DOING RECON LIKE IT'S 2017

APPSECCO

BHARATH KUMAR

BSIDES DELHI | OCTOBER 27, 2017

BSIDES DELHI 2017

ABOUT ME

- Bharath Kumar
- Security Engineer @Appsecco
- **O**ffensive **S**ecurity **C**ertified **P**rofessional
- I enjoy good books, coffee, camping and stargazing!

DEMO ENVIRONMENT

- Feel free to run the DNSSEC attacks from the talk against the following nameserver & domain:

Nameserver: **ns1.insecuredns.com**
Domain: **insecuredns.com**

WHAT IS RECONNAISSANCE?

Reconnaissance is the act of gathering preliminary data or intelligence on your target. *The data is gathered in order to better plan for your attack. Reconnaissance can be performed actively or passively.*

WHAT DO WE LOOK FOR DURING RECON?

- Info to increase attack surface(domains, net blocks)
- Credentials(email, passwords, API keys)
- Sensitive information
- Infrastructure details

WHAT'S COVERED IN THIS TALK?

1. Certificate Transparency for recon
2. DNSSEC Zone Walking
3. Hunting for publicly accessible on cloud storage
4. Code repos for recon
5. Passive recon using public datasets

CERTIFICATE TRANSPARENCY

- Under CT, a Certificate Authority(CA) will have to publish all SSL/TLS certificates they issue in a public log
- Anyone can look through the CT logs and find certificates issued for a domain
- Details of known CT log files - https://www.certificate-transparency.org/known-logs

https://blog.appsecco.com/certificate-transparency-part-2-the-bright-side-c0b99ebf31a8

CT - SIDE EFFECT

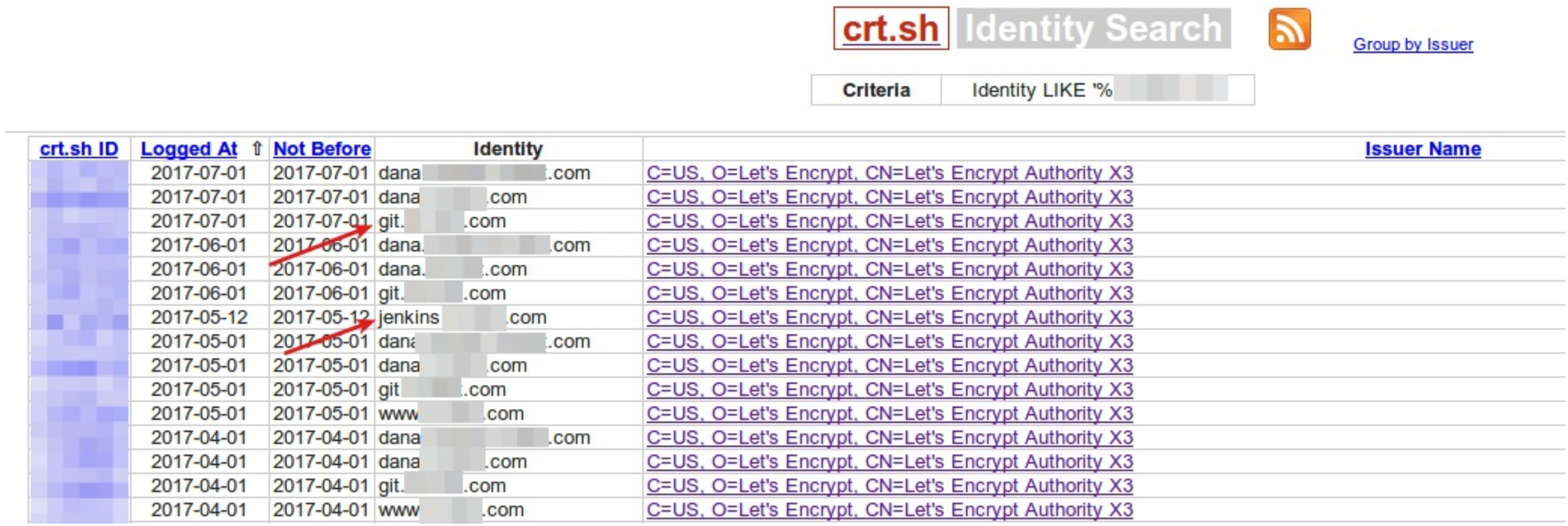
- CT logs by design contain all the certificates issued by a participating CA for any given domain
- By looking through the logs, **an attacker can gather a lot of information** about an organization's infrastructure i.e. internal domains, email addresses in a **completely passive manner**

https://blog.appsecco.com/certificate-transparency-part-3-the-dark-side-9d401809b025

