HAS ANYONE SEEN THE PRINCIPAL?

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Fwd:CloudSec – 13th September 2021

WHO ARE WE?

- Security consultants @F-Secure Consulting
- Professional ~~Meme Masters~~ Cloud enthusiasts – particularly Microsoft's Azure platform
- Helping people secure their cloud estate and breaking stuff along the way

- Shoutout for the original talk idea to Javan Joshua Mnjama - @JavanMnjama

Emilian Cebuc - @RockBoyEmy

Cristian Philipov - @chrispy_sec

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CLOUD COMPROMISES IN THE WILD

- Holmium (APT33) attack – full network control in under a week [1]
- "Living off the Land" (LoL) attacks – leveraging legitimate functionality [2]
- Compromised Azure resources & extensions
- Un-monitored O365 accounts and ADFS
- Password sprays & Phishing
- Lack of MFA

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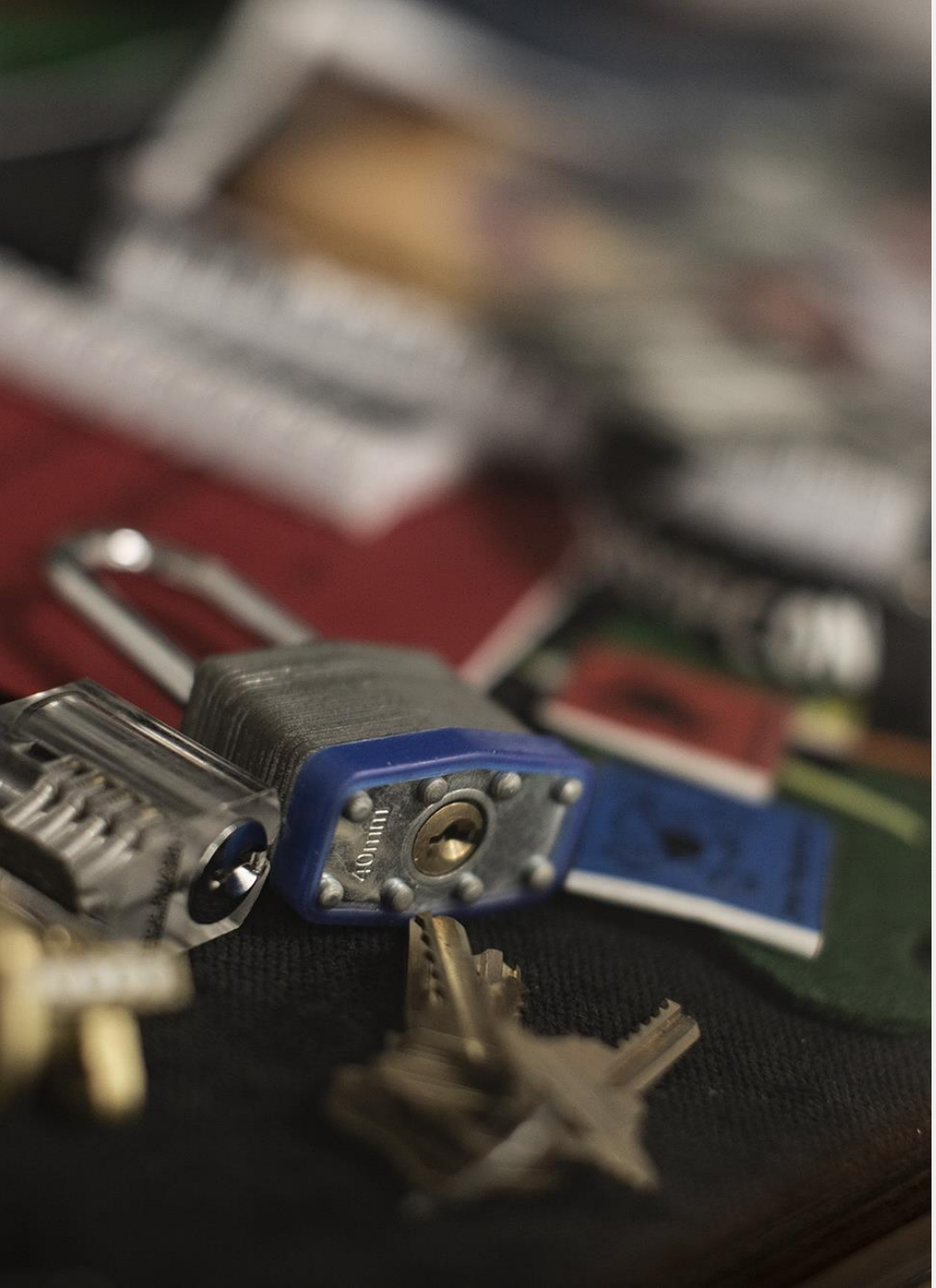

