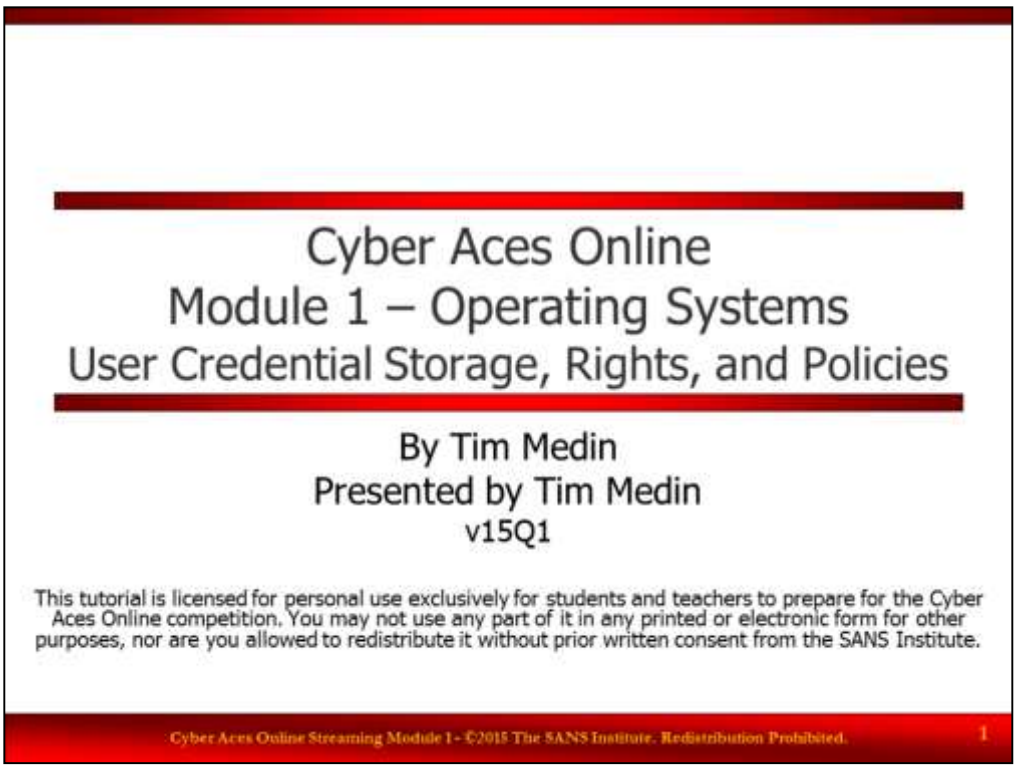
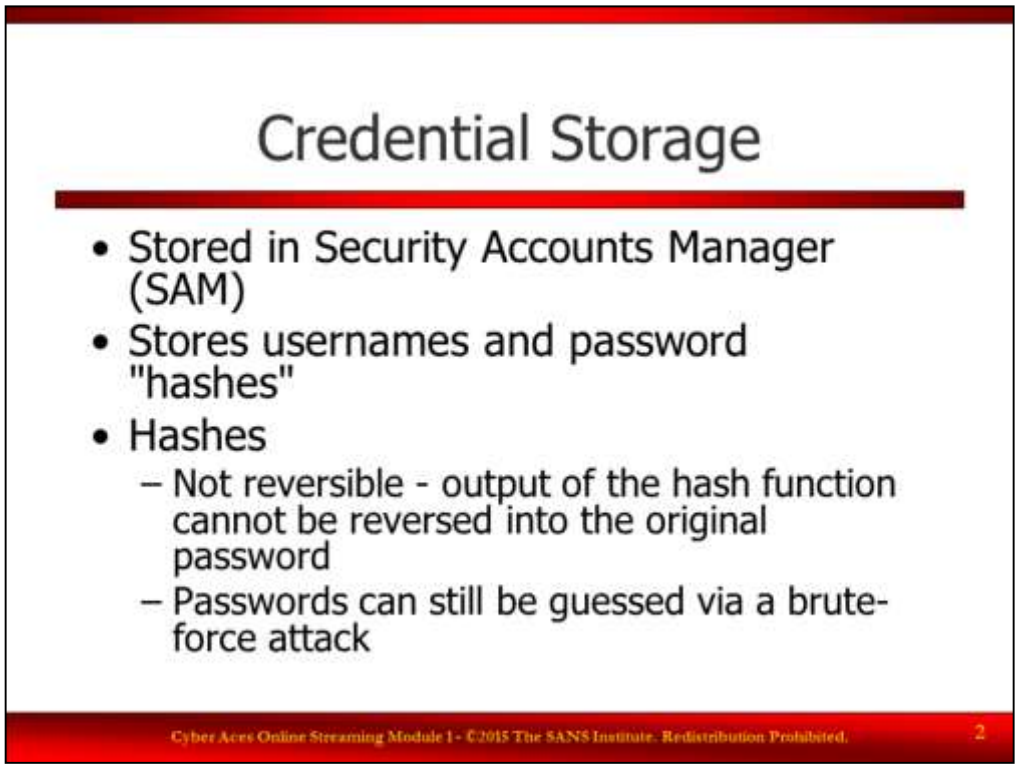