SEARCHING THROUGH CT LOGS

- There are various search engines that collect the CT logs and let’s anyone search through them
  1. https://crt.sh/
  2. https://censys.io/
  3. https://developers.facebook.com/tools/ct/
  4. https://google.com/transparencyreport/https/ct/

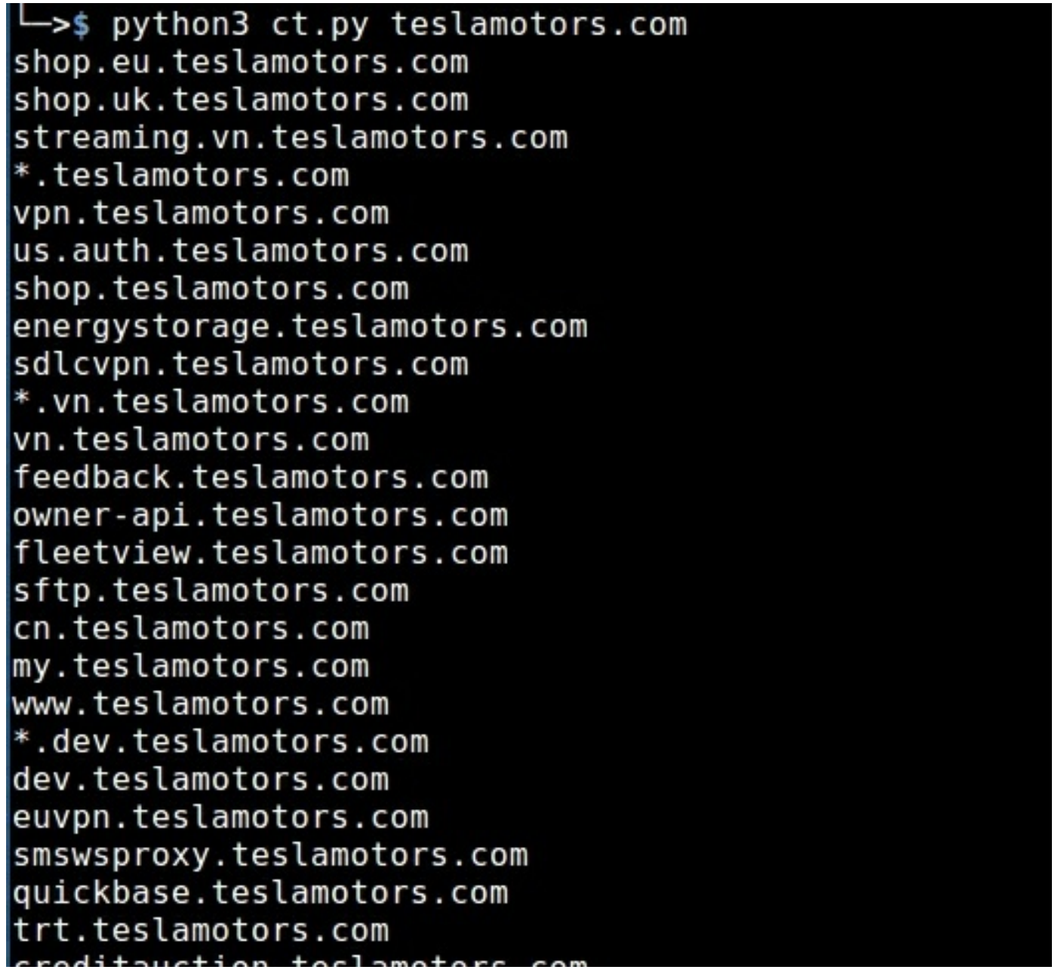
Searching SSL/TLS certificates issued for a domain



crt.sh ID	Logged At ⇧	Not Before	Identity	Issuer Name
	2017-07-01	2017-07-01	dana[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-07-01	2017-07-01	dana[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-07-01	2017-07-01	git.[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-06-01	2017-06-01	dana.[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-06-01	2017-06-01	dana.[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-06-01	2017-06-01	git.[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-05-12	2017-05-12	jenkins[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-05-01	2017-05-01	dana[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-05-01	2017-05-01	dana[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-05-01	2017-05-01	git[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-05-01	2017-05-01	www[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-04-01	2017-04-01	dana[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-04-01	2017-04-01	dana[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-04-01	2017-04-01	git.[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3
	2017-04-01	2017-04-01	www[redacted].com	C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3

