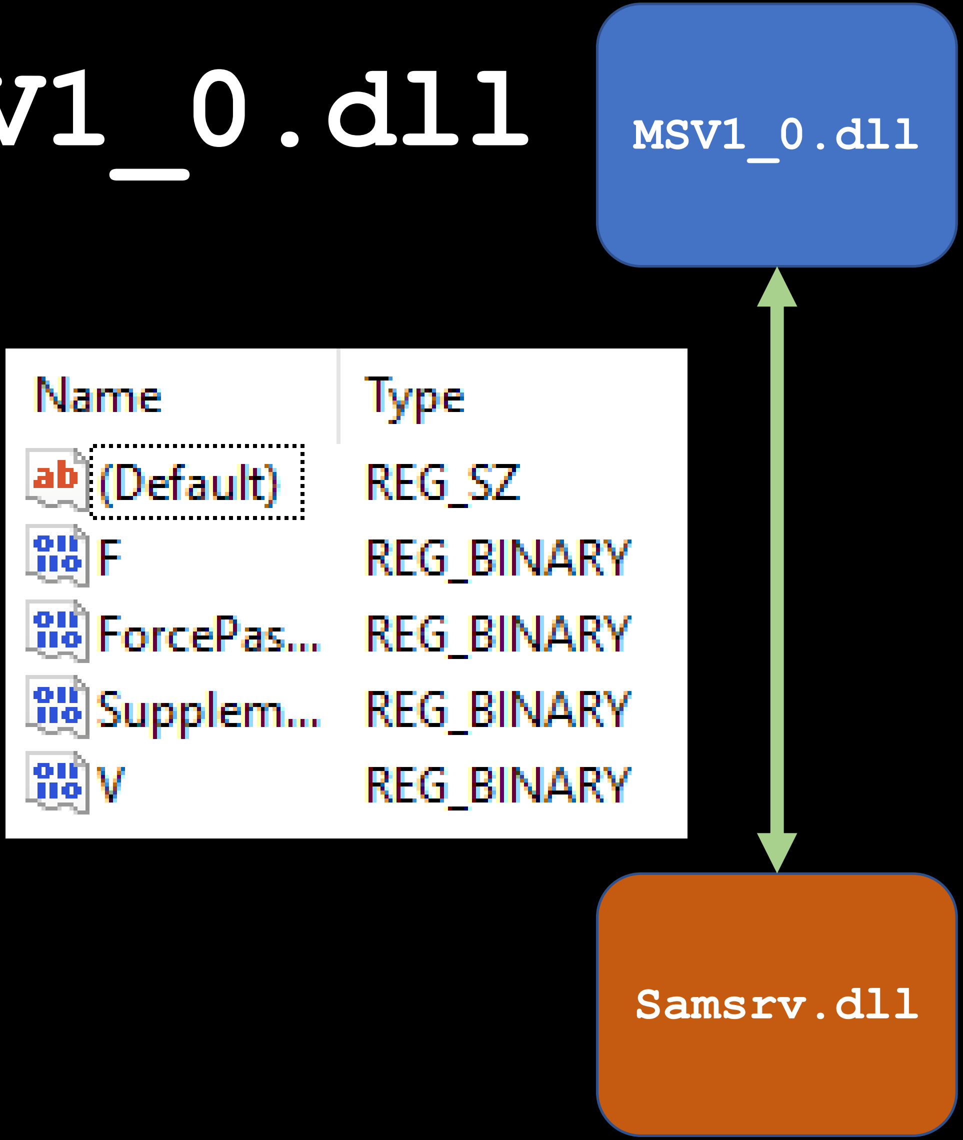
Name	Type	Data
(Default)	REG_SZ	(value not set)
F	REG_BINARY	03 00 01 00 00 00 00 00 d4 53 29 30 f5 49 d4 ...
ForcePas...	REG_BINARY	...9c 05 00 00 02 00 02 00 a0 05 00 ...
Supplem...	REG_BINARY	...f4 00 00 00 03 00 01 00 f4 00 00 0...
V	REG_BINARY	

Samsrv.dll and MSV1_0.dll

SAMSRV looks for the key associated with the RID.

SAMSRV grabs all the data stored in the referenced key.

MSV1_0.dll receives back all the data from SAMSRV.



Name	Type
(Default)	REG_SZ
F	REG_BINARY
ForcePas...	REG_BINARY
Supplem...	REG_BINARY
V	REG_BINARY

Understanding the attack

Why does the SAM store only the RID?

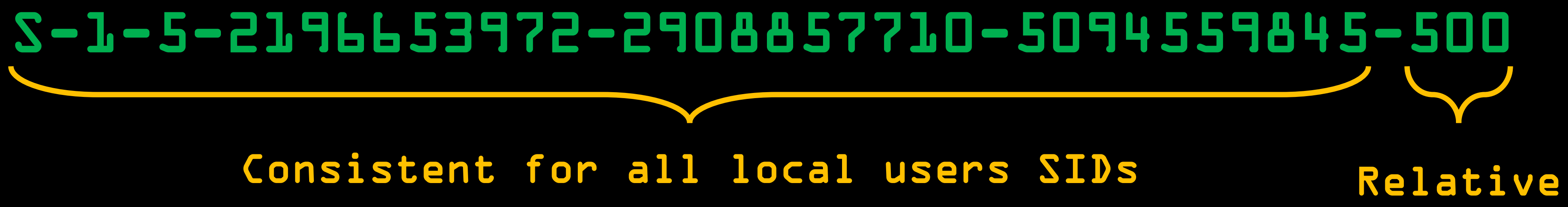
Understanding the attack

Why does the SAM store only the RID?

$$\underbrace{\text{S-1-5-2196653972-2908857710-5094559845}}_{\text{Consistent for all local users SIDs}}\text{-}\underbrace{\text{500}}_{\text{Relative}}$$

Understanding the attack

Why does the SAM store only the RID?



S-1-5-2196653972-2908857710-5094559845-500

Consistent for all local users SIDs

Relative

What info is retrieved from the SAM?

Understanding the attack

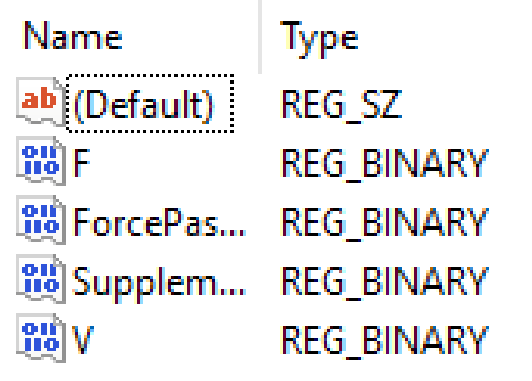
Why does the SAM store only the RID?

S-1-5-2196653972-2908857710-5094559845-500

Consistent for all local users SIDs

Relative

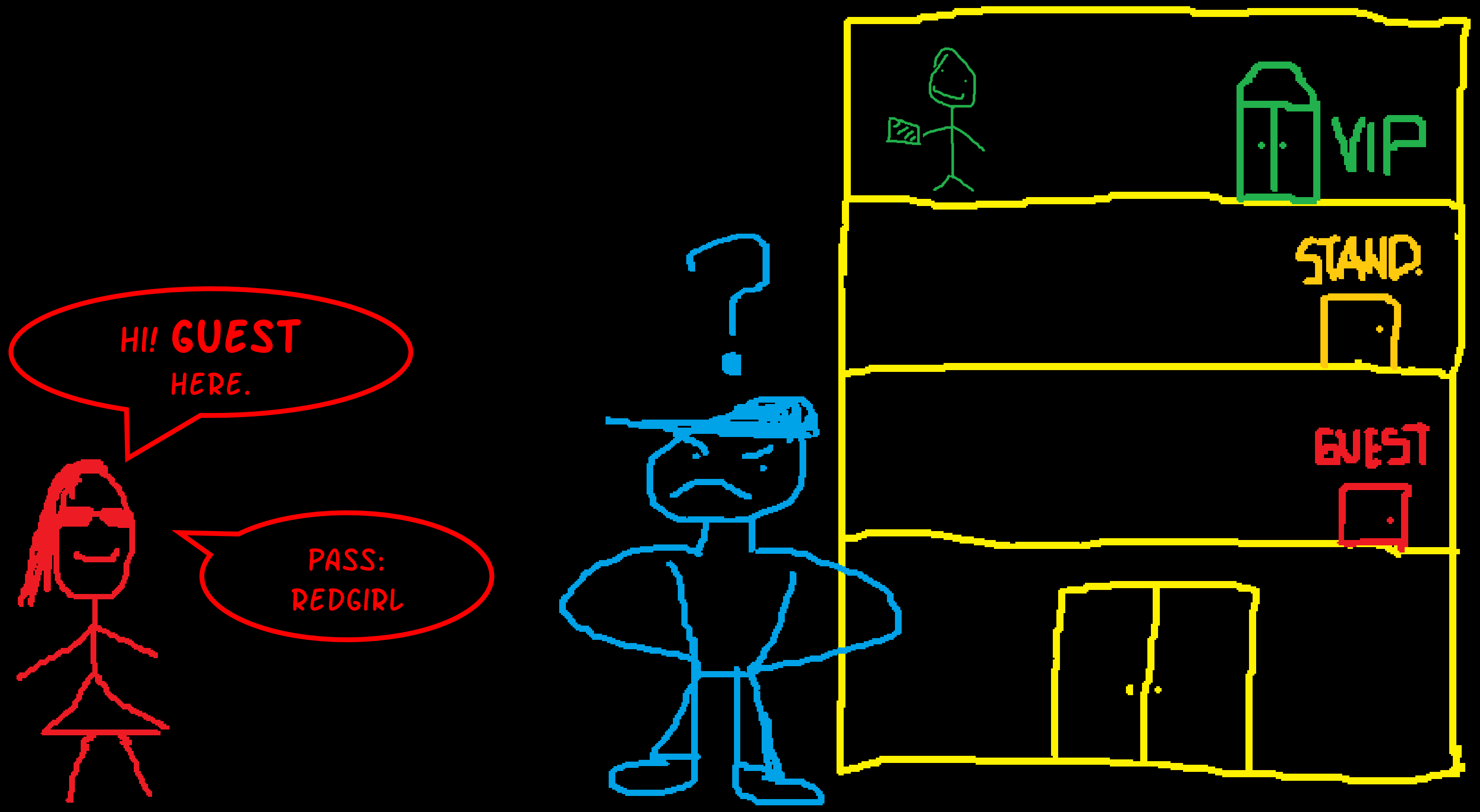
What info is retrieved from the SAM?



