How Criminals Breach your Azure Environment

Marco Schmidt & Manuel Meyer

whoami - Marco

- Security Engineer @ GrabX Solutions
- Working with customers to protect their cloud environments
- Bern, Switzerland
- Like to break things
- thesecurityguy.ch

Introduction

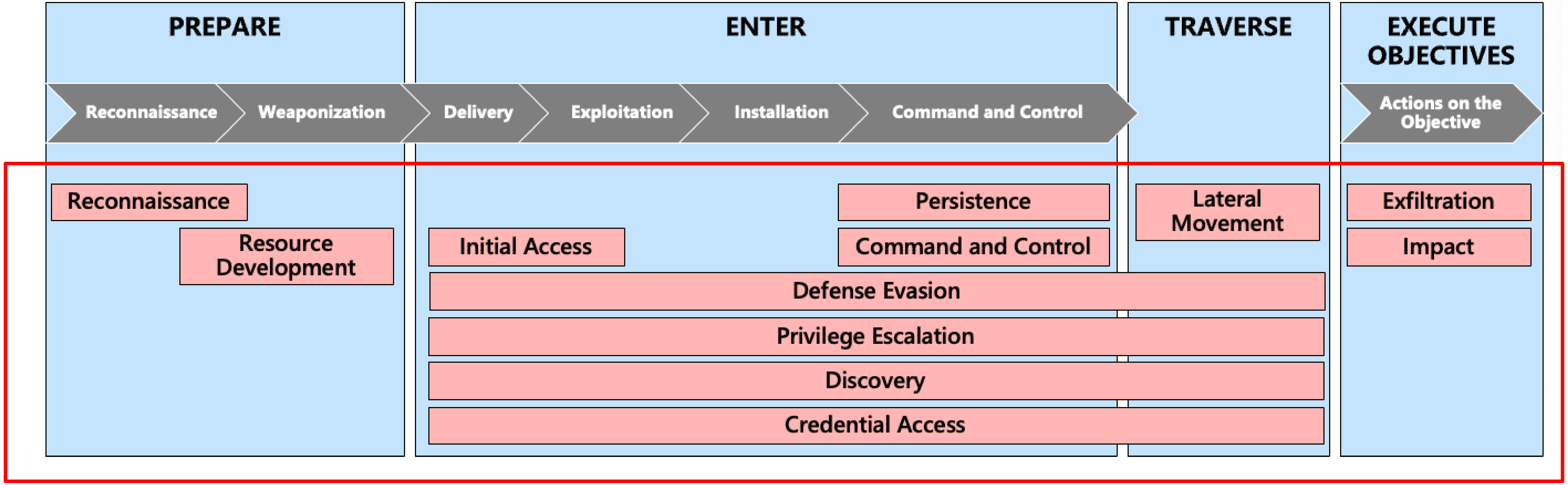
- Fictional Scenario of **Attack Kill Chain** in the Cloud
- All techniques are **valid attack techniques** and have been **used by threat actors in the past**
- Scenario has been **simplified** to fit the session
- REMEMBER:

With great power comes great responsibility! 💪

Attack Chain Models

Describe stages of an attack

PETE	Simple model for business leaders and other non-technical stakeholders
MITRE ATT&CK Framework	Detailed model for technical detection coverage assessments and planning
Lockheed Martin Kill Chain	Legacy Reference Model (missing lateral traversal)



PREPARE

ENTER

TRAVERSE

EXECUTE OBJECTIVES

Reconnaissance

Weaponization

Delivery

Exploitation

Installation

Command and Control

Actions on the Objective

Reconnaissance

Resource Development

Initial Access

Persistence

Command and Control

Lateral Movement

Exfiltration

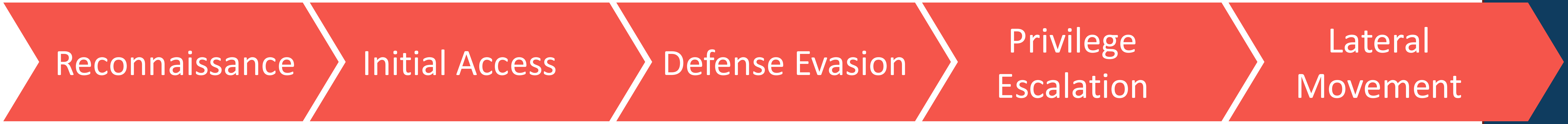
Impact

Defense Evasion

Privilege Escalation

Discovery

Credential Access



Reconnaissance

Initial Access

Defense Evasion

Privilege Escalation

Lateral Movement

-> Find Passwords

-> User Enumeration

-> Password Spray

-> Conditional Access Bypass

-> Abusing Dynamic Groups

-> Abusing VM Contributor Role

Reconnaissance

Find Passwords

How do Hackers get your Passwords?

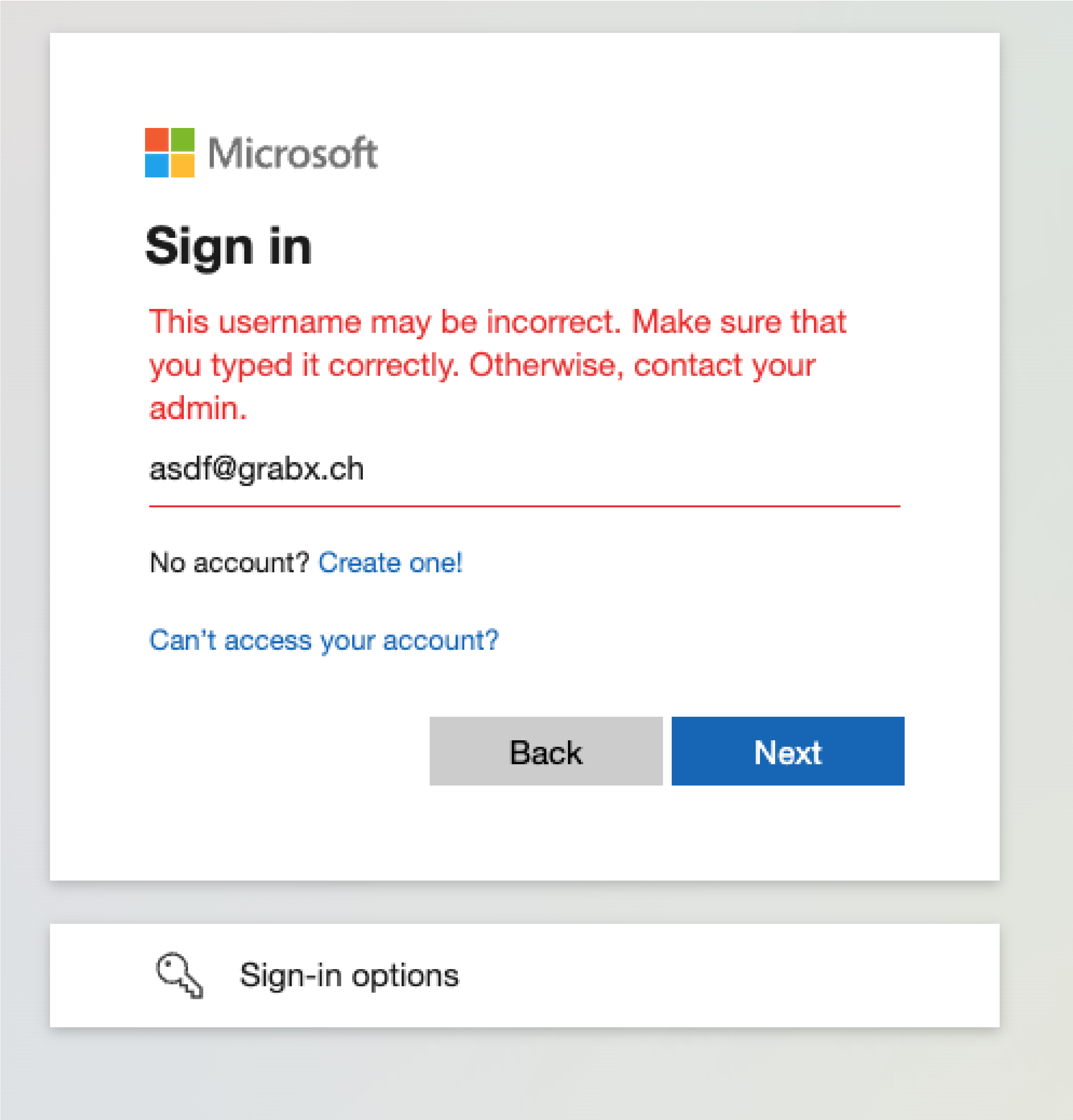
- Open Source Intelligence (OSINT)
- Phishing
- Darkweb
- Dumpster Diving
- Password Attacks
- Malware
- Etc.

Find Passwords

How can you protect against this?

- Use Passkeys
- Entra ID Smart Lockout
- M365 Defender Suite
- User Awareness Training
- Most important: Brain.exe

User Enumeration



Microsoft

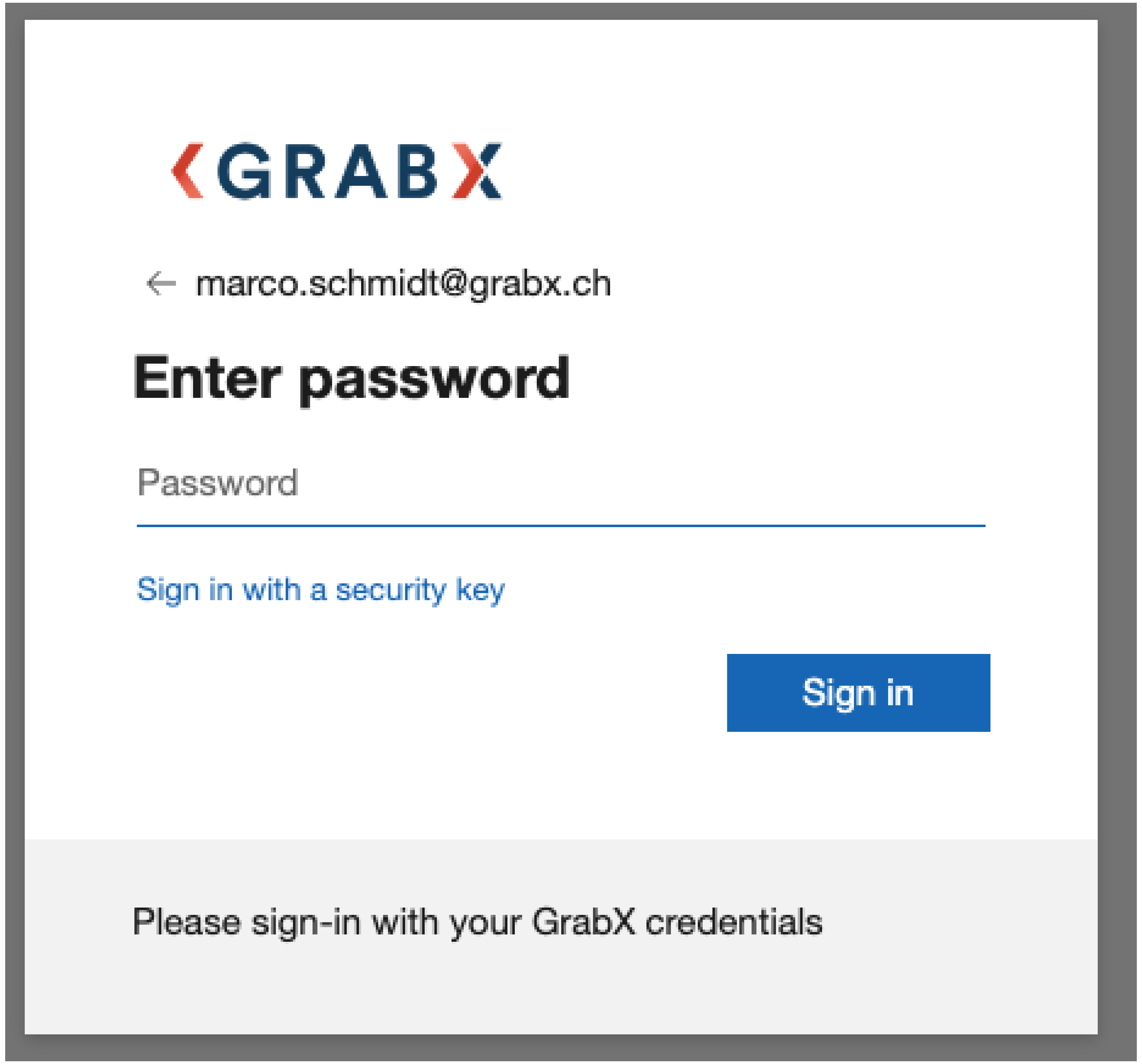
Sign in

This username may be incorrect. Make sure that you typed it correctly. Otherwise, contact your admin.

asdf@grabx.ch

No account? Create one!