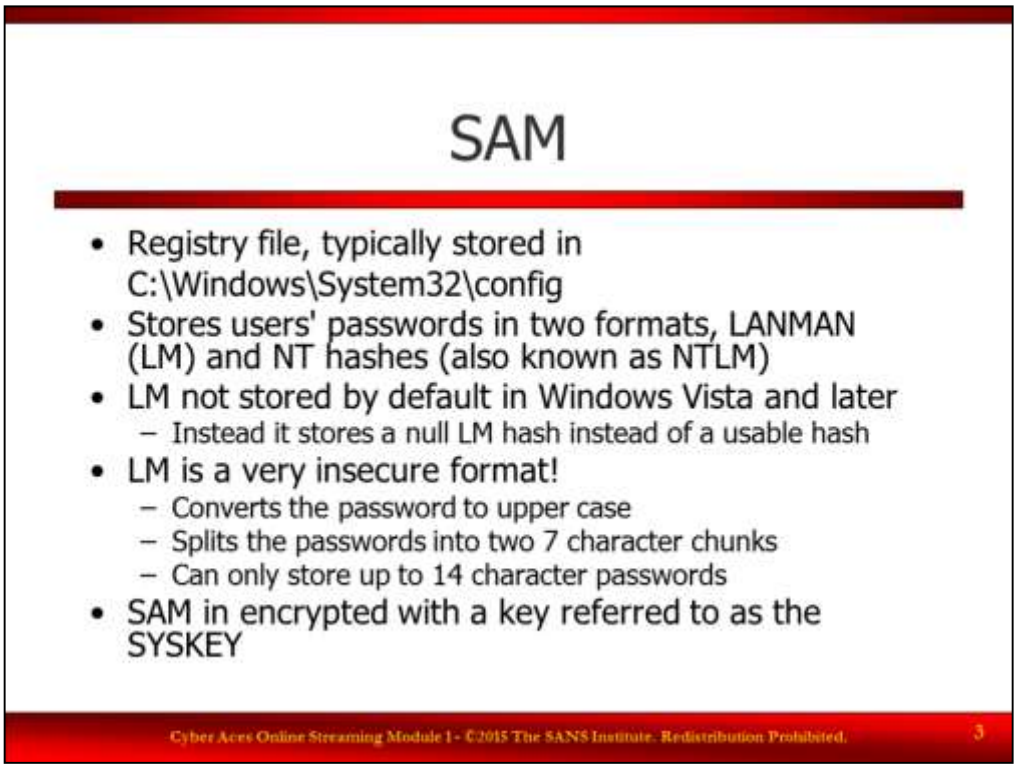