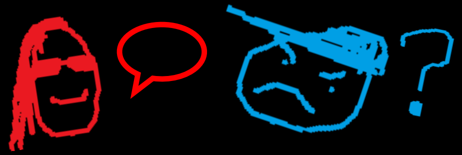
Name	Type
(Default)	REG_SZ
F	REG_BINARY
ForcePas...	REG_BINARY
Supplem...	REG_BINARY
V	REG_BINARY

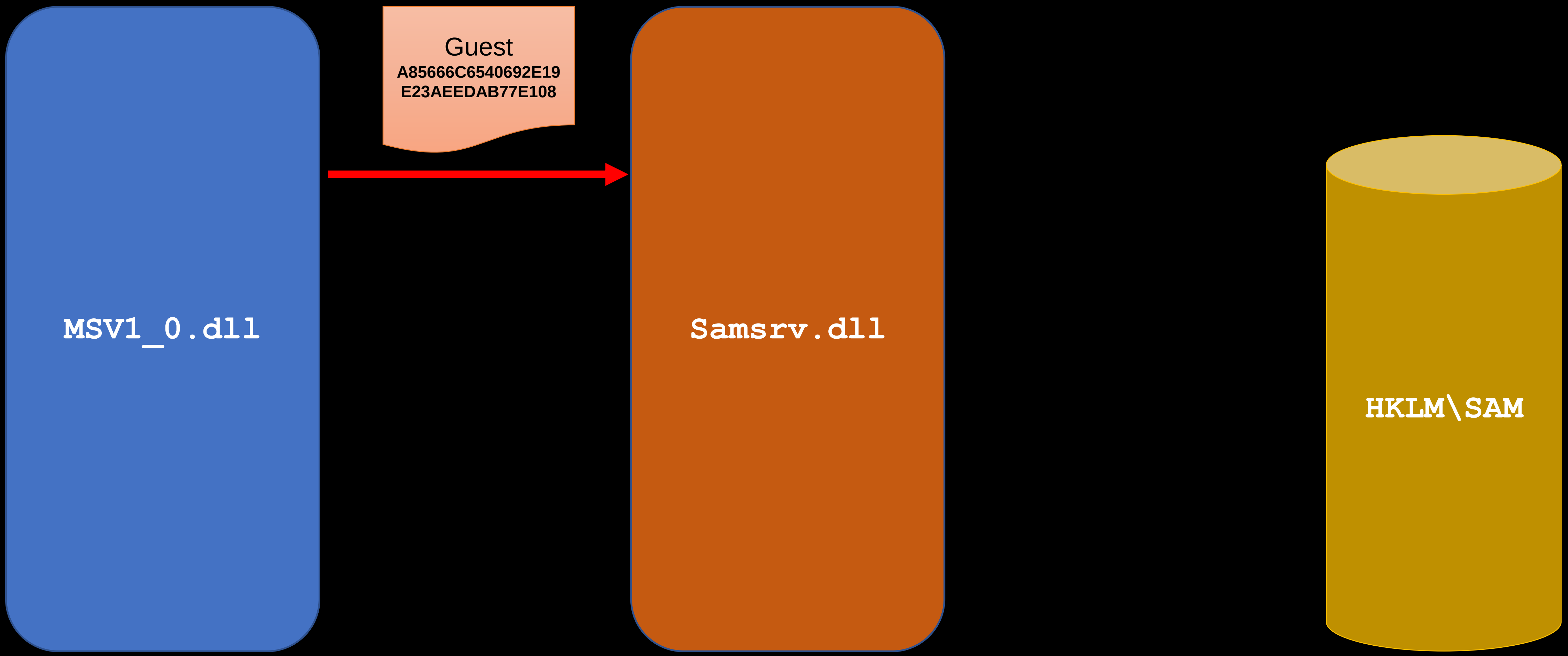
Password's Hash.
Account status (Active: Y/N).
Some account restrictions.
A copy of the user's RID.