Can't access your account?



GRABX

← marco.schmidt@grabx.ch

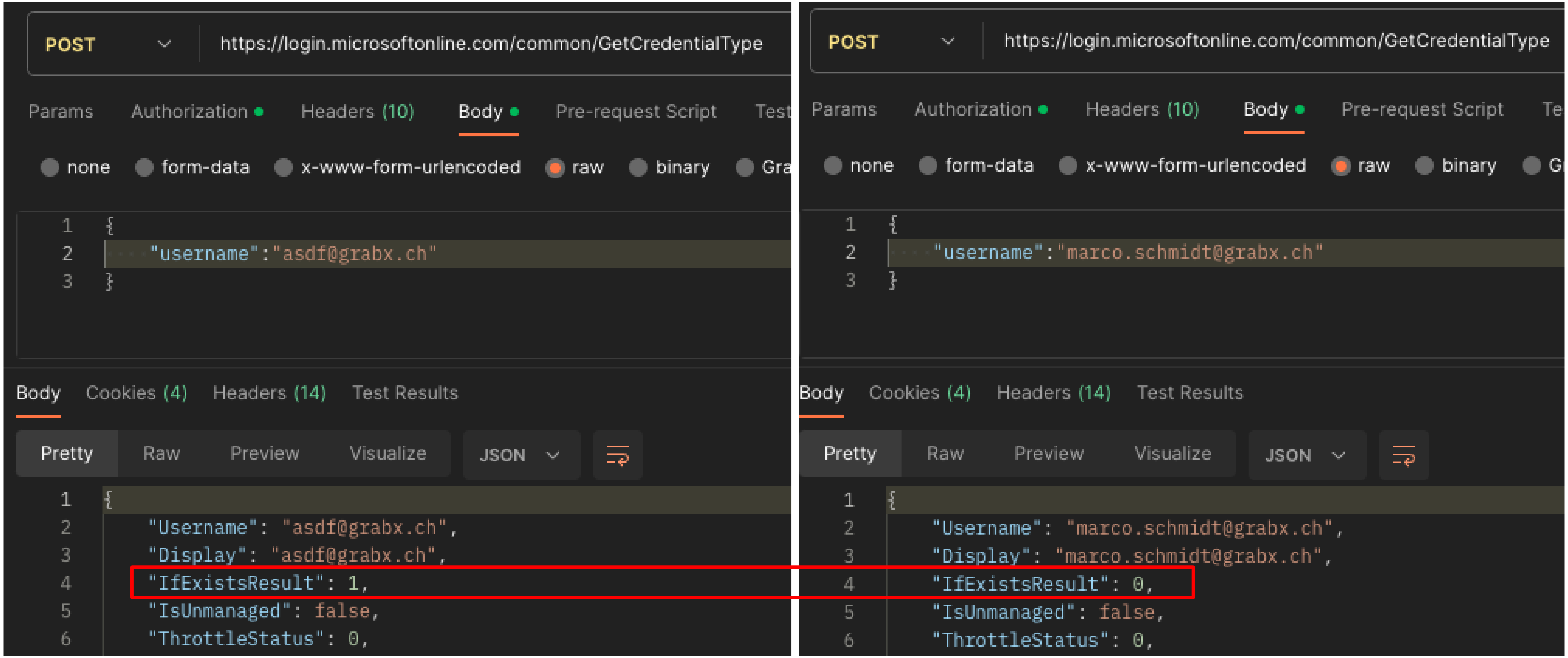
Enter password

Password

Sign in with a security key

Please sign-in with your GrabX credentials

User Enumeration



https://login.microsoftonline.com/common/GetCredentialType

```
{
    "username":"asdf@grabx.ch"
}
```

```
{
    "Username": "asdf@grabx.ch",
    "Display": "asdf@grabx.ch",
    "IfExistsResult": 1,
    "IsUnmanaged": false,
    "ThrottleStatus": 0,
```

https://login.microsoftonline.com/common/GetCredentialType

```
{
    "username":"marco.schmidt@grabx.ch"
}
```

```
{
    "Username": "marco.schmidt@grabx.ch",
    "Display": "marco.schmidt@grabx.ch",
    "IfExistsResult": 0,
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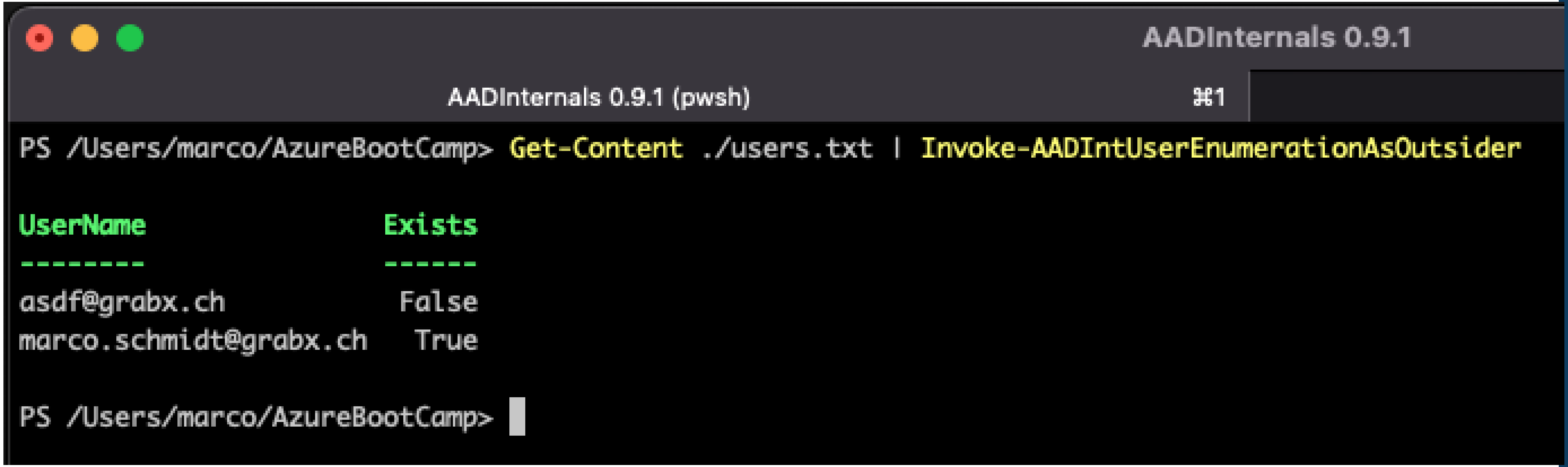
    "ThrottleStatus": 0,
```

User Enumeration



```
PS /Users/marco/AzureBootCamp> Get-Content ./users.txt | Invoke-AADIntUserEnumerationAsOutsider

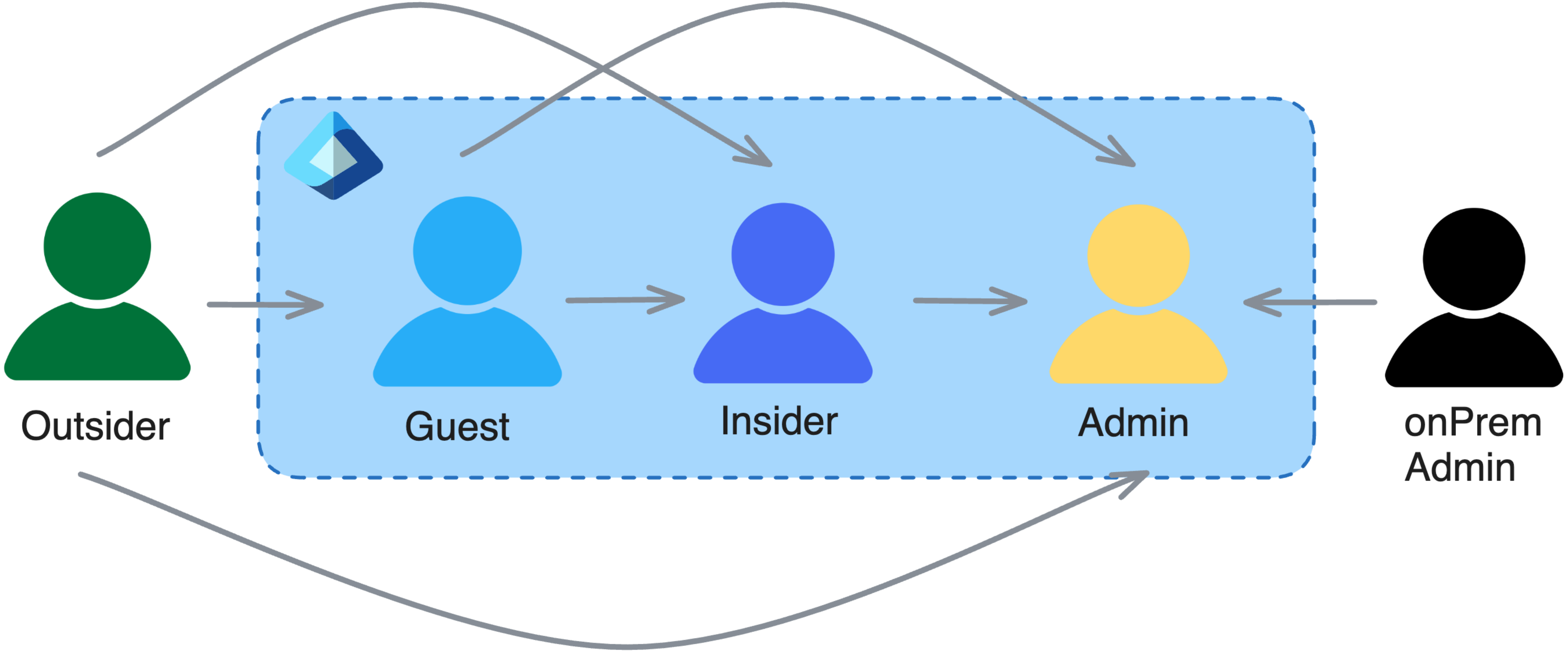
UserName                Exists
---------               ------
asdf@grabx.ch            False
marco.schmidt@grabx.ch    True

PS /Users/marco/AzureBootCamp>
```

AADInternals

- First Released in 2018 by Security Researcher Dr. Nestory Syynimaa
- “The ultimate Azure AD / Microsoft 365 hacking and admin toolkit”
- License: Creative Commons

AADInternals
Kill chain roles



AADInternals

Azure AD and Microsoft 365 kill chain

	Recon	Compromise	Persistence	Actions on Intent
Outsider	Get-AADIntTenantDomains Get-AADIntOpenIDConfiguration Get-AADIntLoginInformation Invoke-AADIntReconAsOutsider Invoke-AADIntUserEnumerationAsOutsider	Invoke-AADIntPhishing		
Guest	Get-AADIntAzureTenants Get-AADIntAzureInformation Get-AADIntSPOSiteUsers Get-AADIntSPOSiteGroups Invoke-AADIntReconAsGuest Invoke-AADIntUserEnumerationAsGuest			
User	Get-AADIntTenantDetails Get-AADIntGlobalAdmins Get-AADIntSyncConfiguration Get-AADIntCompanyInformation Get-AADIntSPOServiceInformation Invoke-AADIntReconAsInsider Invoke-AADIntUserEnumerationAsInsider			New-AADIntBulkPRTToken Join-AADIntDeviceToAzureAD Join-AADIntDeviceToIntune
Admin	Get-AADIntAzureSubscriptions	Grant-AADIntAzureUserAccessAdminRole Set-AADIntAzureRoleAssignment Invoke-AADIntAzureVMScript Register-AADIntPTAAgent Set-UserMFA Set-UserMFAApps	ConvertTo-AADIntBackdoor Set-AADIntPassThroughAuthentication	New-AADIntSAMLToken New-AADIntKerberosTicket Open-AADIntOffice365Portal
On-prem admin		Export-AADIntADFSSigningCertificate Get-AADIntSyncCredentials Set-AADIntUserPassword Install-AADIntPTASpy		New-AADIntSAMLToken New-AADIntKerberosTicket Open-AADIntOffice365Portal

User Enumeration

How can you protect against this?

