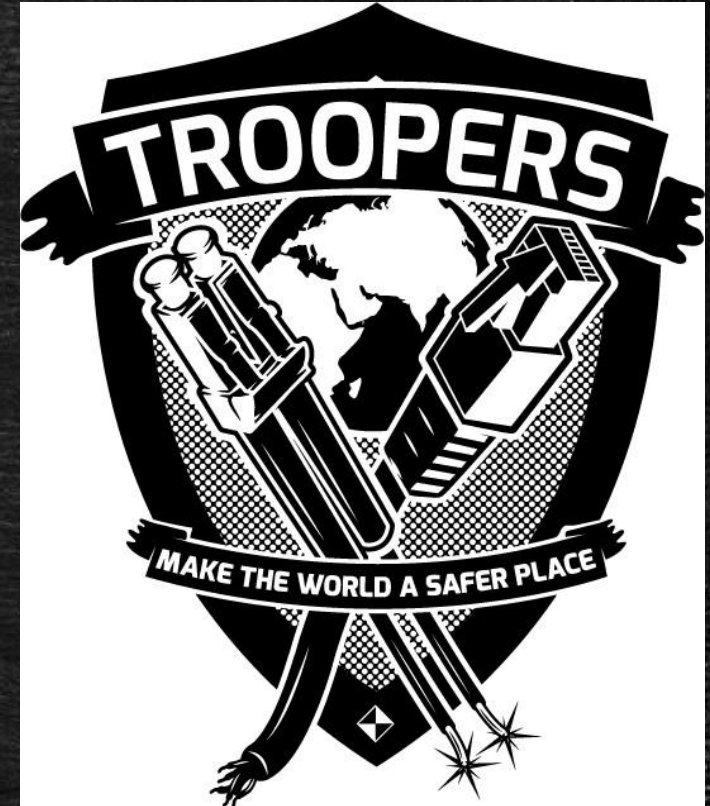# All Your Cloud Are Belong to Us

Hunting Compromise in Azure
Nate Warfield – Microsoft Security Response Center
The opinions expressed are my own and do not necessarily reflect those of Microsoft Corporation.

Whoami: Nate Warfield (@dk_effect)

- Senior Security Program Manger - MSRC
  - Vulnerability Management for Azure, Windows, Hyper-V
  - Battle tested: MS17-010, WannaCry, NotPetya, Spectre/Meltdown

- cat ~/.bash_history
  - 18 years in Network Engineering
  - First hack: BBS over 2400 baud
  - Internet of Insecurable Things
  - Radio hacking hobbyist

  - Twitter: @dk_effect
  - GitHub: n0x08

Captain: What happen?

Traditional Networking (then)	Cloud Networking (now)
• Internet exposure was restricted	• Every VM exposed to the Internet
• Many layers of ACLs + segmentation	• VM's deploy with predefined firewall
• Dedicated deployment teams	• Anyone with access can expose BadThings
• Well-defined patching cadence	• Patch management decentralized
• Servers deployed from the ground up	• VM's inherit the sins of their creators
• Only expose required services	• NoSQL open to the Internet? #yolo

2017: Somebody set us up the bomb

Operator: We get signal

- NoSQL solutions were never intended for Internet exposure

  - "..it is not a good idea to expose the Redis instance directly to the internet"

  - "Allow only trusted clients to access the network interfaces and ports on which MongoDB instances are available."

  - "Elasticsearch installations are not designed to be publicly accessible over the Internet."