Login as Guest



Login as Guest





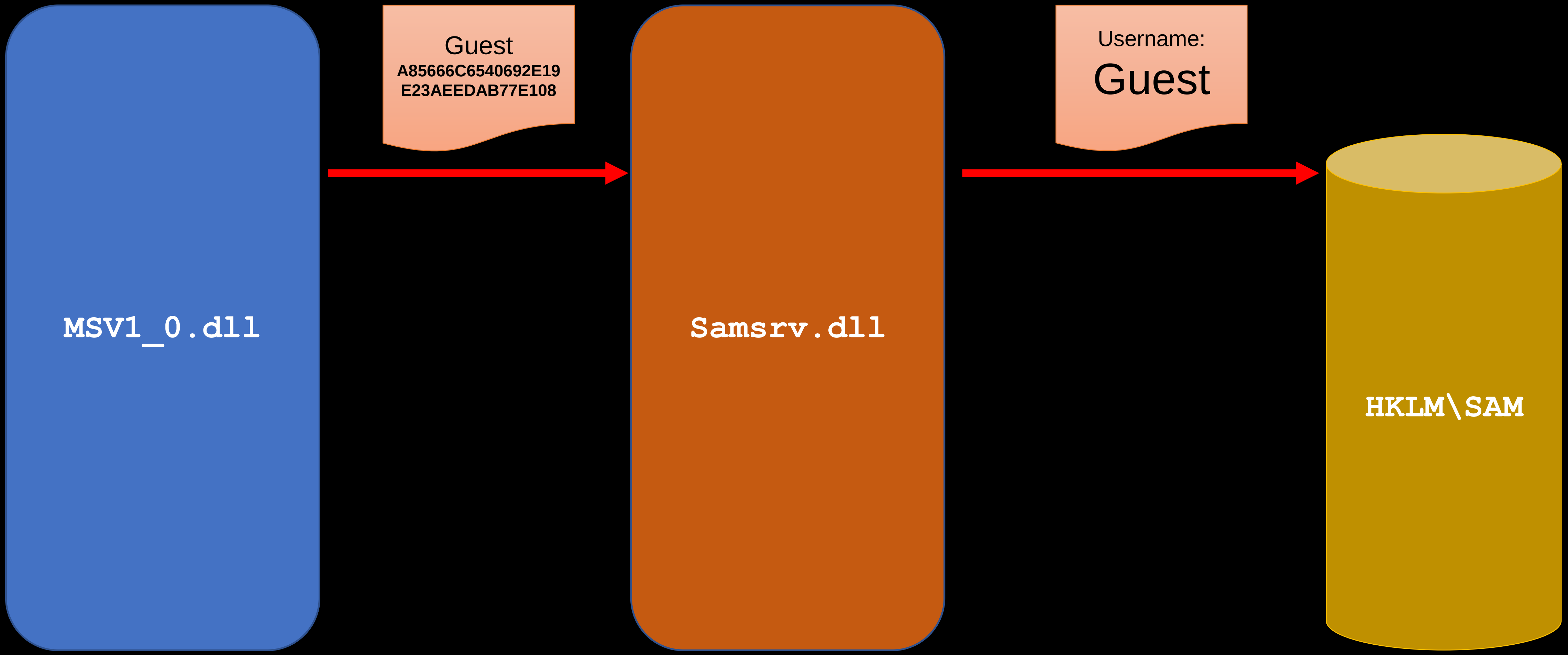
MSV1_0.dll

Guest
A85666C6540692E19
E23AEEDAB77E108

Samsrv.dll

HKLM\SAM

Login as Guest



MSV1_0.dll

Guest
A85666C6540692E19
E23AEEDAB77E108

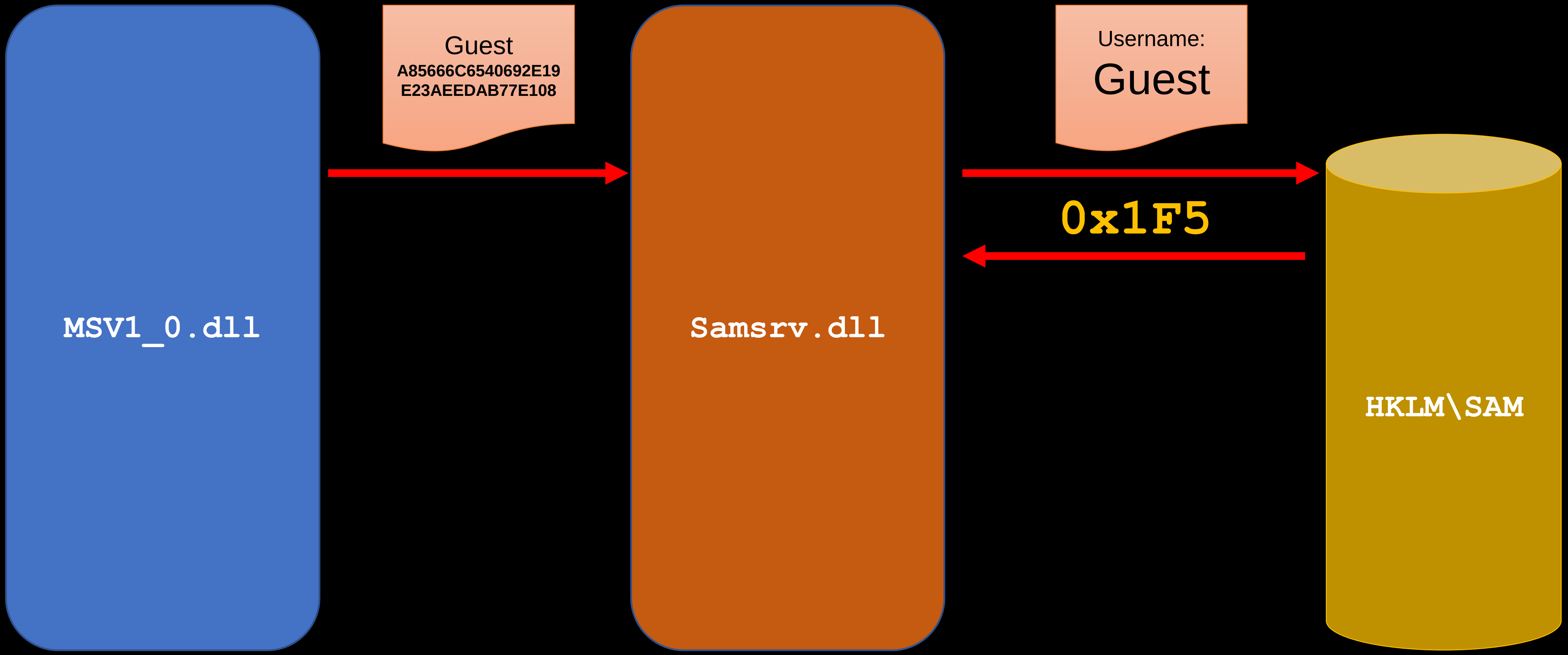
Samsrv.dll

Username:
Guest

HKLM\SAM

RID HIJACKING

Login as Guest



Guest
A85666C6540692E19
E23AEEDAB77E108

Username:
Guest

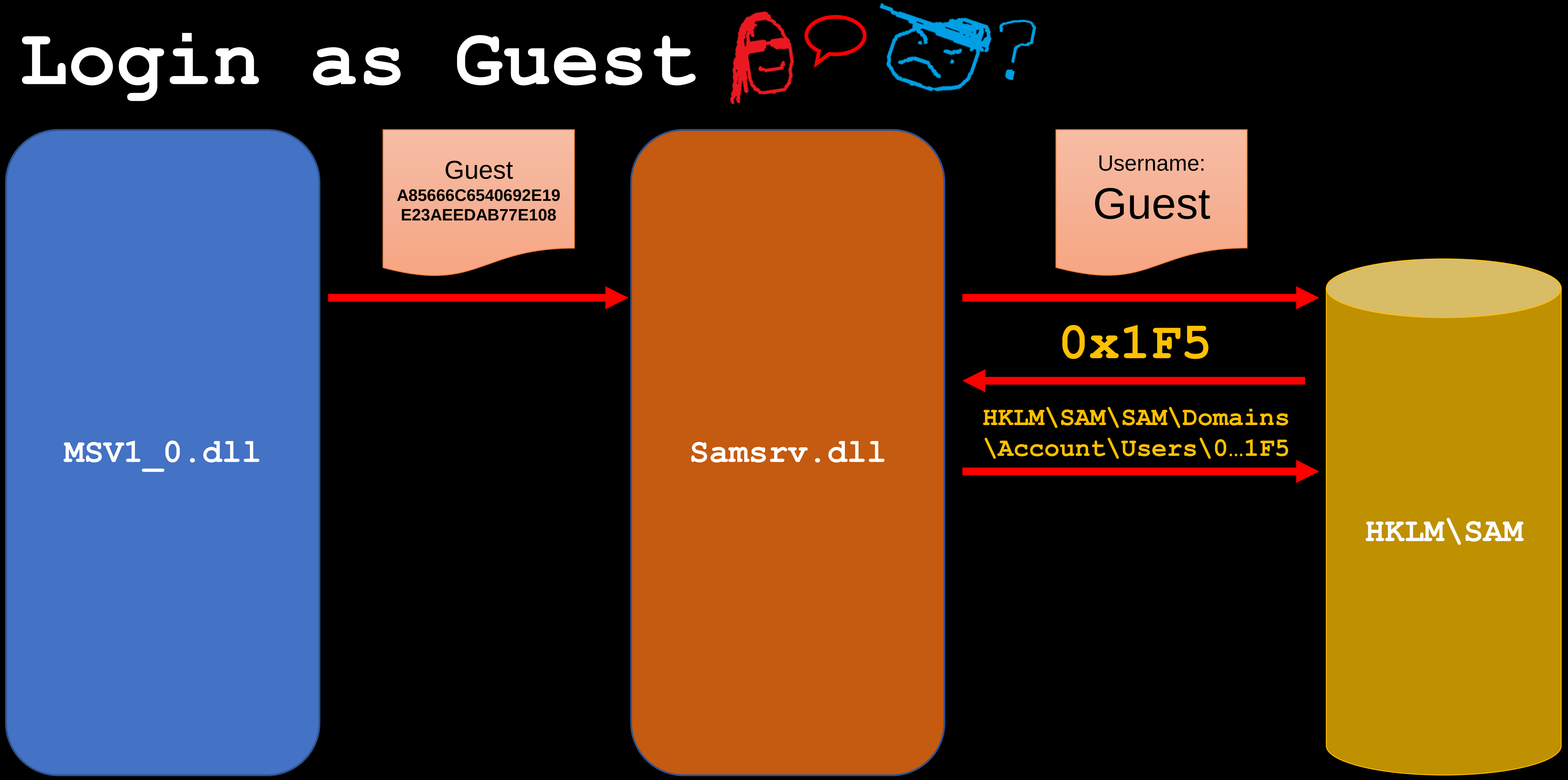
0x1F5

MSV1_0.dll

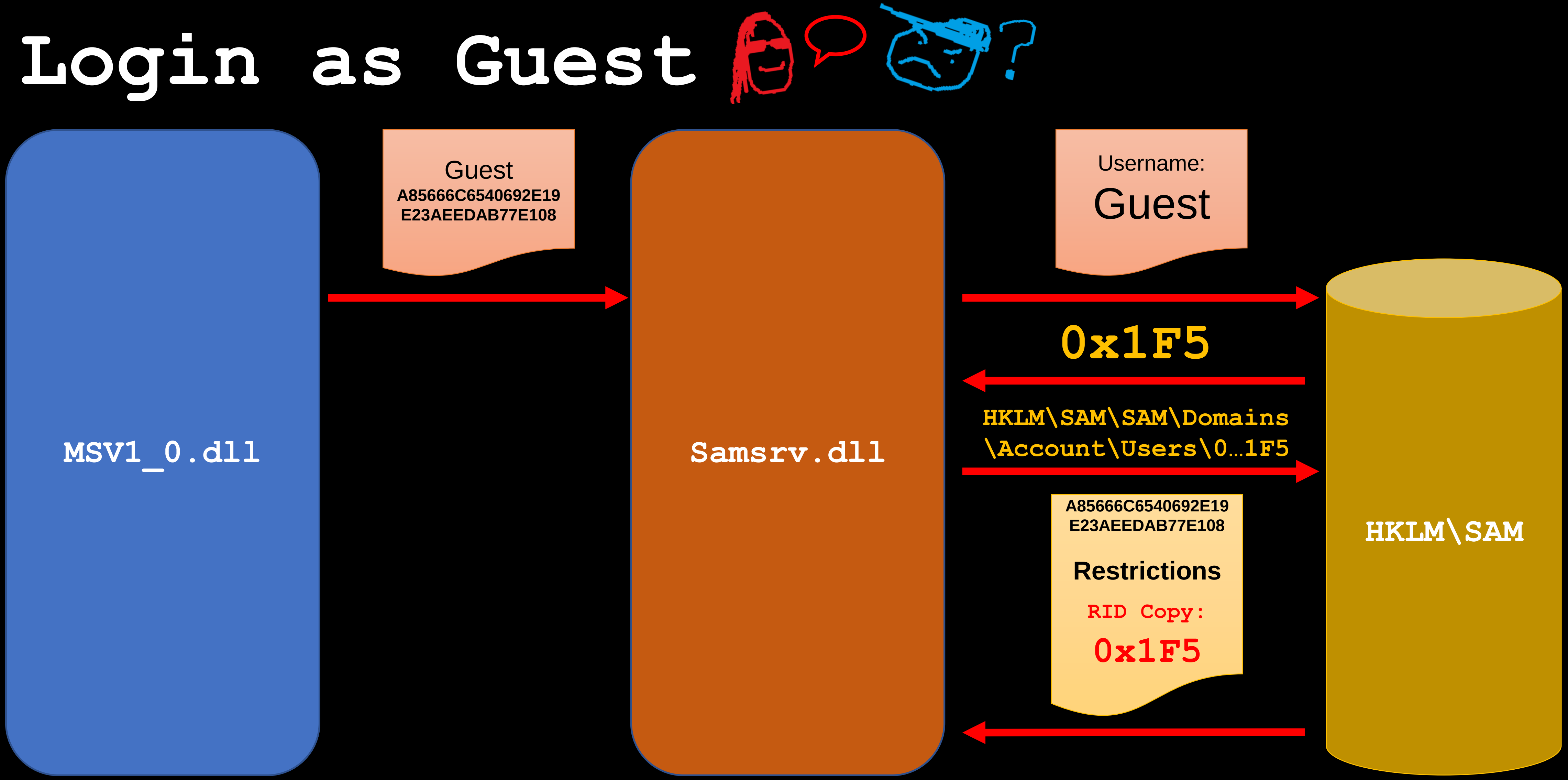
Samsrv.dll

HKLM\SAM

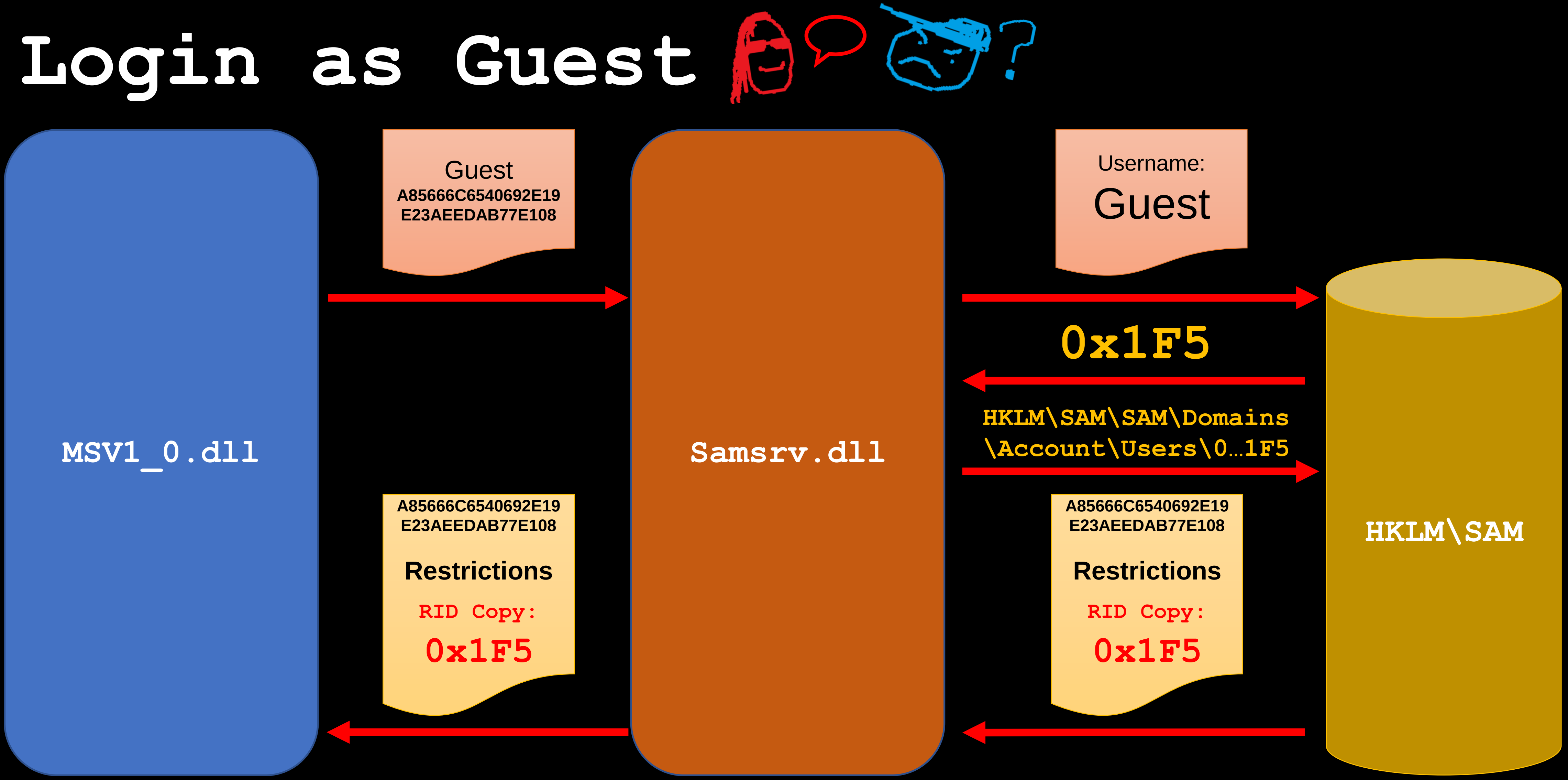
Login as Guest



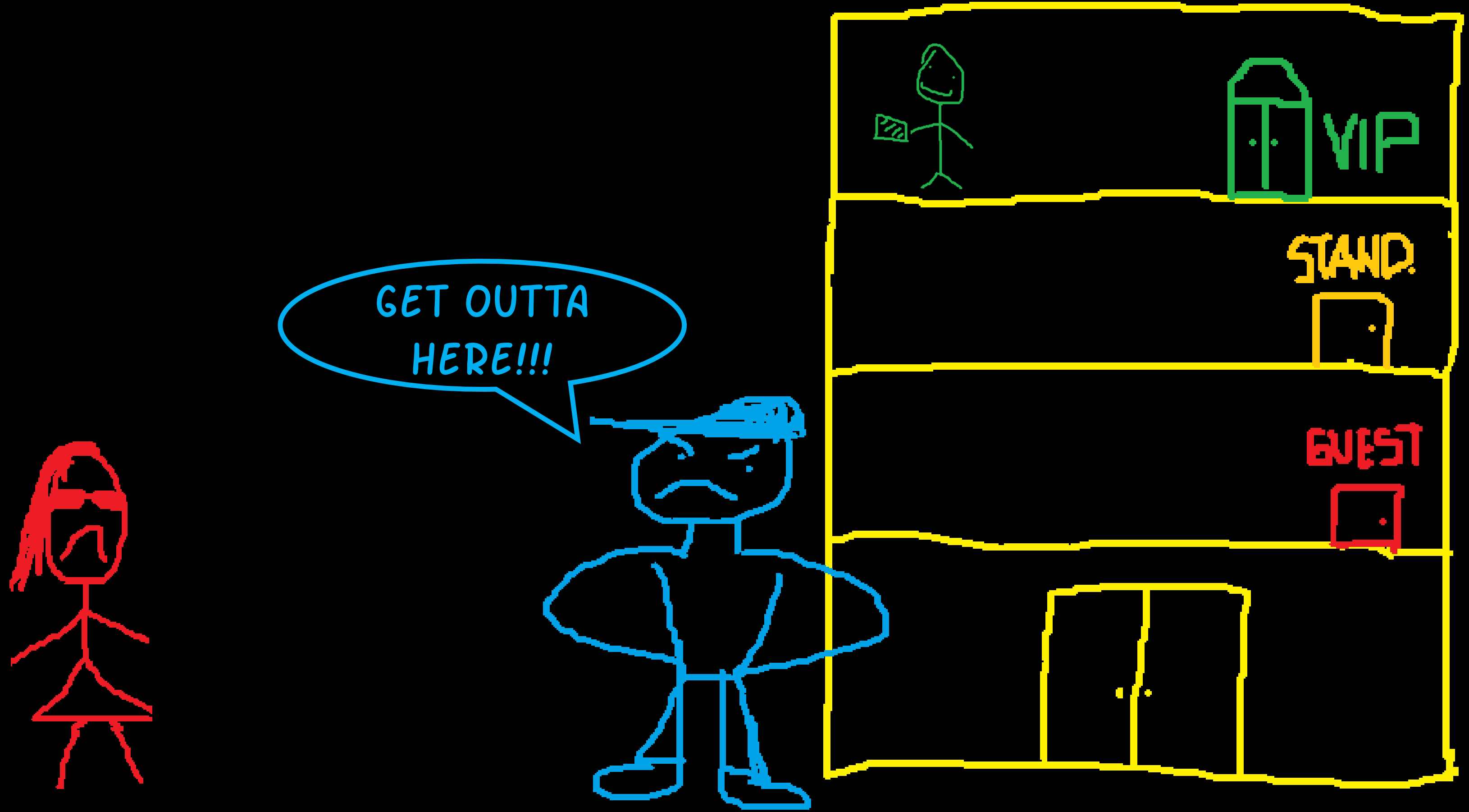
Login as Guest



Login as Guest

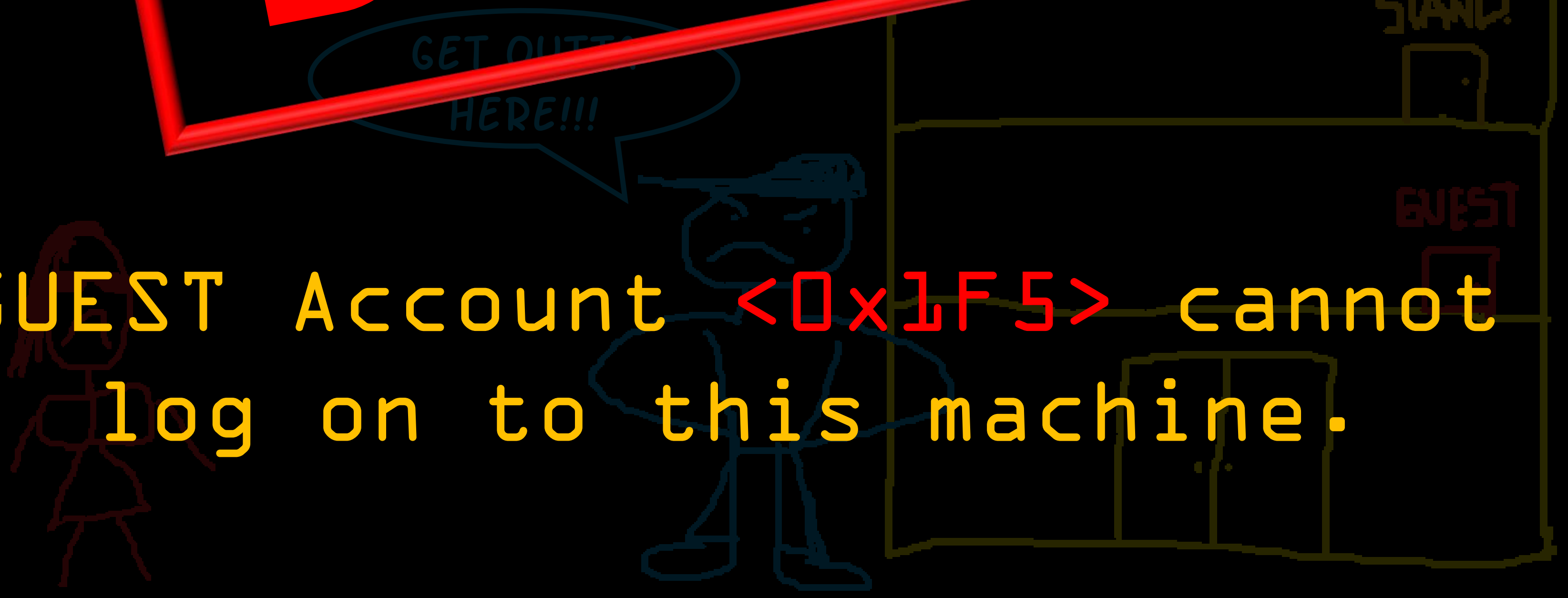