- You can’t

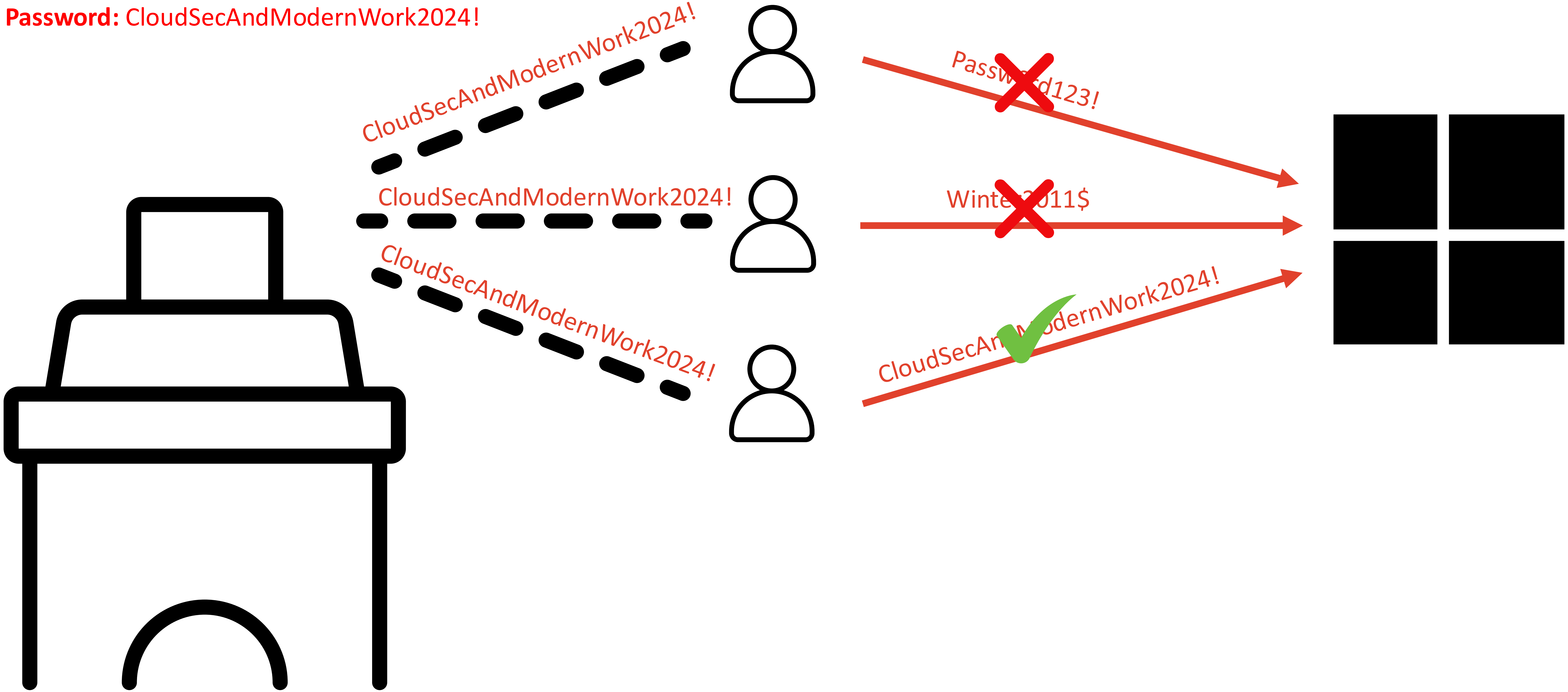
Reconnaissance

Initial Access

Result: Enumerated existing users

Password Spray

Password: CloudSecAndModernWork2024!


CloudSecAndModernWork2024!
CloudSecAndModernWork2024!
CloudSecAndModernWork2024!
Passw✗d123!
Winte✗011$
CloudSecAn✓odernWork2024!

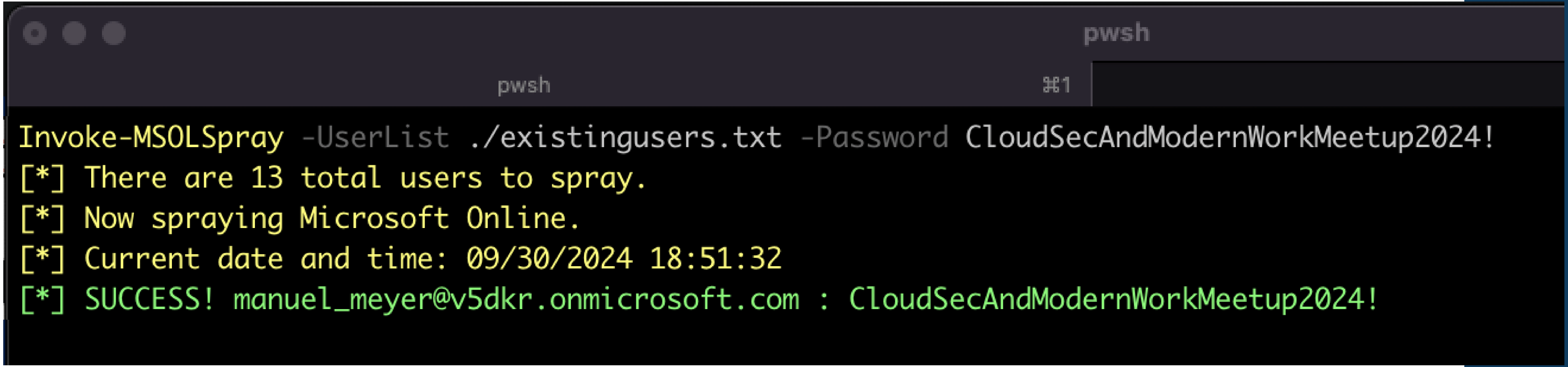
Password Spray

- API Endpoint: https://login.microsoft.com/common/oauth/token
- API Responses:
  - AADSTS50034 -> User doesn’t exist
  - AADSTS50126 -> Invalid password
  - AADSTS50076 or AADSTS50079 -> MFA response
  - AADSTS50057 -> Disabled account
  - AADSTS50055 -> Password expired.

MSOLSpray

- Uses Entra ID Error Codes to find out information about accounts
- Can find out if account has MFA enabled without triggering notifications
- Can use FireProx to rotate source IPs and avoid detection and lockout
- First released in 2020 by Penetration Tester Beau Bullock (MIT License).

MSOLSpray



```
Invoke-MSOLSpray -UserList ./existingusers.txt -Password CloudSecAndModernWorkMeetup2024!
[*] There are 13 total users to spray.
[*] Now spraying Microsoft Online.
[*] Current date and time: 09/30/2024 18:51:32
[*] SUCCESS! manuel_meyer@v5dkr.onmicrosoft.com : CloudSecAndModernWorkMeetup2024!
```

Password Spray

How can you protect against this?

- Make users use strong Passwords
- Use Passwordless Authentication.

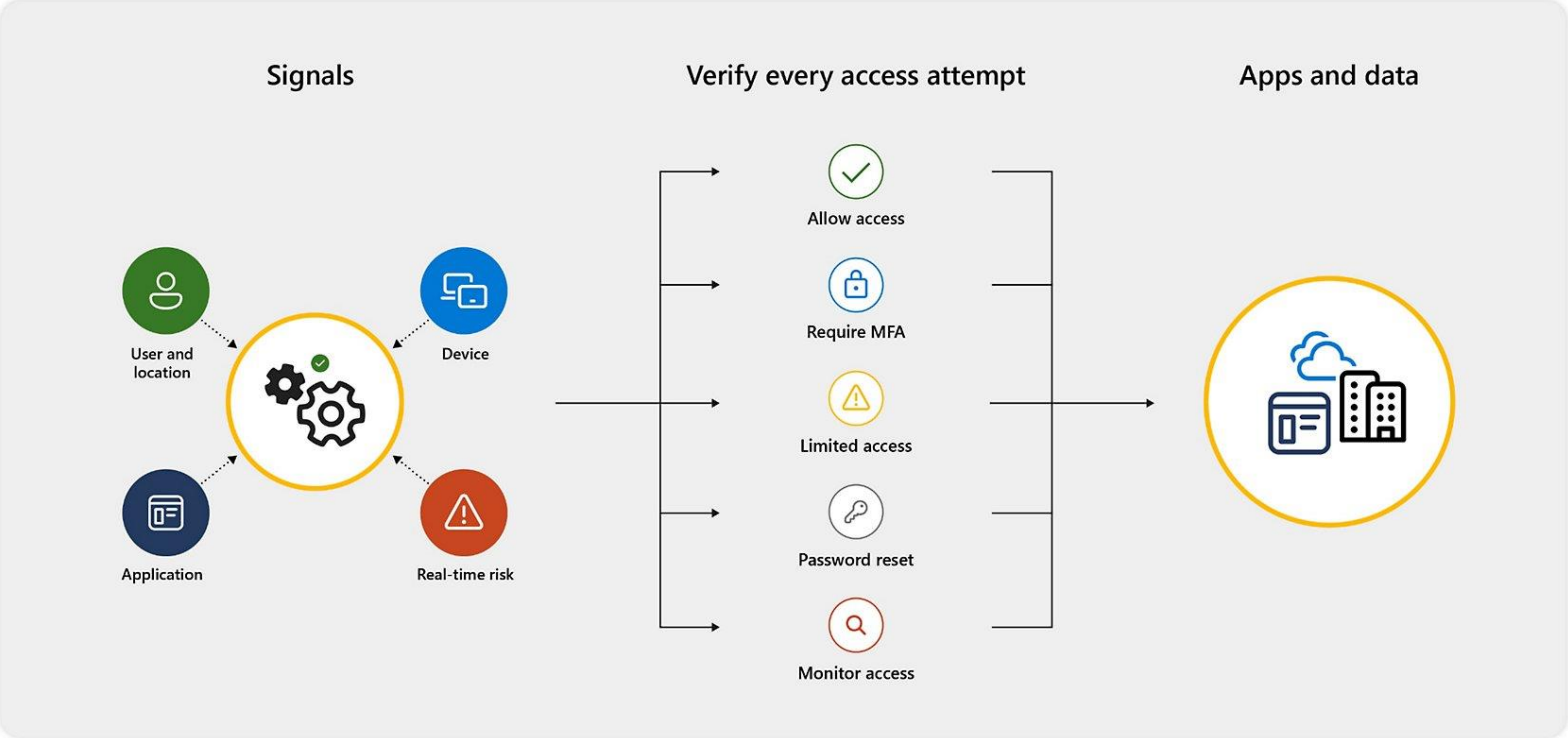
Reconnaissance

Initial Access

Defense Evasion

Result: Found password for Initial Access

Conditional Access Bypass

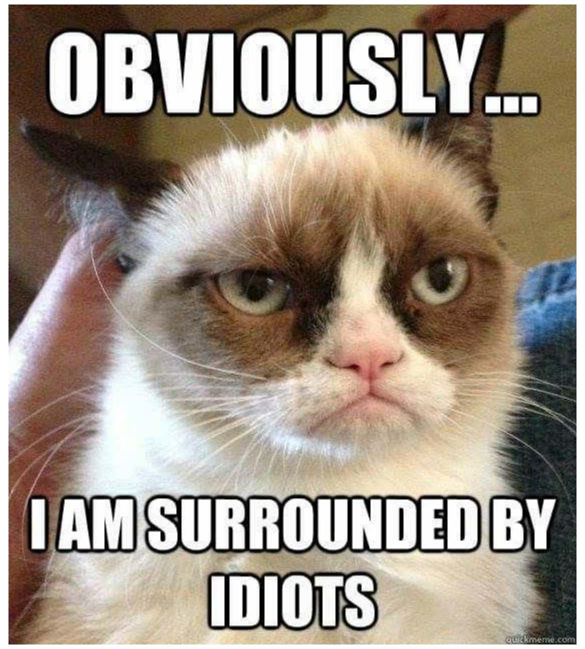


Conditional Access Bypass

- Common Attack Vectors:
  - Location
  - Exclusion Group Abuse
  - Device Platform
  - MITM Attacks (e.g. with Evilginx)
  - MFA Bombing
  - Social Engineering
  - Etc.

