Kerberoasting

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Agenda

- » Kerberos 101
- » Kerberoasting
- » Silver Tickets
- » Golden Tickets
- » Wrapping up

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Kerberos 101 - Overview

- » Authentication protocol for untrusted networks
- » Initially Designed by MIT, adapted by Microsoft
- » Default authentication protocol for Windows networks (Since Windows 2000)
- » Requires valid DNS names (for example, \\10.10.10.10\share will fall back to NTLM)
- » Kerberos relies on tickets for authentication
- » Each ticket is stored in the credential cache on your local maschine

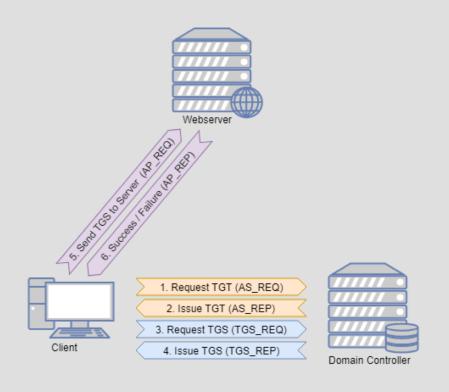
Kerberos 101 – Service Principal Names

- » A service principal name (SPN) is a unique identifier of a service instance. SPNs are used by Kerberos authentication to associate a service instance with a service logon account. (MSDN)
- » Format: <service class>/<host>:<port>/<service name>
 - » MSSQLSvc/sql.lab.local:1433/SQLEXPESS
 - » CIFS/files.lab.local
- » List available SPNs in a domain:
 - » setspn.exe -q */*
- » Only show MSSQL SPNs
 - » setspn.exe -q MSSQLSvc/*

Kerberos 101 - Components

- » Client (Principal)
- » Server
- » Kerberos Distribution Center
 - » Authentication Service
 - » Ticket Granting Service
- » Ticket Granting Tickets
- » Service Ticket

Kerberos 101 – Authentication Workflow



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Kerberoasting - Overview

- » Initially discovered and disclosed by Tim Medin in 2015 (see References for a link to the talk)
- » Goal: Crack weak service passwords
- » Cracked passwords can be used for
 - » Lateral movement
 - » Privilege escalation
 - » Persistence
- » Mitre ATT&CK T1208

Kerberoasting - Details

- Any domain user can request tickets for any service
 - » No high privileges required
 - » Service must not be active
- » SPN scanning to discover service accounts
 - » setspn -q */*
 - » Find-PSServiceAccounts.ps1
- » Request service account via powershell
 - » Add-Type -AssemblyName System.IdentityModel
 - » PNew-Object System.IdentityModel.Tokens.KerberosRequestorSecurityToken ArgumentList "MSSQLSvc\sql.windomain.local:1433"
- » Extract hashes with mimikatz and crack with johntheripper / hashcat
 - » mimikatz.exe "kerberos::list /export" (convert with kirbi2john.py)

Kerberoasting – Details cont.

- » Kerbeoasting has since been automated: Invoke-Kerberoast and Rubeus.
- » Rubeus: C# tool based off Benjamin Delpys kekeo
 - » Written by @harmj0y from Specter Ops
 - » Toolkit for attacking kerberos
- » Rubeus.exe kerberoast /outfile:hashes.txt
 - » yes, that's actually all you need
 - » Will search AD for kerberoastable accounts (accounts with >= 1 SPN, Password never expires), request a ticket per account and dump it in hashcat format
- » Crack ticket(s) with hashcat
 - » ./hashcat64.bin -m 13100 -r hob064.rule hashes.txt rockyou.txt

Kerberoasting - Mitigation

- » Set long and complex passwords for service accounts
 - » Recommended length: >28 characters
- » (Group) Managed Service Accounts
- » Limit privileges of service accounts
 - » Service accounts should NOT be part of the domain admin group!
- Use AES encryption instead of RC4 encryption

Kerberoasting - Detection

- » No default way of detection Kerberoasting, custom detections/alerts are necessary
- » Enable "Audit Kerberos Service Ticket Operations" on DC
- » Kerberos event titled 4769 "A Kerberos service ticket was requested."
- » Looking for TGS-REQ packets with RC4 encryption is probably the best method
- » High rate of false positives
- » Search for users with a high count of event 4769

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Silver Tickets - Overview

- » Technique to maintain persistence in an already compromised domain
- » Goal: Forge service ticket
- » Knowledge of the service account or computer account hash required
- » Stealthy persistence
- » Server does not verify tickets with the KDC
- » Mitre ATT&CK <u>11097</u> (Pass the ticket)

Silver Tickets - Details

- » Password or NTLM hash of service account needed to forge a valid TGS ticket
 - » Kerberoasting
 - » Credential dumping with mimikatz
- » Silver ticket is created directly on a compromised host
 - » No TGT required (no AS-REQ / AS-REP)
 - » No ticket is requested from the KDC (no TGS-REQ / TGS-REP)
 - » Target server does not verify tickets with the KDC
- » Create anywhere and used anywhere on the network, without elevated rights.