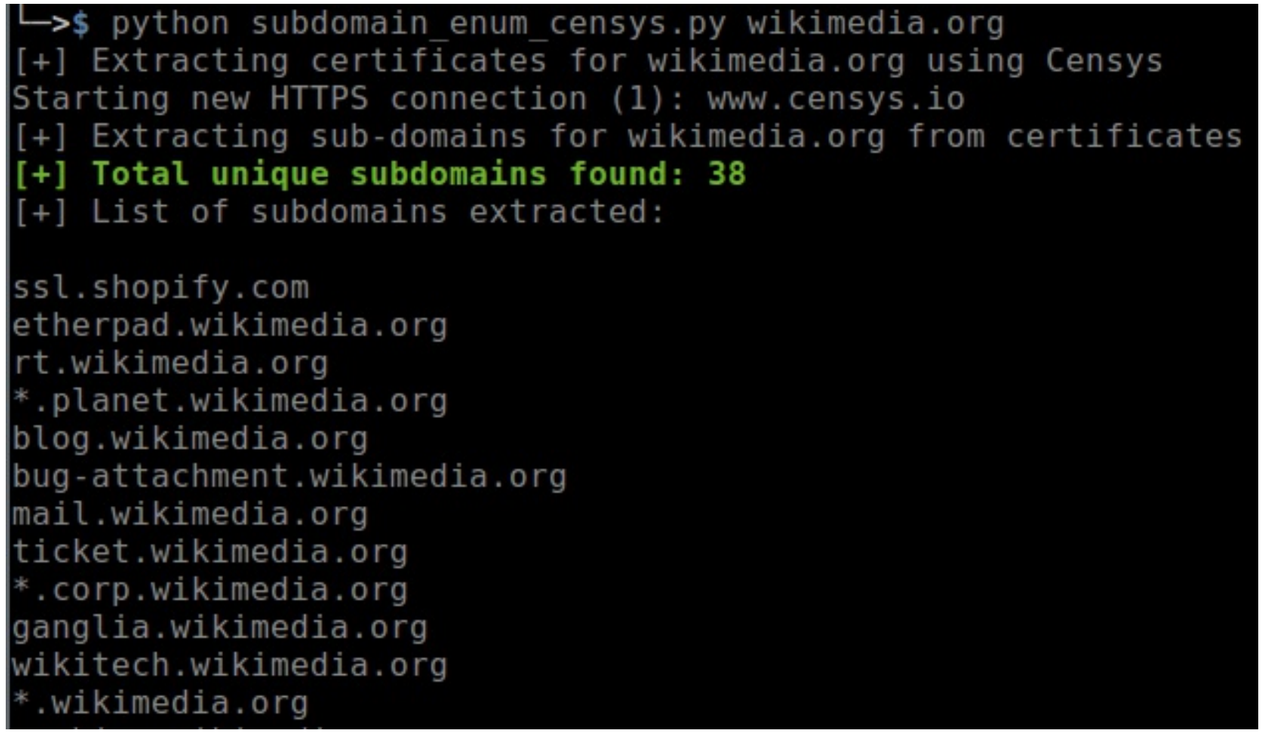
https://crt.sh

Output of a script that searches for sub-domains using crt.sh



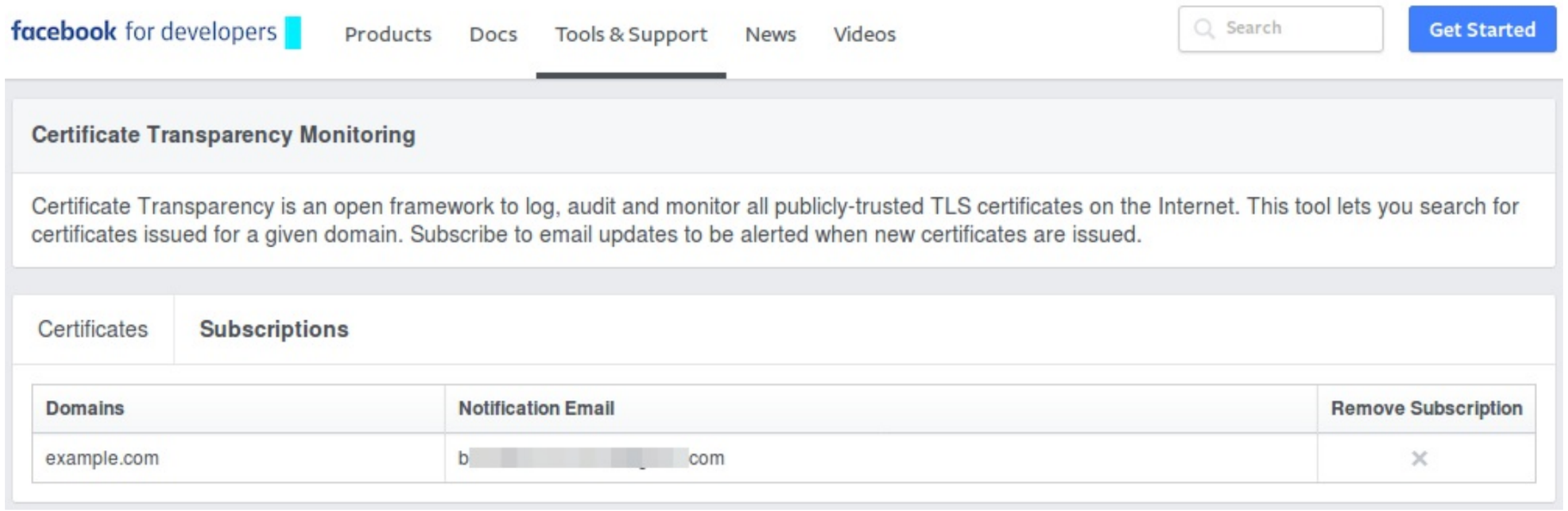
https://crt.sh

Output of a script that searches for sub-domains using censys.io



https://censys.io

KEEPING TRACK OF AN ORGANISATION'S SUB-DOMAINS