- Naturally, people exposed them to the Internet

- To date: MongoDB, CouchDB, Hadoop, Elastic, Redis, CassandraDB

- DB dropped; ransom note added

- 100k+ systems compromised globally

- Azure: 2500+ VM's compromised
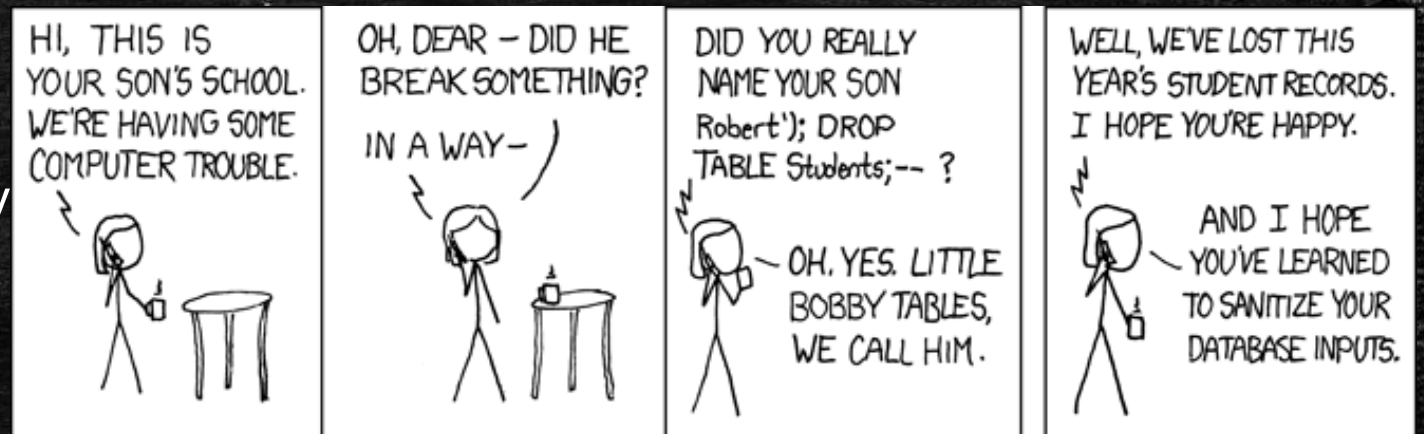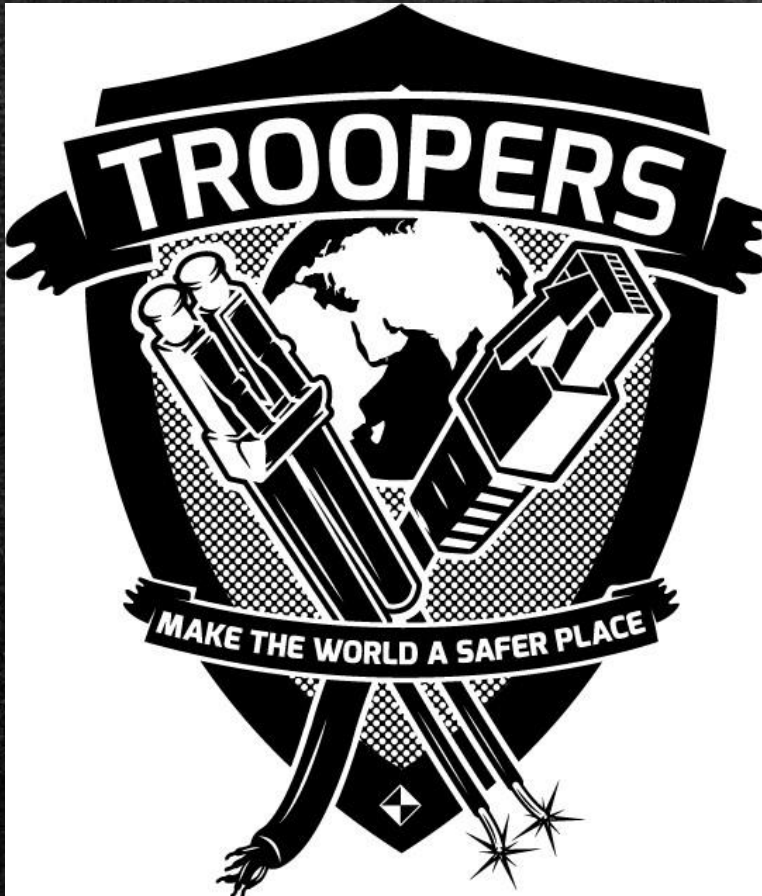
Image Source: https://imgs.xkcd.com/comics/exploits_of_a_mom.png

Hunting NOSQL Compromise in Azure

- 1.6 million Internet exposed IPs in Azure

- Port scans are slow; open port != pwned

- Each NoSQL solution runs on different port

- DB names only indication of compromise

- TL;DR – I use Shodan (what, you don't?)
  - Accurate to with 0.14% of in-house solution
  - Rich metadata for each IP
  - DB names are indexed & searchable
  - JSON export allows for automated hunting

Network Security Group (Azure)

- Network Security Group is the VM firewall

- Firewall config hard-coded by VM vendor

- Configurable during deployment (optional)

- 46% of images expose ports by default

- 96% expose more than management

- 562 unique ports exposed in Azure Gallery

AMI Security Groups (AWS)

- Amazon Marketplace Image is 3rd party IaaS

- AWS doesn't expose AMI SG config via API*

  - *Until you deploy it =)

- Feature request filed with AWS

- 11k AMI's in AWS – 5x as many as Azure

- Data indicates many clouds have this problem

Operator: Main screen turn on

- Use master list of all pwned DB names seen globally

- My code was added to Shodan in December 2017

- tag:compromised – automatically tags pwned NoSQL DBs

- 22k VM's found as of 3/6/2018

- Requires Shodan Enterprise API

- ..or..