Conditional Access Bypass

- Common Attack Vectors:
  - Avoid Conditional Access completely by getting access to an excluded user!
  - Who is typically excluded?
    - BreakGlass Admins
    - Lazy Admins
    - Service Accounts
    - Angry Complaining Users



Conditional Access Bypass

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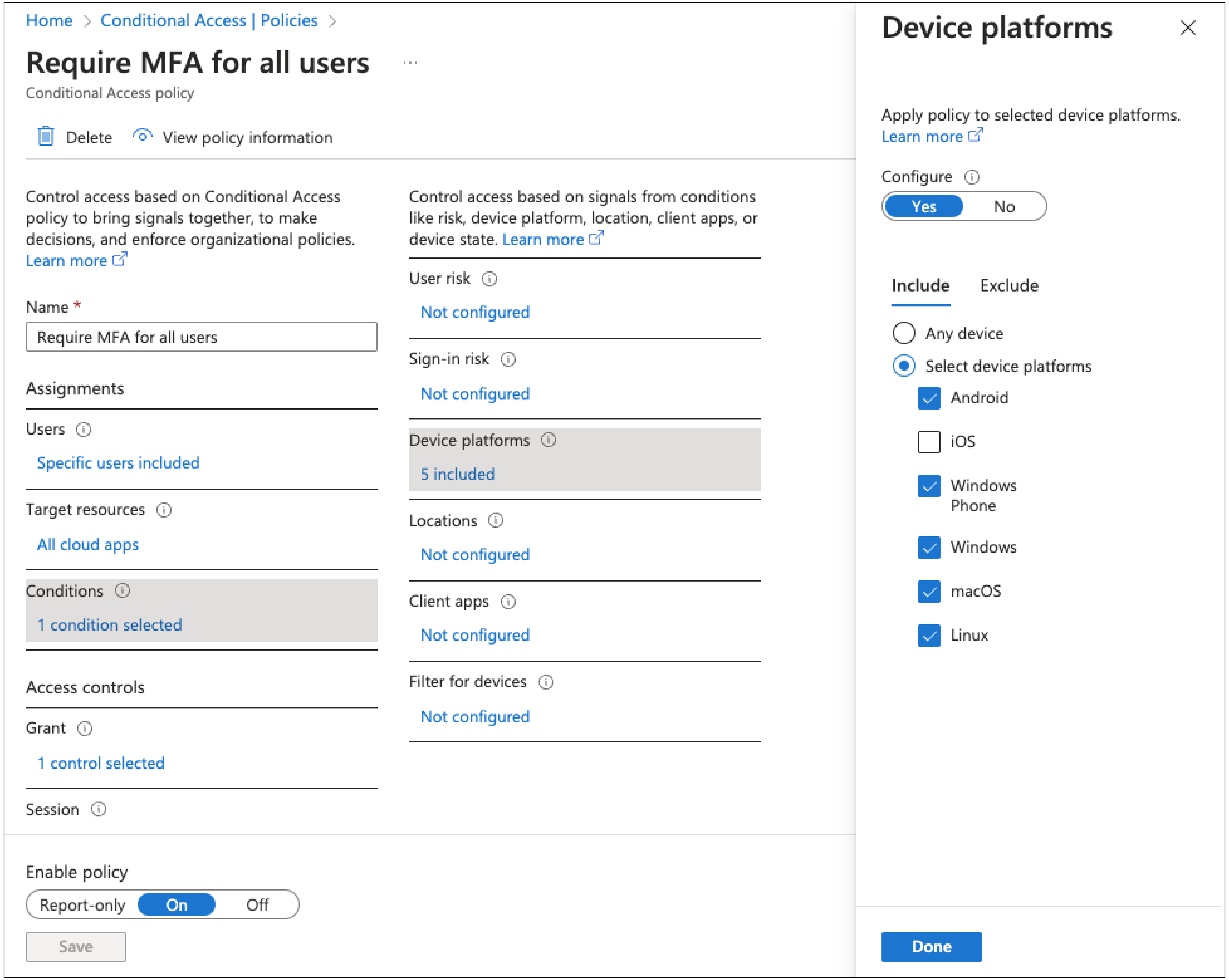
  - Etc.



Home > Conditional Access | Policies >

Require MFA for all users

Conditional Access policy

Delete   View policy information

Control access based on Conditional Access policy to bring signals together, to make decisions, and enforce organizational policies. Learn more

Name *

Require MFA for all users

Assignments

Users ⓘ

Specific users included

Target resources ⓘ

All cloud apps

Conditions ⓘ

1 condition selected

Access controls

Grant ⓘ

1 control selected

Session ⓘ

Control access based on signals from conditions like risk, device platform, location, client apps, or device state. Learn more

User risk ⓘ

Not configured

Sign-in risk ⓘ

Not configured

Device platforms ⓘ

5 included

Locations ⓘ

Not configured

Client apps ⓘ

Not configured

Filter for devices ⓘ

Not configured

Enable policy

Report-only [✓ On] Off

Save

Device platforms

Apply policy to selected device platforms. Learn more

Configure ⓘ

[✓ Yes] No

Include   Exclude

○ Any device

● Select device platforms

☑ Android

□ iOS

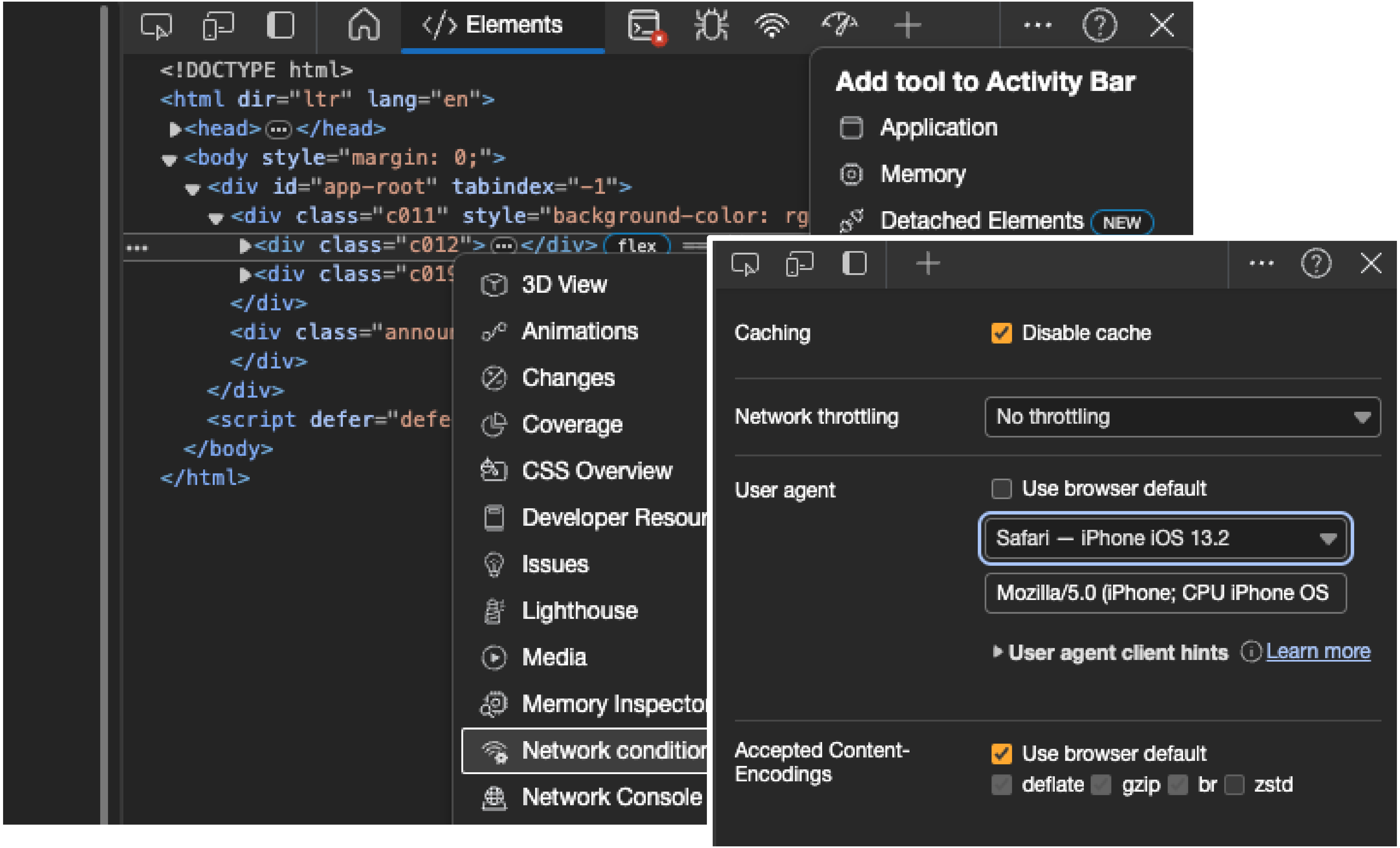
☑ Windows Phone

☑ Windows

☑ macOS

☑ Linux

Done



```
<!DOCTYPE html>
<html dir="ltr" lang="en">
 ▶<head>⋯</head>
 ▼<body style="margin: 0;">
   ▼<div id="app-root" tabindex="-1">
     ▼<div class="c011" style="background-color: rg
       ▶<div class="c012">⋯</div>
       ▶<div class="c019
       </div>
       <div class="annou
       </div>
     </div>
     <script defer="defe
   </body>
</html>
```