Silver Tickets - Details cont.

» Creating a silver ticket:

» mimikatz.exe "kerberos::golden /admin:admkevin /id:1107 /domain:windomain.local /sid:S-1-5-21-539236762-368423896-1554642573 /target:dc.windomain.local /rc4:4fb8848a7509c605673bc4021c05e74f /service:cifs /ptt; exit"

Silver Tickets - Mitigation

- » No direct mitigation available
- » Protect assets (especially the domain controller)
- » Same mitigations as for kerberoastig apply

Silver Tickets - Detection

- » Indicators
 - » The Account Domain field is <u>blank</u> when it should be <u>DOMAIN</u>
 - » The Account Domain field is <u>DOMAIN FQDN</u> when it should be <u>DOMAIN</u>.
- » Events:
 - » 4624 Account Logon
 - » 4634 Account Logoff
 - » 4672 Admin Logon
- » Disclaimer: Not a blue teamer. If I overlooked something, let me know!

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Golden Tickets - Overview

- » Golden Tickets are forged Ticket-Granting Tickets (TGT)
- » Require knowledge of the krbtgt password hash
- » Mitre ATT&CK <u>T1097</u> (Pass the ticket)

Golden Tickets - Details

- » Golden Ticket requires the KRBTGT password hash.
- » Create anywhere and user anywhere on the network, without elevated rights.
- » No AS-REQ or AS-REP (steps 1 & 2) communication with the domain controller (KDC)
- » Golden ticket is a valid TGT Kerberos ticket (signed with krbtgt password hash
- » Requirements (for mimikatz)
 - » Domain Name [AD PowerShell module: (Get-ADDomain).DNSRoot]
 - » Domain SID [AD PowerShell module: (Get-ADDomain).DomainSID.Value]
 - » Domain KRBTGT Account NTLM password hash
 - » UserID for impersonation.

Golden Tickets - Details cont.

- » Creating a golden ticket
 - » .\mimikatz.exe "kerberos::golden /user:kevin /domain:windomain.local /sid:S-1-5-21-539236762-368423896-1554642573 /krbtgt:4fb8848a7509c605673bc4021c05e74f /ptt" exit
- » The user is added to the domain admin group
- The ticket is automatically added to the local credential cache with the /ptt flag
- » To get rid of the golden ticket, the krbtgt account passwort must be changed twice. Once is not enough as the last two poasswords are cached on the DC.

Golden Tickets - Mitigation

- » Behavior is working as intended
- » No real "fix"
- » Protect domain controller and domain admin accounts
- » Protect the domain controller and Domain admin account
- The KRBTGT account password is never changed* and the attacker can create Golden Tickets until the KRBTGT password is changed (twice)
- » It's advisable to regularly change the KRBTGT password (

Golden Tickets - Detection

- » Hard to detect (ticket expiration is not logged by default)
- » MS ATA is able to detect golden tickets
 - » Only when actively used!
- » Indicators:
 - » The Account Domain field is <u>blank</u> when it should be <u>DOMAIN</u>
 - » The Account Domain field is <u>DOMAIN FQDN</u> when it should be <u>DOMAIN</u>
- » Events
 - » 4624 Account Logon
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Wrappig Up

- » Kerberoasting exploits weak passwords and overprovisioned service accounts
- » Silver and Golden tickets are stealthy persistence technqiues for an already compromised domain
- » To mitigate those attacks
 - » Service account passwords > 28 characters
 - » Minimal privileges for service accounts
 - » Portect domain controllers and domain admin accounts

Questions?

THANKS!

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GITHUB: github.com/shellhunter

Sources / References

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- » https://blog.stealthbits.com/extracting-service-account-passwords-with-kerberoasting/
- » https://room362.com/post/2016/kerberoast-pt1/

Tools

- » Rubeus: https://github.com/GhostPack/Rubeus
- » Powersploit: https://github.com/PowerShellMafia/PowerSploit
- » Mimikatz: https://github.com/gentilkiwi/mimikatz
- » Powershell Empire: https://github.com/EmpireProject/Empire