Login as Guest (Case 1)



Login as Guest (Case 1)

DENIED



GUEST Account <0x1F5> cannot log on to this machine.

Login as Guest (Case 2)

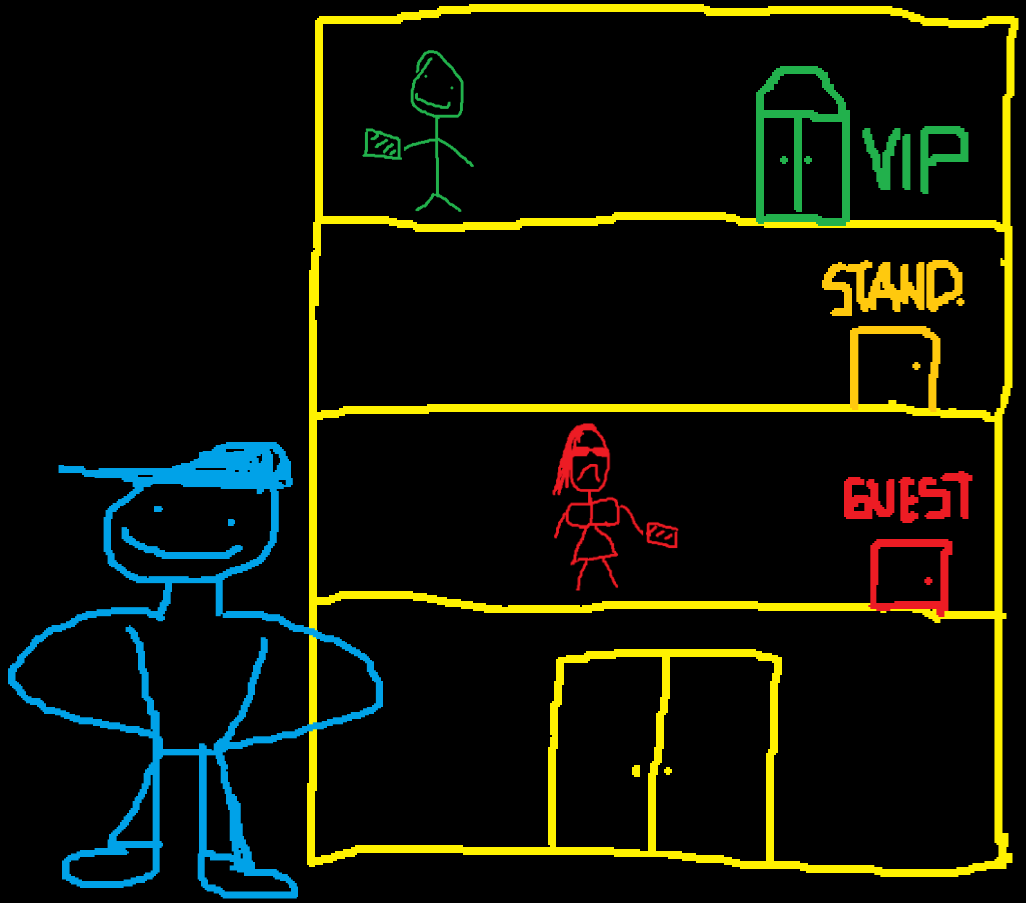
WELCOME 501
HERE'S YOUR
ACCESS TOKEN
VIP
STAND.
GUEST

Login as Guest (Case 2)

Not

DENIED

but could be better!



RID HIJACKING

What if…?

What would happen if the RID COPY is changed to another value?

A85666C6540692E19
E23AEEDAB77E108

Restrictions

RID Copy:

0x1F5

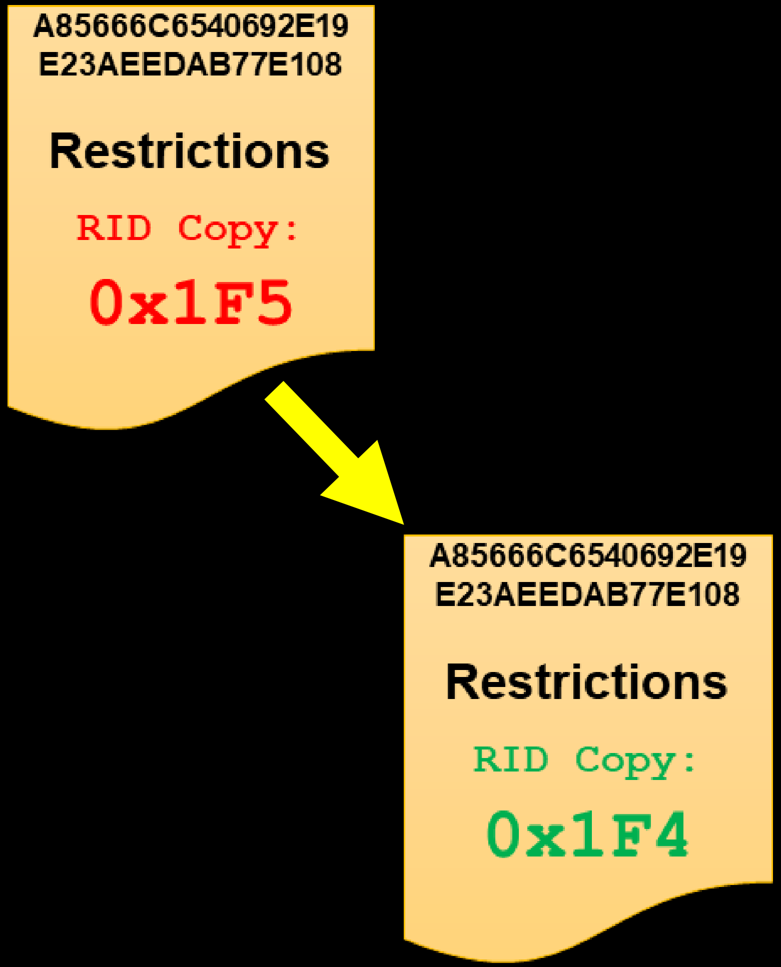
RID HIJACKING

What if…?

What would happen if the RID COPY is changed to another value?

RID(Administrator) = 500

500d = 0x1F4



A85666C6540692E19
E23AEEDAB77E108

Restrictions

RID Copy:

0x1F5

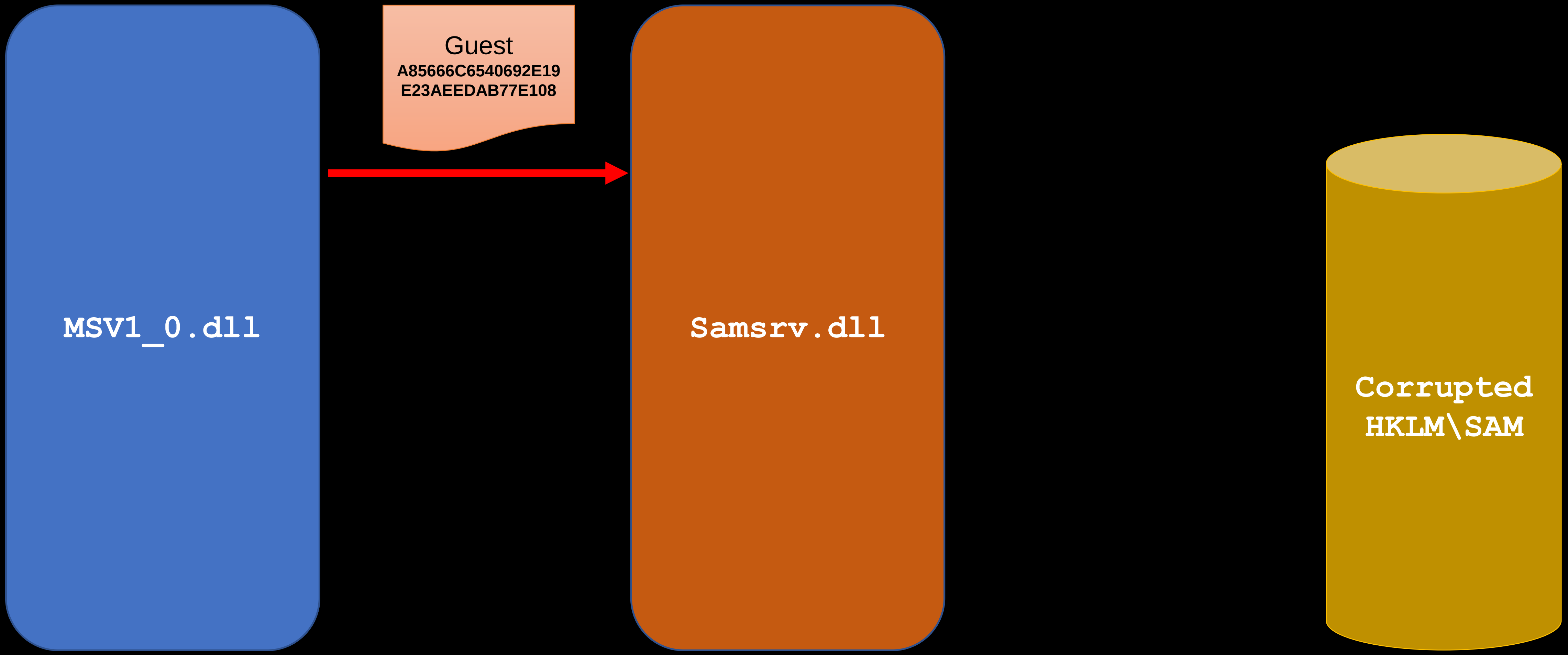
A85666C6540692E19
E23AEEDAB77E108

Restrictions

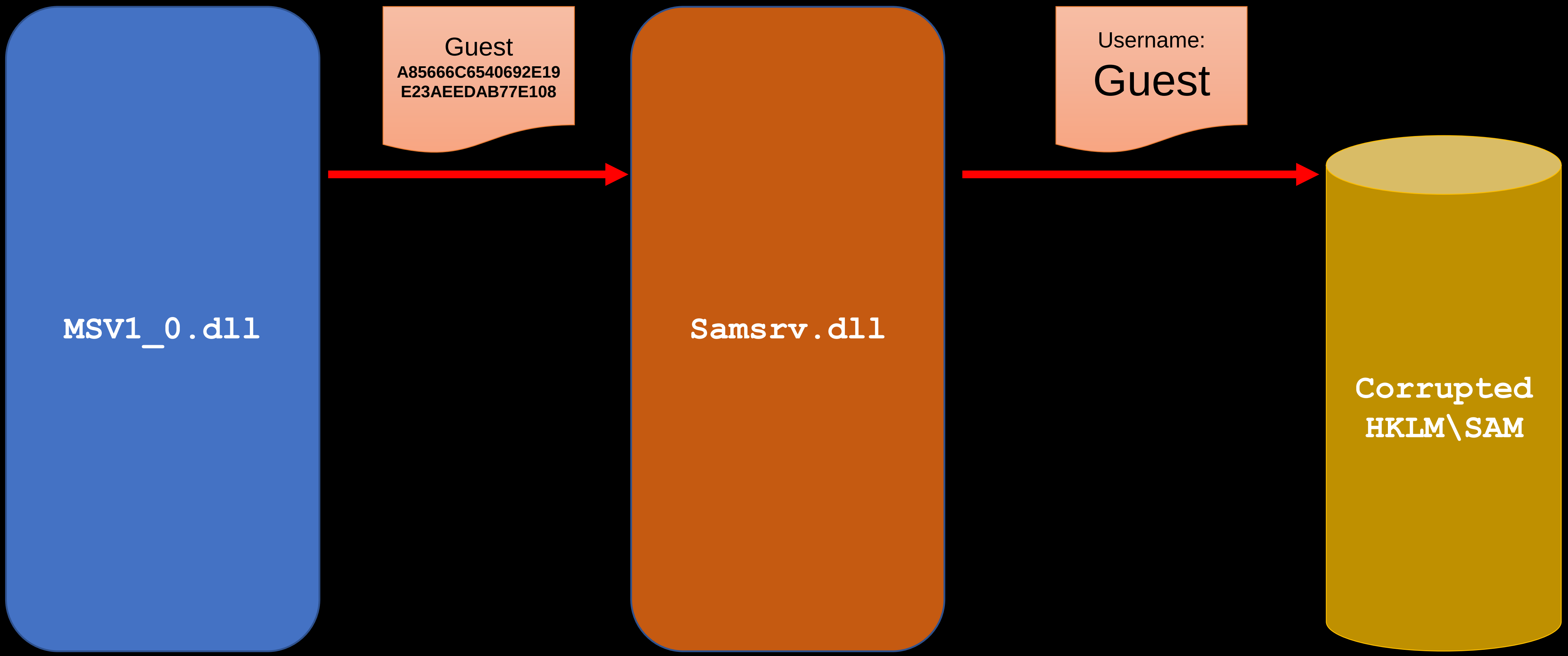
RID Copy:

0x1F4

Login as Guest (the comeback)



Login as Guest (the comeback)



MSV1_0.dll

Guest
A85666C6540692E19
E23AEEDAB77E108

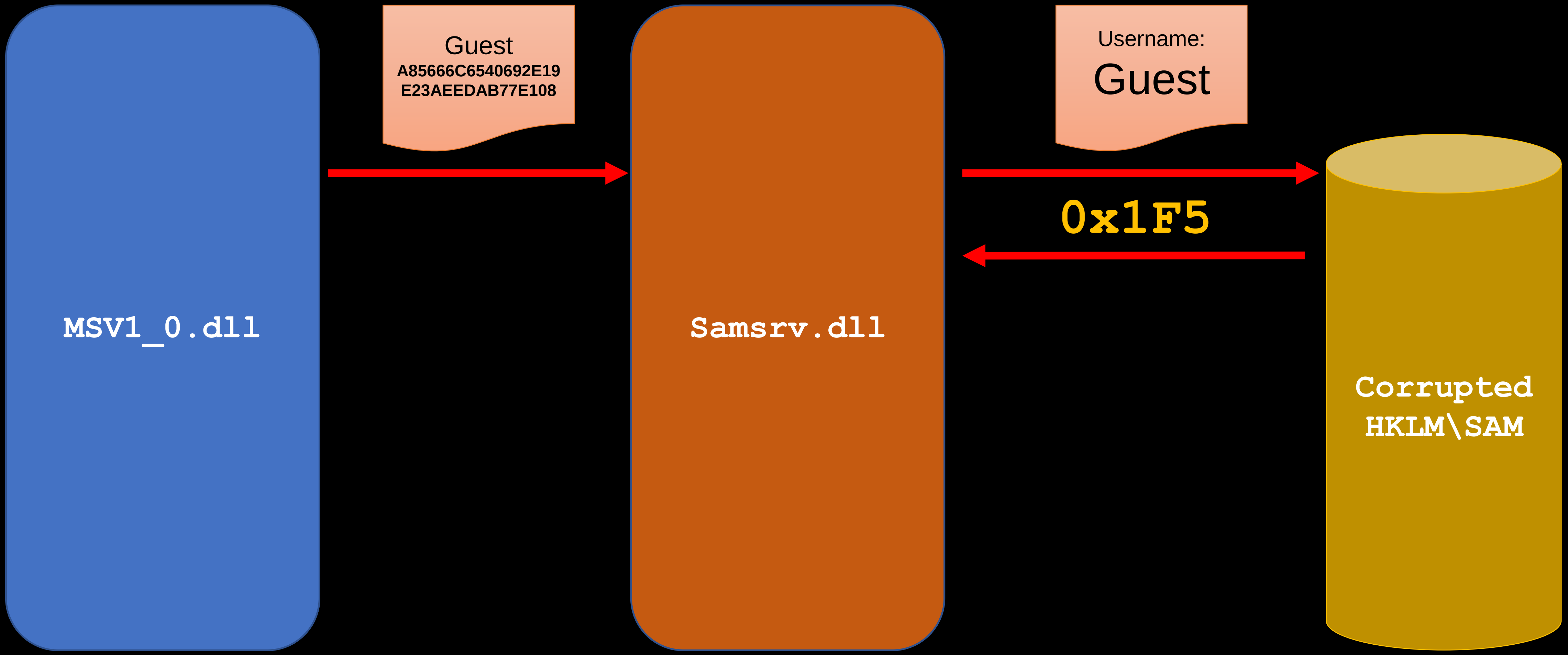
Samsrv.dll

Username:
Guest

Corrupted
HKLM\SAM

RID HIJACKING

Login as Guest (the comeback)



