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Historically Grown Active Directory Environments

You have dead bodies in your basement and you don´t know about it

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DEATHCon 2023

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01 About me

01 | About me

Michael Ritter

- Principal Security Consultant at SEC Consult
- Working in the IT field since 2005
- In offensive security for 9+ years as a consultant
- Focus on Topics:
  - AD related security assessments
  - AD security workshops
  - Post-compromise taskforce

Disclaimer: Not a full-time detection engineer

GitHub michiiii

@BigM1ke_oNe

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02 The tale of “DEATH Enterprises”

02 | AD from a historical view

The tale of “DEATH Enterprises” – early 2000´s

- Jimmy “The skid” Johnson is the IT magician of a little start-up called “DEATH Enterprises” in the early 2000´s tech boom
- Jimmy heard about a Microsoft product that simplifies management of IT resources.
- Jimmy decided to deploy Active Directory into the IT infrastructure of “DEATH Enterprises”

02/2000
Microsoft releases Active Directory with the release of Windows 2000 server

2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024

02 | AD from a historical view

The tale of “DEATH Enterprises” – early 2000´s

- In 2002, Jimmy integrated Active Directory into the company's infrastructure, navigating a landscape with limited established best practices.
- The setup was basic: each user had one account, local admin accounts had static passwords, and third-party services ran under the default "Administrator" domain.
- Jimmy, as the sole IT professional, juggled the complexities of managing the Active Directory while also handling helpdesk responsibilities.
- To simplify his workload, Jimmy delegated some of his administrative tasks to his colleagues

02/2000
Microsoft releases Active Directory with the release of Windows 2000 server

2000 | 2002 | 2004 | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024

08/2002
Jimmy deployed ADDS into “DEATH Enterprises” IT infrastructure

02 | AD from a historical view

The tale of “DEATH Enterprises” – The first big AD security incident

- A bad guy infected one workstation of an employee with malware
- The employee called Jimmy and told him his computer behaved weird
- Jimmy connected to the workstation via RDP and therefore left his credentials on the attacker controlled workstation.
- The attacker got Jimmy´s credentials and moved laterally to steal important research data

Result of the incident: Important research data was stolen and published.

02/2000
Microsoft releases Active Directory with the release of Windows 2000 server

2000 | 2002 | 2004 | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024

08/2002
Jimmy deployed ADDS into “DEATH Enterprises” IT infrastructure

03/2015
“DEATH Enterprises” first security incident.

02 | AD from a historical view

The tale of “DEATH Enterprises” – Secure Active Directory v1

- The research data that was published was useful for the competitors and put “DEATH Enterprises” into a tough time
- As consequence of the incident “DEATH Enterprises” management decided to:
  - Dramatic increase of budget for IT security
  - Active Directory security became a key topic

02/2000
Microsoft releases Active Directory with the release of Windows 2000 server

08/2015
“DEATH Enterprises” established Secure Active Directory v1

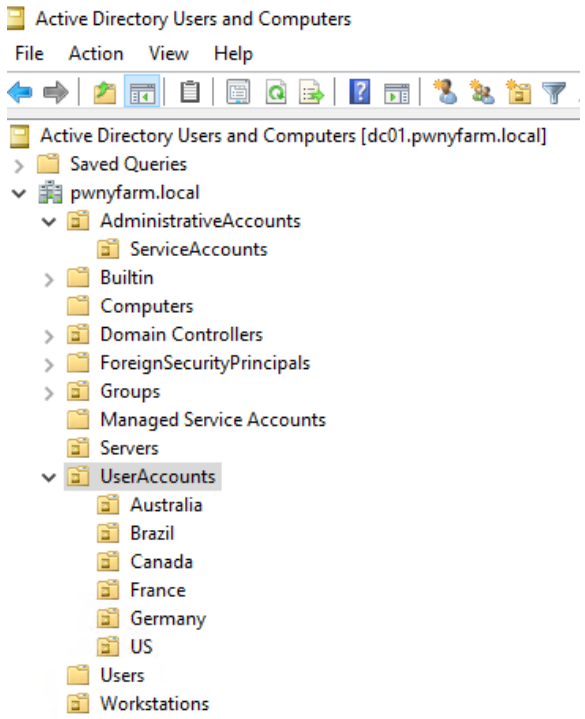
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024

08/2002
Jimmy deployed ADDS into “DEATH Enterprises” IT infrastructure

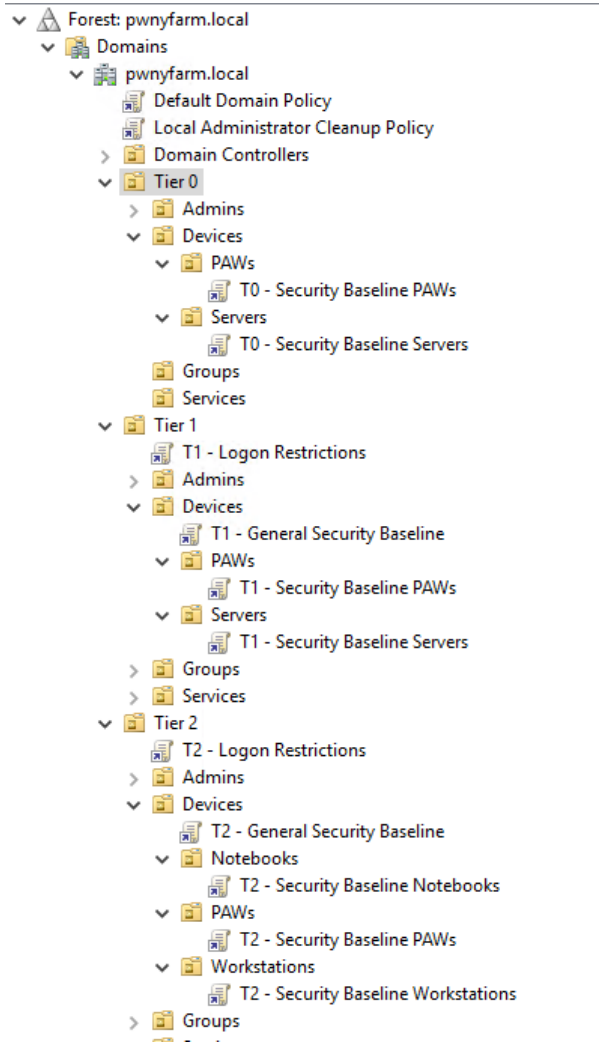
03/2015
“DEATH Enterprises” first security incident.