Caching ☑ Disable cache

Network throttling: No throttling

User agent ☐ Use browser default

Safari — iPhone iOS 13.2

Mozilla/5.0 (iPhone; CPU iPhone OS

▸ User agent client hints ⓘ Learn more

Accepted Content-Encodings ☑ Use browser default

☑ deflate ☑ gzip ☑ br ☐ zstd

Conditional Access Bypass

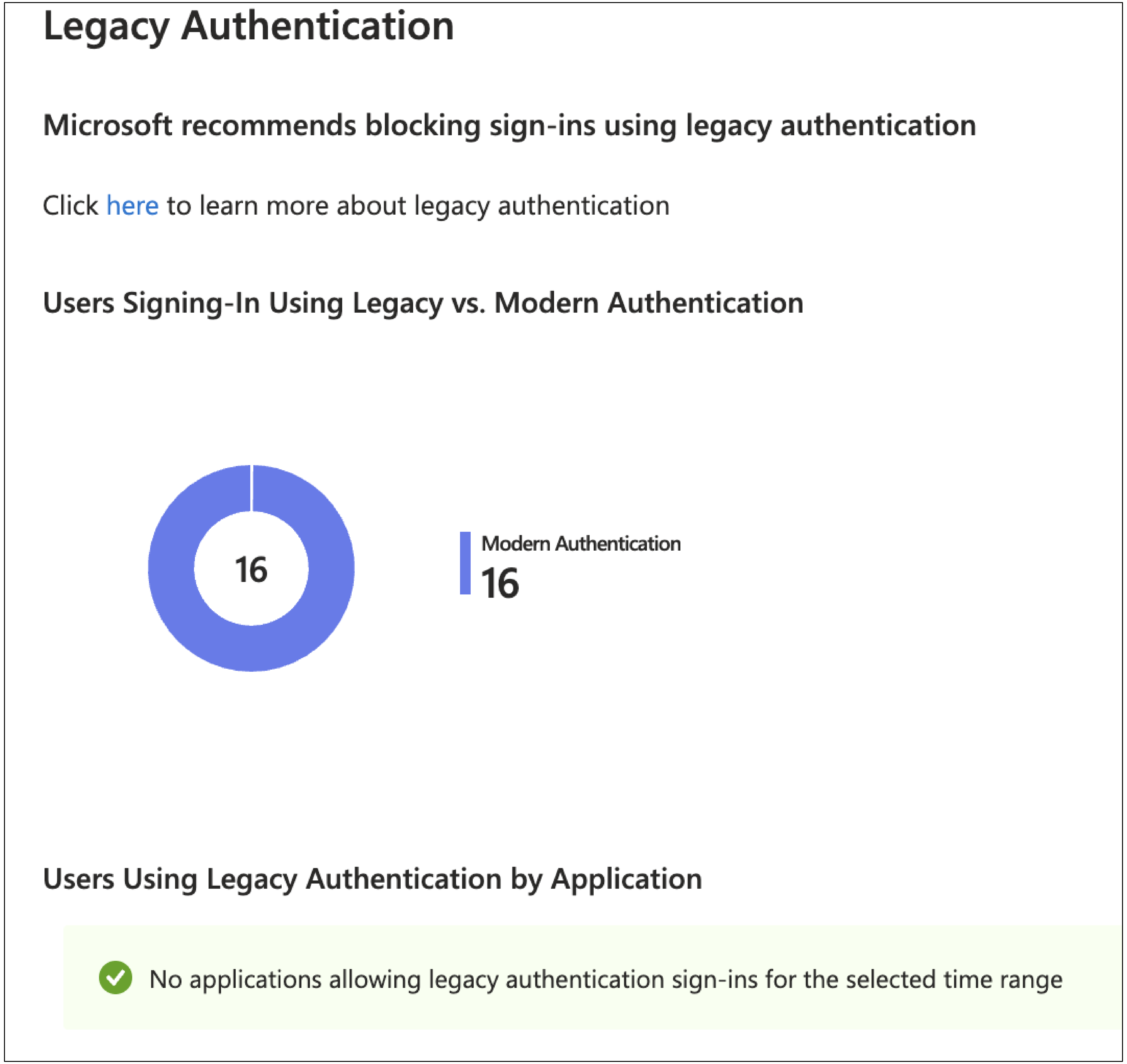
How can you protect against this?

- Keep exclusion list as short as possible
- Create Block Rules to prevent access in unwanted scenarios
- Pay attention to conditions
- Use CA gap analyzer workbook

CA gap analyzer

Prereqs:

- Microsoft Entra Premium P1
- Log Analytics Workspace
- Role for Azure Monitor and Entra ID



Legacy Authentication

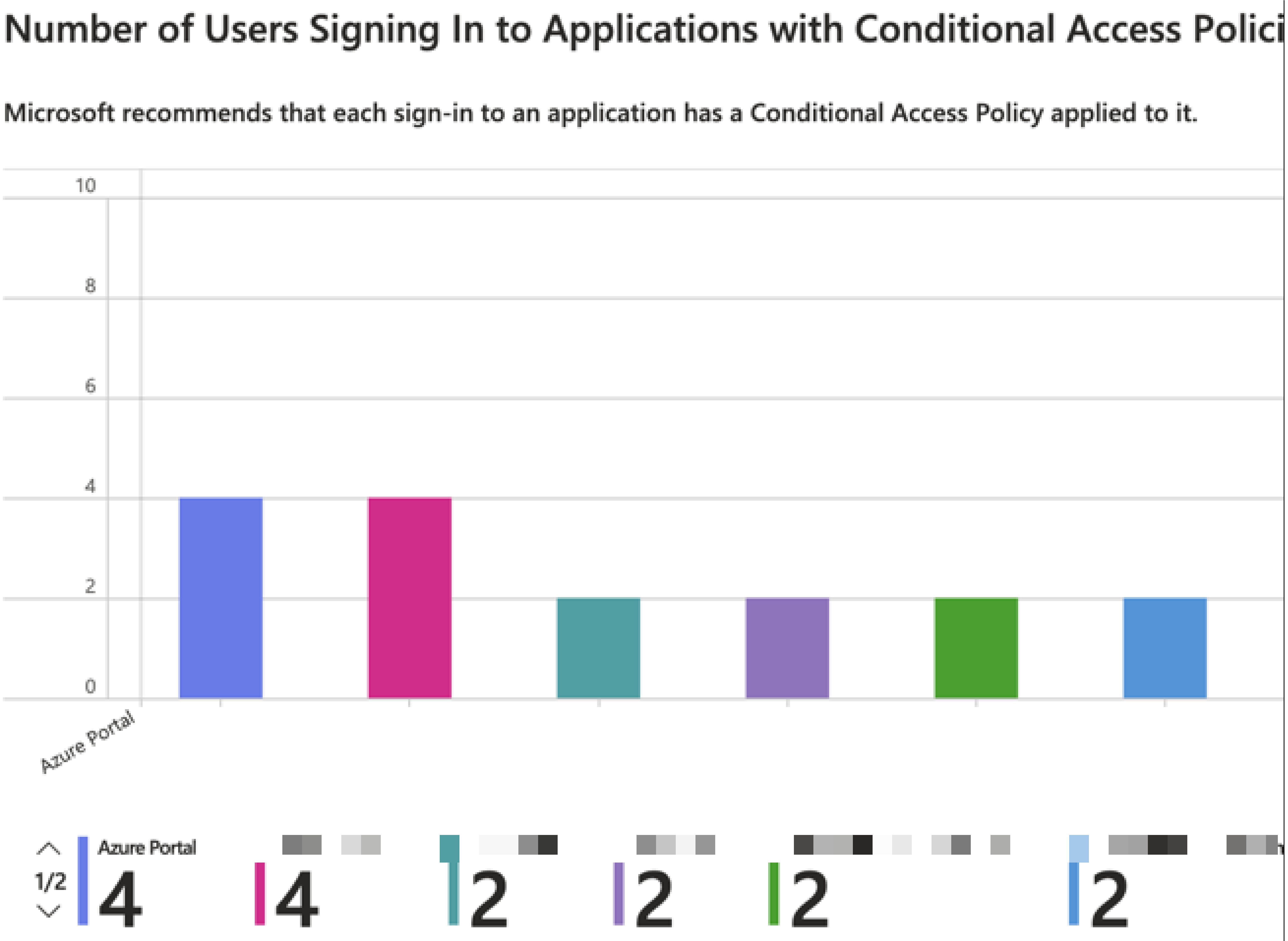
Microsoft recommends blocking sign-ins using legacy authentication

Click here to learn more about legacy authentication

Users Signing-In Using Legacy vs. Modern Authentication

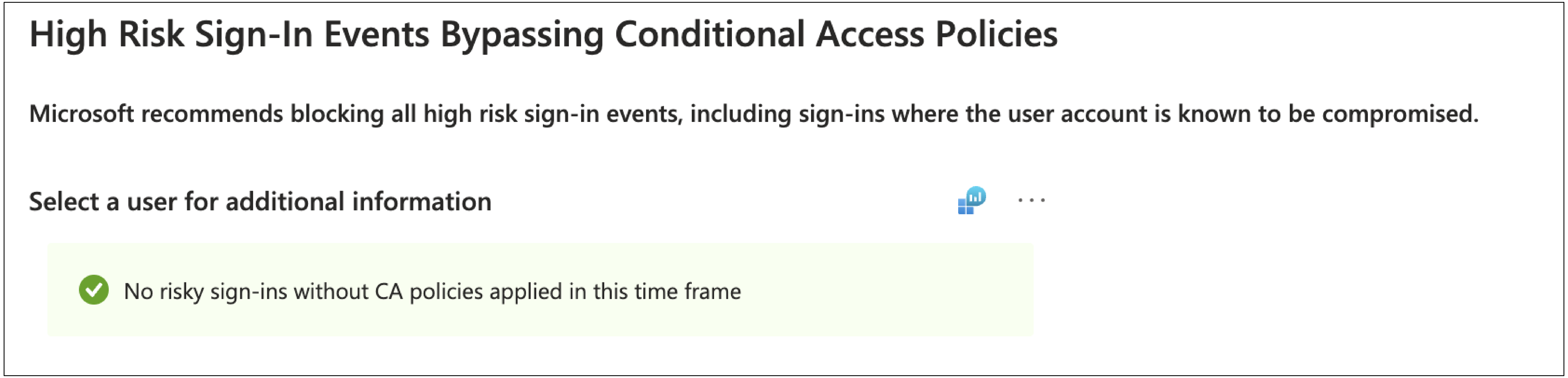
Users Using Legacy Authentication by Application

✓ No applications allowing legacy authentication sign-ins for the selected time range



Number of Users Signing In to Applications with Conditional Access Polici

Microsoft recommends that each sign-in to an application has a Conditional Access Policy applied to it.



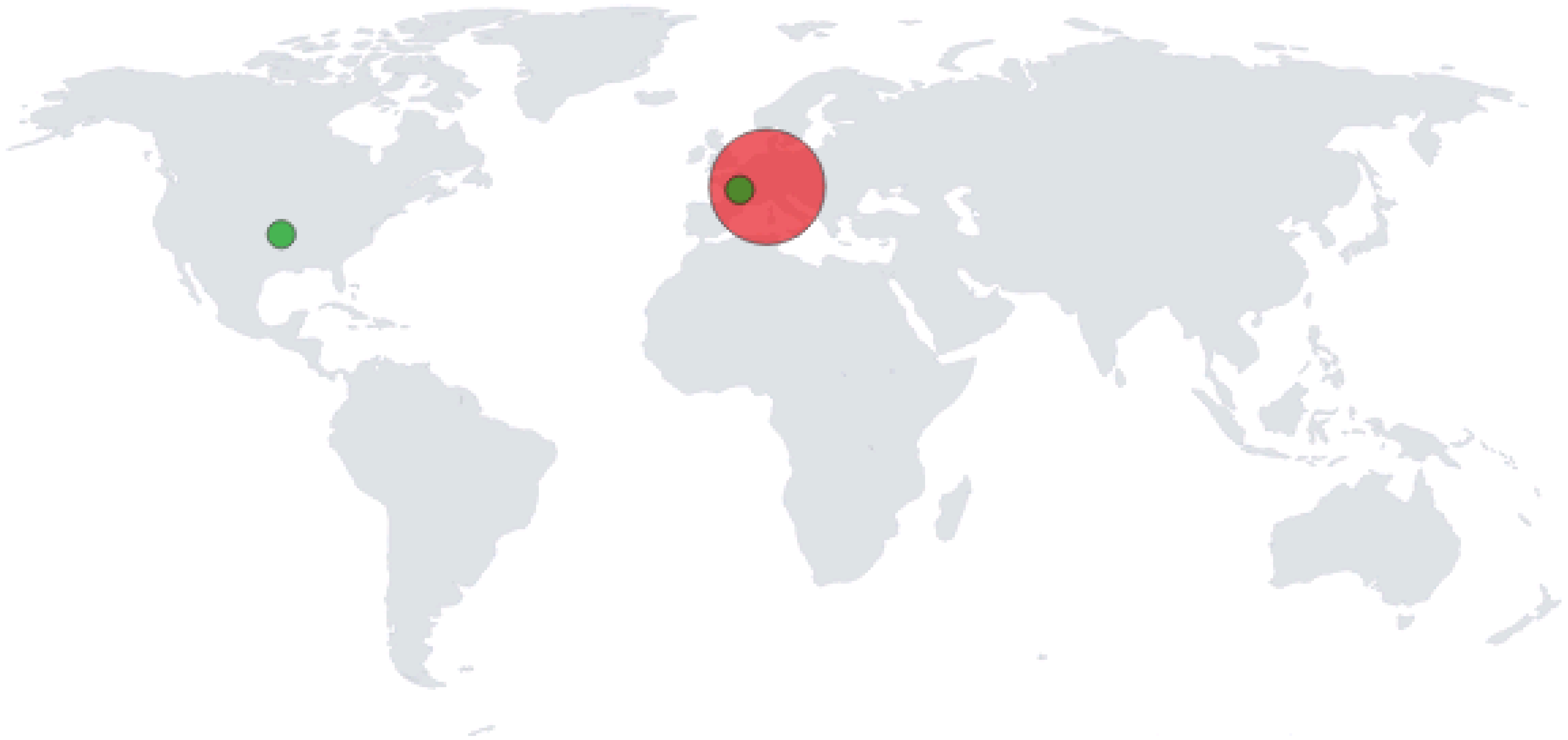
High Risk Sign-In Events Bypassing Conditional Access Policies

Microsoft recommends blocking all high risk sign-in events, including sign-ins where the user account is known to be compromised.