- https://gist.github.com/n0x08

Threat hunting like a BOSS: CVE-2018-6789

- Exim mail server RCE; Azure had 1237 VMs exposed

- 'shodan download product:exim org:microsoft'

- Common Platform Enumeration field FTW

- 'shodan parse --fields ip_str,cpe'

- VMs found: 1221

- Total time: 5 minutes

```
F@MININT-H66832A:~$ shodan parse --fields ip_str,cpe exim_march.json.gz
254.204      cpe:/a:exim:exim:4.89_1
109.147      cpe:/a:exim:exim:4.82
60.113       cpe:/a:exim:exim:4.89_1
.24.172      cpe:/a:exim:exim:4.89_1
147.17       cpe:/a:exim:exim:4.89_1
125.235      cpe:/a:exim:exim:4.89_1
107.248      cpe:/a:exim:exim:4.87
154.229      cpe:/a:exim:exim:4.87
.212.236     cpe:/a:exim:exim:4.86_2
148.162      cpe:/a:exim:exim:4.89_1
250.10       cpe:/a:exim:exim:4.89_1
.147.99      cpe:/a:exim:exim:4.76
200.39       cpe:/a:exim:exim:4.89_1
.52.43       cpe:/a:exim:exim:4.89
```

Default Passwords

- 3rd party IaaS images occasionally contain a default password

- At least it's a strong* PW!: P@sswOrd123

  - *actual PW changed to protect the innocent

- Users always change passwords after installation ;)

- Mostly for services like MySQL, SQL, etc…

```
elliott@khaleesi:~$ shodan stats --facets product tag:database
Top 10 Results for Facet: product
MySQL                        4,550,268
PostgreSQL                     504,495
MongoDB                         55,661
Elastic                         36,665
HDFS NameNode                    5,509
CouchDB                          4,458
Cassandra                        1,424
Apache Hive                      1,261
HBase                            1,035
IBM DB2 Database Server            499
```

Every (MQTT) step you take…

- MQTT – publish/subscribe message protocol

- Used by IoT, Facebook Messanger, many more

- Azure & AWS offer MQTT-based solutions

- Internet exposure +25% in last year

SHODAN   port:1883

Exploits   Maps   Share Search   Down

TOTAL RESULTS

38,125

TOP COUNTRIES

China	9,075
United States	6,587
Germany	2,251
Taiwan	1,569
Hong Kong	1,520

…I'll be tracking you

Cats: How are you gentlemen!!

We view this as keeping our oath to protect and defend against enemies foreign and domestic. TheShadowBrokers has is having little of each as our auction was an apparent failure. Be considering this our form of protest.

--ShadowBrokers, April 8th 2017

Cats: You are on the way to destruction

- [REDACTED] weaponized an SMBv1 exploit (EternalBlue)

- [REDACTED] added it to their Metasploit clone

- [REDACTED] lost control of this tool

- Microsoft patched in March 2017 via MS17-010

- ShadowBrokers dropped 0-day on April 14th, 2017 (MS17-010 +31 days)

- No sane person would expose SMB to the Internet…..