02 | AD from a historical view

The tale of “DEATH Enterprises” – Secure Active Directory v1 – 08/2015

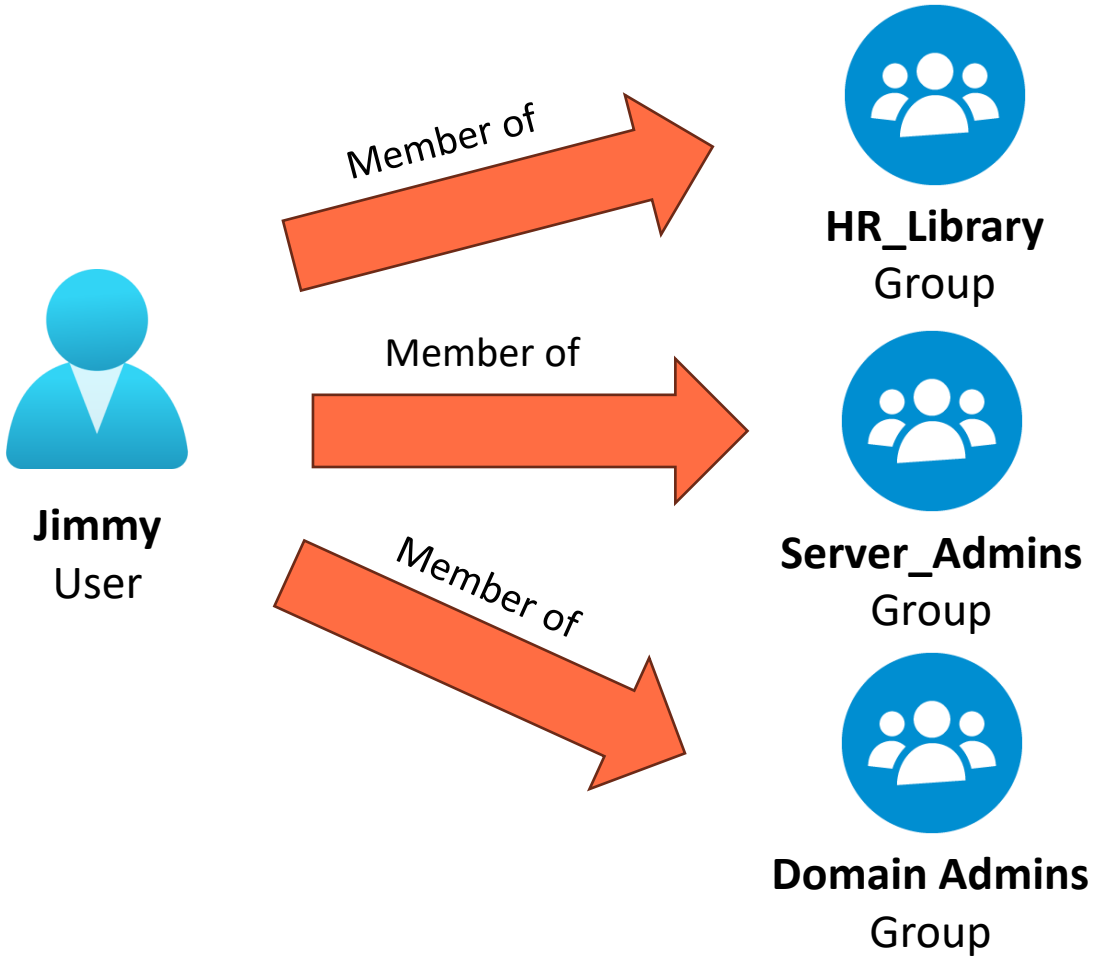


Transformation



02 | AD from a historical view

The tale of “DEATH Enterprises” – Secure Active Directory v1 – 08/2015

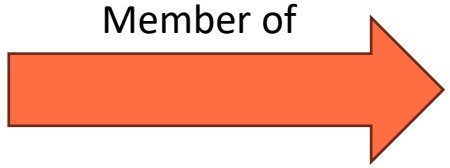


02 | AD from a historical view

The tale of “DEATH Enterprises” – Secure Active Directory v1 – 08/2015

Jimmy
T2 User

Member of

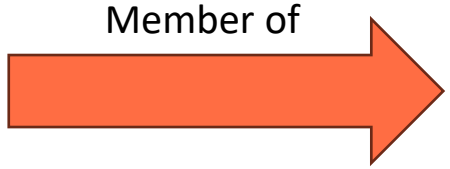


HR_Library
Group

Domain Admins
Group

T1_Jimmy_ADM
T1 Admin user

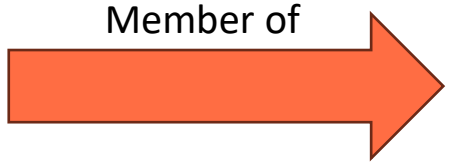
Member of



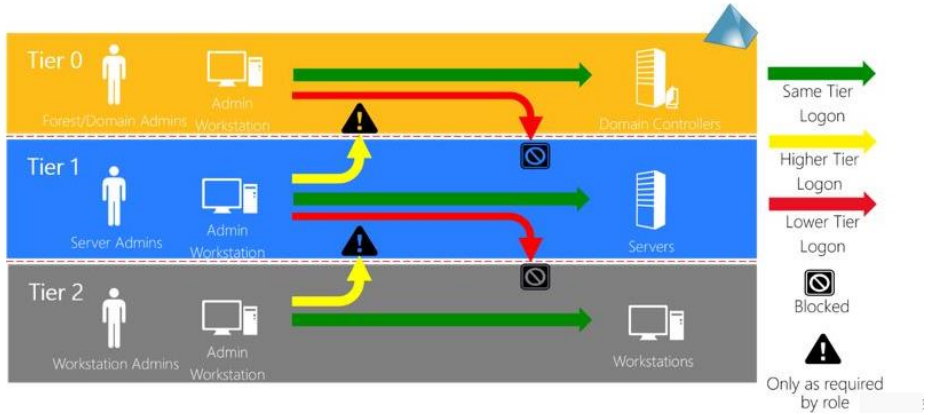
Server_Admins
Group

T2_Jimmy_ADM
T2 Admin user

Member of



Helpdesk_Admins
Group



02 | AD from a historical view

The tale of “DEATH Enterprises” – Secure Active Directory v1 – 08/2015

- As part of the implementation of the the Admin Tiering concept
  - Privileged access workstations PAW´s were introduced
  - Logon restriction were technically implemented

- Solution for the management of local administrators
  - LAPS was introduced to manage secrets of local administrative accounts
  - A GPO for the cleanup of local users and groups on all assets was implemented

- Helpdesk concept
  - User helpdesk was done with a remote support software that does not leave credentials

- External security firm was hired to conduct a security assessment which confirmed an overall good security posture

02 | AD from a historical view

The tale of “DEATH Enterprises” – Conclusion

- Take this story as an example how an Active Directory environment could have transformed during it´s lifecycle
  - Over its lifecycle within an organization, an Active Directory environment can undergo multiple transformations, reflecting changes in technology, organizational structure, security practices, and administrative philosophies.

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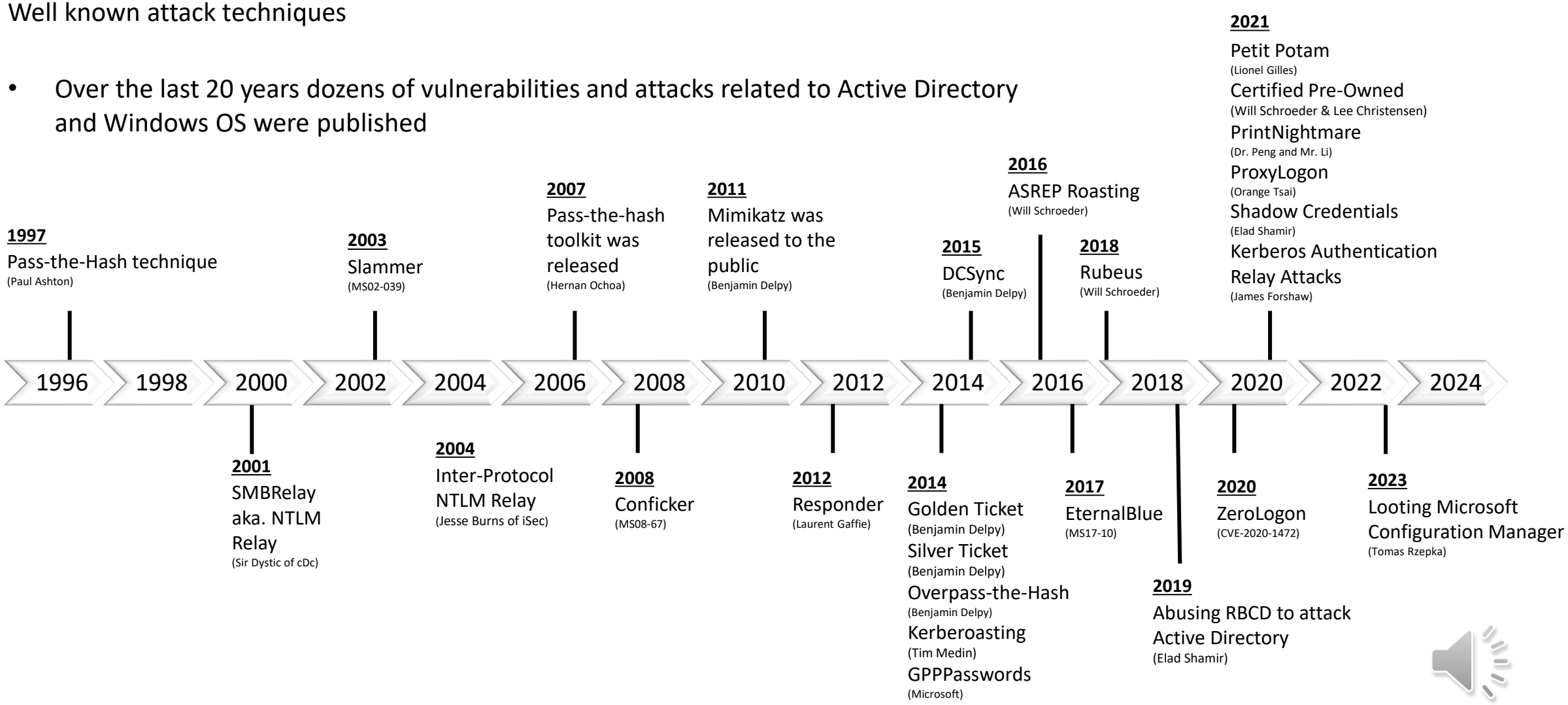
03 Evolution of AD attacks and security controls