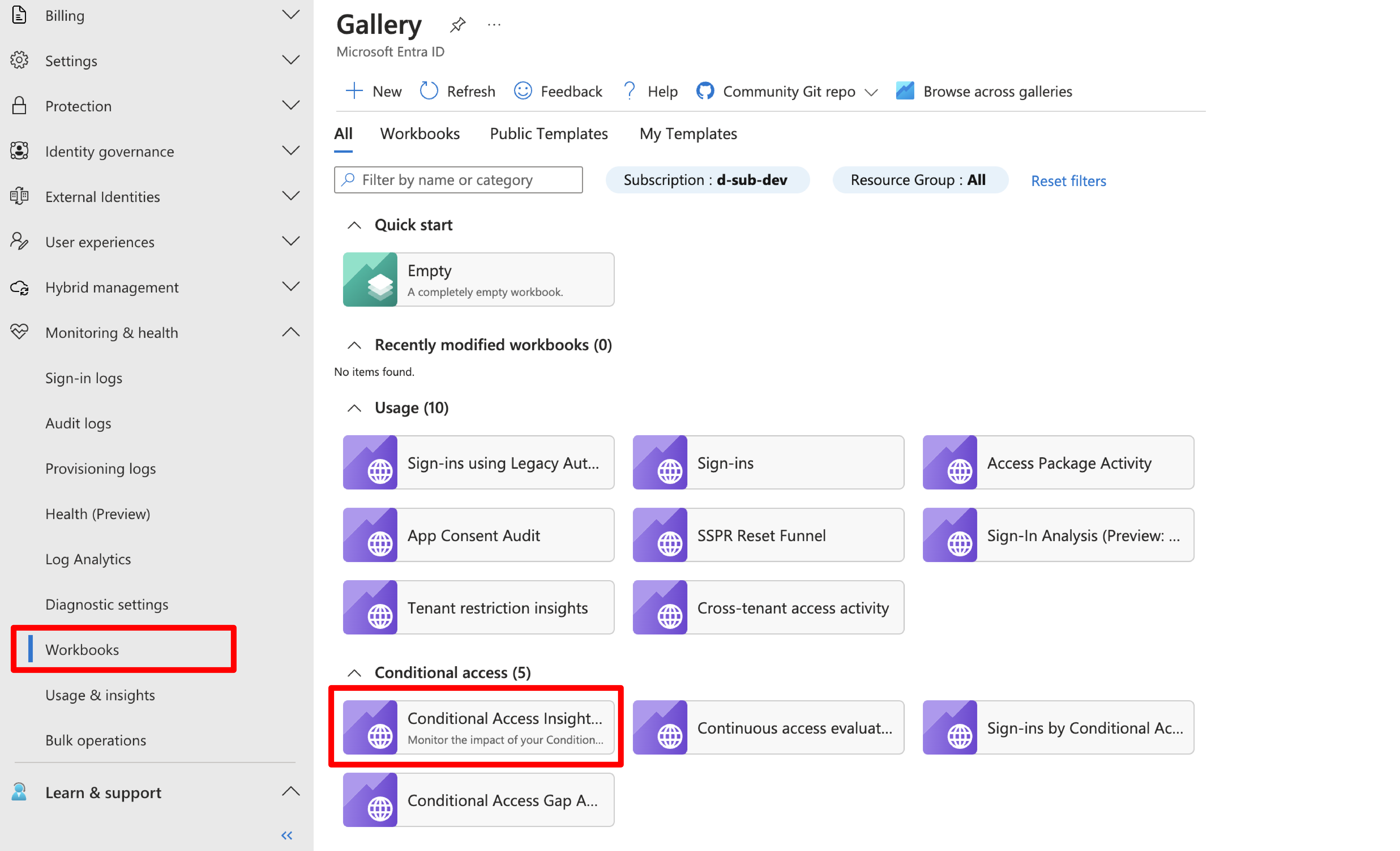
Select a user for additional information

✓ No risky sign-ins without CA policies applied in this time frame

Users With No Conditional Access Coverage by Location



Switzerland	France	United States
151	1	1



Subscription : **d-sub-dev**

Resource Group : **All**

Empty: A completely empty workbook.

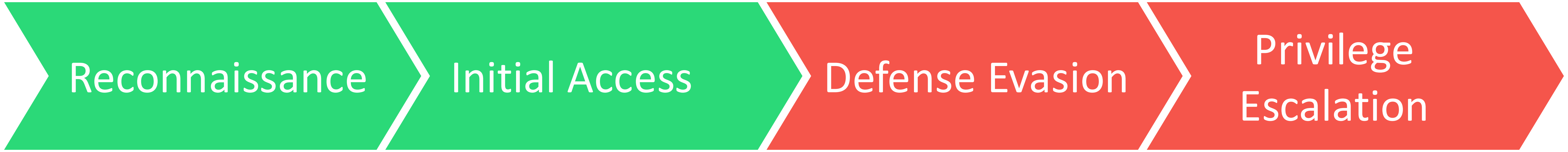
No items found.

Conditional Access Insight...: Monitor the impact of your Condition...

CA gap analyzer

Preview Features:

- Named Locations with no Conditional Access Coverage
- Sign-ins from IPv6 addresses not assigned to a Named Location



Reconnaissance

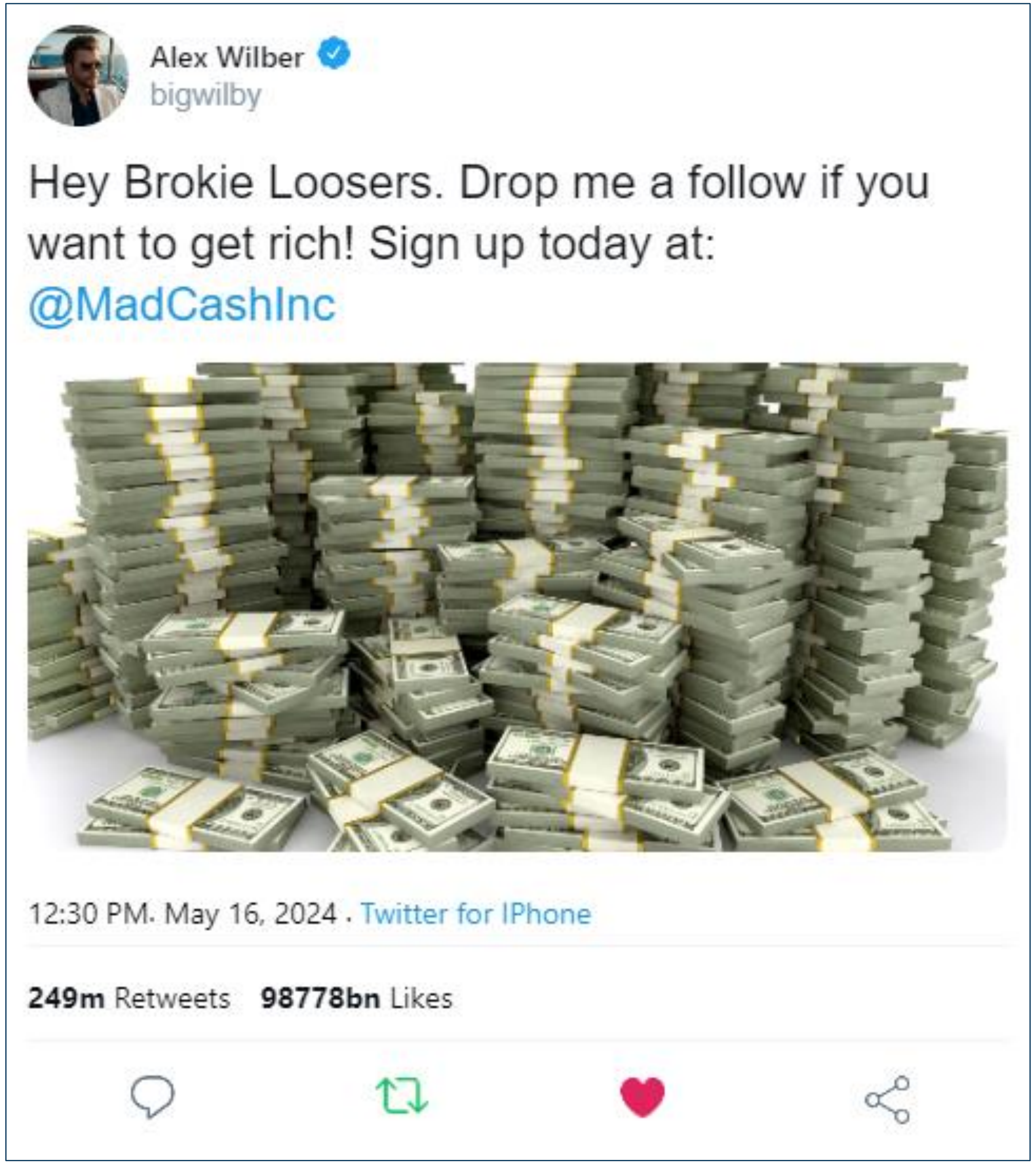
Initial Access

Defense Evasion

Privilege Escalation

Result: Bypassed Conditional Access Policies

Demo Time

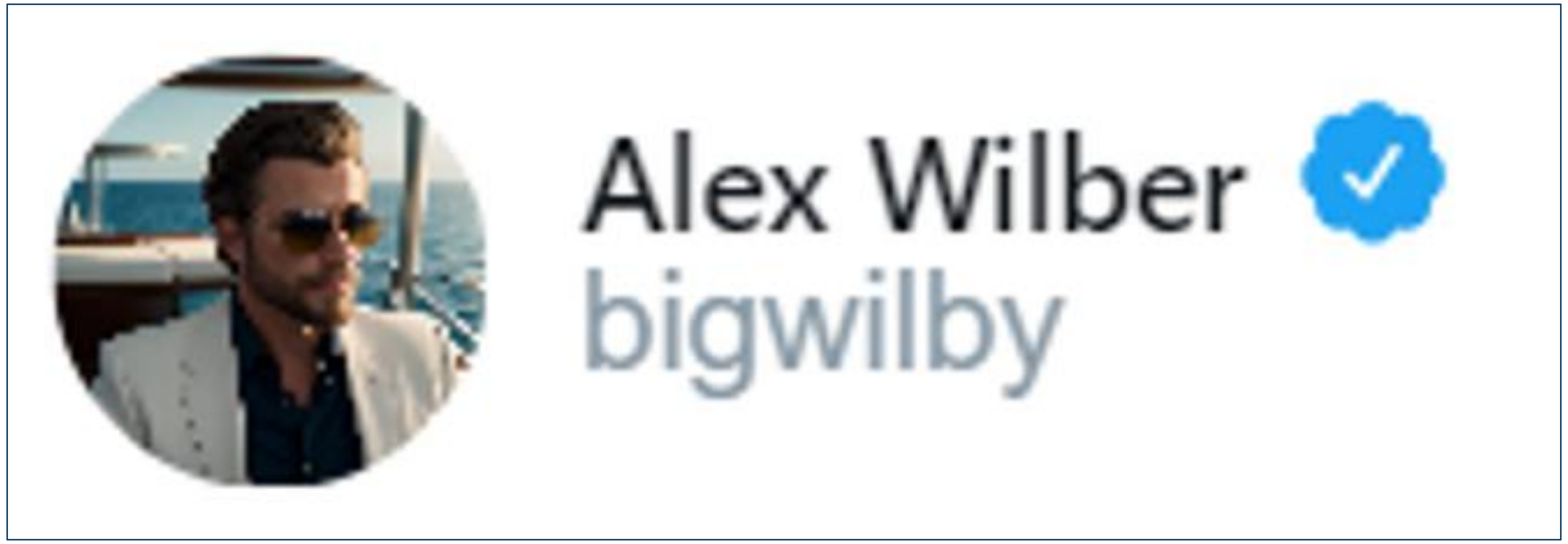


Alex Wilber
bigwilby

Hey Brokie Loosers. Drop me a follow if you want to get rich! Sign up today at: @MadCashInc

