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Privilege Escalation

Nick Jones

20th March 2017

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Who am I?

Nick Jones

+ Security Consultant at MWR InfoSecurity
+ Web Applications and Infrastructure Assessments

Research Topics:

+ Cloud/DevOps
+ Malware Command and Control

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Who are MWR InfoSecurity?

A global, research-led cybersecurity consultancy

+ Global – 3 UK offices + US, Singapore, South Africa, Poland
+ Research-led – everyone gets research time, even juniors
+ Cybersecurity consultancy – help clients secure their networks, get paid to hack things

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Why are we Awesome?

Lots of good people, fun place to work

+ Multiple Pwn2Own wins, talks at Black Hat, DEF CON etc

HackFu

+ Annual two-day hacking challenge

MWRICON

+ Annual internal conference - talks and workshops from our consultants

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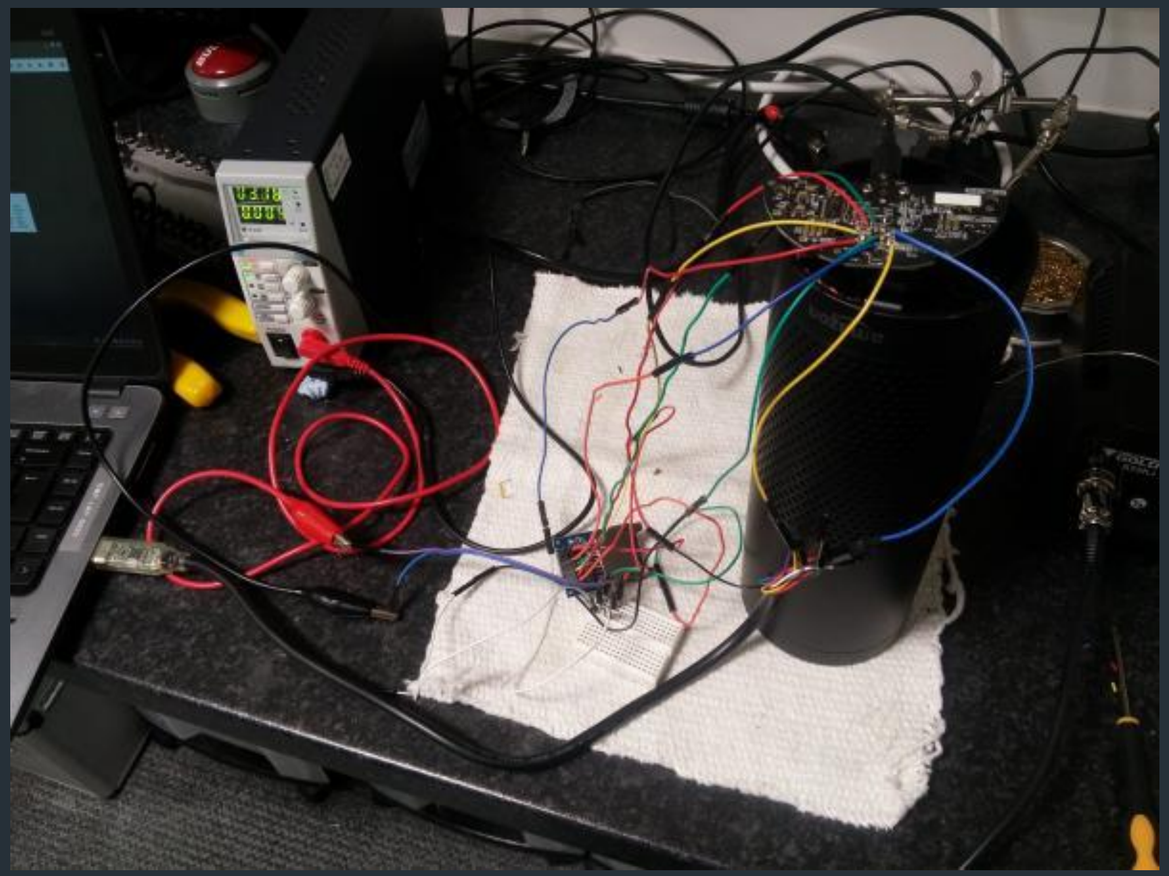
Research

Amazon Alexa

+ Exposed debug ports + SD card booting = root



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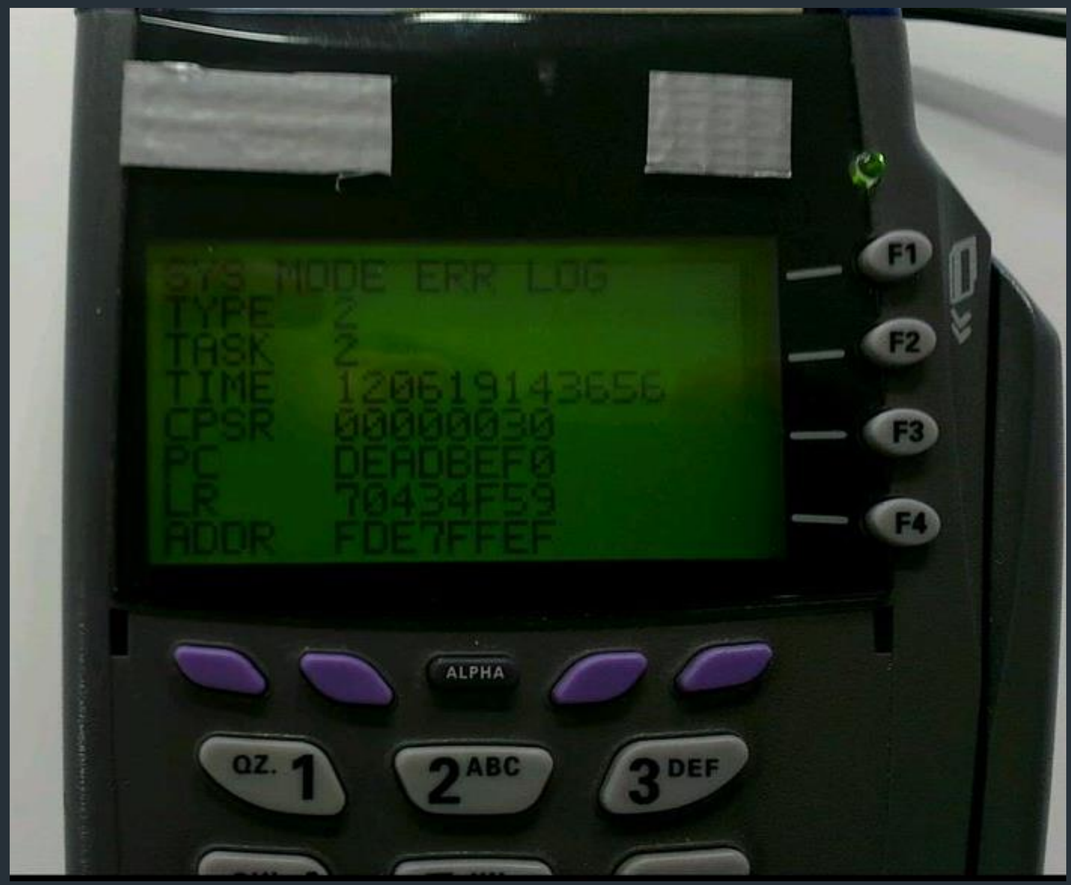
Why are we Awesome?

+ Buffer overflow on credit card reader led to…



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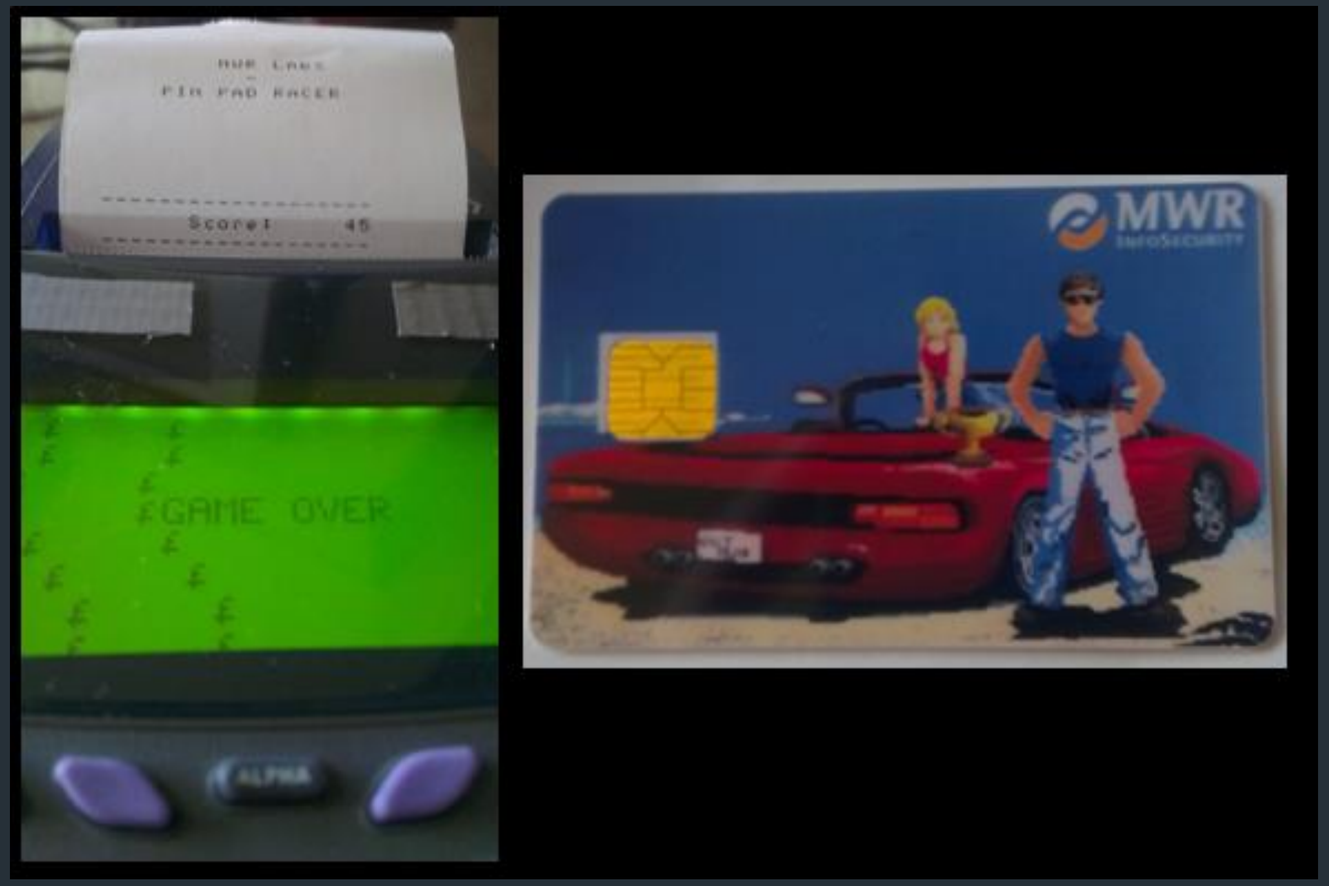
Why are we Awesome?