03 | Evolution of AD attacks and security controls

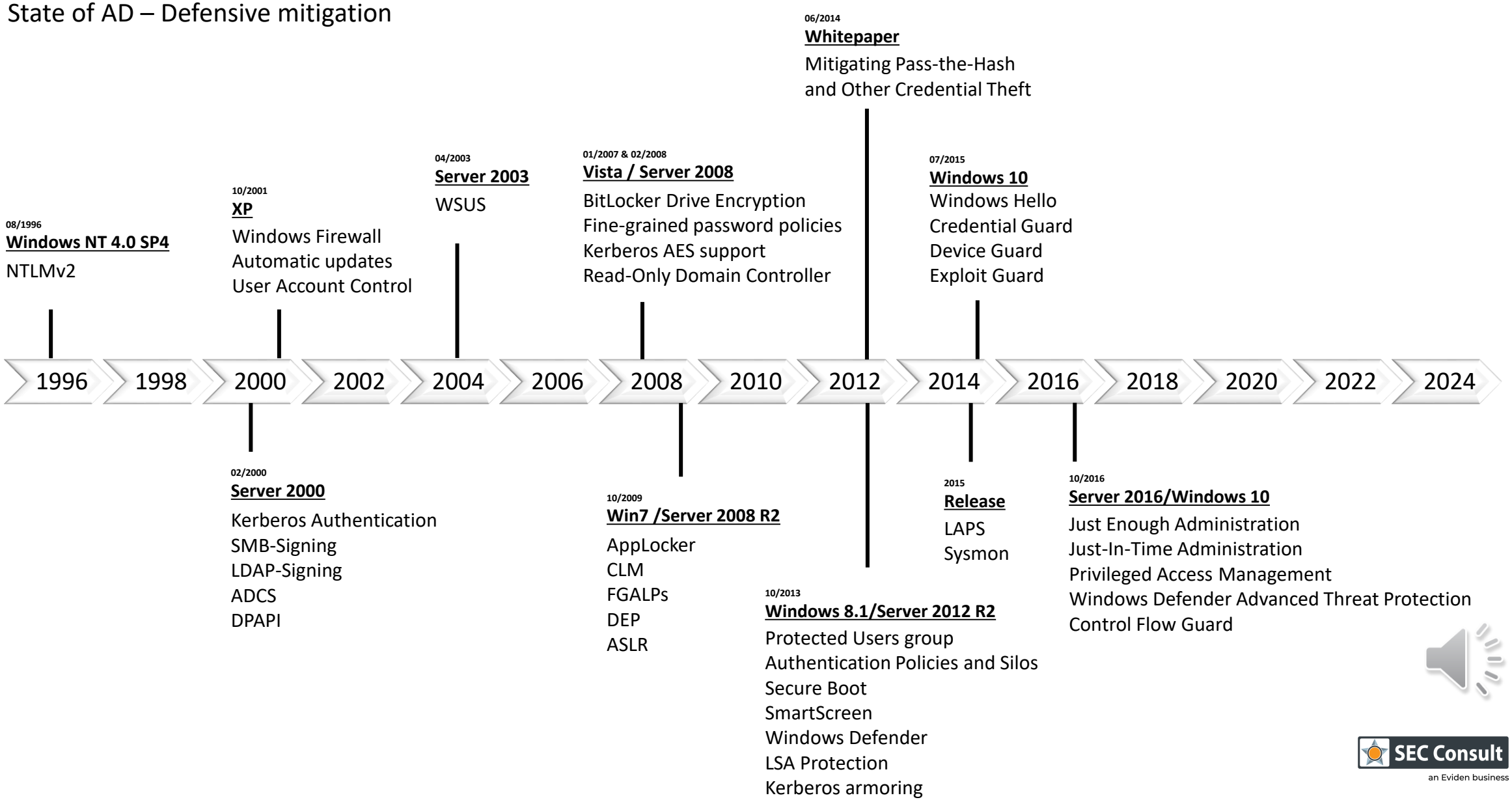
Well known attack techniques

- Over the last 20 years dozens of vulnerabilities and attacks related to Active Directory and Windows OS were published



03 | Evolution of AD attacks and security controls

State of AD – Defensive mitigation



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4 The dead bodies in the basement

04 | The dead bodies in the basement

AD Object permissions – What happened?

- Over the last 20 years Jimmy and his IT colleagues created many:

User objects

Group objects

OU´s objects

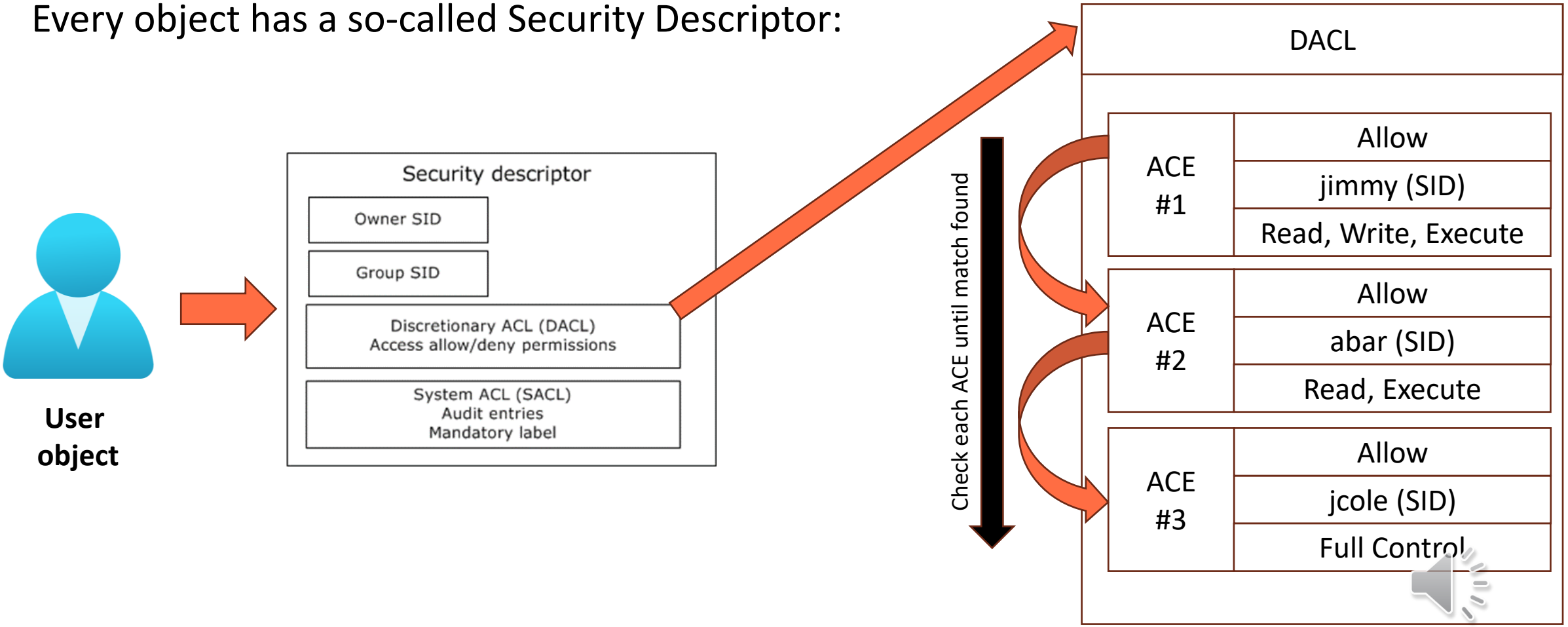
GPO objects

There are more object types in Active Directory… but let´s keep it simple

04 | The dead bodies in the basement

AD Object permissions – Security descriptors

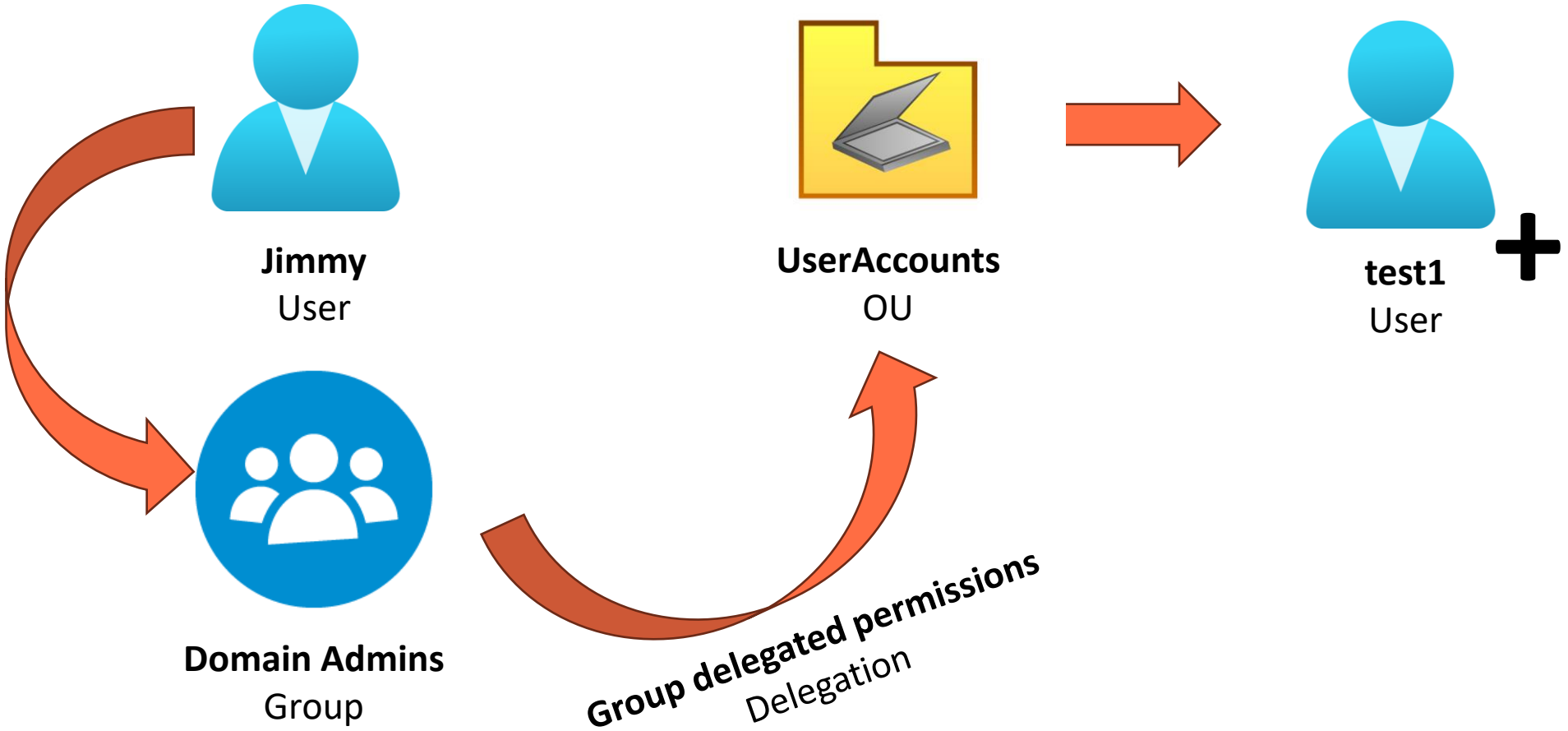
- Every object has a so-called Security Descriptor:



04 | The dead bodies in the basement

AD object permissions – What happens if you create an AD object

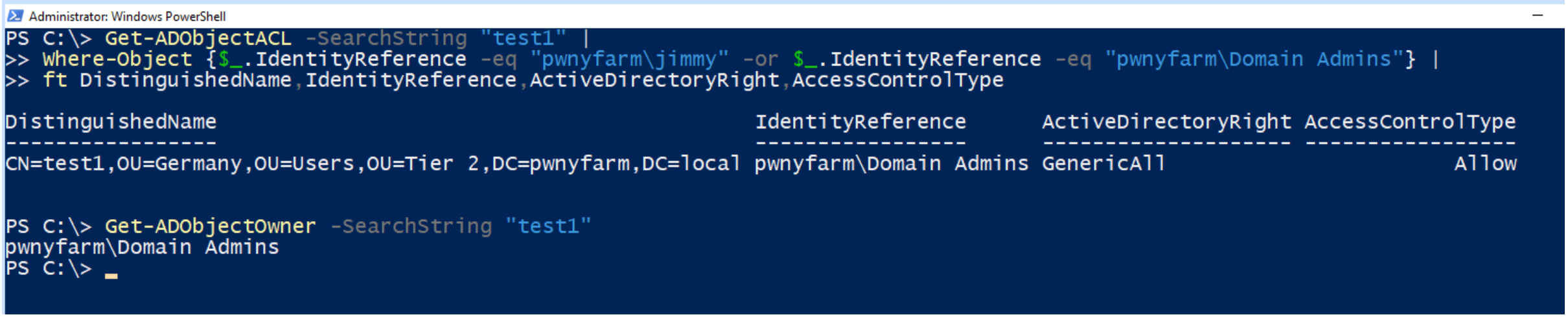
- Situation 1: Creating a AD object as Domain Administrator
  - User creation



04 | The dead bodies in the basement

AD object permissions – What happens if you create an AD object

- Situation 1: Creating a AD object as Domain Administrator
  - User creation



Object Owner:
- Domain Admins

ACL:
- No first degree permission for Jimmy
- Group delegated object control due to inheritance
  - Group membership of Domain Admins

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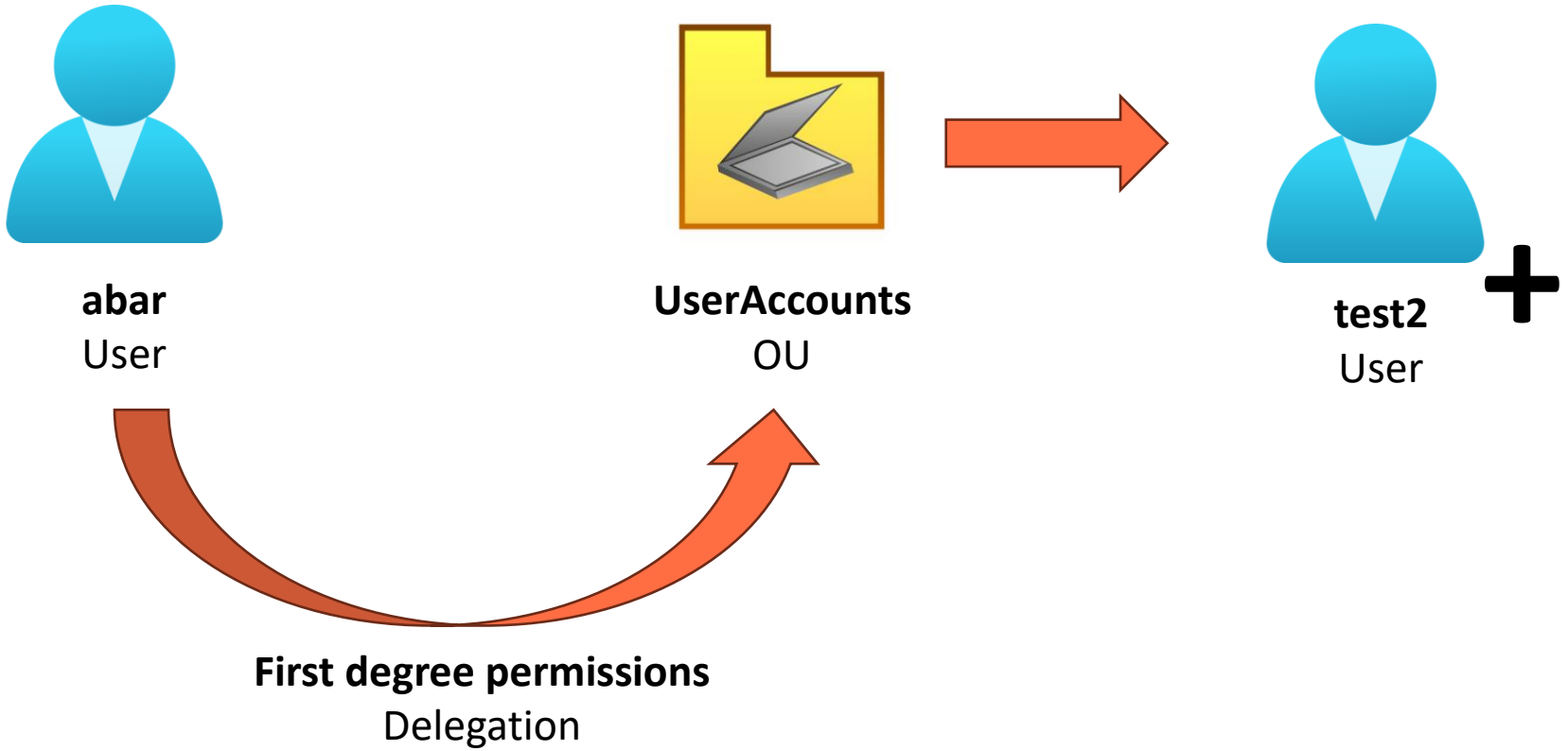
AD object permissions – What happens if you create an AD object