https://developers.facebook.com/tools/ct/

DOWNSIDE OF CT FOR RECON

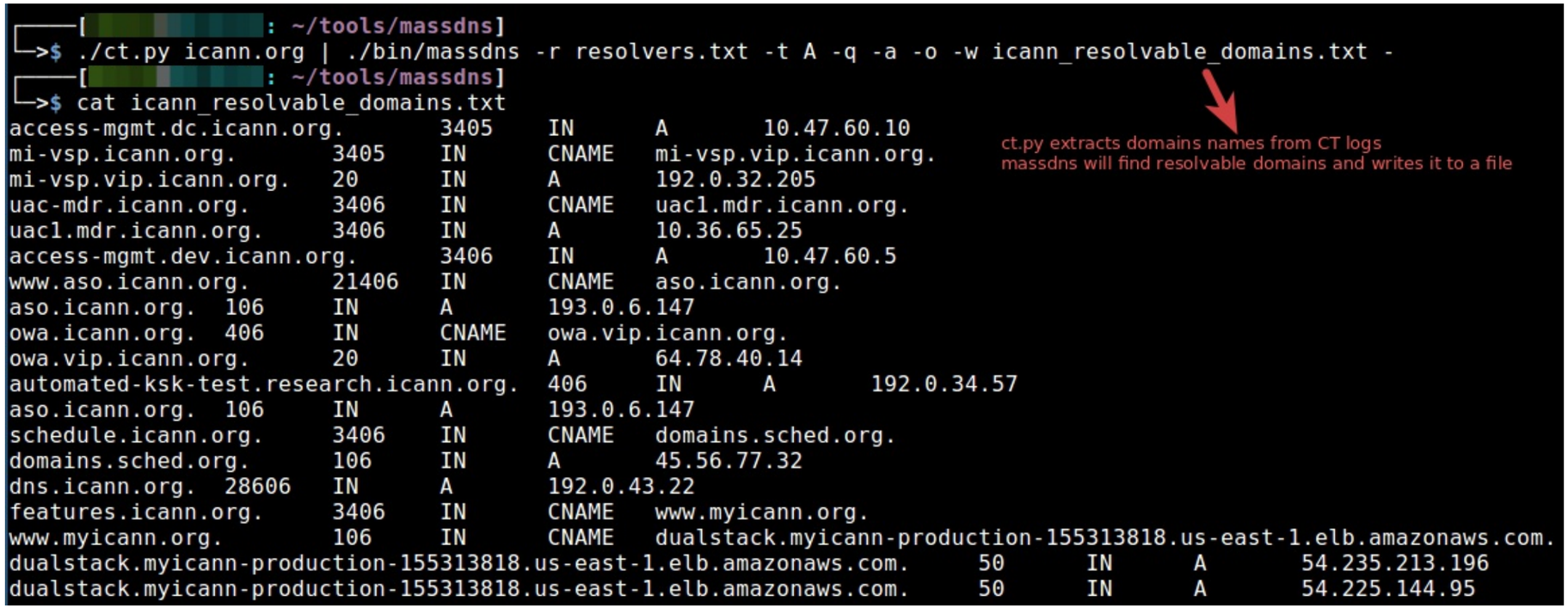
- CT logs are append-only. There is no way to delete an existing entry
- The domain names found in the CT logs may not exist anymore and thus they can’t be resolved to an IP address