+ Flappy Bird!
+ Game loads off malicious chip & pin card
+ Insert card, play game



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What is Privilege?

The level of access that a user or application has

+ The files or data they can read/write
+ The programs they can run
+ The hardware they can interface with

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Why Escalate it?

Perform actions we're not supposed to

+ Read/write files we currently can't access
+ Execute programs we currently can't run
+ Access devices we can't currently communicate with

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Types of Escalation

Vertical

+ Extra privileges
+ Normal user -> admin/root

Horizontal

+ Access rights of a different user the same level

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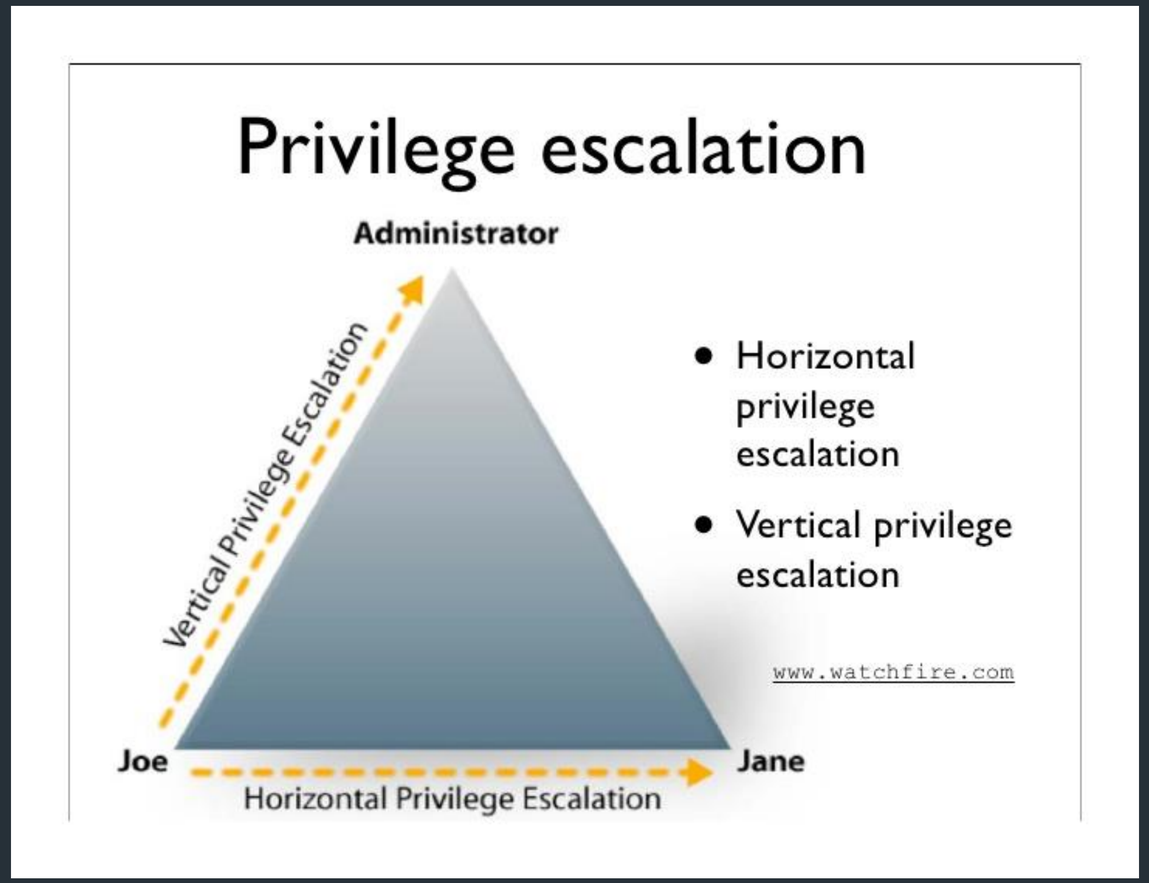
Horizontal vs Vertical



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Why Escalate Horizontally?

+ Amazon – purchase on someone else's card
+ Online Banking – move money around from someone else's account
+ Student Management Systems – view someone else's grades

More generally, they may have files, emails, etc. containing passwords, or other useful info

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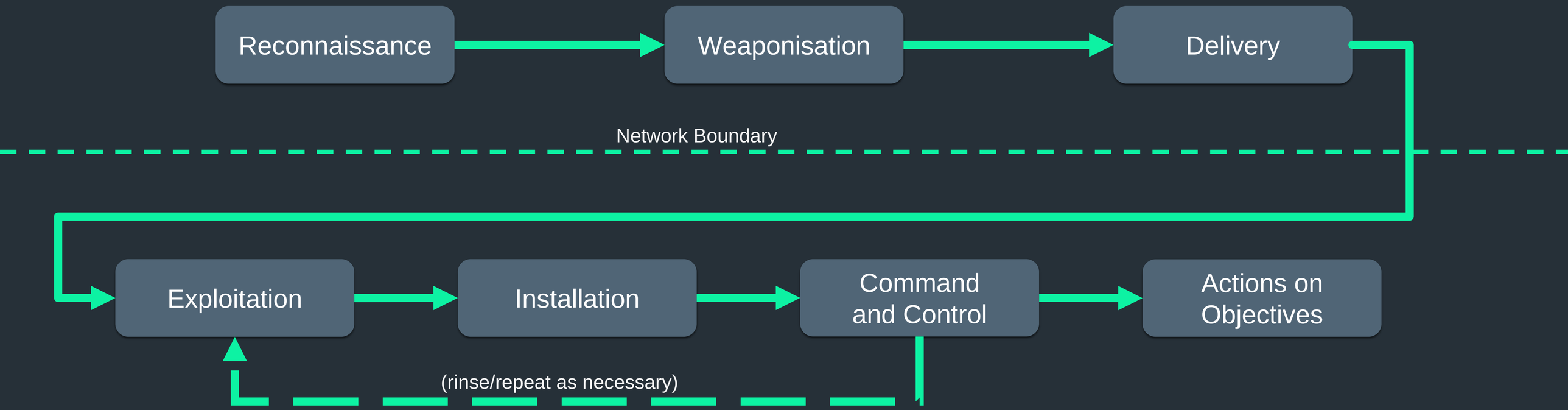
Attack Paths – The Cyber Killchain



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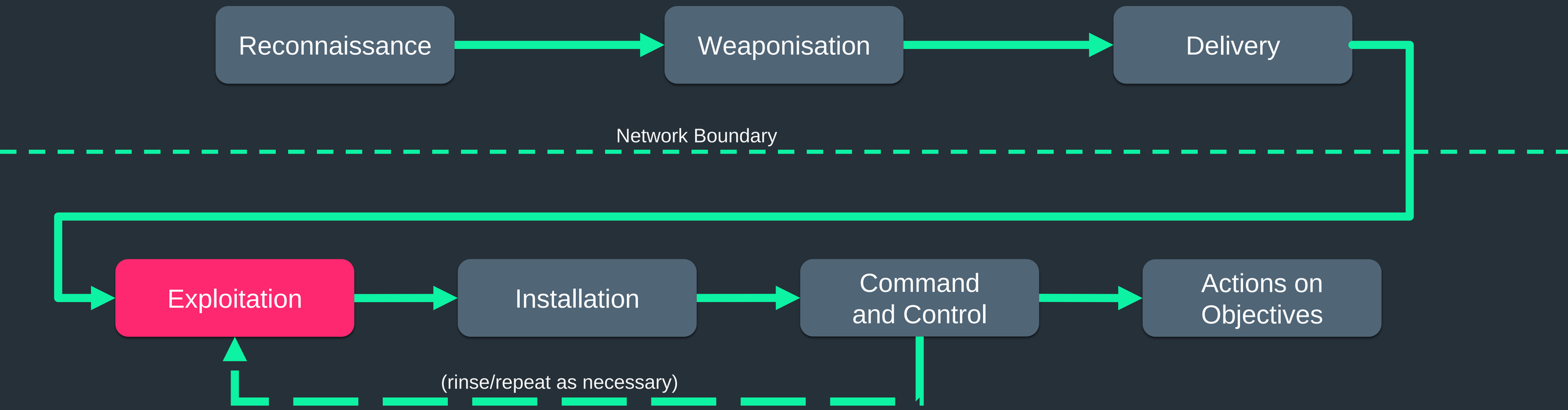
Attack Paths – The Cyber Killchain