- Situation 2: Creating a AD object as delegated user
  - User creation



04 | The dead bodies in the basement

AD object permissions – What happens if you create an AD object

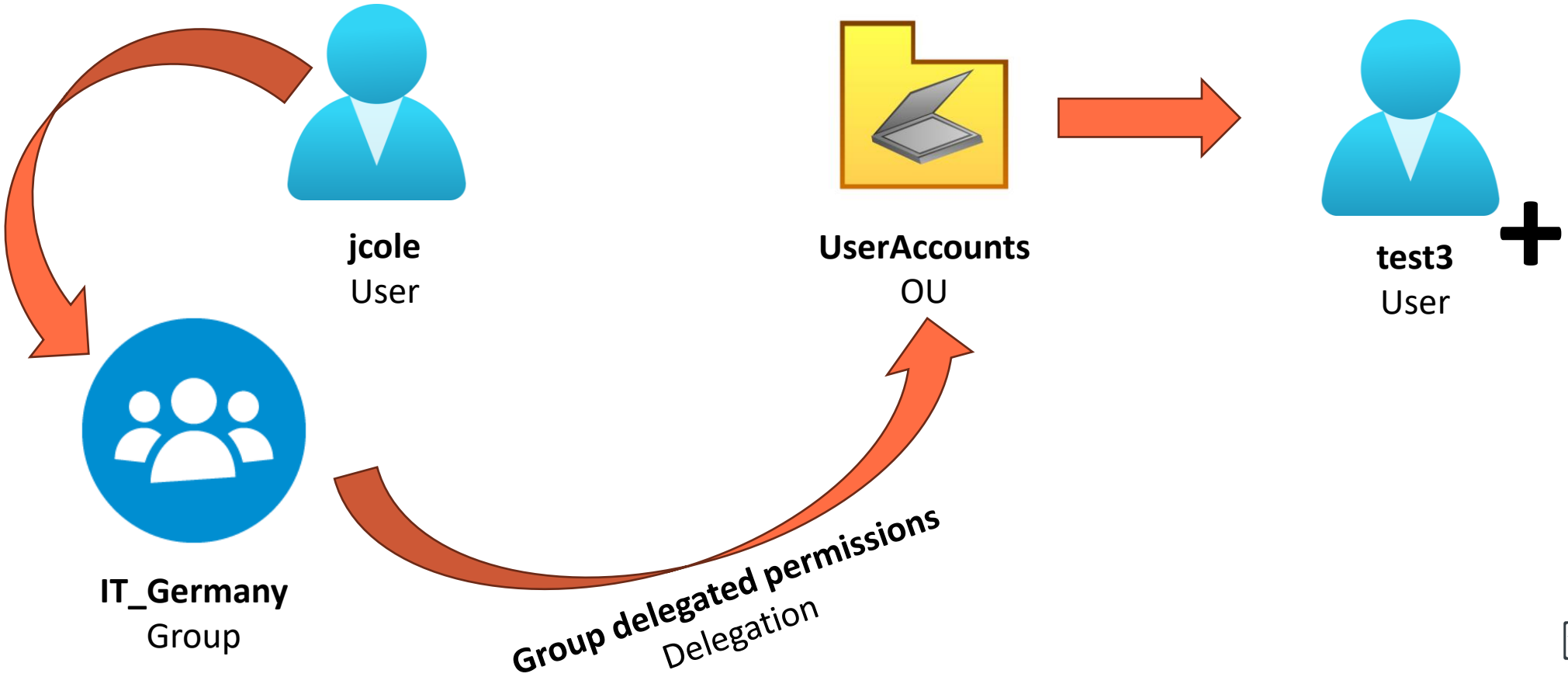
- Situation 2: Creating a AD object as delegated user
  - User creation

Object Owner
- abar

ACL
- First degree permission for abar

AD object permissions – What happens if you create an AD object

- Situation 3: Creating a AD object as group delegated user
  - User creation



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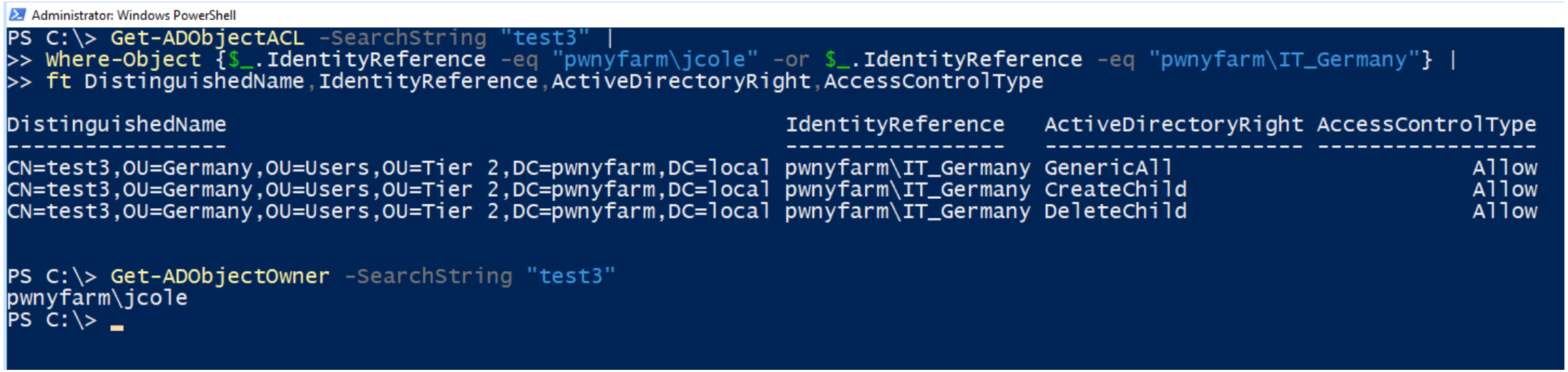
AD object permissions – What happens if you create an AD object

- Situation 3: Creating a AD object as group delegated user
  - User creation



Object Owner
- jcole

ACL
- No first degree permission for jcole
- Group delegated object control due to inheritance

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AD object permissions – What happens if you create an AD object – Conclusion of the results

- Results for the object owner in Situation 1 and 3 should be the same but they are not:
  - Situation 1: The delegated group is the object owner
  - Situation 2: The user that is member of the group delegated is the object owner
- The result in Situation 2: In general it is bad practice to give first degree object permissions directly to a user… but it happens

Question:

- Why could this be a problem in historically grown AD environments?

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AD object permissions – What happens if you create an AD object – Conclusion of the results

Active Directory Users and Computers

File Action View Help

- Active Directory Users and Computers [dc01.pwnyfarm.local]
  - Saved Queries
  - pwnyfarm.local
    - AdministrativeAccounts
      - ServiceAccounts
    - Builtin
    - Computers
    - Domain Controllers
    - ForeignSecurityPrincipals
    - Groups
    - Managed Service Accounts
    - Servers
    - UserAccounts
      - Australia
      - Brazil
      - Canada
      - France
      - Germany
      - US
    - Users
    - Workstations

Transformation

- Forest: pwnyfarm.local
  - Domains
    - pwnyfarm.local
      - Default Domain Policy
      - Local Administrator Cleanup Policy
      - Domain Controllers
      - Tier 0
        - Admins
        - Devices
          - PAWs
            - T0 - Security Baseline PAWs
          - Servers
            - T0 - Security Baseline Servers
        - Groups
        - Services
      - Tier 1
        - T1 - Logon Restrictions
        - Admins
        - Devices
          - T1 - General Security Baseline
          - PAWs
            - T1 - Security Baseline PAWs
          - Servers
            - T1 - Security Baseline Servers
        - Groups
        - Services
      - Tier 2
        - T2 - Logon Restrictions
        - Admins
        - Devices
          - T2 - General Security Baseline
          - Notebooks
            - T2 - Security Baseline Notebooks
          - PAWs
            - T2 - Security Baseline PAWs
          - Workstations
            - T2 - Security Baseline Workstations
        - Groups