AGENDA

- Azure AD Service Principals
- Azure StormSpotter & cypher queries
- Attack scenarios & exploitation
- Detection & prevention

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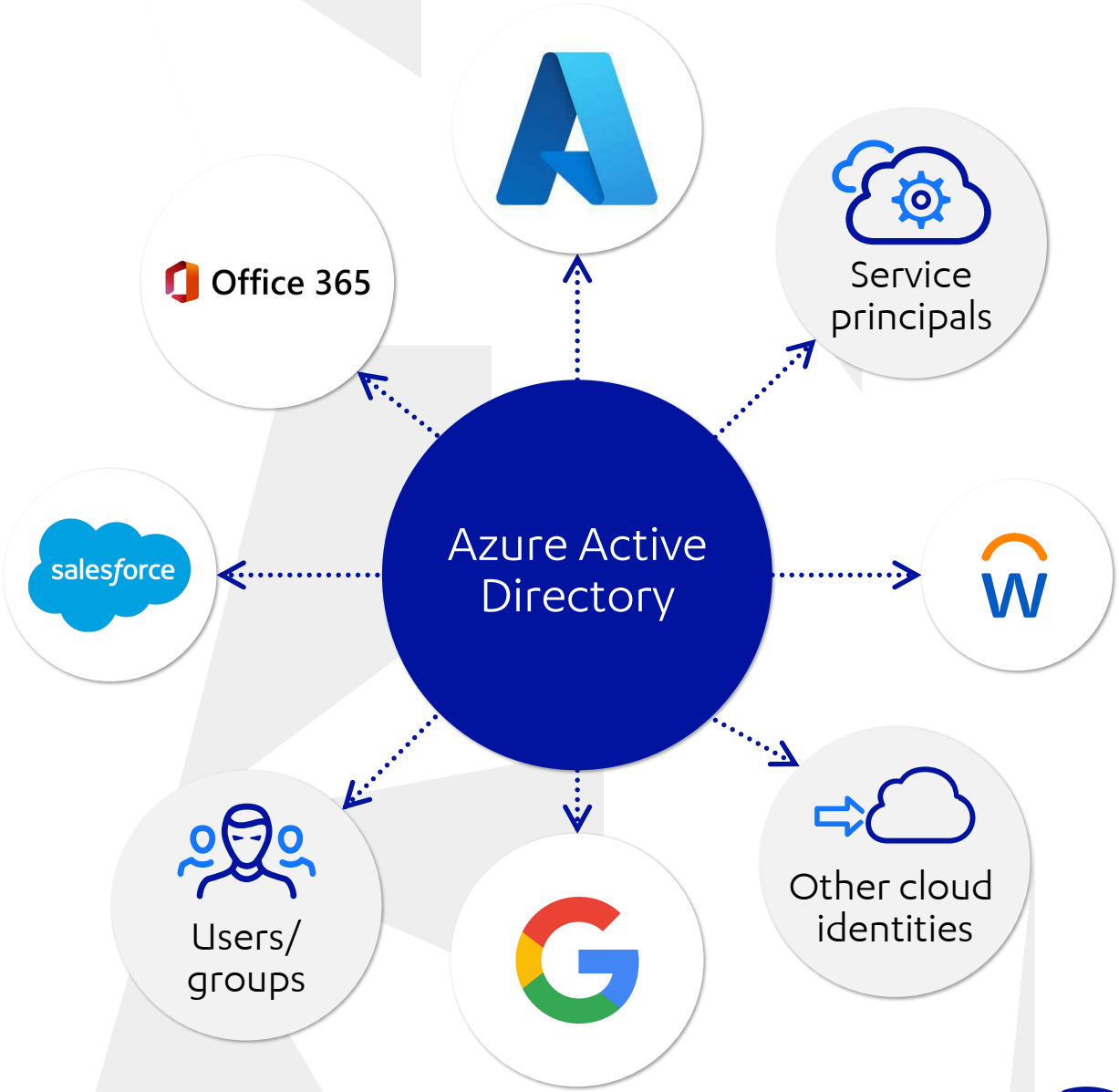
AZURE AD & SERVICE PRINCIPALS