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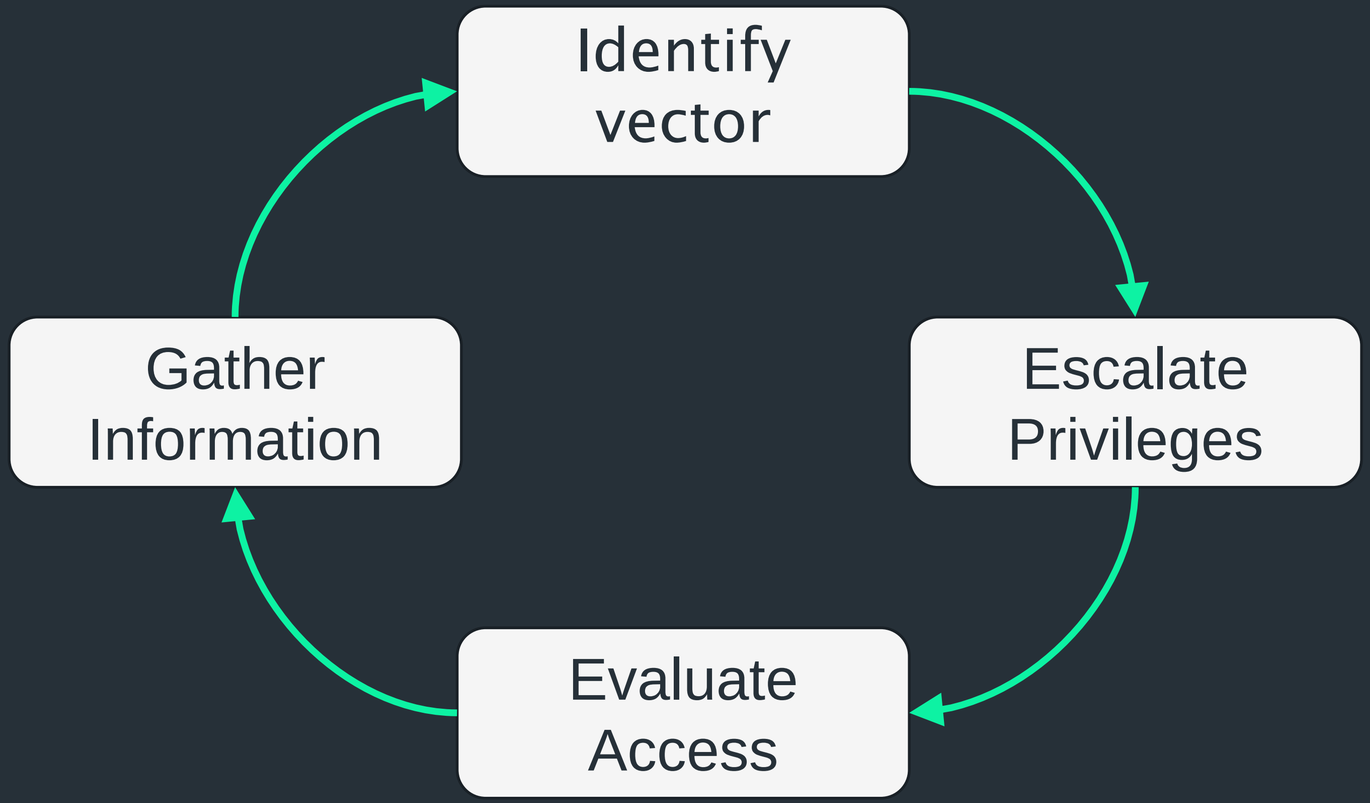
What is the Process?



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What is the Process?

You may need to repeat this process multiple times.

+ Web app: normal user -> app administrator -> root
+ Windows: Low integrity -> local user -> SYSTEM
+ Linux: user -> root -> root on another box

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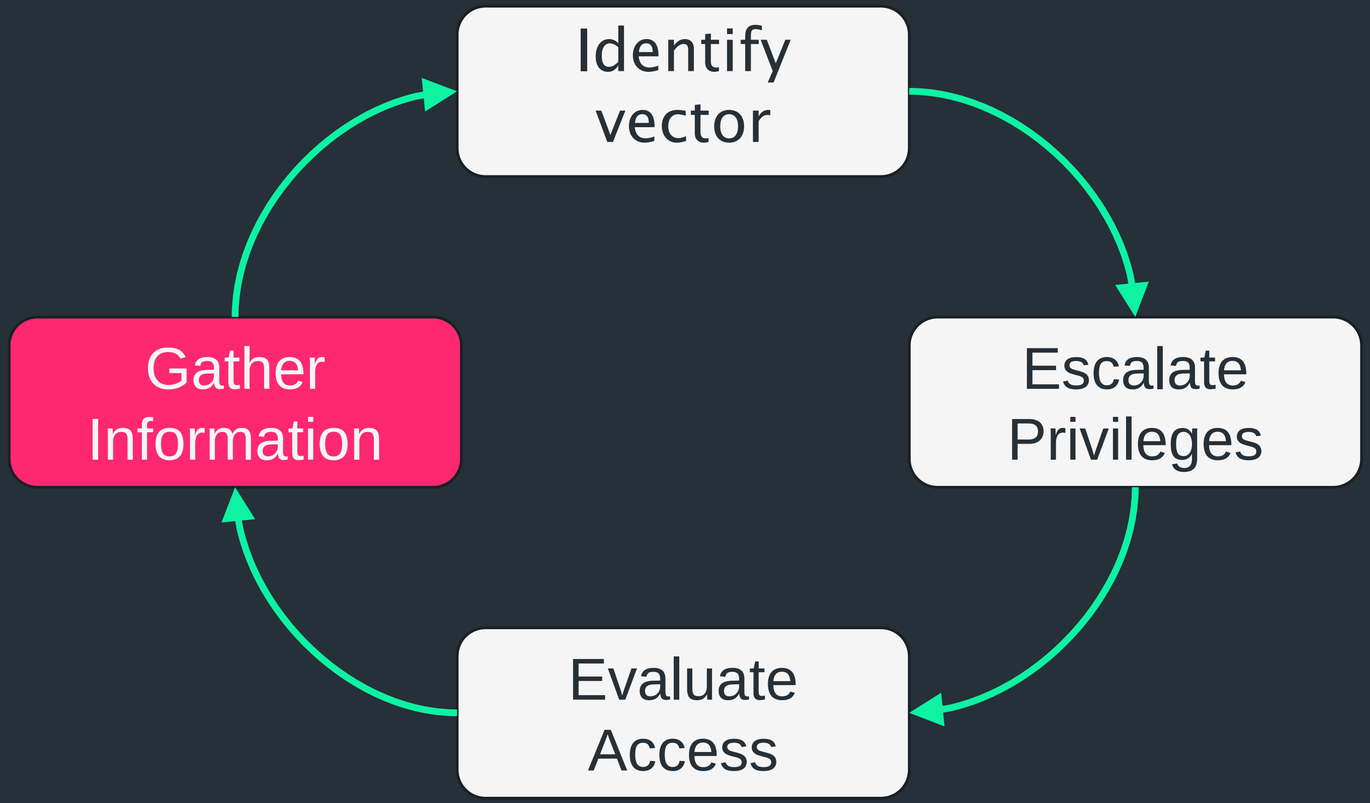
What is the Process?



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Gather Information

+ Otherwise known as reconnaissance, or enumeration
+ Details of the system, software, users, network…
+ More information -> better chance of finding an escalation vector
+ What information is useful?