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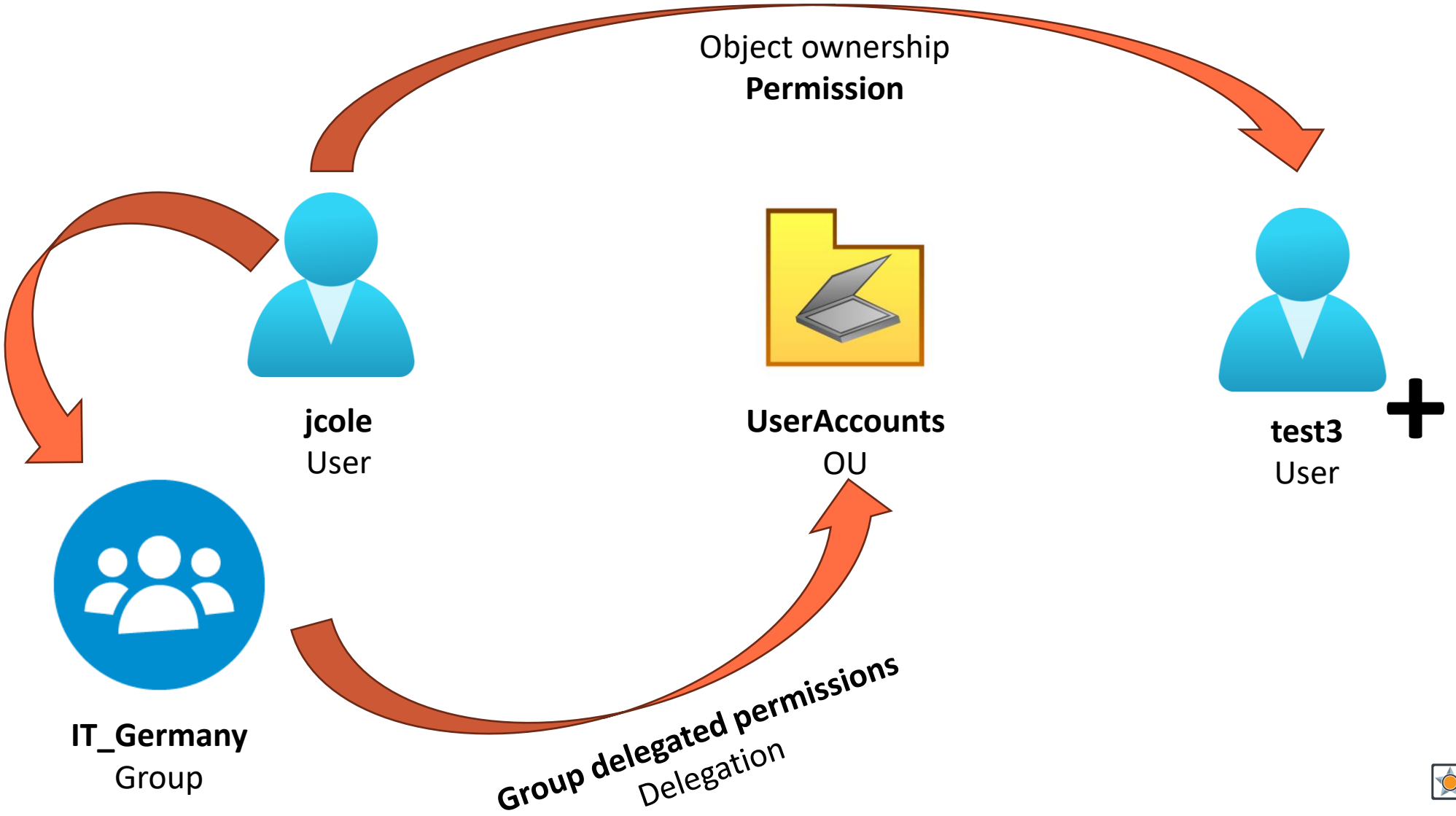
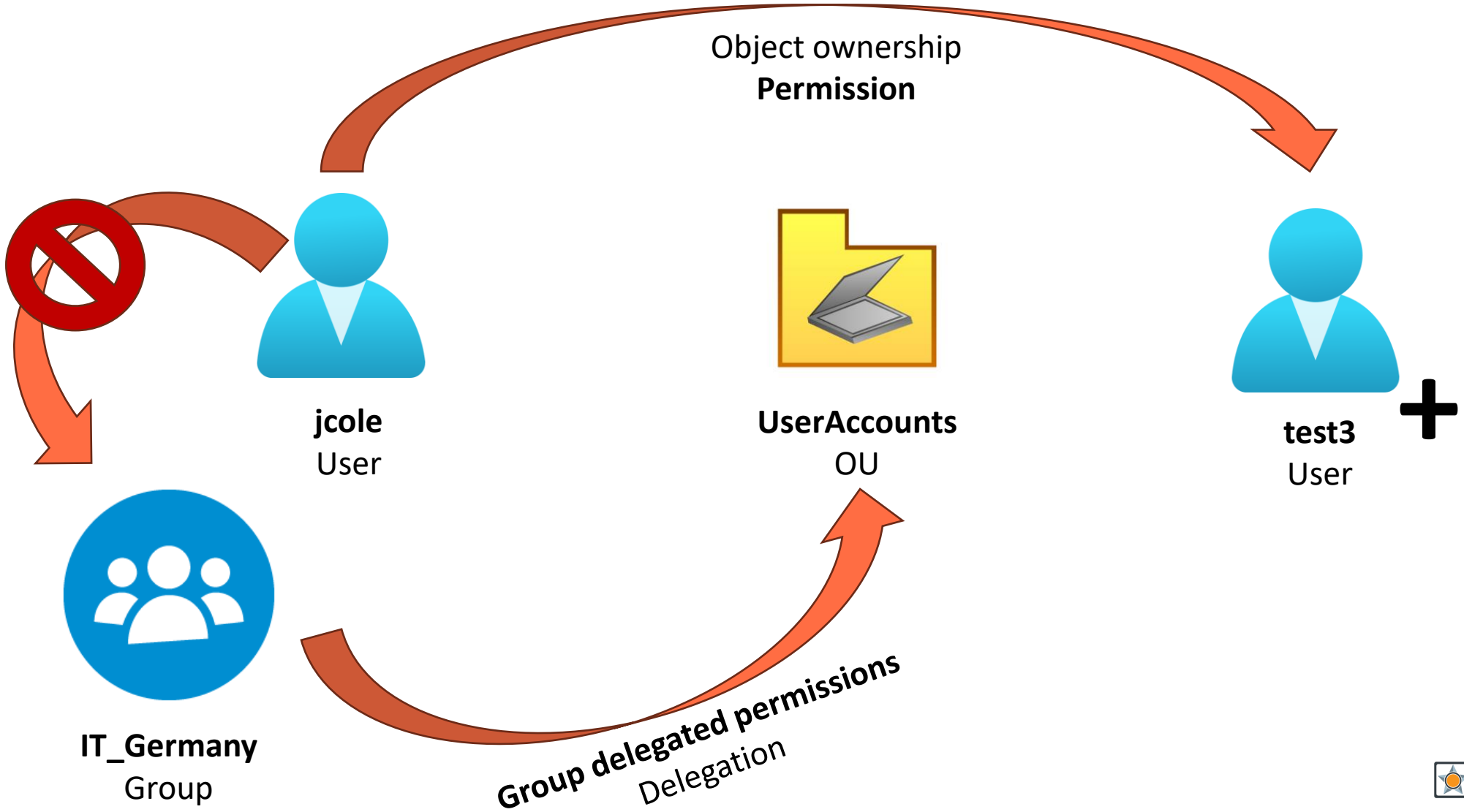
AD object permissions – What happens if you create an AD object – Conclusion of the results



04 | The dead bodies in the basement

AD object permissions – What happens if you create an AD object – Conclusion of the results



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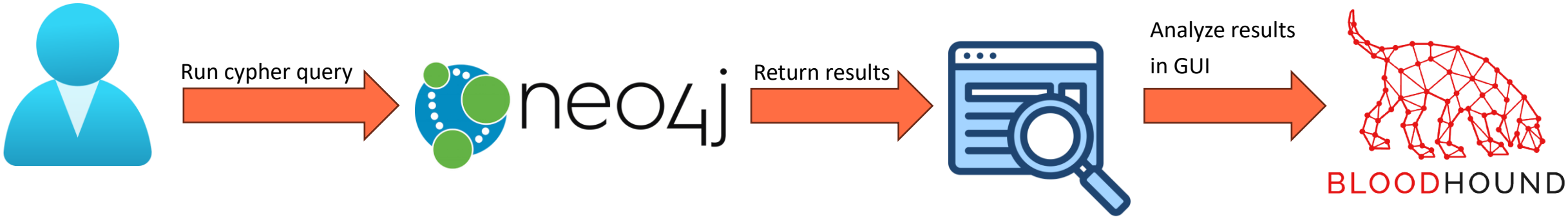
AD object permissions – How to hunt for these kind of issues

- To identify these kind of permission issues we can use existing tooling



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AD object permissions – How to hunt for these kind of issues