https://blog.appsecco.com/a-penetration-testers-guide-to-sub-domain-enumeration-7d842d5570f6

CT LOGS + MASSDNS

- You can use tools like massdns along with CT logs script to quickly identify resolvable domain names.

```
python3 ct.py example.com | ./bin/massdns -r resolvers.txt -t A -a -o -w res
```



FINDING VULNERABLE CMS USING CT

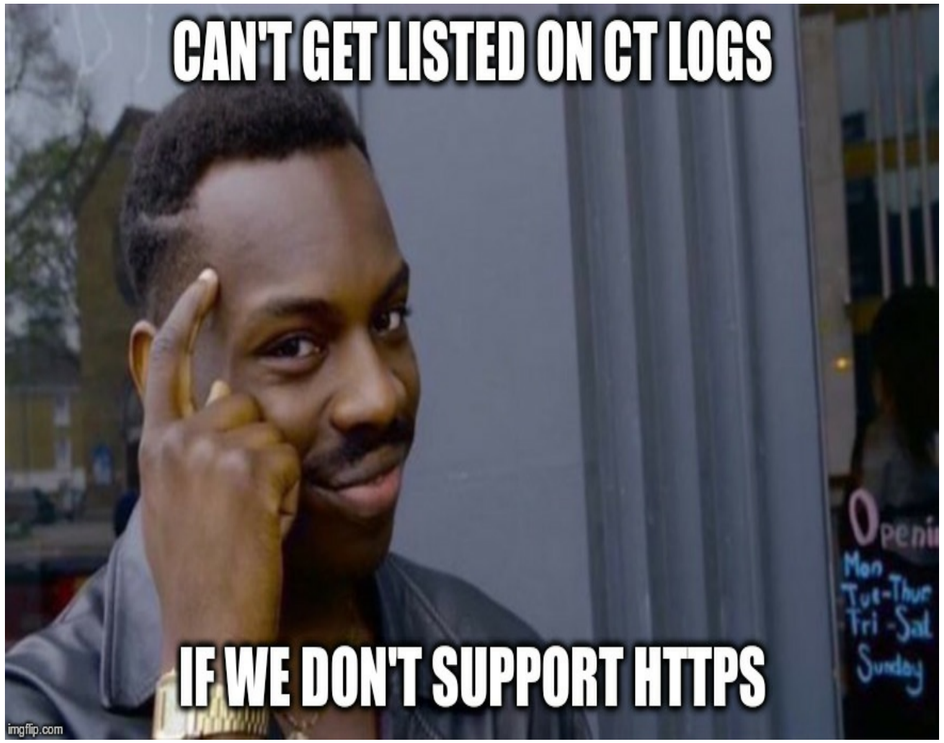
- When setting up some CMSs like Wordpress, Joomla and others, there is a window of time where the installer has no form of authentication
- If the domain supports HTTPS it will end up on a CT log(sometimes in near real time)
- If an attacker can search through CT Logs and find such a web application without authentication then he/she can take over the server

FINDING VULNERABLE CMS USING CT

- This attack has been demonstrated by Hanno Böck at Defcon 25
- He claimed to have found 5,000 WordPress installations using CT logs over a period of 3 months that he could have potentially taken over
- HD Moore also discussed this technique in his talk at BSidesLV 2017

CT LOGS - MITIGATION

- Not have SSL/TLS support. This approach is definitely not recommended



CT LOGS - MITIGATION

- Using wildcard certificates will avoid sub-domain names being listed in CT Logs but **wildcard certs are a security risk**