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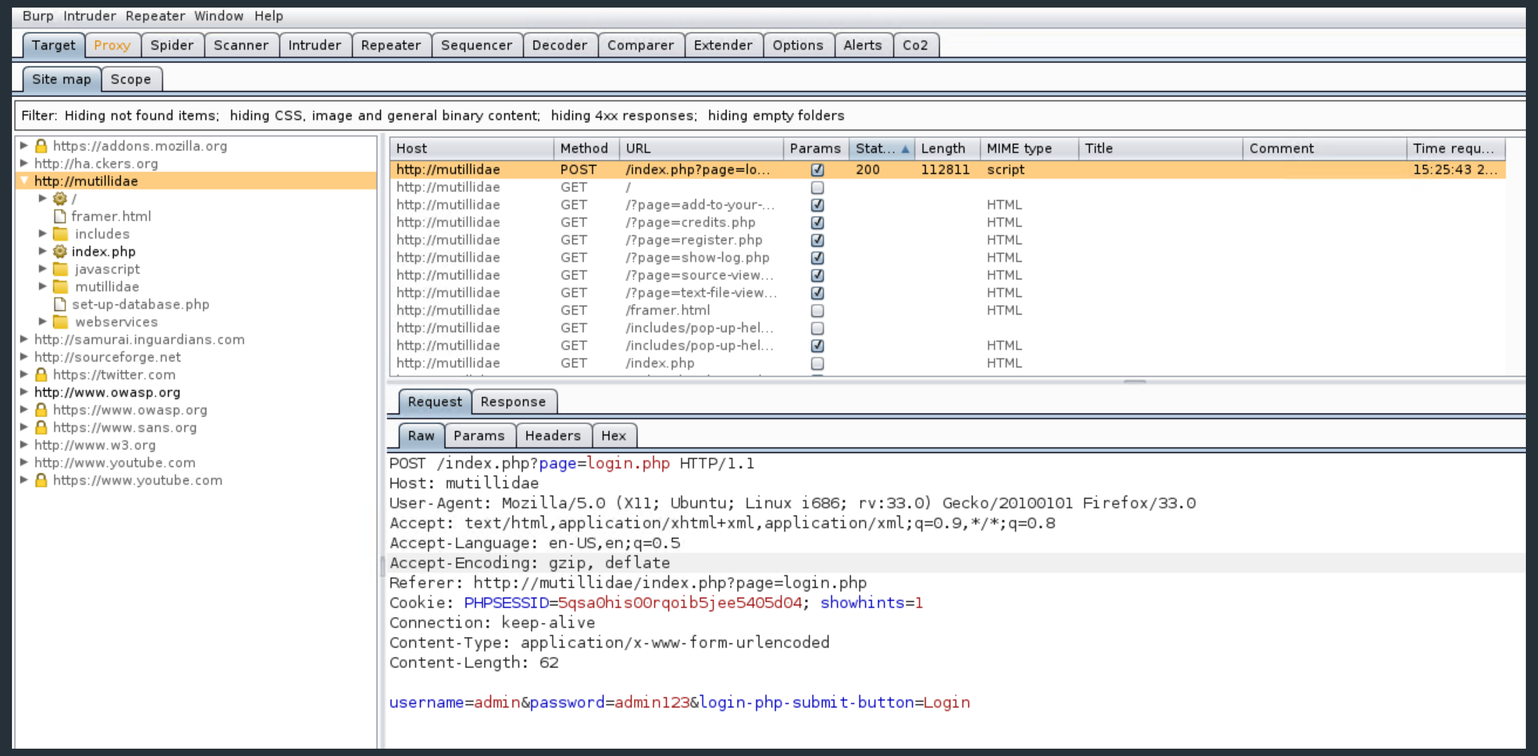
What information is useful – Web Apps

A site map



https://azeemnow.wordpress.com/2016/02/17/samuraiwtf-and-burp/

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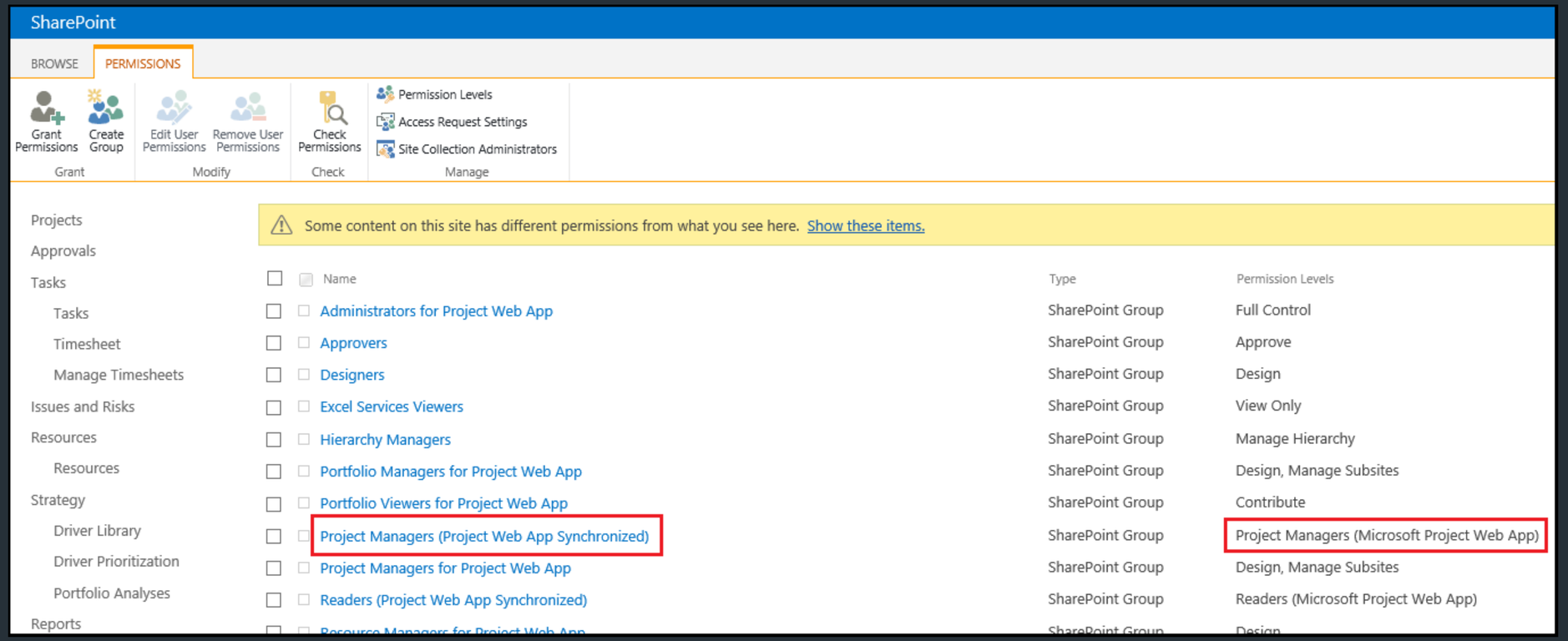
What information is useful – Web Apps

Permissions models



http://www.mpug.com/articles/managing-project-web-app-site-permissions-project-online-project-server-2013/

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What information is useful – Web Apps

Technical information

+ What language is it built in?
+ What frameworks have they used?
+ What databases does it communicate with?
+ Are there any perimeter defences (firewalls, WAFs etc)?

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What information is useful? - Windows/Linux

+ Which version of the OS is this?
+ What users are on the system? Who am I currently?
+ Installed software and devices
+ Network information, routing tables, firewall rules etc
+ Services/daemons and their permissions
+ Scheduled Tasks/cron etc.

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Web app reconnaissance tools

+ A web browser
+ Application help pages
+ An intercepting proxy - Burp Suite/ZAP/Fiddler
+ Nmap
+ Nikto/Arachni/Netsparker/{insert app scanner here}

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Windows reconnaissance tools

+ Native windows commands/GUI components - systeminfo, net, netstat, tasklist, services.msc...
+ WMIC
+ PowerSploit's PowerUp modules
+ Metasploit's Windows Post-Exploitation Modules
+ Sysinternals Suite
+ Windows-exploit-suggester / windows-privesc-check

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Linux reconnaissance tools

+ Native Linux commands – service/init.d, ps, netstat…
+ Digging through log/config files - /etc/passwd, .bash_history, service config…
+ Metasploit's Linux Post-Exploitation Modules
+ Linuxprivchecker.py
+ LinEnum
+ Unix-privesc-check

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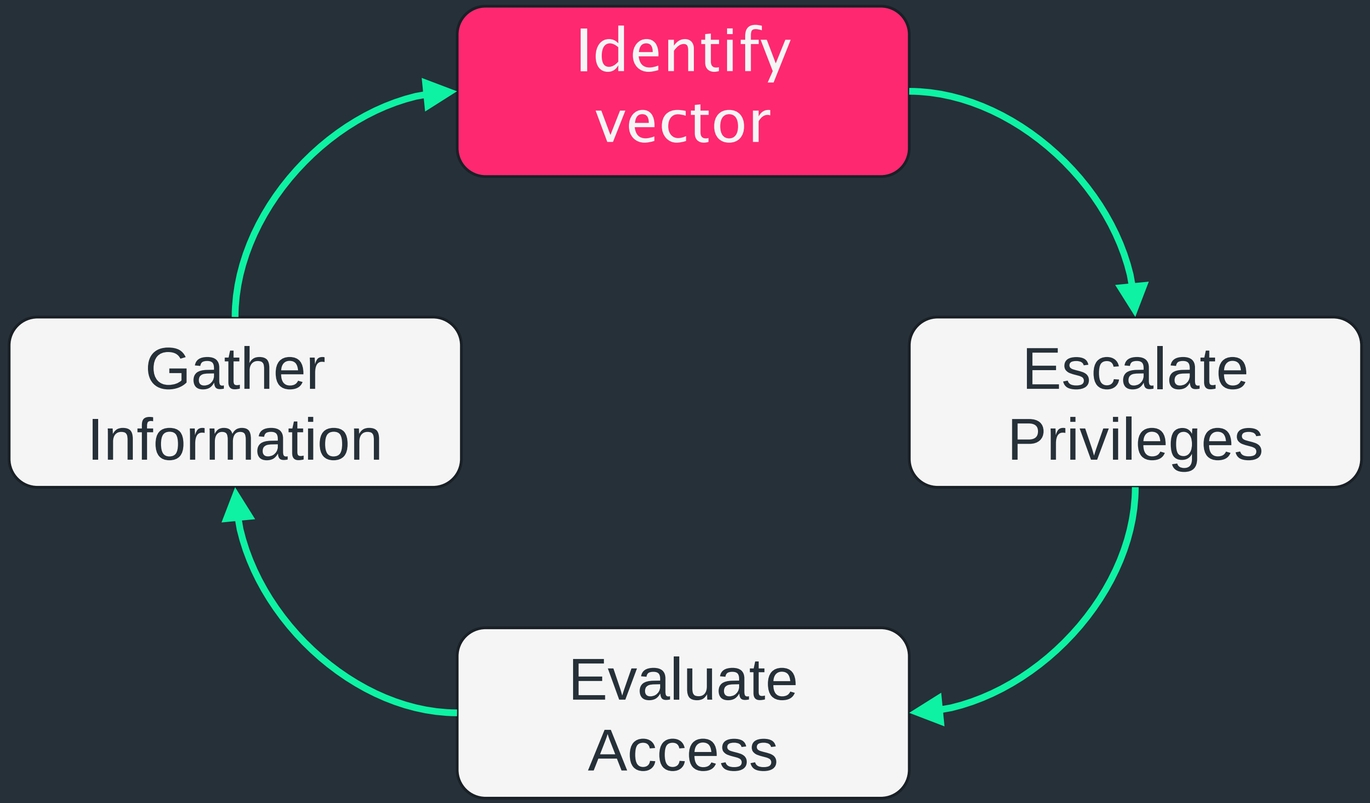
What is the Process?