- Let´s have a look on which users own how many objects using a cypher query:

```
MATCH (u:User)-[:Owns]->(n) RETURN
count(DISTINCT(n.name)) AS OwnedObjects,
u.name AS USER ORDER BY
count(DISTINCT(n.name)) DESC
```

```
neo4j$ MATCH (u:User)-[:Owns]→(n) RETURN count(DISTINCT(n.name)) AS OwnedObjects, u.name AS USER ORDER BY count(DISTINCT(n.name)) DESC
```

Table | Text | Code

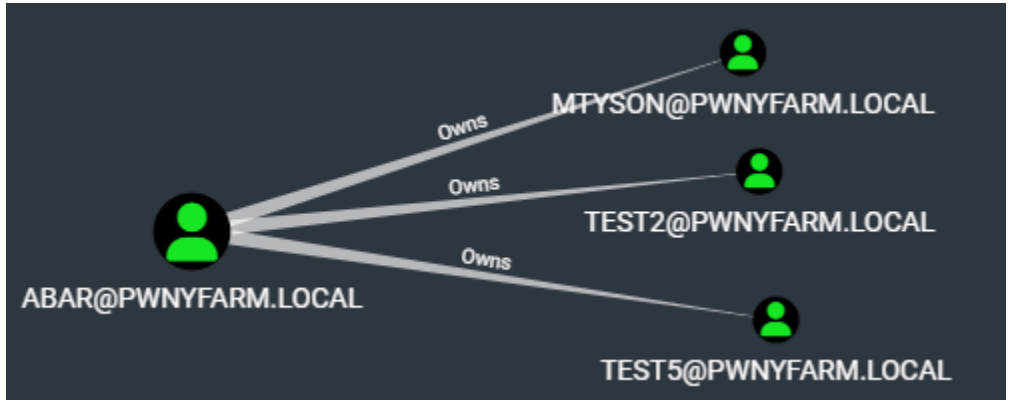
	OwnedObjects	USER
1	3	"ABAR@PWNYFARM.LOCAL"
2	2	"JCOLE@PWNYFARM.LOCAL"

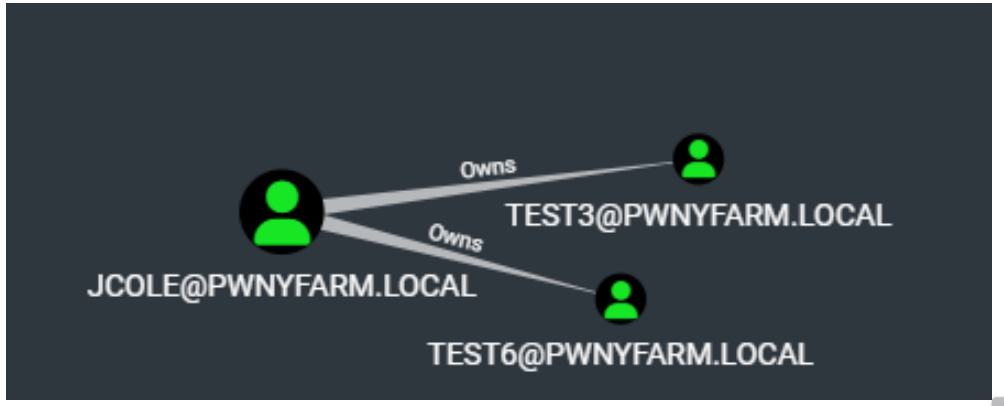
04 | The dead bodies in the basement

AD object permissions – How to hunt for these kind of issues

- Let´s have a look on which users own how many objects using a cypher query:

```
MATCH (n:User) WHERE n.name =~ 'ABAR@PWNYFARM.LOCAL'
MATCH (m) WHERE NOT m.name = n.name
MATCH p=allShortestPaths((n)-[r:Owns|SQLAdmin*1..]->(m))
RETURN p
```





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AD object permissions – Conclusions

- There is a common misconception that cleaning up the group memberships during a AD transformation project will remove all critical permissions
- We can identify these issues by using neo4j and Bloodhound
- After identification, we can start fixing the issues

- There are three more useful neo4j queries I will leave you for the workshop

04 | The dead bodies in the basement

File permissions – What happens if you create a file on a share

- Let´s focus on some critical shares

Why these shares?

- Because they are very critical, since they are hosting settings and logon script that are deployed throughout the environment.

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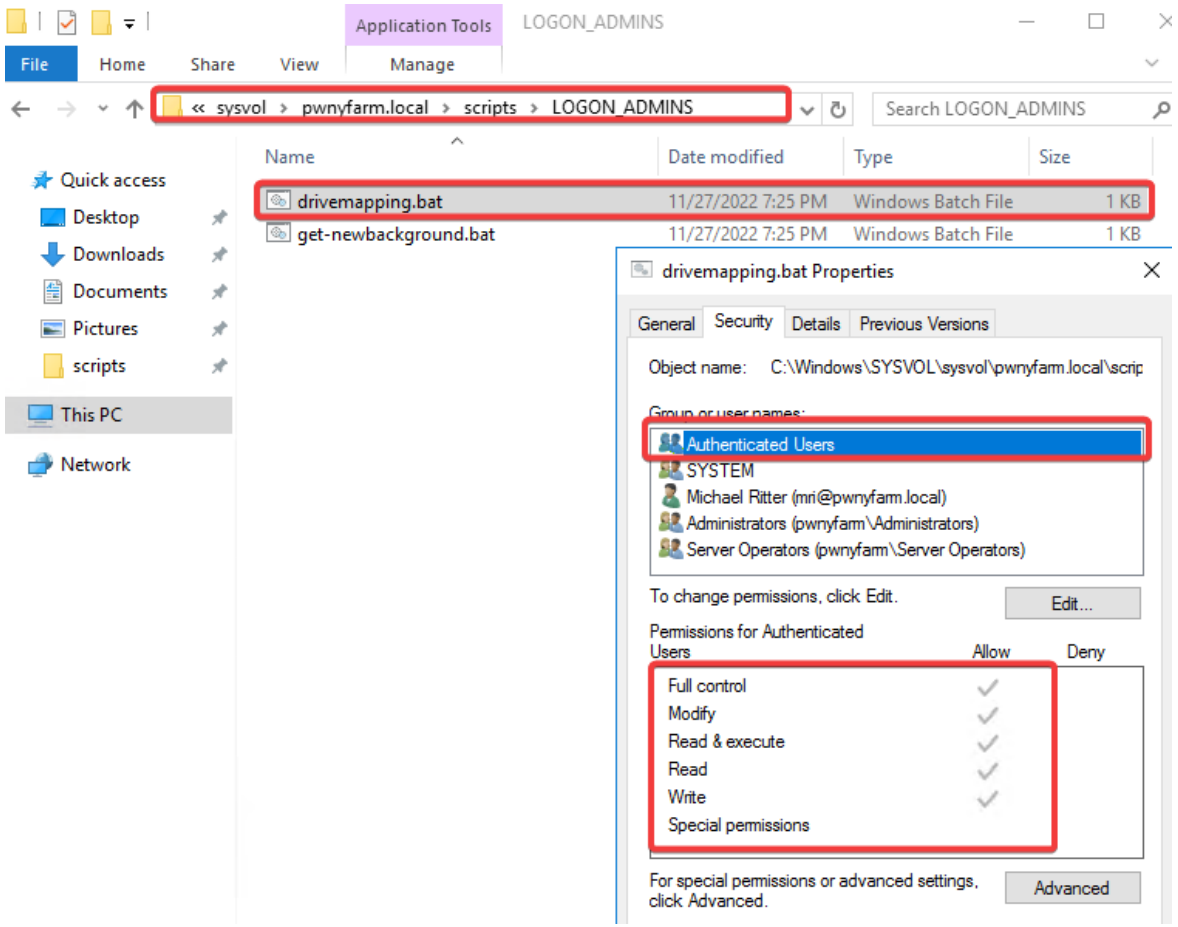
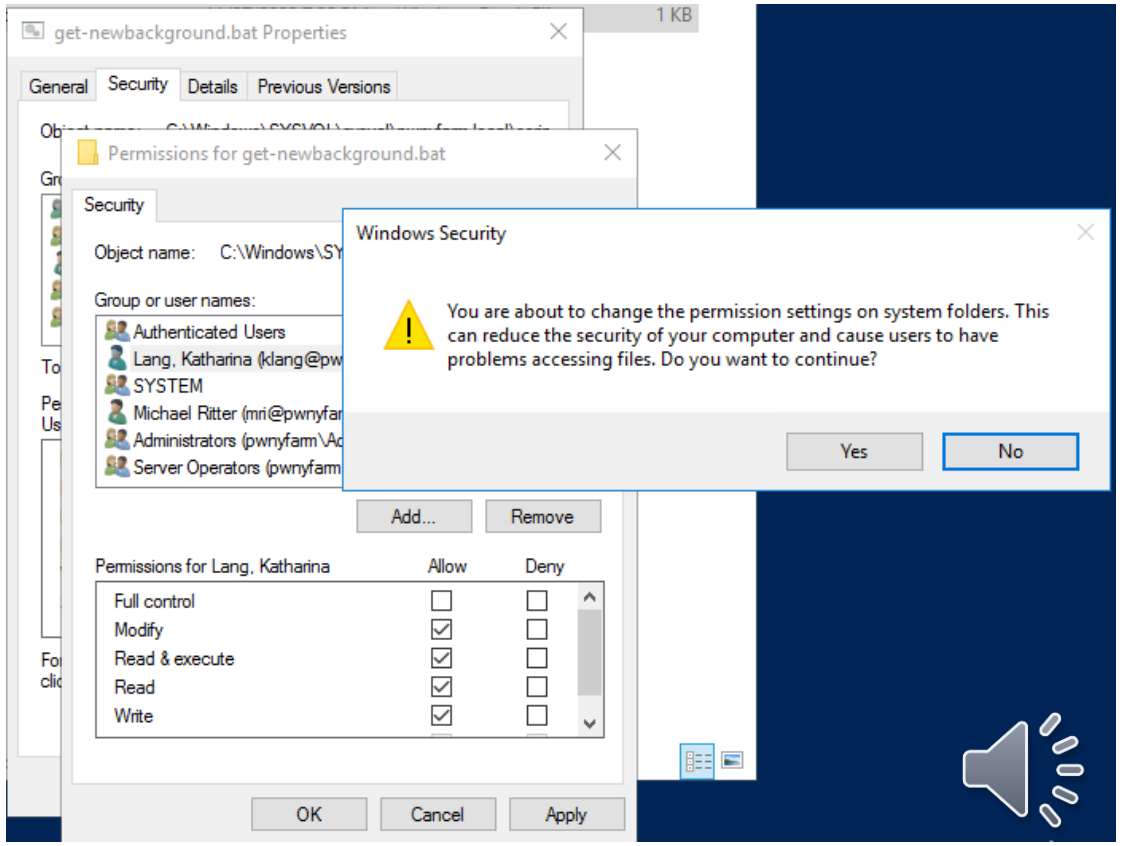
File permissions – What happens if you create a file on a share