Finding DoublePulsar in Azure
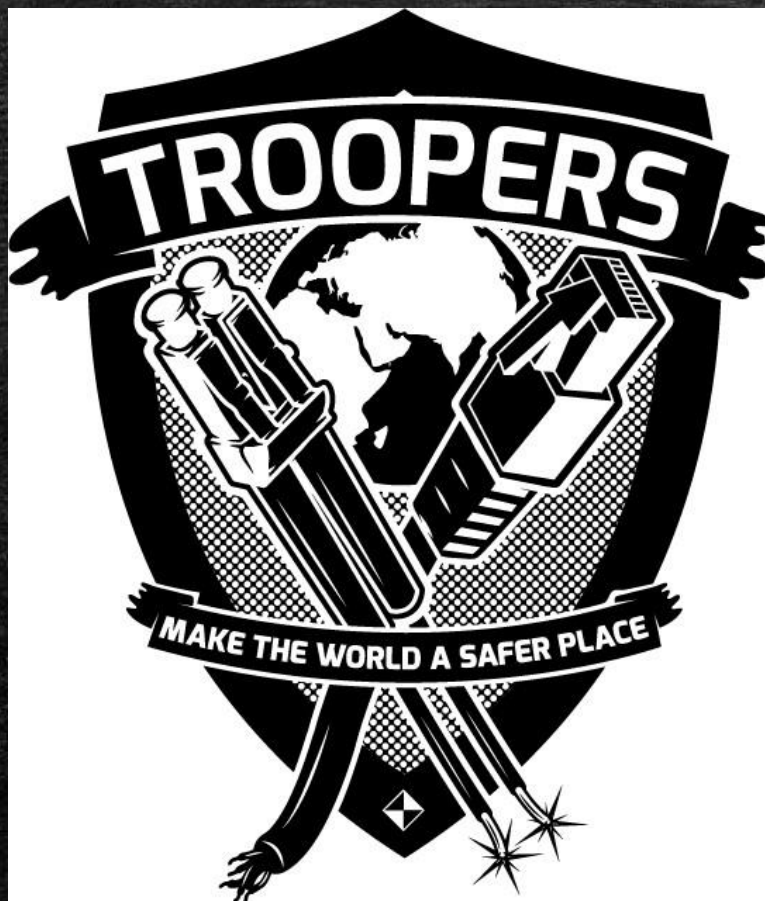
- Only 14k VM's exposing TCP/445

- Initially undetectable by Shodan

- Detection via unused SMB error code (0x51)

- Manually scanned all IP's exposing TCP/445

- Low number of implants (<50)

- That means everyone patched!!!

Cats: You have no chance to survive make your time

- WannaCry hit on May 12, 2017

- Azure exposed SMB: 14,480 VMs

- Targeted unpatched MS17-010

- Initial infection via Internet-exposed SMB port

- 230k+ systems in 150 countries affected

- Comparatively low-tech

- Propagated via EternalBlue
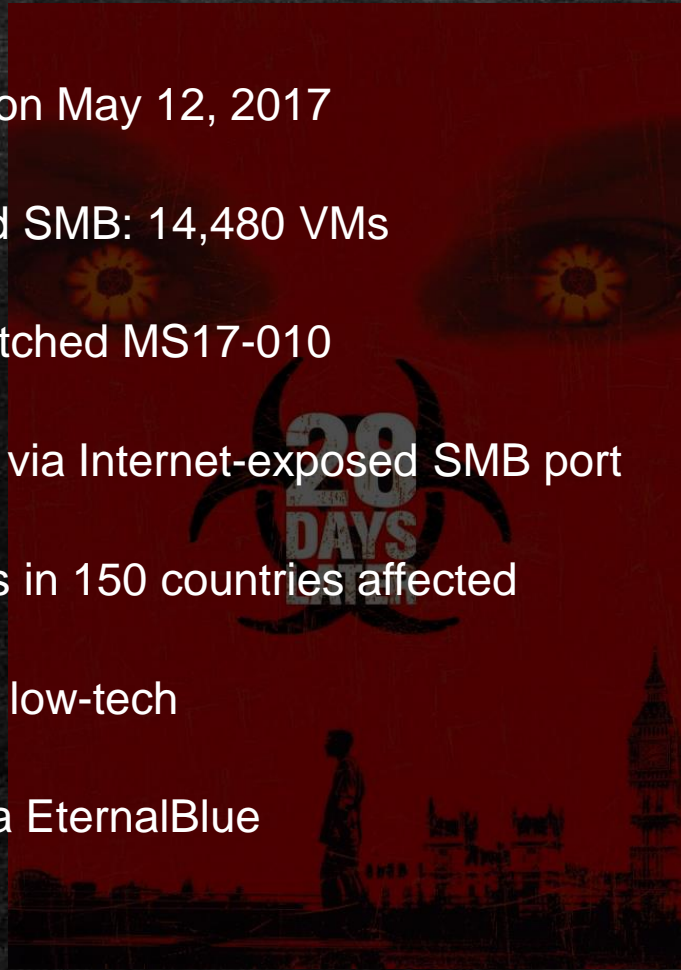
- NotPetya hit on June 27, 2017

- Azure exposed SMB: 16,750 VMs (+13.55%)