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Identify escalation vector

Review gathered information, identify your options

Pick a vector based on your requirements

+ Test Environment? Pick the easiest
+ Production environment? Pick one that won't break things
+ Need to be stealthy? Pick something that'll blend in

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Examples of Escalation Vectors

+ Authorisation bypasses
+ Poor passwords / password reuse
+ Misconfiguration
+ Exploits
+ Design flaws

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Authorisation bypasses

Escalate by accessing privileged content, without the necessary rights

+ Direct object referencing
+ Admin:true in a web cookie
+ Interacting with Android app IPC endpoints that should be locked down

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Poor Passwords/Password Reuse

Guess or crack an account's passwords, try passwords you've found elsewhere

+ Pa55w0rd on a windows domain admin account
+ Use XSS to Keylog someone's credentials, password also used on their email account
+ Password spraying – try a known or common user/password on other systems
+ Brute-force – guess until you find it, last resort

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Misconfiguration

Someone's misconfigured a service, file permissions, server hardening features…

+ Windows: No software restriction policies, unquoted service paths, permissive service configuations…

+ Linux: suid files, writeable authorized_keys files, readable private keys, cron jobs with world writeable scripts…

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Exploits

Poorly written code -> privilege escalation

+ Not just in apps, check OS, libraries in use, etc.
+ Jailbreaks are a form of exploit-related privilege escalation
+ Be careful here – exploits often unstable, may crash apps/systems

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Design Flaws

Flaws in the design of applications and protocols

+ Hard to patch
+ Usually low-risk

Great example from one of our interns

+ Unintended feature in Microsoft Exchange ActiveSync
+ Valid email account -> read from any file share on an internal network

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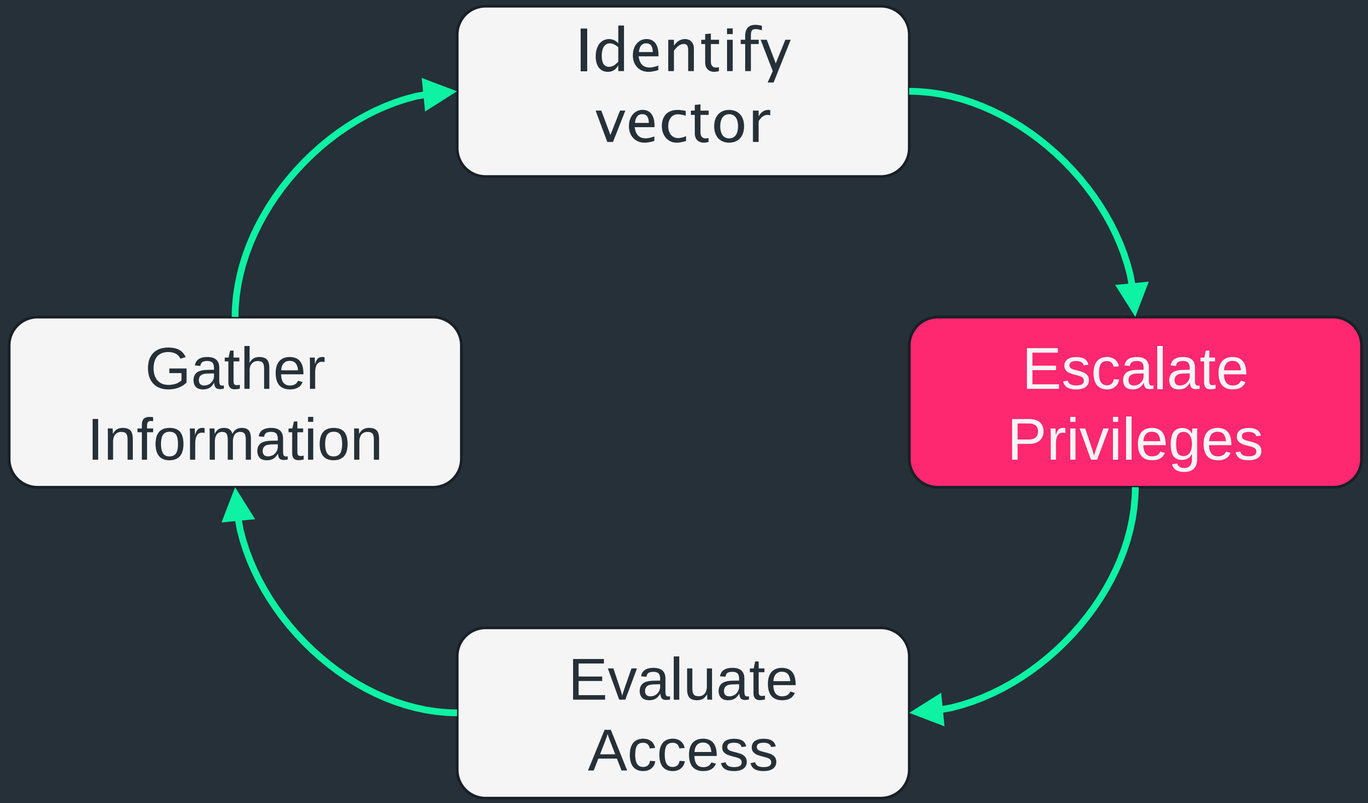
What is the Process?



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Escalate

Exploit the identified vectors

Important to consider potential side effects

+ If exploiting a code bug, will this crash the app?
+ If trying to be stealthy, will this be spotted by EDR, threat hunters or incident responders?

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Escalate - Examples

Launch the privilege escalation attack

+ Use an authorisation bypass
+ Log in with a cracked password
+ Run an exploit
+ Alter a windows service to run a malicious binary

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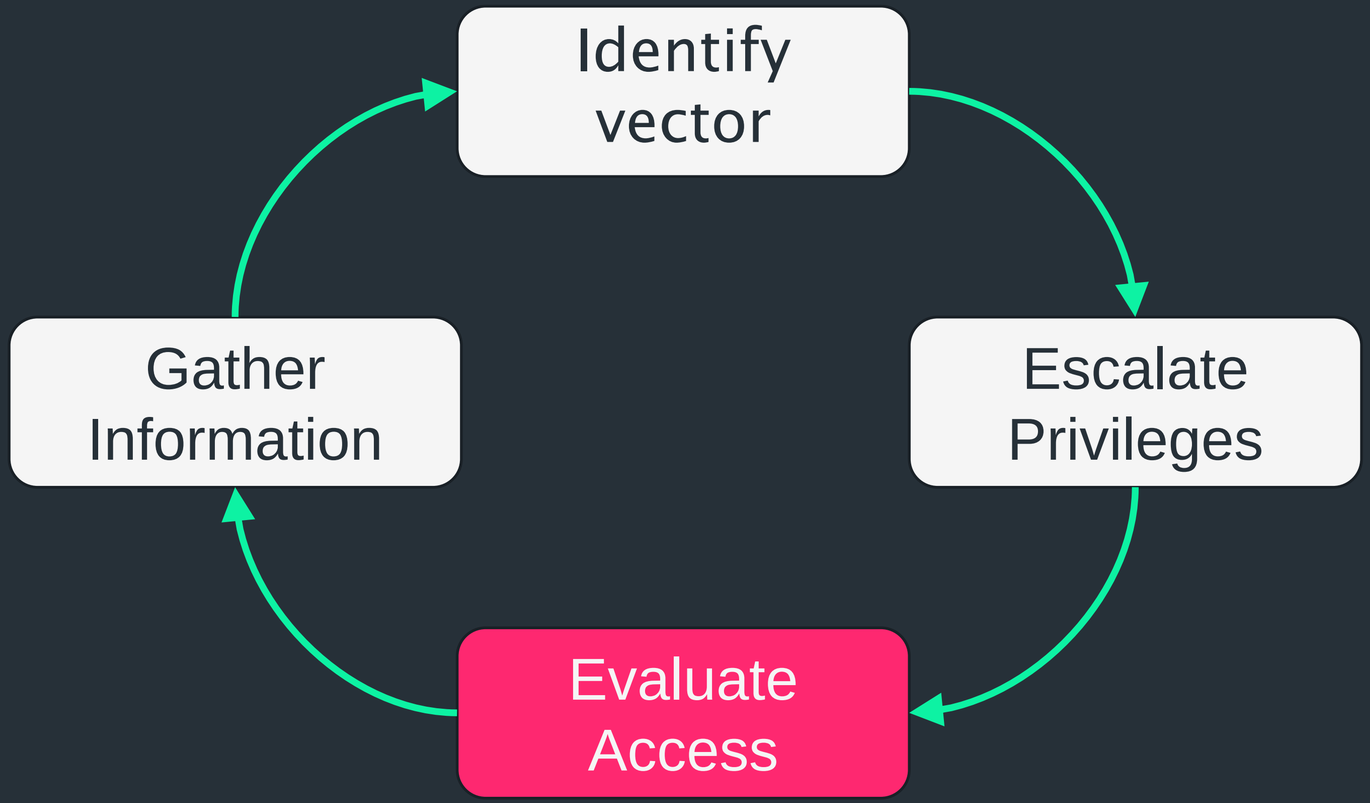
What is the Process?