Welcome to Cyber Aces Online, Module 1! A firm understanding of operating systems is essential to being able to secure or attack one. This module dives in to Microsoft Windows Operating System and user information; specifically, credential storage, rights and policies.



Credential Storage

Windows employs a technology known as Security Accounts Manager (SAM) to manage user credentials. User account names and hashed passwords are saved to SAM. The SAM database is located in the directory c:\windows\system32\config\. SAM data also resides in the registry under HKEY_LOCALMACHINE\SAM.

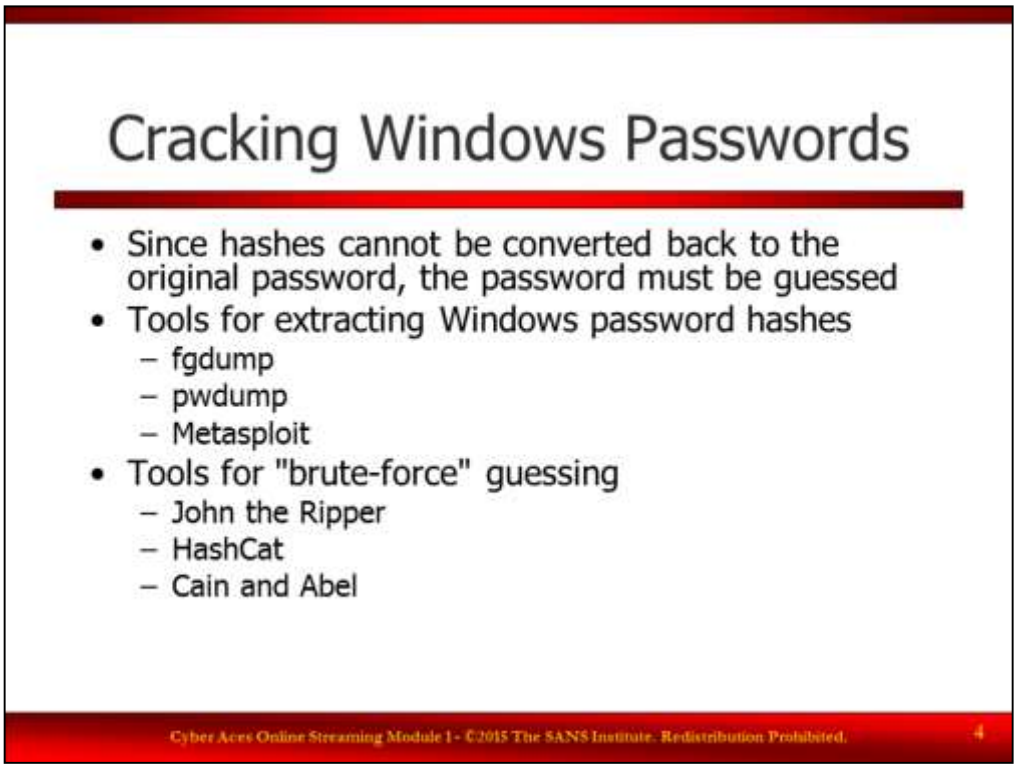


SAM

Windows employs a technology known as Security Accounts Manager (SAM) to manage user credentials. User account names and encrypted passwords are saved to SAM. The SAM database is located in the directory C:\windows\system32\config\. SAM data also resides in the registry under HKEY_LOCALMACHINE\SAM.

The LM password hash is very insecure given today's modern computing power. It takes the password and converts it to upper case (losing the additional entropy offered by mixing case) and splits the password into two 7 character chunks. This means a 12 character password would effectively be split into a 7 character and a 5 character passwords, significantly weakening the password hash.

Windows stores the password in two formats, NTLM and LANMAN (commonly referred to as LM). Neither password format uses a salt, so precomputation attacks are possible.