- An Identity Provider (IdP) & Identity and Access Management (IAM) service, in the cloud
- In Azure, you can have identities
- These can have *roles* assigned to them
- Service Principals are accounts for representing non-user entities



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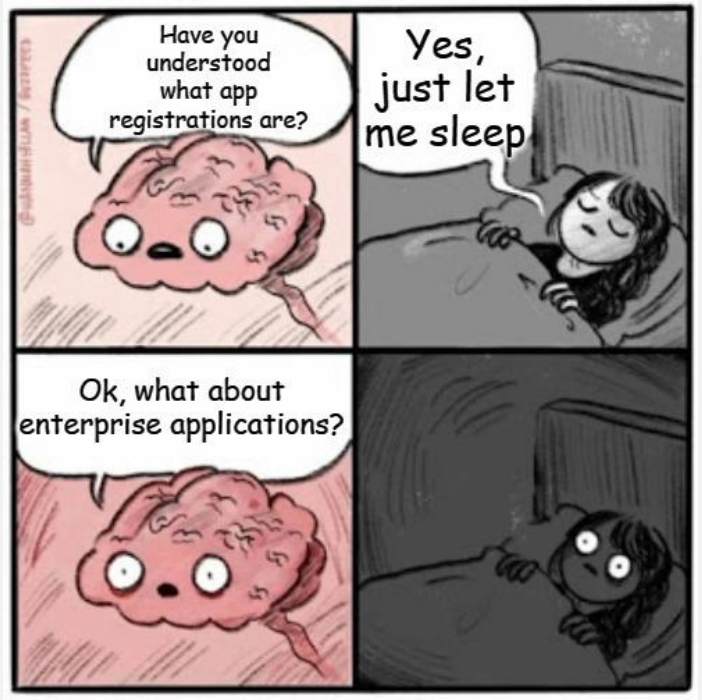
SERVICE PRINCIPALS AND CLOUD APPS

- Numerous possibilities for applications in the cloud
  - For employees, customers and partners
- AAD Apps can be "registered" – unique definition
  - A *class* if you think of OOP
- "Instantiate" a copy of the app
- A Service Principal account gets created



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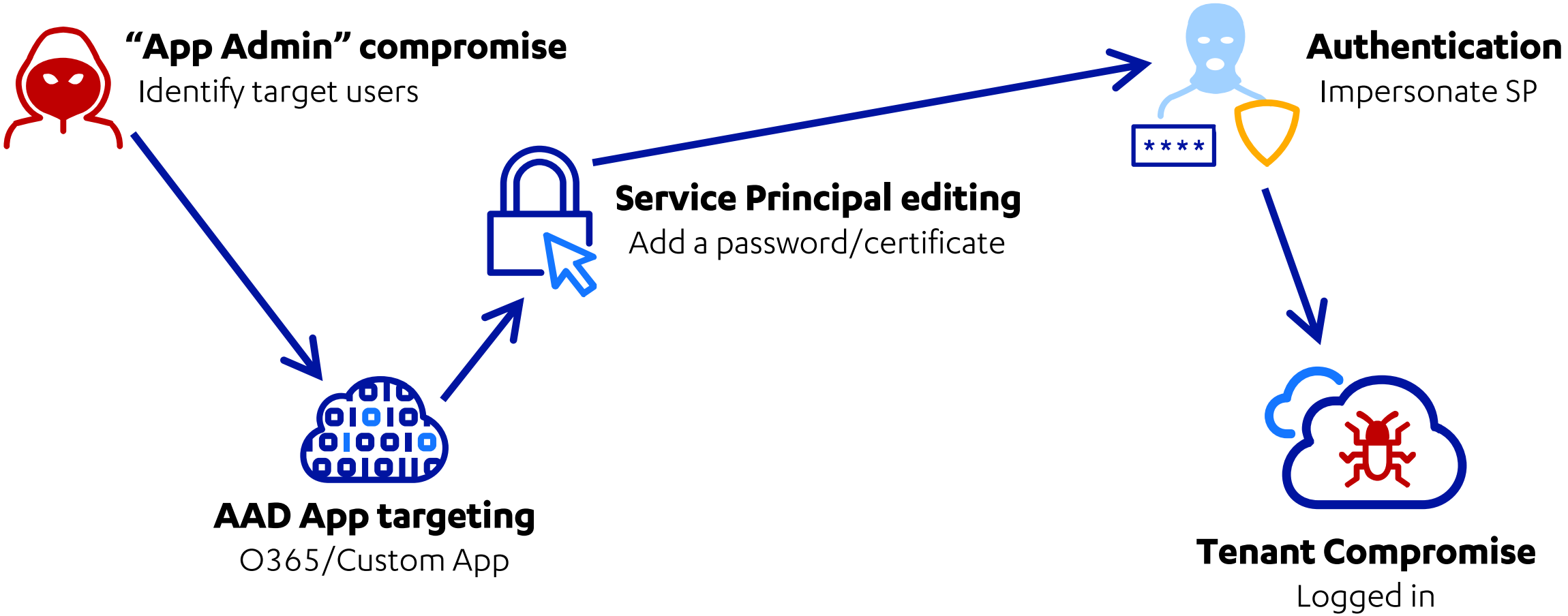
WHY DO WE CARE?