MSV1_0.dll

Guest
A85666C6540692E19
E23AEEDAB77E108

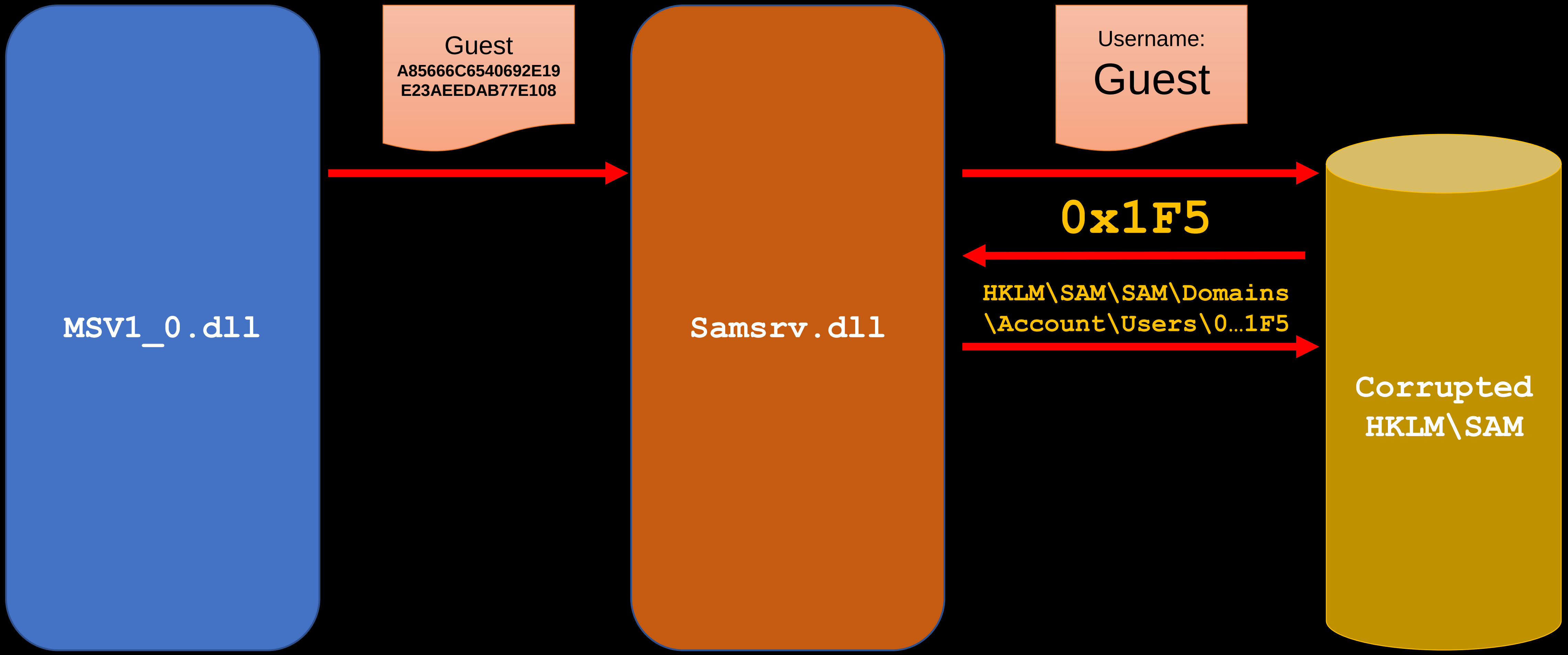
Samsrv.dll

Username:
Guest

0x1F5

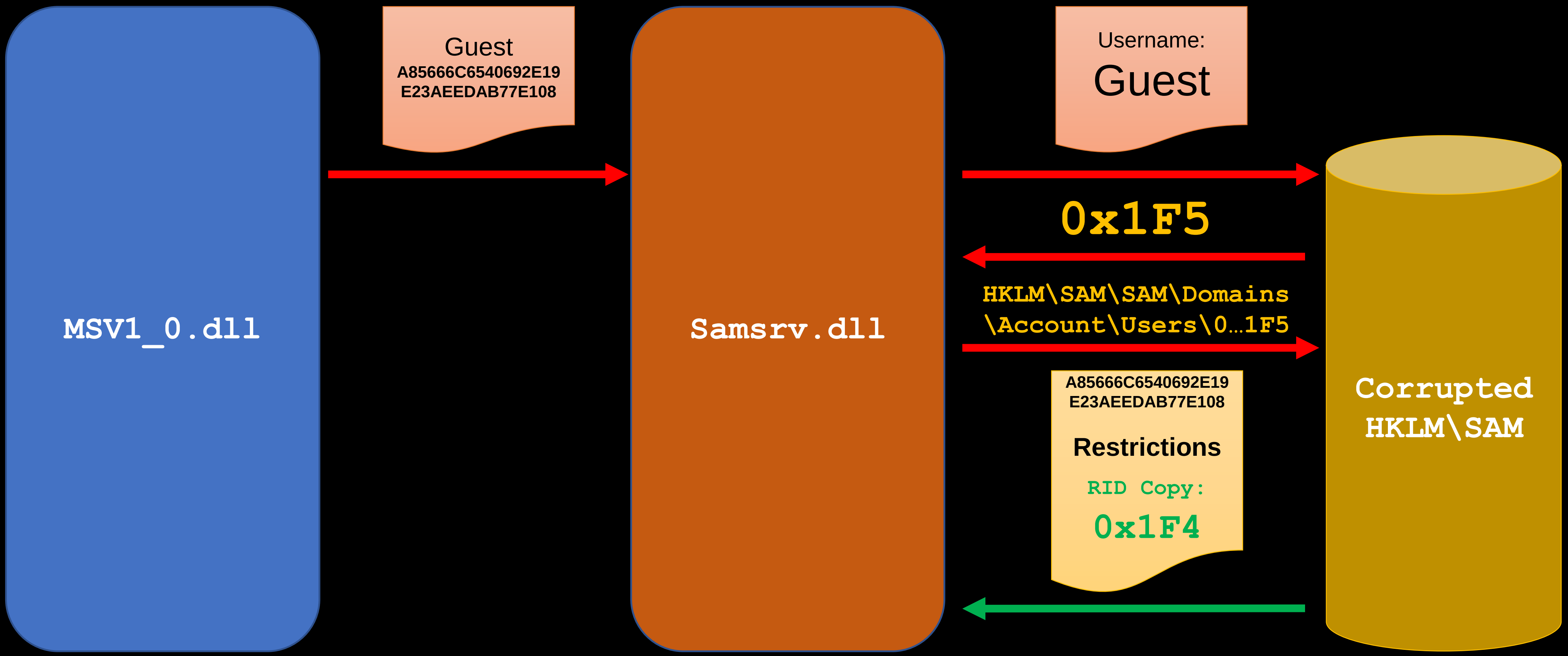
Corrupted
HKLM\SAM

Login as Guest (the comeback)



RID HIJACKING

Login as Guest (the comeback)



MSV1_0.dll

Guest
A85666C6540692E19
E23AEEDAB77E108

Samsrv.dll

Username:
Guest

0x1F5

HKLM\SAM\SAM\Domains
\Account\Users\0…1F5

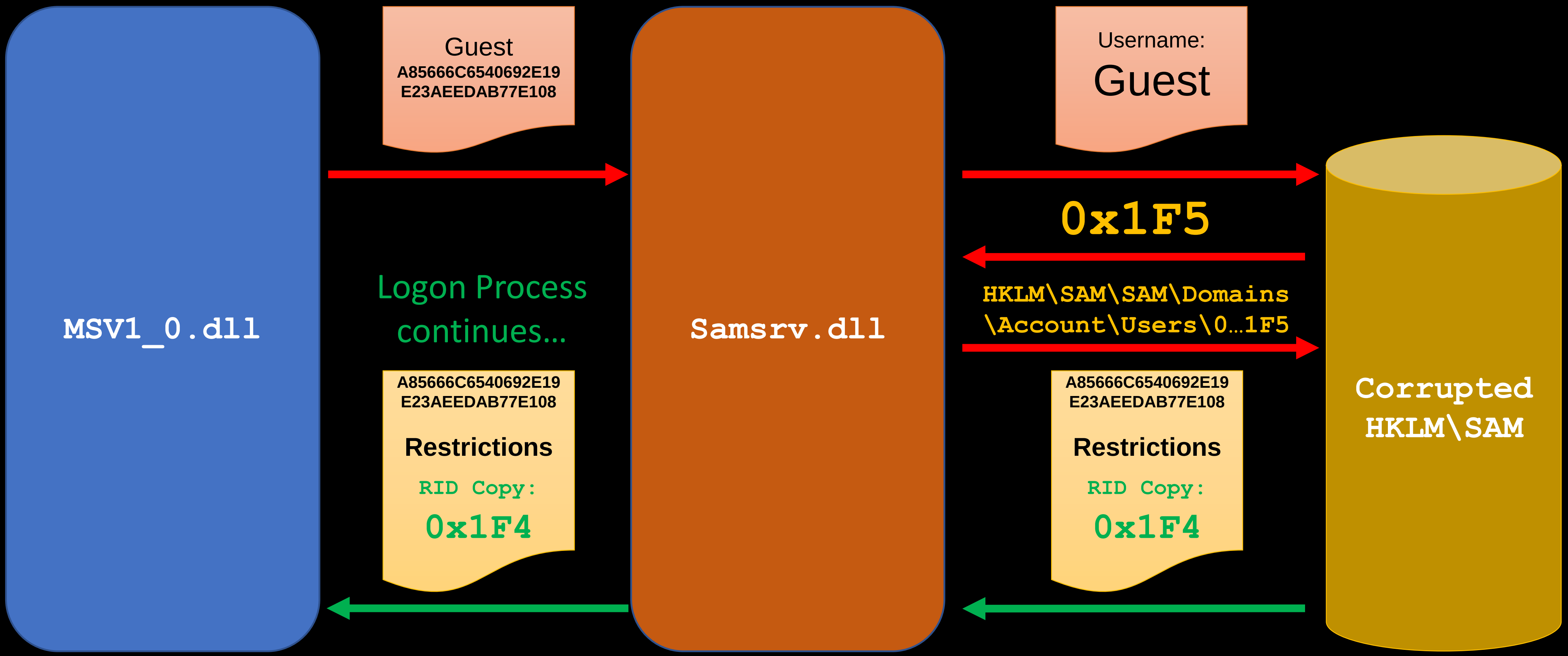
A85666C6540692E19
E23AEEDAB77E108

Restrictions

RID Copy:
0x1F4

Corrupted
HKLM\SAM

Login as Guest (the comeback)



MSV1_0.dll

Guest
A85666C6540692E19
E23AEEDAB77E108

Samsrv.dll

Username:
Guest

0x1F5

HKLM\SAM\SAM\Domains
\Account\Users\0…1F5

Corrupted
HKLM\SAM

Logon Process
continues…

A85666C6540692E19
E23AEEDAB77E108

Restrictions

RID Copy:
0x1F4

A85666C6540692E19
E23AEEDAB77E108

Restrictions

RID Copy:
0x1F4

RID HIJACKING

Login as Guest (the comeback)

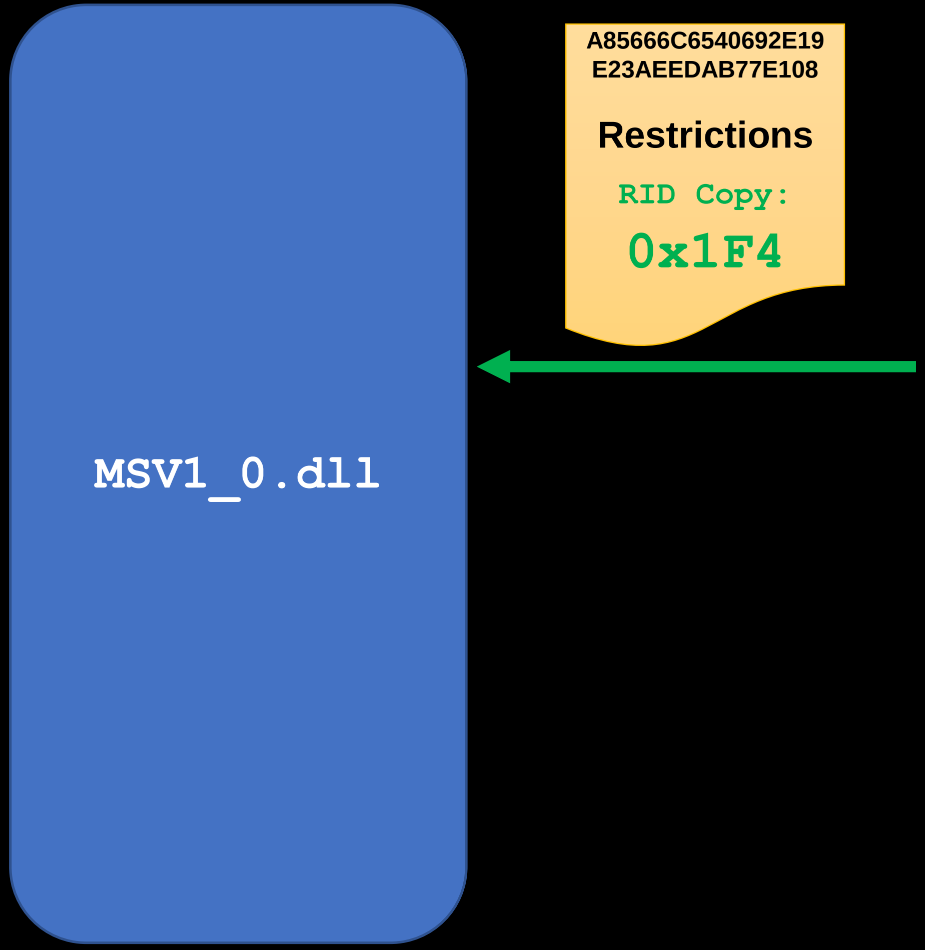
MSV1_0 checks the account restrictions provided from SAMSRV.

If allowed, then compares:

SAMSRV response password hash

VS

User entered hashed password



Login as Guest (the comeback)

MSV1_0 checks the account restrictions provided from SAMSRV.