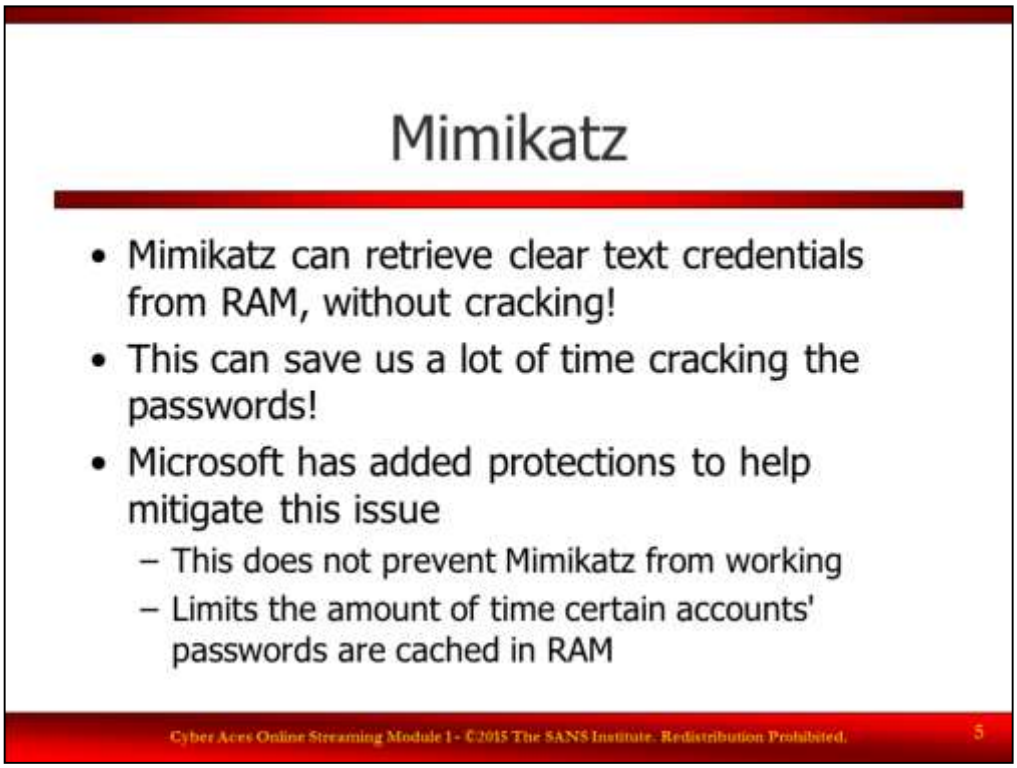


Cracking Windows Passwords

Hashes cannot be reversed into the original clear text, but we can guess a password, hash it, and check if the two hashes match. We could try a list of common passwords, dictionary words, and mangled versions (i.e. appending a 1, 2, 3) as guesses for our password. We could also try all possible passwords, starting with a → z, aa → az, etc. This is called a brute force attack. According to Wikipedia (https://en.wikipedia.org/wiki/Brute-force_attack): "In cryptography, a brute-force attack, or exhaustive key search, is a strategy that can, in theory, be used against any encrypted data. Such an attack might be utilized when it is not possible to take advantage of other weaknesses in an encryption system (if any exist) that would make the task easier. It involves systematically checking all possible keys until the correct key is found. In the worst case, this would involve traversing the entire search space."

There are a few common ways of extracting passwords: Metasploit's hashdump, fgdump, and pwdump. The tools listed above that are used for extracting password hashes also retrieve the SYSKEY so the SAM can be decrypted. The SYSKEY does not decrypt the passwords themselves, but decrypts the file that contains the hashes.

Once we have acquired the password hashes, we can crack the password with a number of different tools. The most common password cracking tools include John the Ripper, HashCat, and Cain and Abel.



Mimikatz

Mimikatz is a tool that can extract passwords from RAM for most logged in users. This is a tremendous benefit for penetration testers, but it is also very useful for malicious attackers. The tool was initially released in 2012 and has since been integrated into the Metasploit framework.

Recently, Microsoft released a patch that will more quickly clear the credentials from RAM when a user logs off, reducing the window of opportunity where Mimikatz can be used.

Mimikatz is written by Benjamin Delpy (gentilkiwi) and is available at http://blog.gentilkiwi.com/mimikatz.

Windows Passwords Review

- Which two hash formats does SAM store user passwords in?
  - LANMAN and NTLM
  - Whirlpool and CRC32
  - MD5 and SHA1
  - DES and MD4
- You have confirmed LANMAN is in use on your computer system. How can you prevent LANMAN hashes from being stored without disabling LANMAN on your system?
  - Change your password to be longer than 14 characters
  - Configure Automatic Updates to install optional updates
  - LANMAN must be allowed on all Windows systems
  - Install the latest Service Pack