- SPs tend to be overlooked
  - During development
  - Security assessments
- 300+ Apps onboarded with an O365 E3 or E5 tenant license
  - Research in 2019 by Dirkjan [3]
  - However, 2 years later, the situation is not quite the same anymore

ATTACK PATH 1



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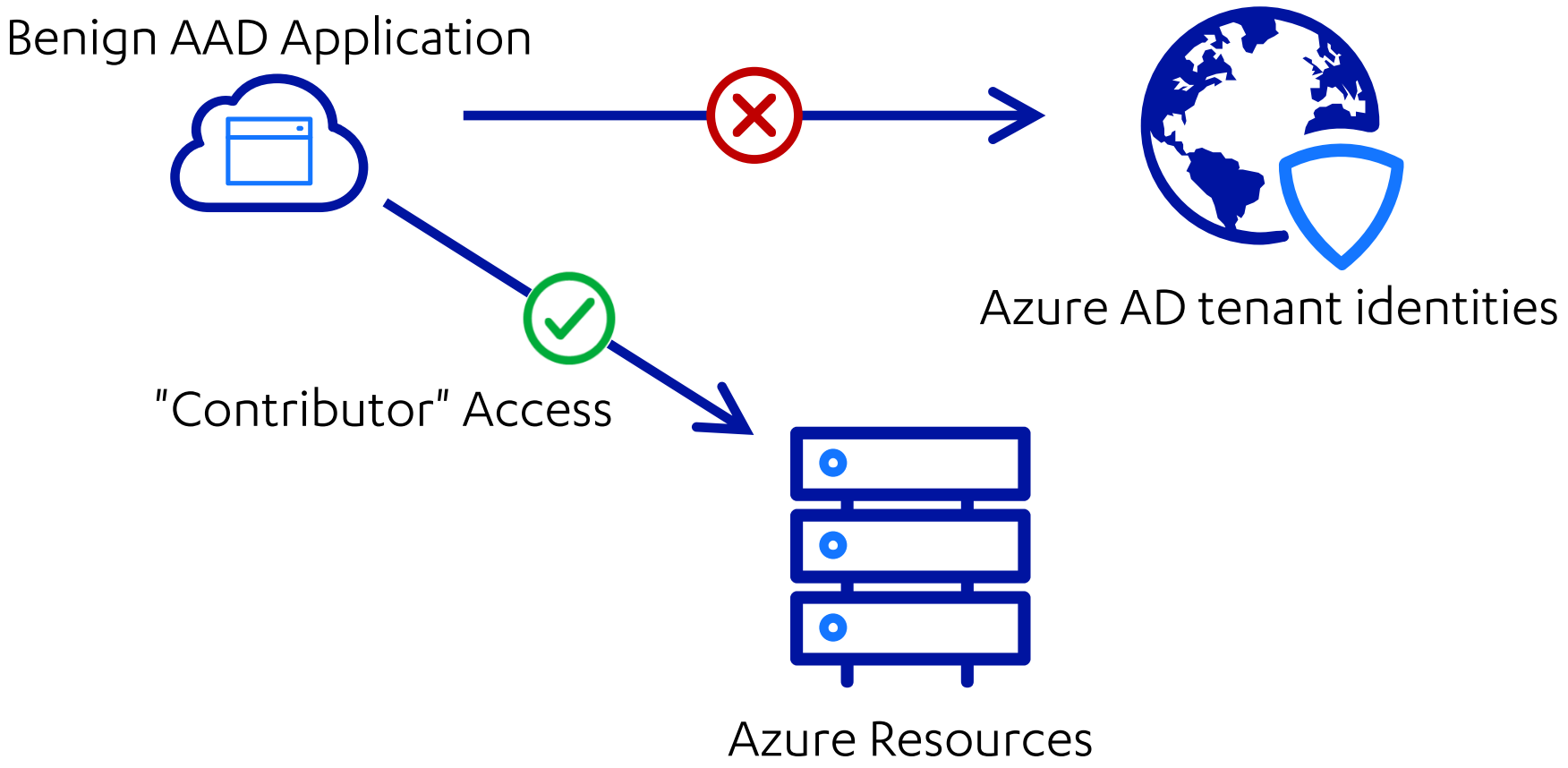
ATTACK PATH 2