- Specifically targeted Ukraine

- Initial infection via trojaned MEDocs software

- Blast radius increased by VPN links to Ukraine

- Comparatively high-tech

- Propagated via psexec, mimikatz, MS17-010
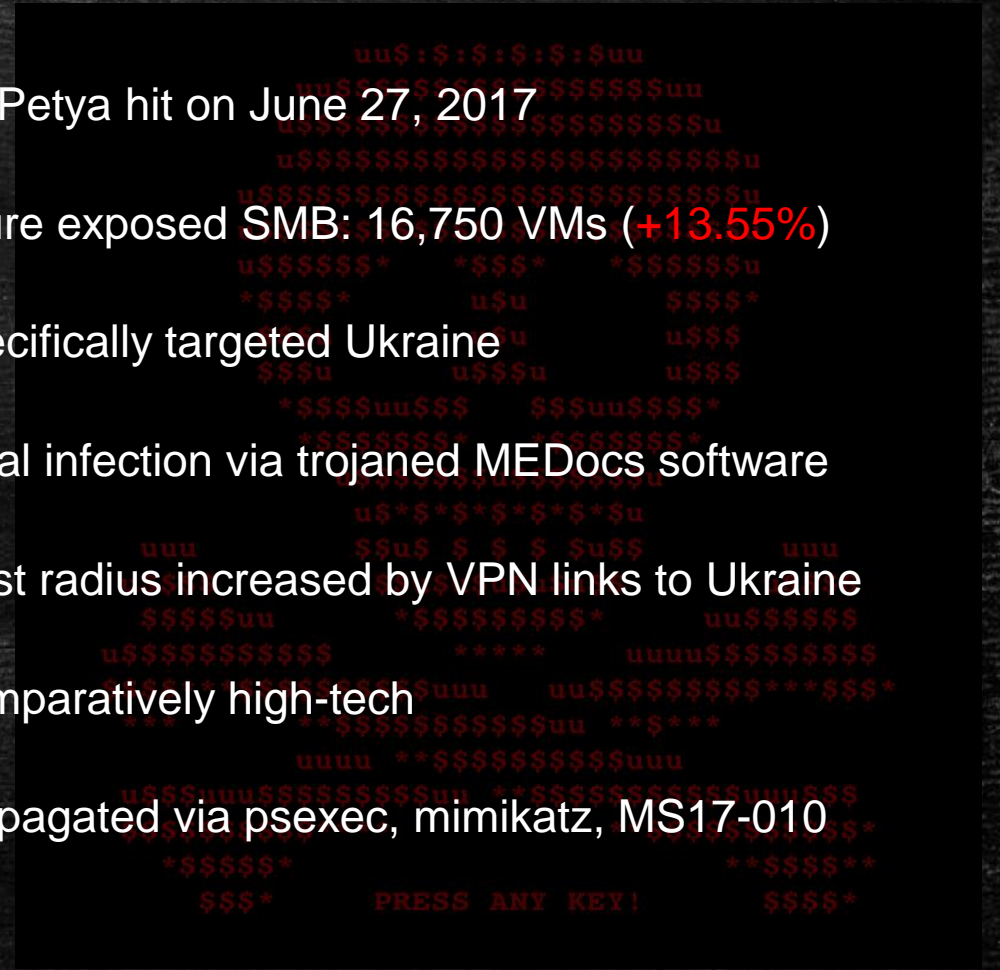
Your IaaS security *is your responsibility*

- Ever hear about Express Route and Direct Connect?

  - "Microsoft Azure ExpressRoute lets you extend your on-premises networks into the Microsoft cloud…."

  - "Direct Connect makes it easy to establish a dedicated network connection from your premises to AWS."

- That sounds like a VPN! (spoiler alert: it is)

- How are you managing ACL's on P2P cloud connections?

- Is your cloud *actually* isolated from on-premises network?

- Do your IT policies extend to your cloud subscriptions?