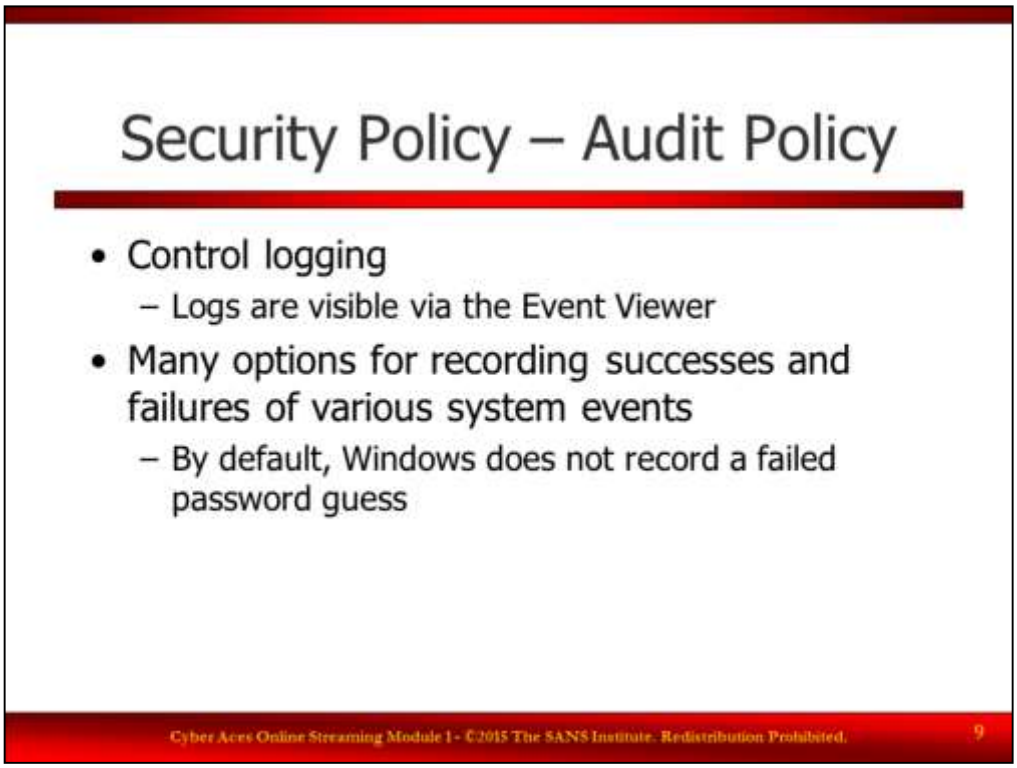
Answers

- Which two hash formats does SAM store user passwords in?
  - **LANMAN and NTLM**
  - The LANMAN and NTLM hashes are stored in the SAM and are encrypted with the SYSKEY

- You have confirmed LANMAN is in use on your computer system. How can you prevent LANMAN hashes from being stored without disabling LANMAN on your system?
  - **Change your password to be longer than 14 characters**
  - The LANMAN (a.k.a. LM) hashes can only store a password that is 14 characters or shorter

User Rights & Security Policies

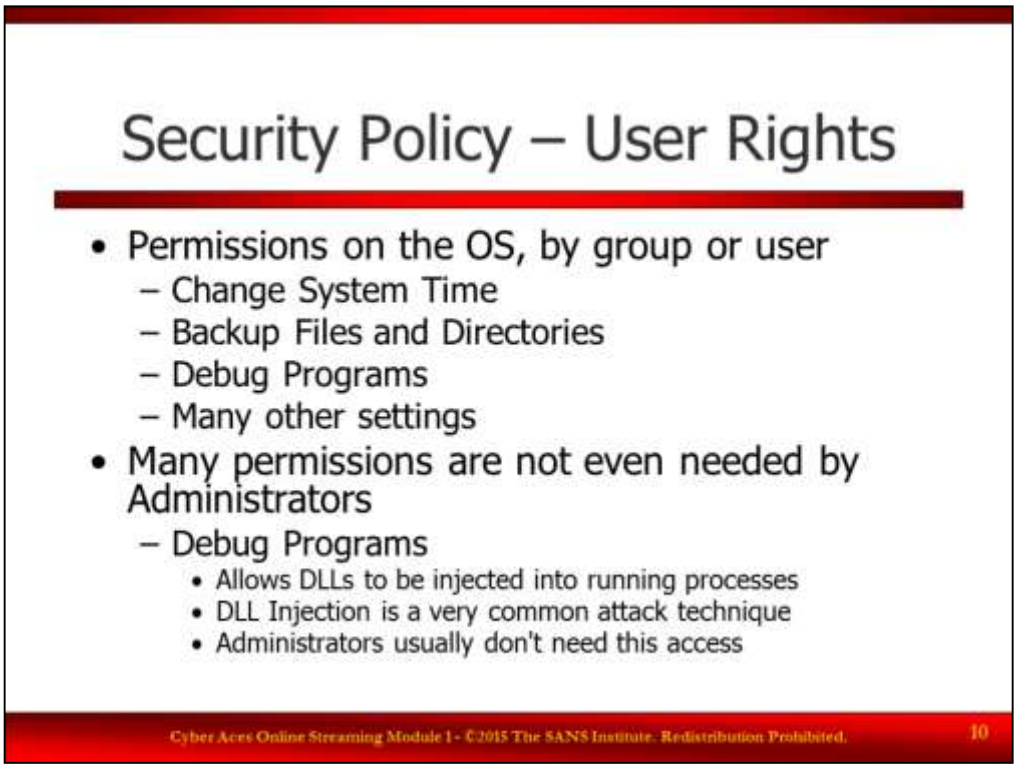
In addition to File and Directory permissions, user accounts and groups are granted specific permissions in the Operating System. These permissions are configured inside of "Security Policies" and are configured using the "Local Security Policy" MMC console snap-in. In large networks these policies are centrally managed by "Group Policies" and automatically enforced on all computers on that network. Security Policies are broken down into three major parts: Audit Policy, User Rights and Security Options.