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Evaluate Access

Do you have the access you wanted?

+ If yes, game over
+ If not, repeat the process

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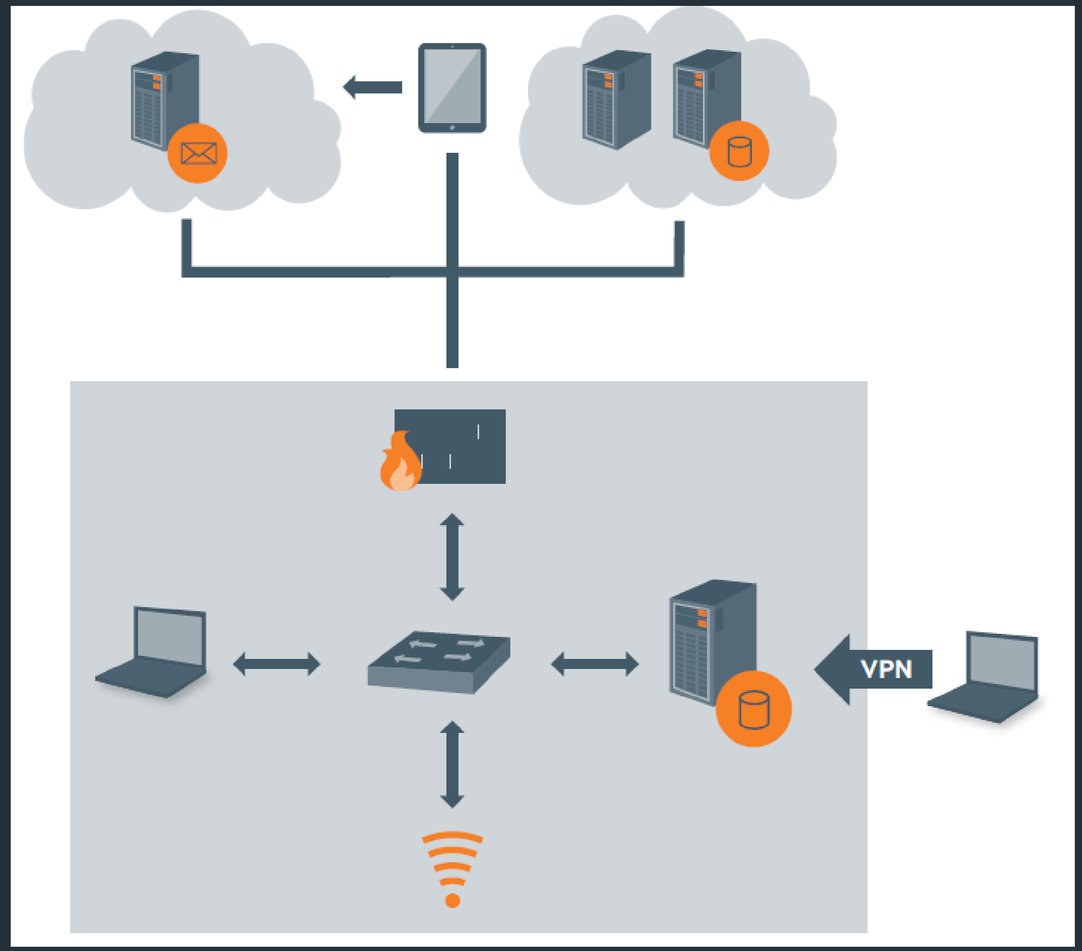
Modern Enterprise Networks

+ Thousands of endpoints
+ Hundreds of servers
+ Mobile Devices
+ VPNs
+ Custom Apps



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Modern Attacks

+ Sophisticated attacks are usually objective-based
+ Compromising one system is rarely enough
+ Escalate across multiple systems or applications
+ Pivot between systems to gain greater access

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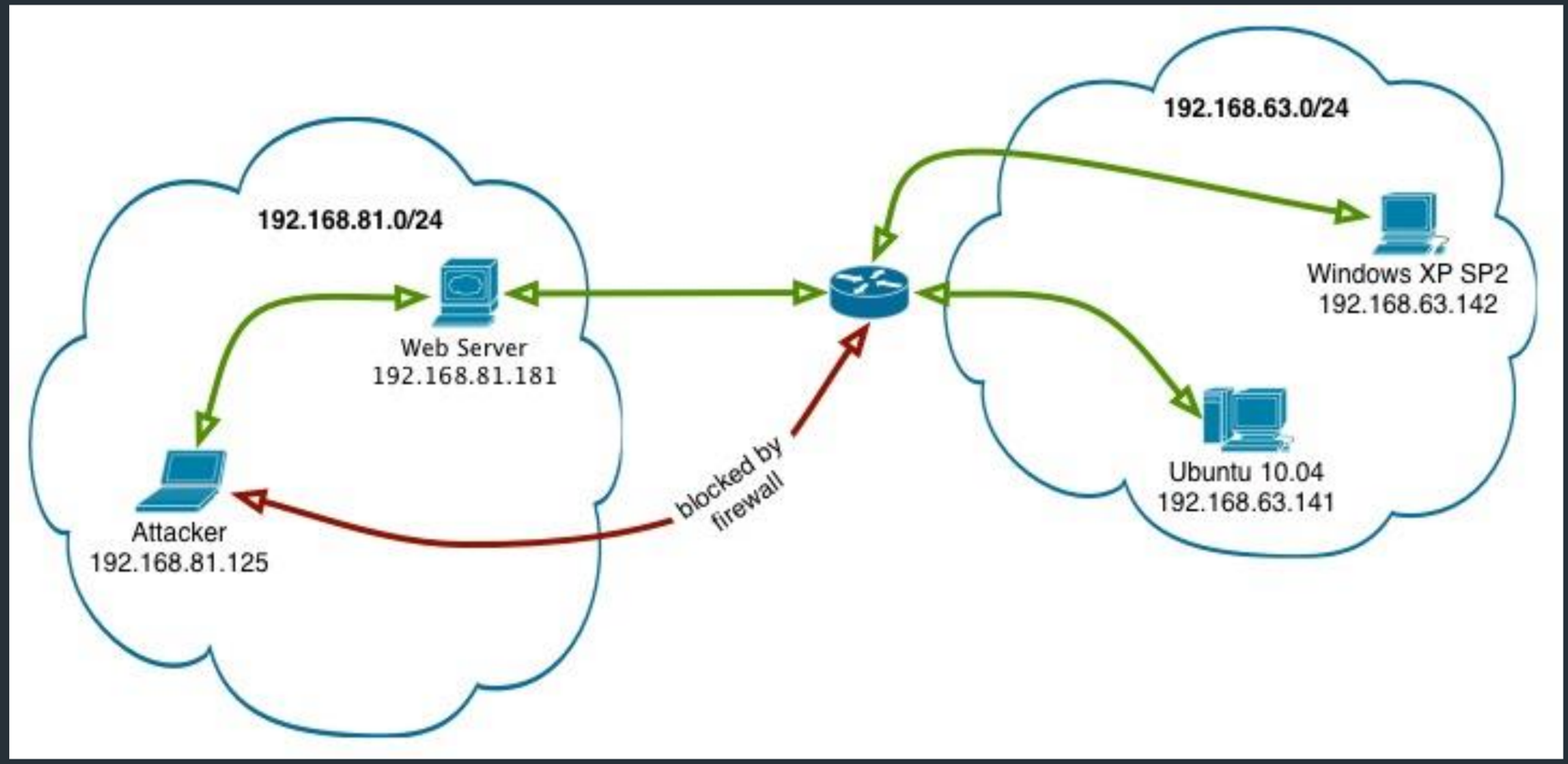
Pivoting



https://blog.techorganic.com/2012/10/06/introduction-to-pivoting-part-1-ssh/

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Pivoting Techniques

Tunnel over:

+ VPN
+ SSH – port forwarding or SOCKS proxy
+ HTTP CONNECT proxy
+ …

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Escalation in Windows Domains

Active Directory

+ Centralised management for windows networks
+ Domain controller – server controlling authentication/authorisation
+ Domain admin – Admin on all systems within the domain

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Get Domain Admin, ???, Profit!