STORMSPOTTER

- Tool for identifying infrastructure and AD components in Azure[4]
- Made by the Azure peeps – neo4j, graphing capabilities
- Cypher queries - creation of visual links among components

STORMSPOTTER

DEMO

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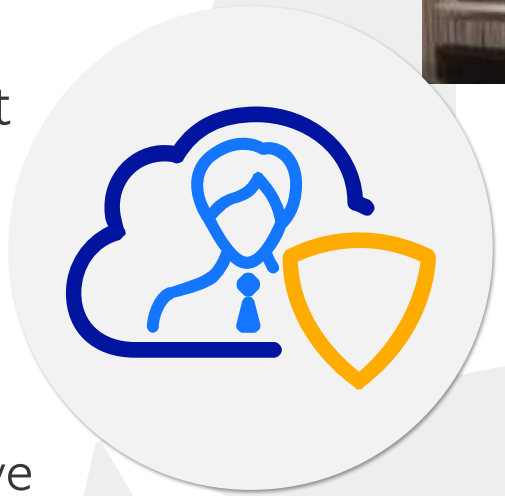
MICROSOFT SERVICE PRINCIPALS

COMMON NAME	PERMISSIONS
Microsoft Rights Management Services	Directory.Read.All Member.Read.Hidden
Office 365 Exchange Online	Directory.Read.All Group.ReadWrite.All User.Read.All
Office 365 SharePoint Online	Files.ReadWrite.All TeamsActivity.Send TeamsAppInstallation.ReadWriteSelfForUser.All
Yammer	Policy.Read.All Reports.Read.All

PREVENTION – USER ACCOUNTS

- Custom roles for users managing applications
  - built-in ones can be quite permissive
  - tailor very specifically
- Disable any AD user's ability to register and consent applications
- Assign "App/Cloud App Admin" and/or "App Developer" accordingly
  - Can still bypass the previous two security toggles above
- PIM, MFA, and CAs (when available for SPs) if possible



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PREVENTION – SERVICE PRINCIPALS

- Principle of least privilege - Assign only needed Graph permissions
  - Particularly for admin privileges
- Restrict role assignments for Azure resources
  - "Contributor" by default
  - Remove passwords, if added for any reason
- Perform regular reviews SPs login events
  - Any left with passwords?

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DETECTION AND MONITORING?

- Can be quite difficult specifically for this issue - allowed by design
- Your existing logging/monitoring capabilities can detect *some* things
- A tailored set of alerting policies
  - Focus on critical SP's activity, not just user's
- No sign-in logs for 1st party Microsoft Applications

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ATTACK PATH IDENTIFICATION CYPHER QUERIES

- `MATCH (a:AADRole)-[r]-(t:AADUser) WHERE (a.name = 'Application Administrator' OR a.name = 'Cloud Application Administrator') RETURN *`
- `MATCH (a:AADRole) WHERE a.name = 'Application Developer' RETURN *`
- `MATCH (a:AADRole)-[r]-(t) WHERE r.roleName = 'Contributor' AND a.objectType = 'ServicePrincipal' OR a.objectType = 'Application' RETURN *`
- `MATCH (a)-[r]-(t) WHERE (r.roleName = 'Contributor' OR r.roleName = 'Owner') AND (a.objectType = 'ServicePrincipal' OR a.objectType = 'Application') RETURN *`
- `MATCH (a) WHERE a.objectType = "ServicePrincipal" AND (a.passwordCredentialCount > 0 OR a.keyCredentialCount > 0) RETURN *`
- `MATCH (w:ResourceGroup)-[p]-(s:Subscription)-[y]-(a:AADUser)-[r]-(g:AADGroup)-[d:MemberOf]-(AADRole) WHERE (y.roleName = "Contributor" OR y.roleName = "Owner") RETURN *`