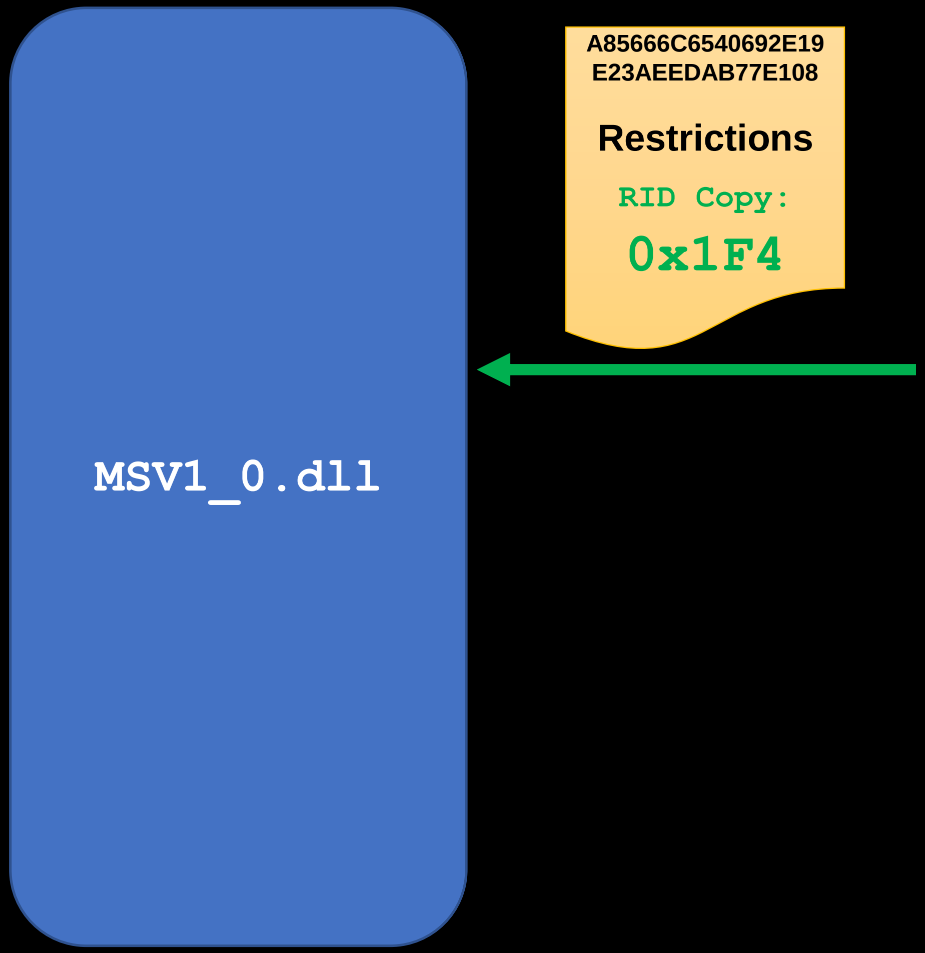
If allowed, then compares:

SAMSRV response password hash

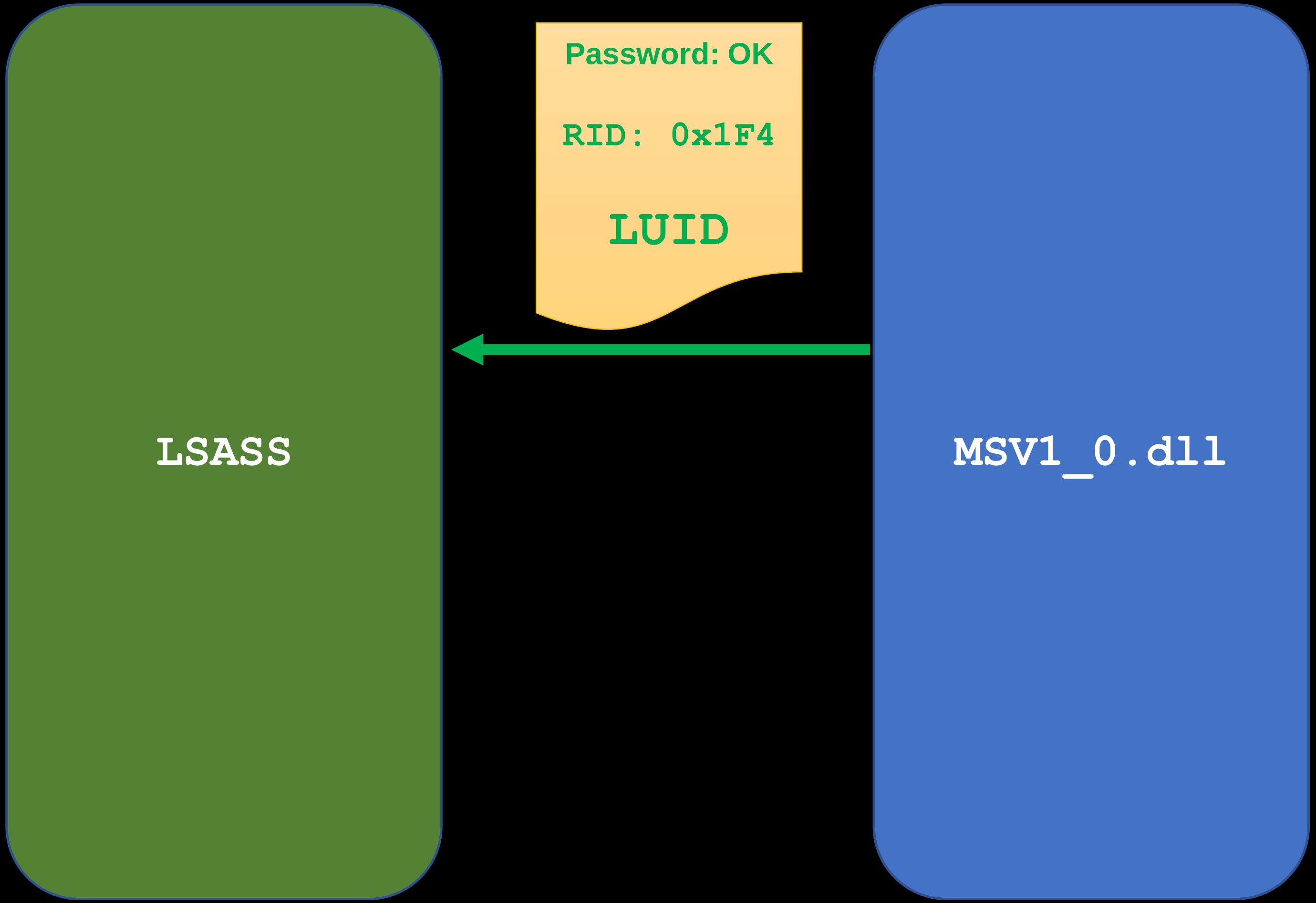
VS

User entered hashed password

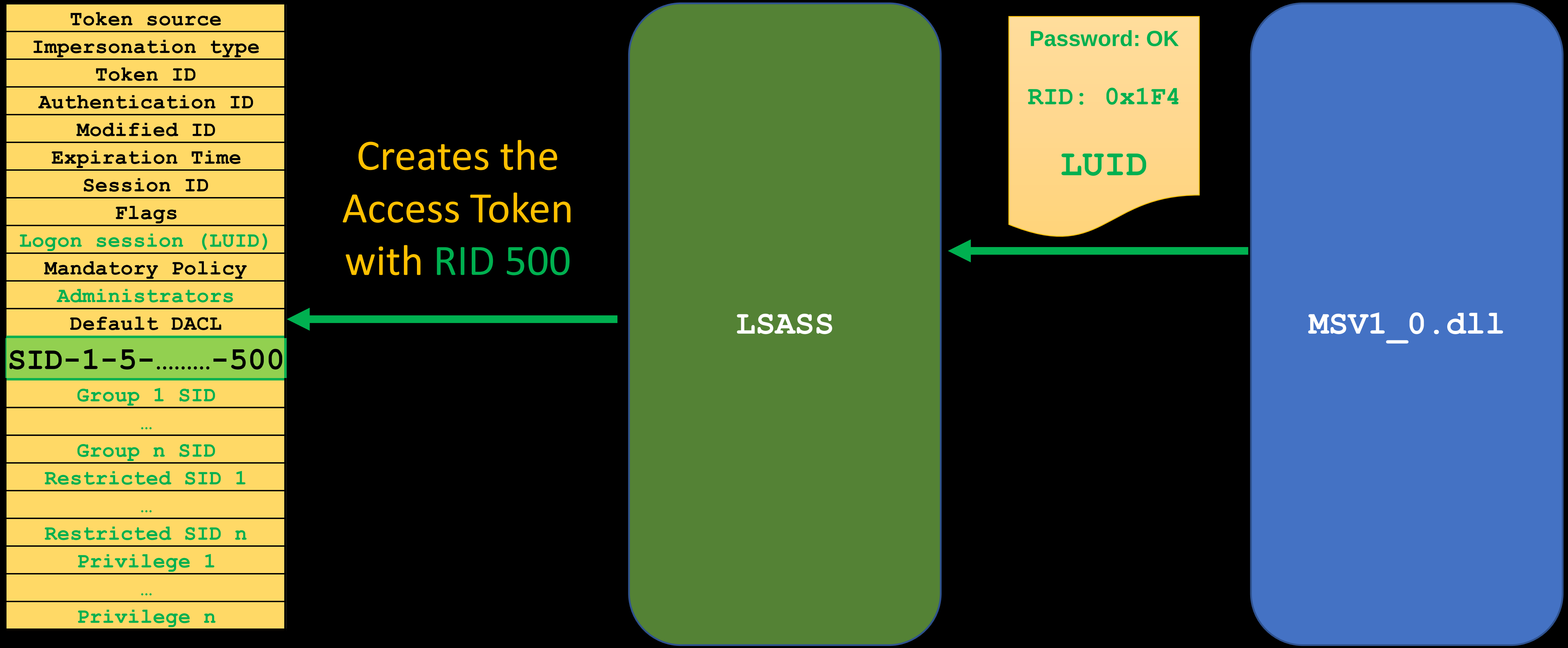
Hash will be the same



Login as Guest (the comeback)



Login as Guest (the comeback)



Token source
Impersonation type
Token ID
Authentication ID
Modified ID
Expiration Time
Session ID
Flags
Logon session (LUID)
Mandatory Policy
Administrators
Default DACL
SID-1-5-………-500
Group 1 SID
…
Group n SID
Restricted SID 1
…
Restricted SID n
Privilege 1
…
Privilege n

Creates the Access Token with RID 500

RID HIJACKING

RID HIJACKING

Login as Guest (the comeback)

Token source
Impersonation type
Token ID
Authentication ID
Modified ID
Expiration Time
Session ID
Flags
Logon session (LUID)
Mandatory Policy
Administrators
Default DACL
SID-1-5-....-500
Group SID
Group n SID
Restricted SID
Restricted SID n
Privilege 1
...
Privilege n