+ Identify domain admin accounts
+ Find active domain admin sessions
+ Gain administrative access on those systems
+ Steal their credentials or tokens

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Identifying Target Users and Systems

Can be done manually

+ Net user – find domain admins
  `net user “domain admins” /domain`

+ Net view – find all machines in the domain
  `net view /domain`

+ netsess.exe – who’s logged in on a machine?
  `netsess.exe \\<host>`

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PowerView

Automates most of this

+ Invoke-CheckLocalAdminAccess - Check if user is local admin on specified machine

```
Invoke-CheckLocalAdminAccess -ComputerName sqlserver
```

+ Invoke-UserHunter - Find where a user's logged in

```
Invoke-UserHunter -UserName "John Smith"
```

+ Invoke-UserHunter - Find all domain admin sessions where current user has admin access

```
Invoke-UserHunter -CheckAccess
```

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Bloodhound

Enumerate windows domains and identify multi-hop paths to domain admin automatically

+ Collect data with the powershell ingestor
+ Load collected data into Bloodhound
+ Review graph for escalation routes

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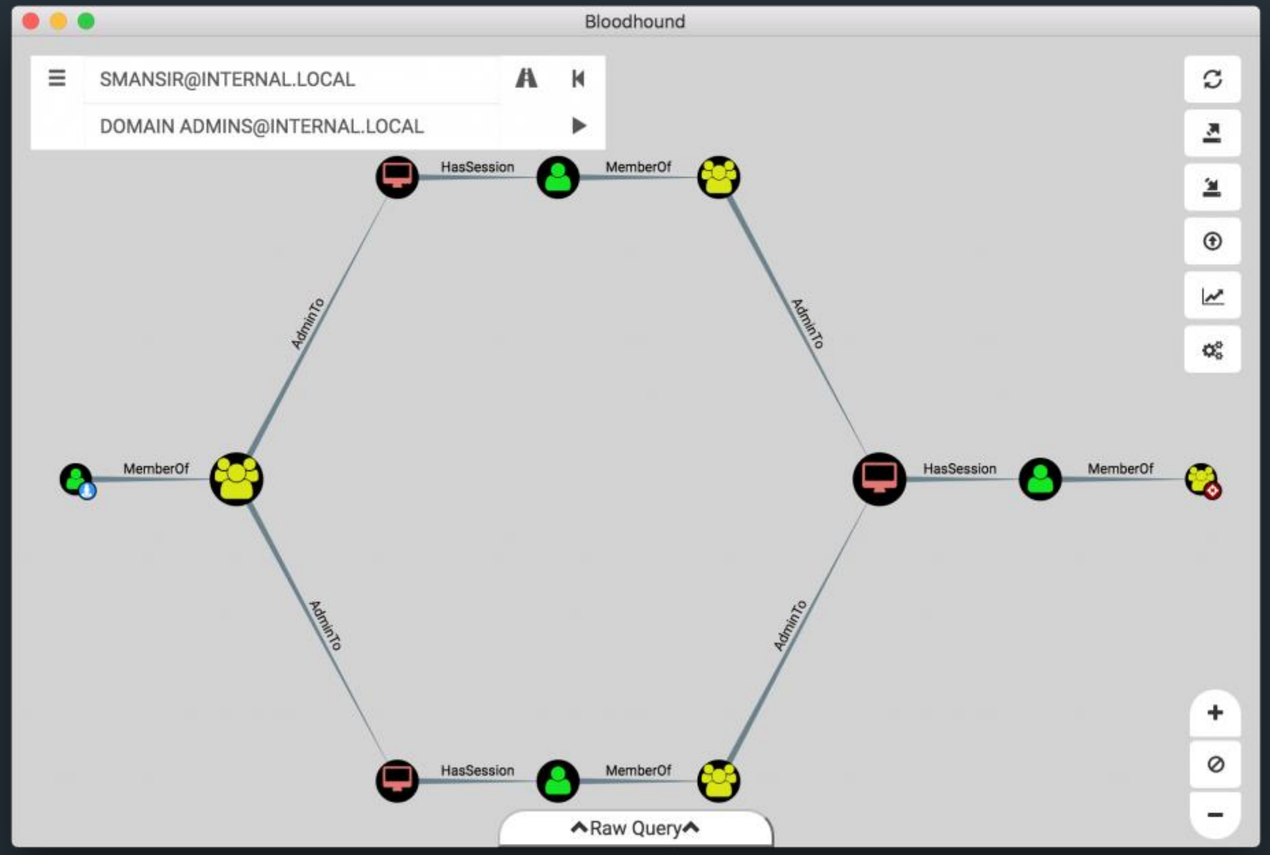
Bloodhound



https://wald0.com/?p=68

Privilege Escalation

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Bloodhound

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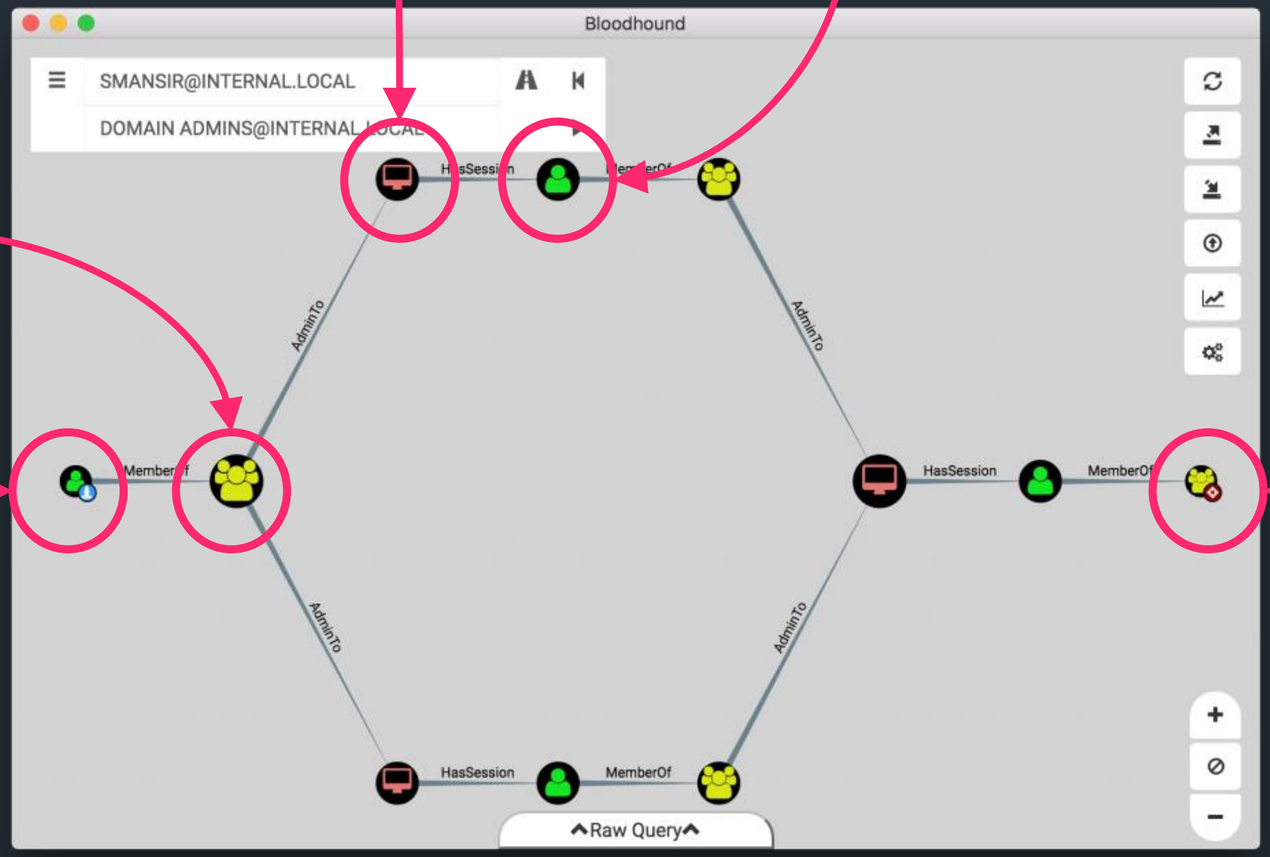