  - Who is patching your IaaS servers?
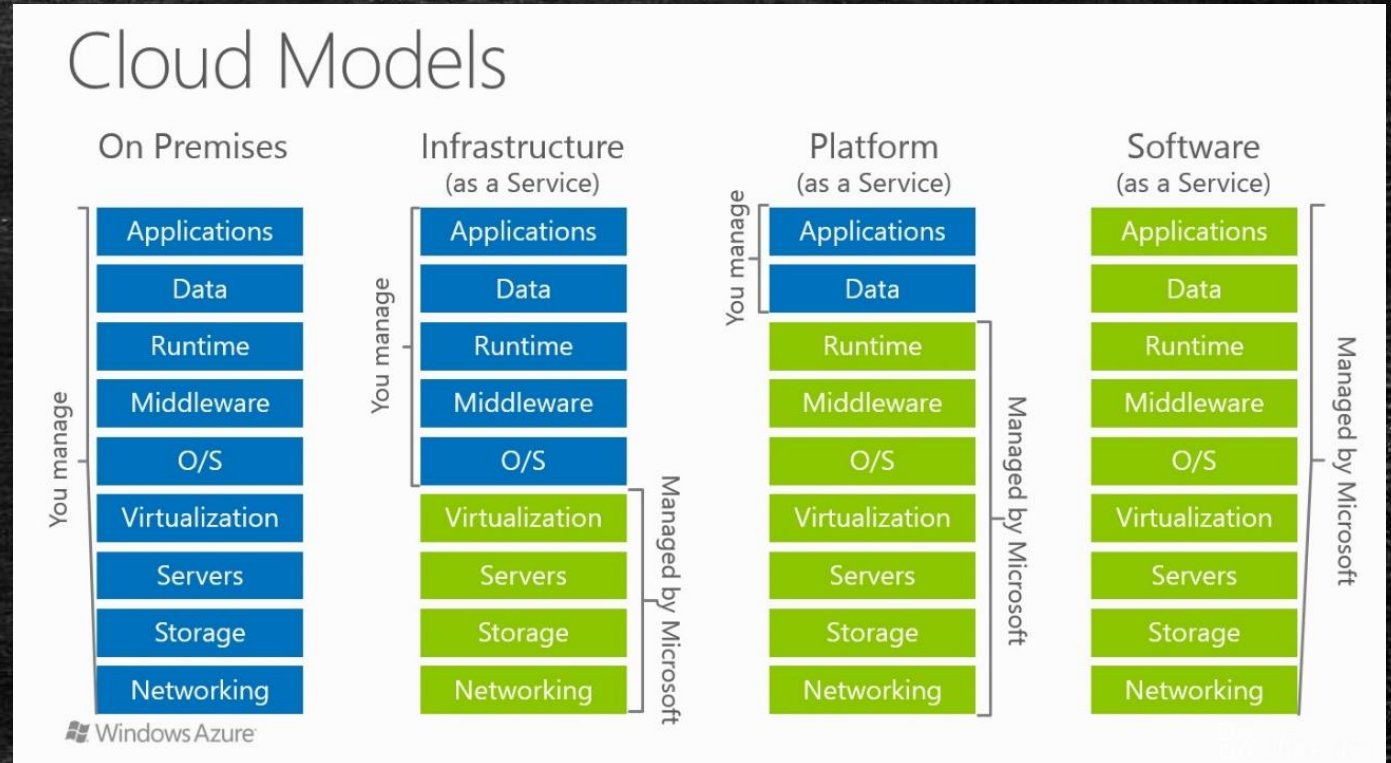
Jeffrey Snover ✔
@jsnover

We made a huge investment in security for Azure Stack so it would "just work".

But.. users are responsible for the security of their VMs and Apps.

9:11am · 15 Feb 2018 · Twitter Lite

PaaS & SaaS are shared responsibility

- "Patching causes downtime"

- "My cloud provider handles patching"

- PaaS & SaaS can help!

- Understand shared responsibility

- Patching handled by Microsoft
  - SaaS
  - PaaS (if you let us)

Cloud Models

On Premises	Infrastructure (as a Service)	Platform (as a Service)	Software (as a Service)
Applications	Applications	Applications	Applications
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Middleware	Middleware	Middleware	Middleware
O/S	O/S	O/S	O/S
Virtualization	Virtualization	Virtualization	Virtualization
Servers	Servers	Servers	Servers
Storage	Storage	Storage	Storage
Networking	Networking	Networking	Networking

Windows Azure

Cloud marketplaces are supply chains

- Supply chain attacks are increasingly common

- Cloud marketplaces could be next

- Lots of resources; high value targets

- Minimal validation of 3rd party IaaS VM images

- 3rd party IaaS images are *OLD*
    - Average Azure Age: **123 days**
    - Average AWS Age: **717 days**

- Updating IaaS VM images is not retroactive

2018: Year of the CryptoMiner

- Cryptomining is the new Ransomware

- NoSQL attack campaign shifted

- Open S3 buckets being attacked

- Any vulnerable system is a target

Captain: For great justice

- Update your IaaS VMs immediately after deployment

- Review firewall settings before deployment

- For sensitive roles consider building your IaaS Image

- Better visibility into out-of-the-box IaaS VM security

  - Age of IaaS VM image

  - Default firewall policies

  - Version info of daemons/services

- Azure Security Center: Free tier provides recommendations

Questions?

Nate Warfield – @dk_effect

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