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SP ACTIVITY KQL DETECTION QUERIES

```
// Most active Service Principals (Custom Apps)
AADServicePrincipalSignInLogs
| where TimeGenerated > ago(7d)
| summarize CountPerServicePrincipal = count() by ServicePrincipalName,
ServicePrincipalId, AppId, IPAddress
| order by CountPerServicePrincipal desc
//TimeGenerated
```

```
// Most active AAD Applications (MS Apps)
AADNonInteractiveUserSignInLogs
| where TimeGenerated > ago(7d)
| summarize CountPerServicePrincipal = count() by AppDisplayName, AppId, Identity,
IPAddress, TimeGenerated
//| order by CountPerServicePrincipal desc
```

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SP ACTIVITY KQL DETECTION QUERIES

```
// Suspicious activity by SPs

// Look for audit logs in the last x days as needed
// Filter by SP OperationName of interest for these attacks
// Filter by escalation-related OperationName and AAD App Identity

AuditLogs
| where TimeGenerated > ago(7d)
| where OperationName == "Add service principal credentials"
or OperationName == "Remove service principal credentials"
or OperationName == "Add app role assignment to service principal"
or OperationName == "Update service principal"
//| where OperationName == “Add member to group“ and Identity == "Office 365 Exchange Online"
| summarize CountPerServicePrincipal = count() by Identity, OperationName
//TimeGenerated
```

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TAKEAWAYS

Service principals are an equally interesting attack vector as privileged users	Proactively identify potential targets of compromise	Prevention of these issues is no easy task
• Aim at identifying anomalous behavior indicating human intervention	• Admin users, Apps deployed, sensitive Azure resources • Tools such as StormSpotter and cypher queries can be of great help	• Build layered defenses [5] • Set up detection around eventual compromise

REFERENCES

1. https://www.microsoft.com/security/blog/2020/06/18/inside-microsoft-threat-protection-mapping-attack-chains-from-cloud-to-endpoint/
2. https://www.microsoft.com/security/blog/2021/03/09/azure-lolbins-protecting-against-the-dual-use-of-virtual-machine-extensions/
3. https://dirkjanm.io/azure-ad-privilege-escalation-application-admin/
4. https://github.com/Azure/Stormspotter
5. https://lnkd.in/e7RPappr
6. Follow us on Twitter for news on the tool release

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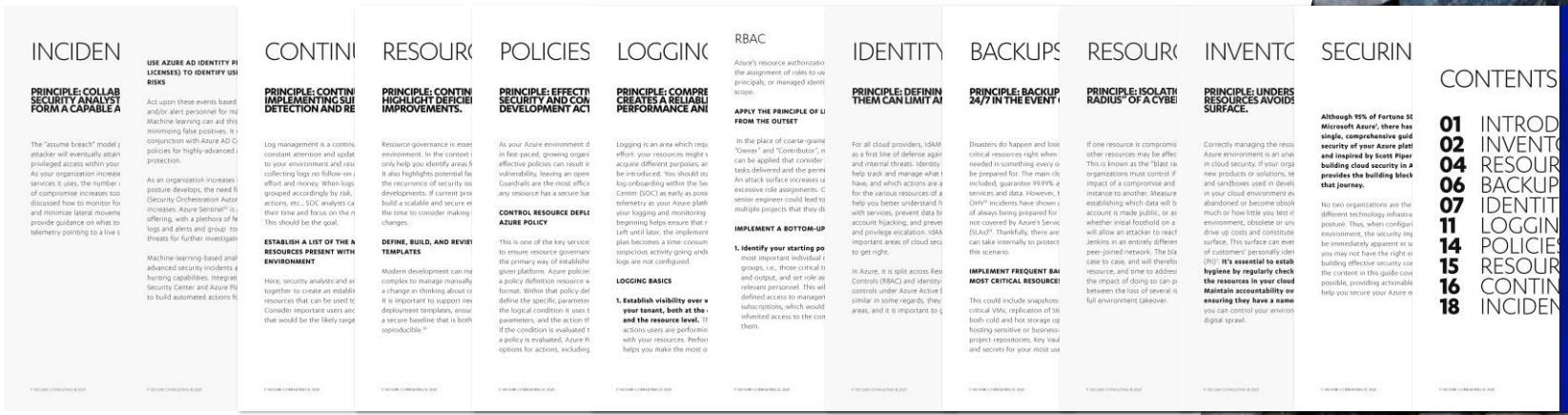
THE END – THANK YOU!

Questions?



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