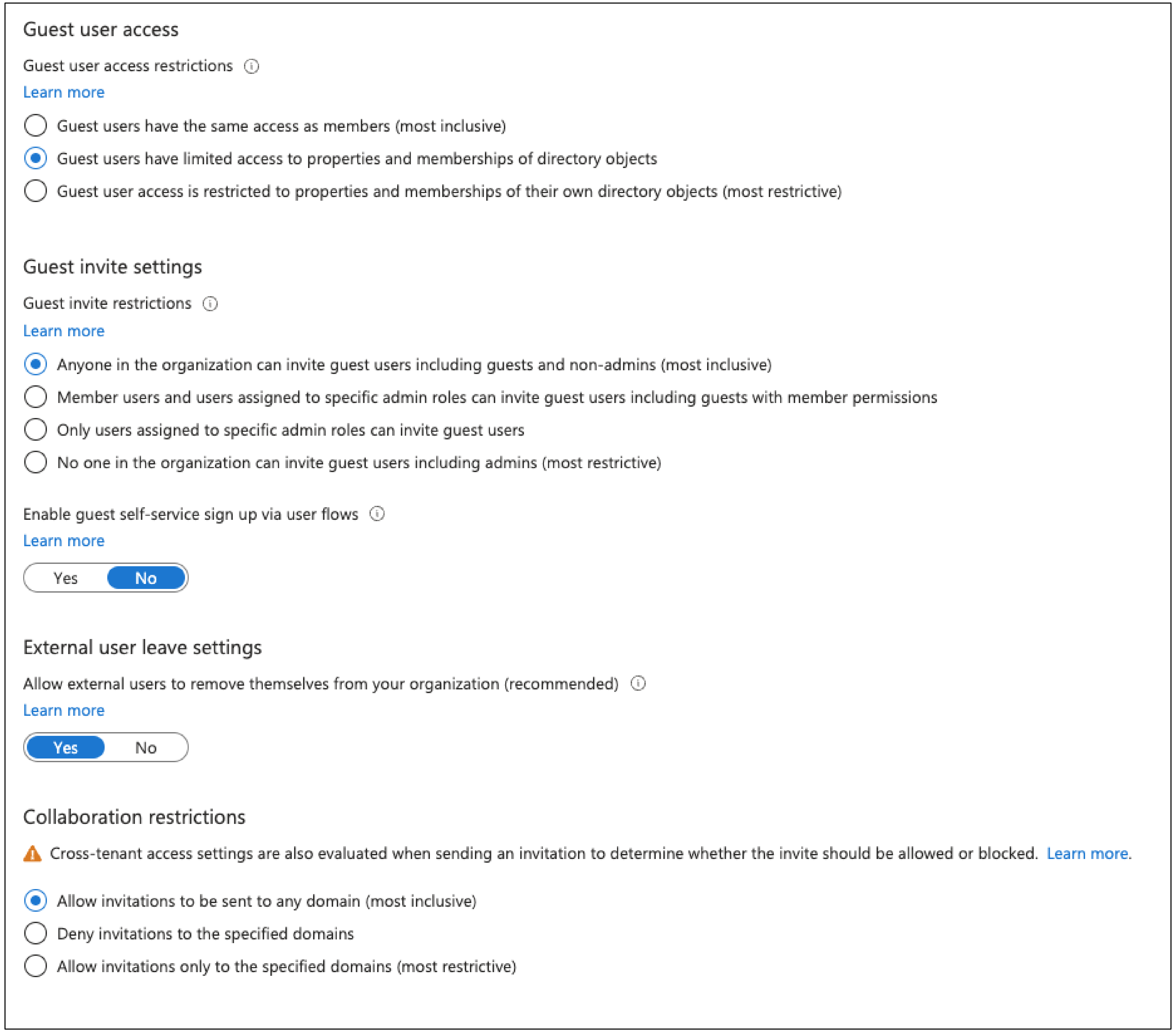
12:30 PM. May 16, 2024 . Twitter for IPhone

249m Retweets **98778bn** Likes



Alex Wilber
bigwilby

Entra ID Guest Accounts – Default Settings



Guest user access

Guest user access restrictions ⓘ

Learn more

○ Guest users have the same access as members (most inclusive)

● Guest users have limited access to properties and memberships of directory objects

○ Guest user access is restricted to properties and memberships of their own directory objects (most restrictive)

Guest invite settings

Guest invite restrictions ⓘ

Learn more

● Anyone in the organization can invite guest users including guests and non-admins (most inclusive)

○ Member users and users assigned to specific admin roles can invite guest users including guests with member permissions

○ Only users assigned to specific admin roles can invite guest users

○ No one in the organization can invite guest users including admins (most restrictive)

Enable guest self-service sign up via user flows ⓘ

Learn more

Yes [✓ No]

External user leave settings

Allow external users to remove themselves from your organization (recommended) ⓘ

Learn more

[✓ Yes] No

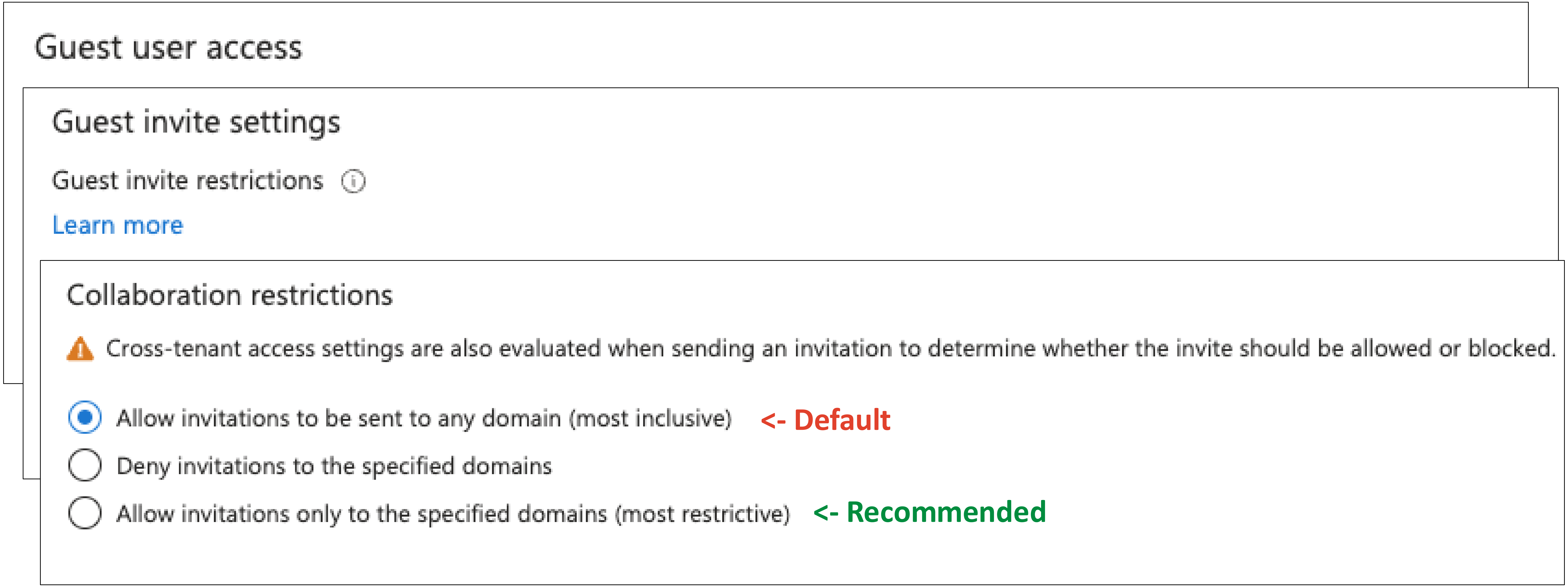
Collaboration restrictions

⚠ Cross-tenant access settings are also evaluated when sending an invitation to determine whether the invite should be allowed or blocked. Learn more.

● Allow invitations to be sent to any domain (most inclusive)

○ Deny invitations to the specified domains

○ Allow invitations only to the specified domains (most restrictive)



Guest user access

Guest invite settings

Guest invite restrictions ⓘ

Learn more

Collaboration restrictions

⚠ Cross-tenant access settings are also evaluated when sending an invitation to determine whether the invite should be allowed or blocked.

● Allow invitations to be sent to any domain (most inclusive) <- Default

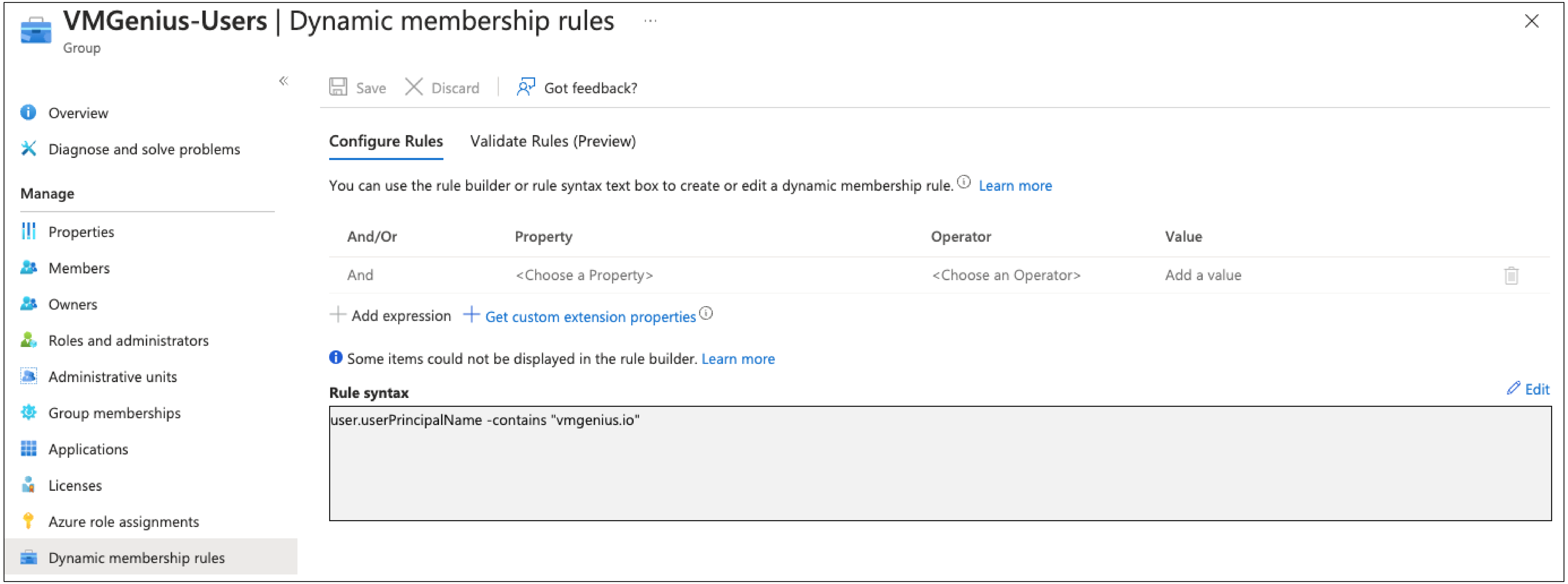
○ Deny invitations to the specified domains

○ Allow invitations only to the specified domains (most restrictive) <- Recommended

Abusing Dynamic Groups

- Scenario:
  - Company has outsourced Azure VM Management to another company
  - The name of this fictional company is: VMGenius.io
  - All users are invited as Guest Users.