Creates the Access Token with RID 500

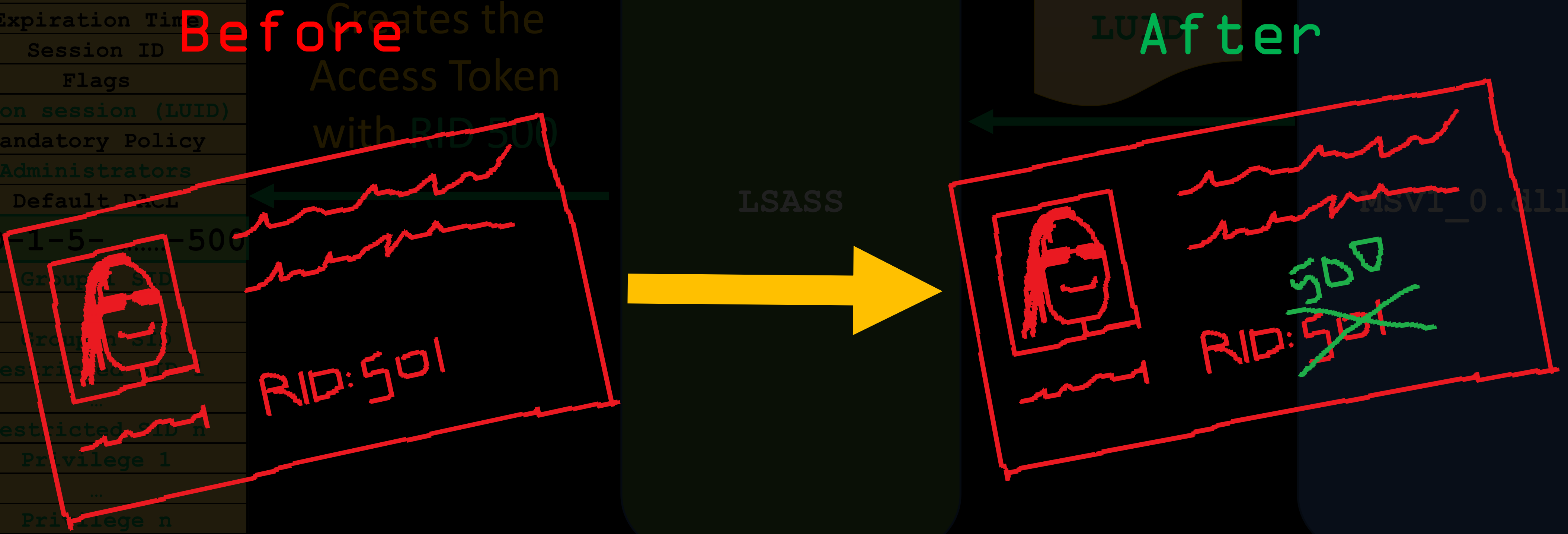
LSASS

Password: OK

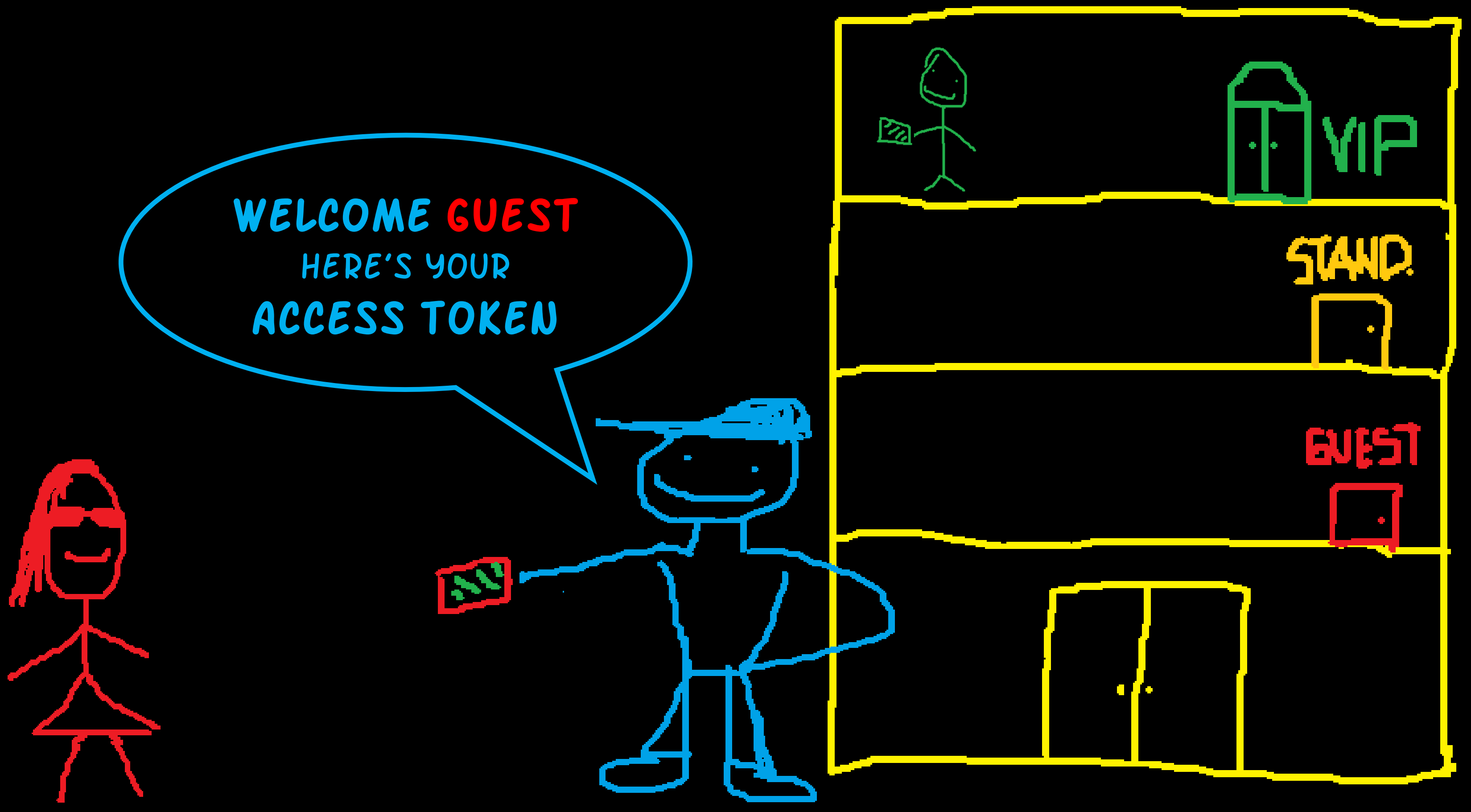
RID: 0x1F4

LUID

MSV1_0.dll



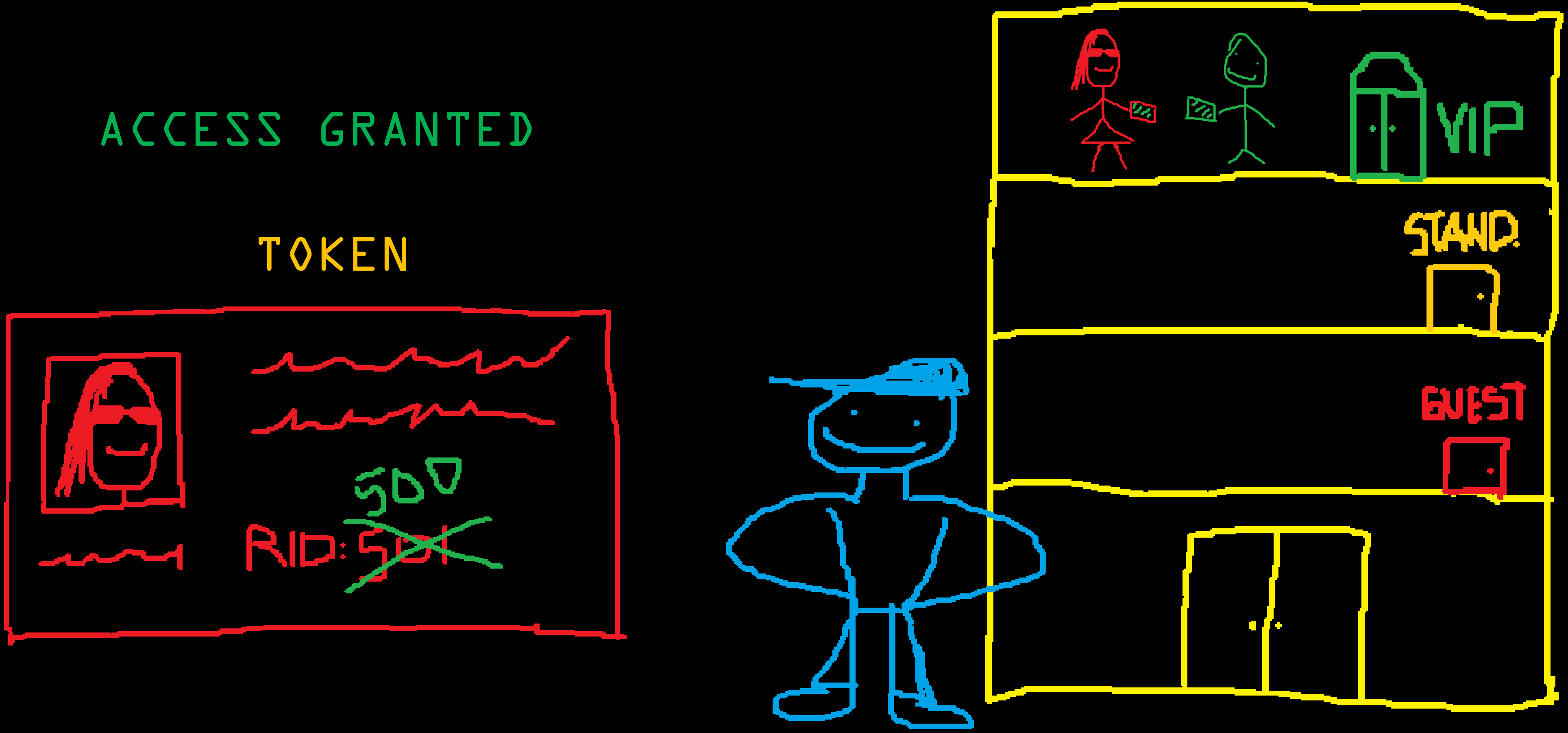
Login as Guest



Login as Guest

ACCESS GRANTED

TOKEN



SECURITY ISSUES

0x01. SAMSRV does not check if the RID associated with the user is consistent to the RID COPY.

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0x02. LSASS does not corroborate the RID with the username before creating the access token.

SECURITY ISSUES

0x01. SAMSRV does not check if the RID associated with the user is consistent to the RID COPY.

0x02. LSASS does not corroborate the RID with the username before creating the access token.

0x03. LSASS never looks for RID inconsistencies during the user's session.

Agenda

0x01. Exposing the RID Hijacking Attack.

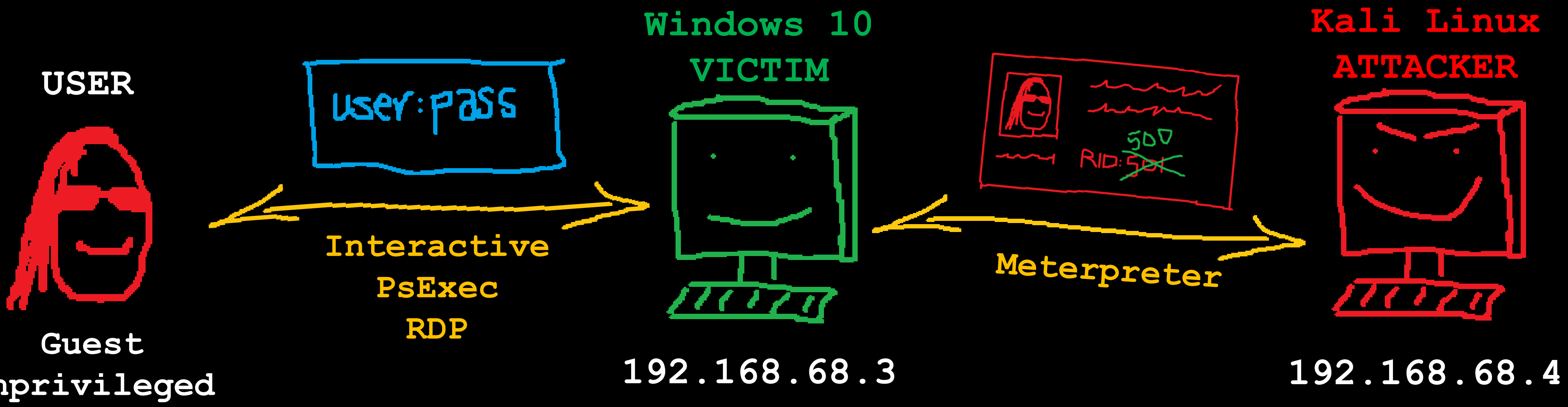
0x02. A Windows Authorization Story.

0x03. Hijacking the RID.

0x04. Demo.

0x05. Conclusions.

Demonstration



USER

Guest
Unprivileged

Interactive
PsExec
RDP

Windows 10
VICTIM

192.168.68.3

Meterpreter

Kali Linux
ATTACKER

192.168.68.4

Agenda

0x01. Exposing the RID Hijacking Attack.

0x02. A Windows Authorization Story.

0x03. Hijacking the RID.

0x04. Demo.

0x05. Conclusions.

Conclusions

References

1. http://csl.com.co/rid-hijacking/

2. Russinovich, Mark. Solomon, David A. Ionescu, Alex. “Windows Internals”. 6th Edition.

3. Scambray, Joel. McClure, Stuart. “Hacking Exposed: Windows Security Secrets & Solutions”. 3rd Edition.

4. https://technet.microsoft.com/pt-pt/library/cc780332(v=ws.10).aspx

5. https://docs.microsoft.com/en-us/windows-server/security/windows-authentication/credentials-processes-in-windows-authentication