Kerberoasting

OWASP Stammtisch Frankfurt | 27.02.2018

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

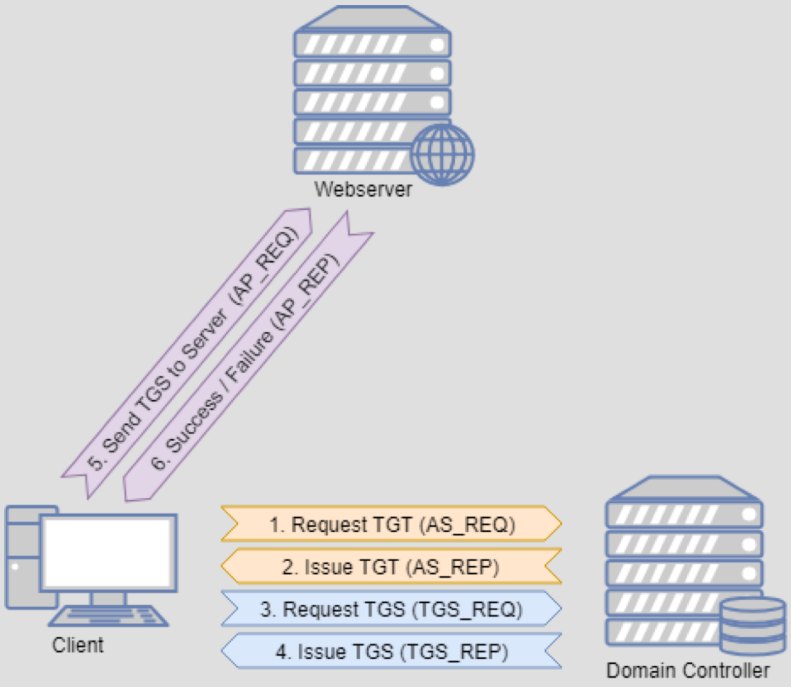
Kerberos 101 – Service Principal Names

- 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 T1097 (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 blank when it should be DOMAIN
  - The Account Domain field is DOMAIN FQDN when it should be DOMAIN.
- 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 T1097 (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 blank when it should be DOMAIN
  - The Account Domain field is DOMAIN FQDN when it should be DOMAIN
- Events
  - 4624 Account Logon
  - 4672 Admin 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://www.varonis.com/blog/kerberos-how-to-stop-golden-tickets/
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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