Security Policy – Audit Policy

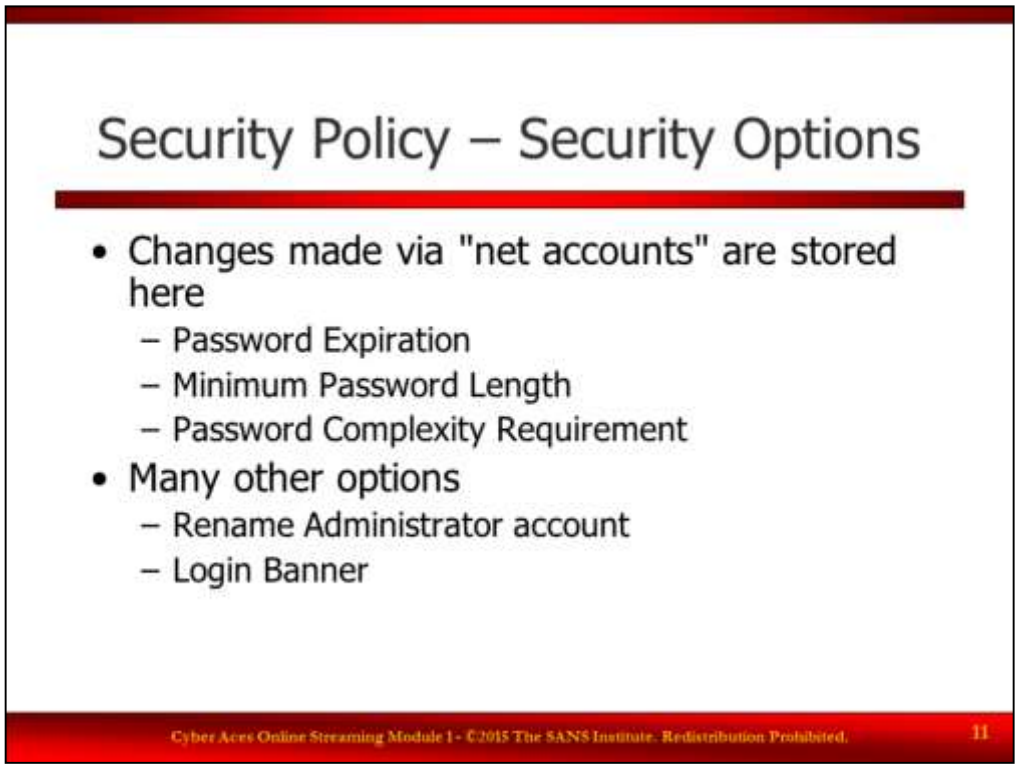
The Audit Policy is used to control what gets logged in the Event Viewer. By default, the Windows Operating System does not record when a user enters the password incorrectly. Attackers LOVE the fact that we don't record when they try to guess our passwords and fail! But they love it even more when we don't record that they successfully guessed our passwords. Within the Audit Policy we tell Windows which failures and successes we want recorded in the event log. Once you turn on event logging in the Audit policy, you can control the logging of events for groups or users by changing the ACLs on the AUDIT tab of an object

*Note: Secpol.msc is not available on Home versions of Windows.