https://wald0.com/?p=68

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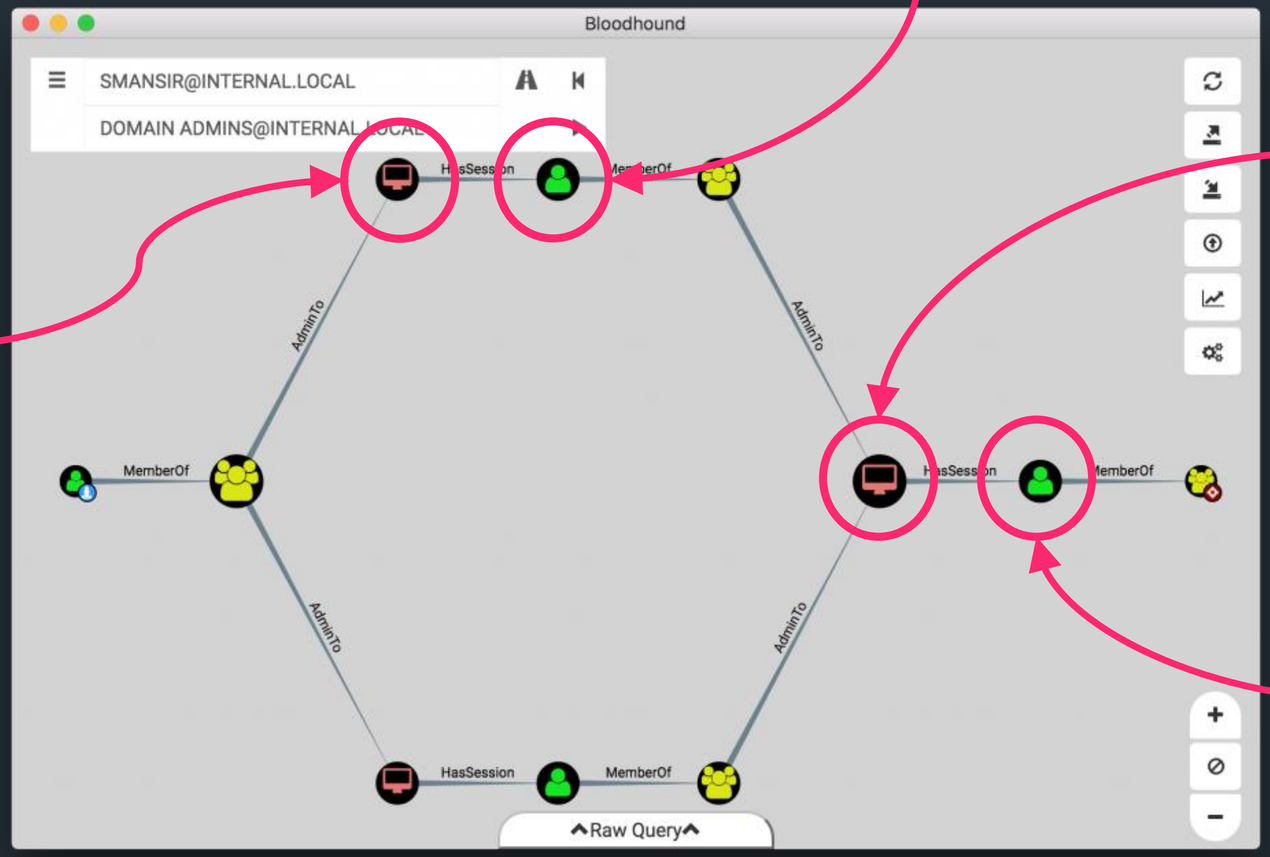
Bloodhound

Steal their credentials

Login here with initial creds

Login here with stolen creds

Domain Admin



https://wald0.com/?p=68

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Pass-The-Hash

Some Windows Protocols allow authentication via hash rather than passwords

1. Compromise host
2. Acquire hashes
3. Transmit hashes as part of authentication requests to services using NTLM authentication

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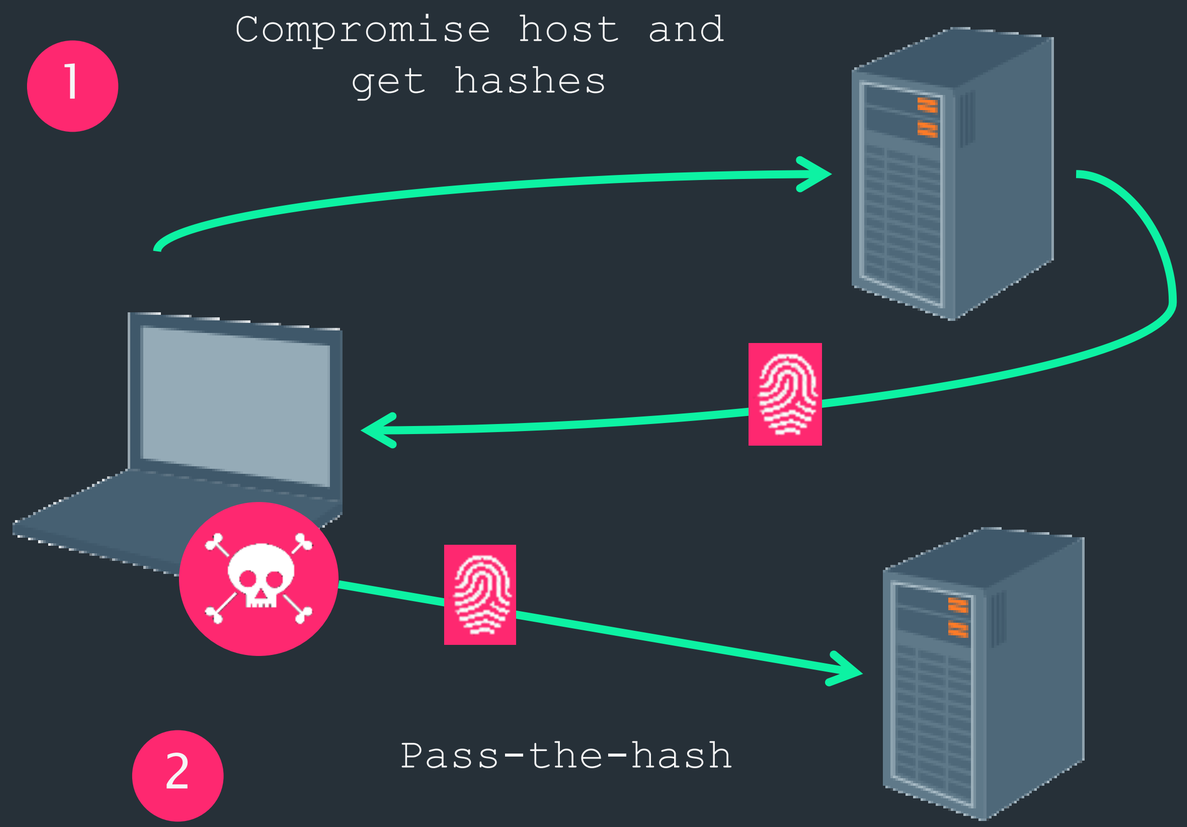
Pass-The-Hash



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Credential Theft – Mimikatz

"A little tool to play with Windows security"

Mimikatz can dump passwords from different sources:

+ Terminal Services
+ Wdigest
+ Kerberos (Domain Authentication)
+ Windows Live

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Credential Theft – Mimikatz

"A little tool to play with Windows security"

+ Extract plaintext passwords, hashes and Kerberos tickets from memory.

```
mimikatz(powershell) # sekurlsa::logonpasswords

Authentication Id : 0 ; 911306 (00000000:000de7ca)
Session           : Interactive from 3
User Name         : lukeskywalker
Domain            : ADSECLAB
SID               : S-1-5-21-1581655573-3923512380-696647894-2629
        msv :
         [00000003] Primary
         * Username : LukeSkywalker
         * Domain   : ADSECLAB
         * LM       : 3c0978ad4d3672cebe5ef0f17c30ad5e
         * NTLM     : 177af8ab46321ceef22b4e8376f2dba7
         * SHA1     : e1e310802741223f486f661032e1472a308dae3b
        tspkg :
         * Username : LukeSkywalker
         * Domain   : ADSECLAB
         * Password : TheForce99!
        wdigest :
         * Username : LukeSkywalker
         * Domain   : ADSECLAB
         * Password : TheForce99!
        kerberos :
         * Username : lukeskywalker
         * Domain   : LAB.ADSECURITY.ORG
         * Password : TheForce99!
        ssp :
        credman :
```

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Escalation in Windows Domains

+ In this example, accounts are always admin on target system

+ If not? Escalate your privileges on each system.

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Useful Resources

+ Vulnhub – Vulnerable VMs
  https://www.vulnhub.com/

+ All Roads Lead to SYSTEM
  https://labs.mwrinfosecurity.com/publications/windows-services-all-roads-lead-to-system/

+ g0tmi1k's Basic Linux Privilege Escalation
  https://blog.g0tmi1k.com/2011/08/basic-linux-privilege-escalation/

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Thanks for listening!

Questions?

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Tool References – Web Apps

+ Burp Suite – https://portswigger.net/burp/
+ ZAP (Zed Attack Proxy) – https://www.owasp.org/index.php/OWASP_Zed_Attack_Proxy_Project
+ NMAP – https://nmap.org/
+ Nikto – https://github.com/sullo/nikto
+ Arachni – http://www.arachni-scanner.com/
+ Netsparker – https://www.netsparker.com/web-vulnerability-scanner/

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Tool References - Windows

+ Sysinternals - https://technet.microsoft.com/en-gb/sysinternals/bb545021.aspx
+ Sysinternals Suite - https://technet.microsoft.com/en-gb/sysinternals/bb842062
+ Powersploit - https://github.com/PowerShellMafia/PowerSploit
+ Windows Exploit Suggester - https://github.com/GDSSecurity/Windows-Exploit-Suggester
+ Windows-privesc-check - https://github.com/pentestmonkey/windows-privesc-check
+ Netsess.exe - http://www.joeware.net/freetools/tools/netsess/index.htm
+ Bloodhound - https://github.com/BloodHoundAD/BloodHound

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Tool References - Linux

+ Metasploit - https://github.com/rapid7/metasploit-framework
+ LinuxPrivChecker - https://www.securitysift.com/download/linuxprivchecker.py
+ Unix-privesc-check - https://github.com/pentestmonkey/unix-privesc-check
+ LinEnum - https://github.com/rebootuser/LinEnum