Abusing Dynamic Groups



You can use the rule builder or rule syntax text box to create or edit a dynamic membership rule. Learn more

And/Or	Property	Operator	Value
And	<Choose a Property>	<Choose an Operator>	Add a value

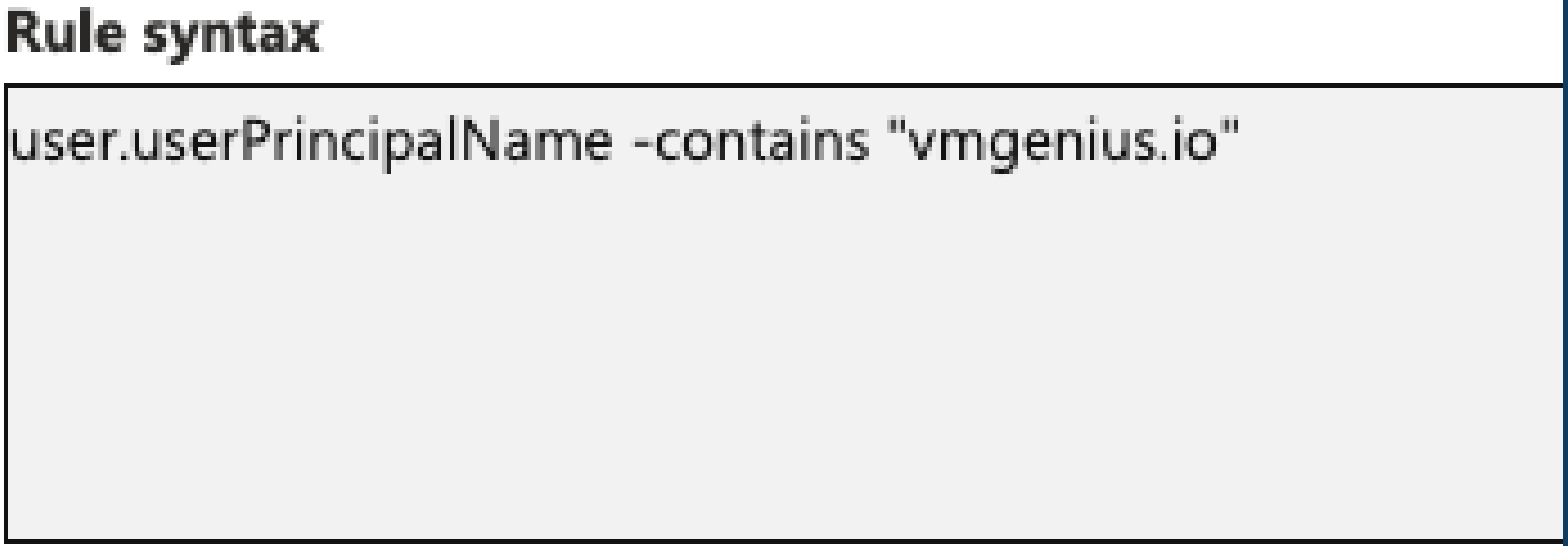
Some items could not be displayed in the rule builder. Learn more

Rule syntax

```
user.userPrincipalName -contains "vmgenius.io"
```

Group has Virtual Machine Contributor Role

Abusing Dynamic Groups



Rule syntax

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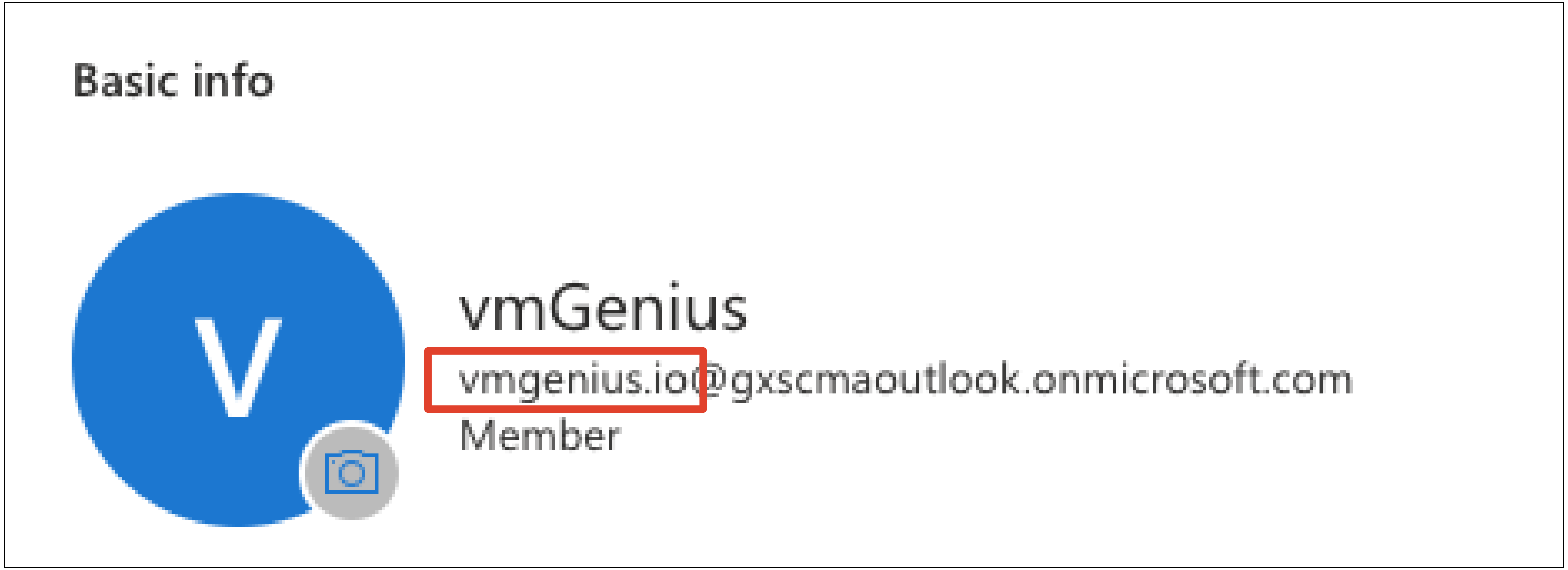
user.userPrincipalName -contains "vmgenius.io"
```

Group has Virtual Machine Contributor Role

Abusing Dynamic Groups



Basic info

vmGenius

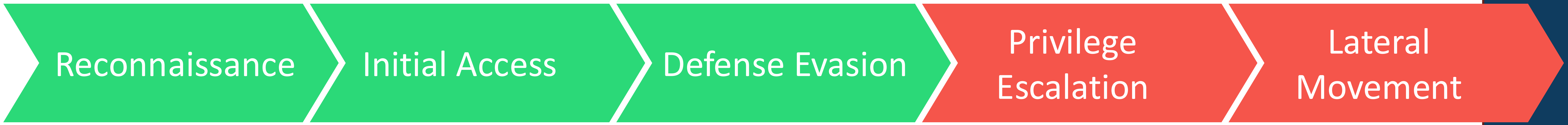
vmgenius.io@gxscmaoutlook.onmicrosoft.com

Member

Abusing Dynamic Groups

How can you protect against this?

- Don’t allow all users to invite guest accounts
- Don’t base dynamic group membership rules on user-controlled attributes
- Be aware that even non-user controlled attributes could be changed somehow (e.g. from Entra ID Cloud Sync)
- Be careful when designing dynamic group membership rules.



Reconnaissance

Initial Access

Defense Evasion

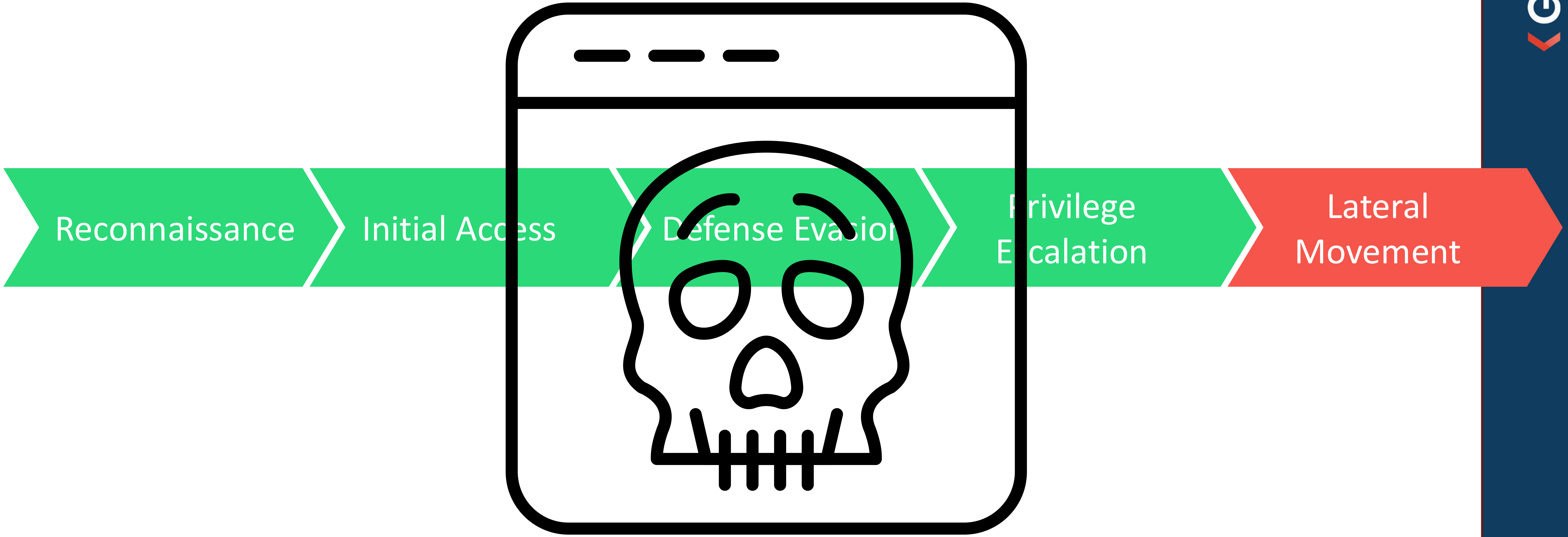
Privilege Escalation

Lateral Movement

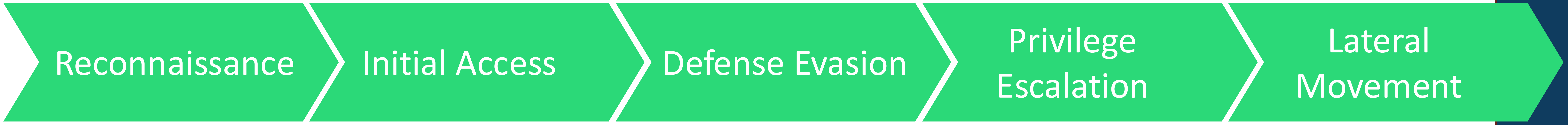
Result: Escalation to privileged role

Abusing VM Contributor Role

- It is a privileged Role
- It can execute Scripts on VM with SYSTEM Privileges
- Abusing Examples:
    - Extract NTLM Hashes from VMs
    - Install Malware on Systems
    - Extract Information from File Servers
    - Elevate Privileges from Cloud-only to onPrem
- RL Example:
    - TA UNC3944 uses Serial Console to deploy remote management software



Reconnaissance
Initial Access
Defense Evasion
Privilege Escalation
Lateral Movement



Reconnaissance

Initial Access

Defense Evasion

Privilege Escalation

Lateral Movement

-> Find Passwords

-> User Enumeration

-> Password Spray

-> Conditional Access Bypass

-> Abusing Dynamic Groups

-> Abusing VM Contributor Role

Conclusion

- Be careful when exposing information publicly
- Use built-in protection features from Microsoft
- Look at configurations from an attackers perspective
- Keep an eye on you CA Policies and Dynamic Groups
- Don’t be lazy! (at least in Cyber Security ☺)

Description	Link
GitHub of Beau Bullock (Azure Pentesting Tools)	https://github.com/dafthack
MicroBurst Toolkit for Attacking Azure	https://github.com/NetSPI/MicroBurst
Website of AADInternals	https://aadinternals.com
Hands-on Azure Pentesting Training	https://cloudbreach.io/breachingazure
Microsoft Penetration Testing Rules of Engagement	https://www.microsoft.com/en-us/msrc/pentest-rules-of-engagement
VM Contributor Role Abuse RL Example	https://www.csoonline.com/article/575297/attacker-uses-the-azure-serial-console-to-gain-access-to-microsoft-vm.html
Video about Passkeys from John Savill	PASSKEYS - What they are, why we want them and how to use them! (youtube.com)

Marco Schmidt
marco@thesecurityguy.ch
thesecurityguy.ch

Manuel Meyer
blog@manuelmeyer.net
manuelmeyer.net