Security Policy – User Rights

"User Permissions" include the ability to "Change System Time" and "Backup Files and Directories". Several of these OS permissions are very important to control. For example, "Debug Programs" allows the user to inject DLL's into the memory of running programs and pause the execution of a program. These two steps are often used by attackers to do "DLL injection". Attackers use DLL injection to hide their malicious code inside of other programs and alter the way our user mode applications behave. By default, this permission is granted to all members of the Administrators group. If you're properly controlling members of the administrators group, then no one will have "debug" permissions during their daily operation of the computer. However, if administrative privileges are commonly granted to normal users, removing the "Debug Programs" permissions from the administrators group is a good idea.



Security Policy – Security Options

The third part of the Security Policy is known as the "Security Options". This is where you set things like the minimum required password length, the frequency at which passwords must be changed, and the ability to rename the Administrator account.

Security Policy Review

- In which section of the Local Security Policy do you grant a user the ability to change the time zone?
  - Audit Policy
  - Administrative Templates
  - User Rights Assignment
  - Security Options
- In which section of the Local Security Policy do you control whether CTRL-ALT-DEL is required before you login?
  - Administrative Templates
  - Security Options
  - Audit Policy
  - User Rights Assignment

Answers

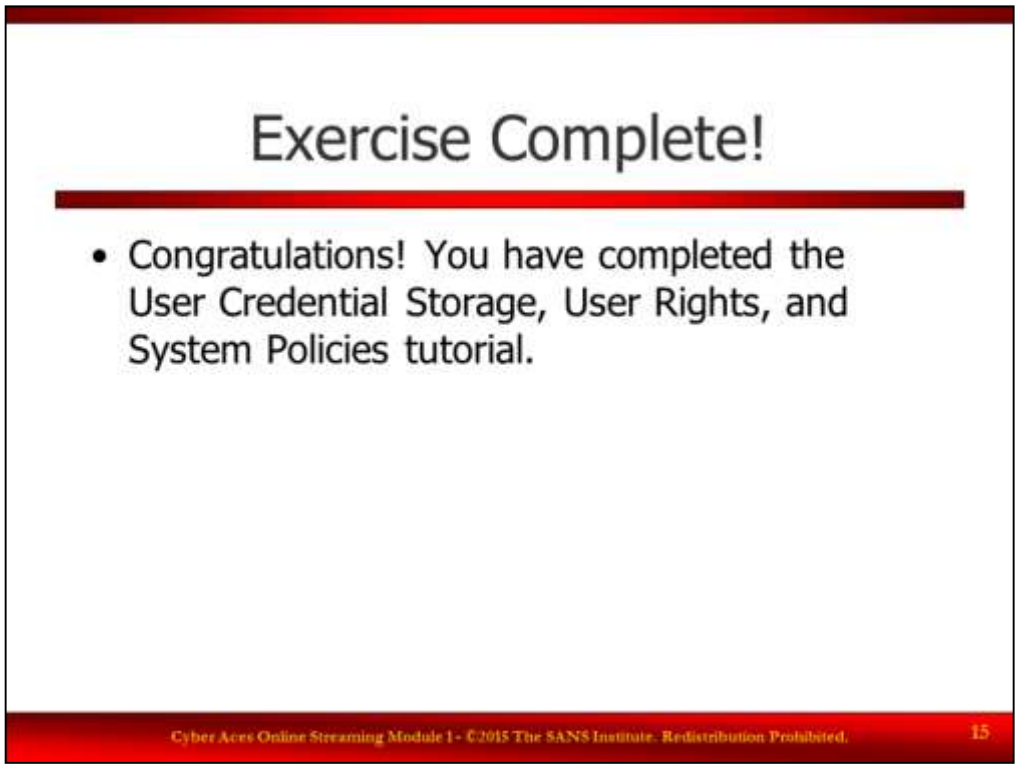
- In which section of the Local Security Policy do you grant a user the ability to change the time zone?
  - User Rights Assignment
  - This policy is used to specify which users or groups have OS permissions, such as logon and task privileges, on the sytem

- In which section of the Local Security Policy do you control whether CTRL-ALT-DEL is required before you login?
  - Security Options
  - Enables or disabled security settings on the system

Exercise

- Examine the account settings on your system and answer these questions:
  - When do the passwords expire?
  - How many bad passwords will trigger a lockout?
  - When a lockout occurs, how long will it last?
  - What is the minimum password length?

- Note: If you are using the VM, you are looking at the default settings in Windows



Exercise Complete

Congratulations, you have completed the tutorial on the Windows user credential storage, user rights, and system policies.