- Example:





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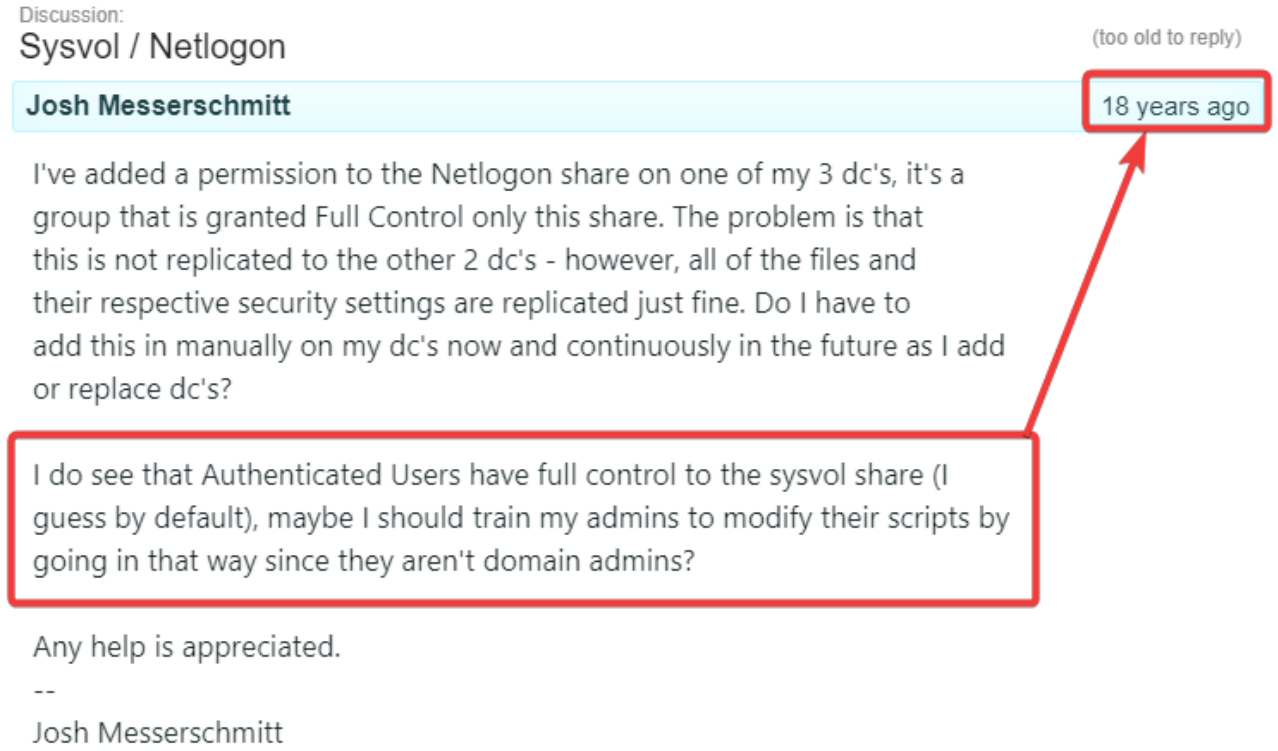
File permissions – The internet never forgets

- Plus I found this article during my research
  - https://microsoft.public.windows.server.active-directory.narkive.com/SBmR8YhL/sysvol-netlogon



Discussion:
Sysvol / Netlogon

(too old to reply)

Josh Messerschmitt — 18 years ago

I've added a permission to the Netlogon share on one of my 3 dc's, it's a group that is granted Full Control only this share. The problem is that this is not replicated to the other 2 dc's - however, all of the files and their respective security settings are replicated just fine. Do I have to add this in manually on my dc's now and continuously in the future as I add or replace dc's?

I do see that Authenticated Users have full control to the sysvol share (I guess by default), maybe I should train my admins to modify their scripts by going in that way since they aren't domain admins?

Any help is appreciated.
--
Josh Messerschmitt

04 | The dead bodies in the basement

File permissions – What happens if you create

- How to analyze the shares for interesting permissions?

```
# Download and load required functions
- https://github.com/michiiii/Get-FileShareAccessRights

# Collect the permissions
$permissions = Get-FileShareCriticalPermissions -NetworkSharePath \\pwnyfarm.local\netlogon

# Get an overview of users that have potential critical permissions
Get-CriticalPermissionOverview -SharePermissions $permissions
```

```
PS C:\Users\abar\Downloads\SharpHound-v2.0.1> Get-CriticalPermissionOverview -SharePermis

Name                                Count
----                                -----
NT AUTHORITY\Authenticated Users       36
pwnyfarm\mri                           18
pwnyfarm\lkaiser                        7
pwnyfarm\jcole                          9
```

04 | The dead bodies in the basement

File permissions – What happens if you create

```
# Finally, you can filter the results for intersting user/groups
Get-CriticalPermissionsByUser -SharePermissions $permissions -UserName mri
```

```
Administrator: Windows PowerShell
PS C:\Users\abar\Downloads\SharpHound-v2.0.1> Get-CriticalPermissionsByUser -SharePermissions $permissions -UserName mri

Path                                                    Username     AccessRight            IsInherited
----                                                    --------     -----------            -----------
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri WriteData                       True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri CreateFiles                     True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri AppendData                      True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri WriteExtendedAttributes         True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri WriteAttributes                 True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri Write                           True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri Delete                          True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri ChangePermissions               True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\drivemapping.bat pwnyfarm\mri TakeOwnership                   True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri WriteData                  True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri CreateFiles                True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri AppendData                 True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri WriteExtendedAttributes    True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri WriteAttributes            True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri Write                      True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri Delete                     True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri ChangePermissions          True
\\pwnyfarm.local\netlogon\LOGON_ADMINS\get-newbackground.bat pwnyfarm\mri TakeOwnership              True
```

04 | The dead bodies in the basement

File permissions – Conclusions

- File permission issues on NETLOGON and SYSVOL can have severe consequences for the overall security in an Active Directory environment
- I still have no explanation why this issue is present in so many “older” environments
  - I am still not able to reproduce this issue in an modern environment
  - The default inheritance settings are usually passed to any file that is created on the SYSVOL or NETLOGON share
  - Maybe in the past there was a silent patch that fixed a permission issue

I would love to get feedback about the results you get when analyzing your environment?

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5 Conclusion

Thank you!

Dou you have any further questions?
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