CT LOGS - MITIGATION

- Deploy your own Public Key Infrastructure(PKI)
- CFSSL project by CloudFlare helps you build an internal PKI.
- Certmgr by Cloudflare automates certificate management using a CFSSL.
- Opt out of CT logs but you’ll miss out on all the security benefits that CT provides
- Name redaction in CT logs let's you hide your sub-domain information in a CT log

DNSSEC

- DNSSEC provides a layer of security by adding cryptographic signatures to existing DNS records
- These signatures are stored alongside common record types like A, AAAA, MX etc

DNSSEC - NEW RECORDS

Record	Purpose
RRSIG	Contains a cryptographic signature.
NSEC and NSEC3	For explicit denial-of-existence of a DNS record
DNSKEY	Contains a public signing key
DS	Contains the hash of a DNSKEY record

DNSSEC - AUTHENTICATED DENIAL OF EXISTENCE(RFC 7129)

In DNS, when client queries for a non-existent domain, the server must deny the existence of that domain. It is harder to do that in DNSSEC due to cryptographic signing.

PROBLEMS WITH AUTHENTICATED DENIAL OF EXISTENCE(DNSSEC)

1. *NXDOMAIN* responses are generic, attackers can spoof the responses
2. Signing the responses on the fly would mean a performance and security problem
3. Pre-signing every possible *NXDOMAIN* record is not possible as there will be infinite possibilities

NSEC

- Zone entries are sorted alphabetically, and the NextSECure(NSEC) records point to the record after the one you looked up
- Basically, **NSEC record says, “there are no subdomains between sub-domain X and sub-domain Y.”**

```
$ dig +dnssec  @ns1.insecuredns.com firewalllll.insecuredns.com
... snipped ...
firewall.insecuredns.com. 604800 IN NSEC mail.insecuredns.com. A RRSIG
... snipped ...
```

ZONE WALKING NSEC - LDNS

- The ldns-walk(part of ldnsutils) can be used to zone walk DNSSEC signed zone that uses NSEC.

```
# zone walking with ldnsutils
$ ldns-walk iana.org
iana.org. iana.org. A NS SOA MX TXT AAAA RRSIG NSEC DNSKEY
api.iana.org. CNAME RRSIG NSEC
app.iana.org. CNAME RRSIG NSEC
autodiscover.iana.org. CNAME RRSIG NSEC
beta.iana.org. CNAME RRSIG NSEC
data.iana.org. CNAME RRSIG NSEC
dev.iana.org. CNAME RRSIG NSEC
ftp.iana.org. CNAME RRSIG NSEC
^C
```

ZONE WALKING NSEC - LDNS

```
┌──[ ~/appsecco/conferences/levelup/artifacts]
└─>$ ldns-walk @ns1.insecuredns.com insecuredns.com
insecuredns.com.        insecuredns.com. A NS SOA TXT RRSIG NSEC DNSKEY
champ.insecuredns.com. A RRSIG NSEC
conference.insecuredns.com. A RRSIG NSEC
damn.insecuredns.com. A RRSIG NSEC
firewall.insecuredns.com. A RRSIG NSEC
mail.insecuredns.com. A RRSIG NSEC
ns1.insecuredns.com. A RRSIG NSEC
ns2.insecuredns.com. A RRSIG NSEC
null.insecuredns.com. A RRSIG NSEC
secrets.insecuredns.com. A RRSIG NSEC
staging.insecuredns.com. A RRSIG NSEC
vpn.insecuredns.com. A RRSIG NSEC
www.insecuredns.com. A RRSIG NSEC
```

INSTALLING LDNSUTILS

```
# On Debian/Ubuntu
$ sudo apt-get install ldnsutils
```

```
# On Redhat/CentOS
$ sudo yum install ldns
# You may need to do
$ sudo yum install -y epel-release
```

ZONE WALKING NSEC - DIG

- You can list all the sub-domains by following the linked list of NSEC records of existing domains.

```
$ dig +short NSEC api.nasa.gov
apm.nasa.gov. CNAME RRSIG NSEC
```

```
$ dig +short NSEC apm.nasa.gov
apmcpr.nasa.gov. A RRSIG NSEC
```

EXTRACTING THE SUB-DOMAIN FROM NSEC

- You can extract the specific sub-domain part using awk utility.

```
$ dig +short NSEC api.nasa.gov |  awk '{print $1;}'
apm.nasa.gov.
```

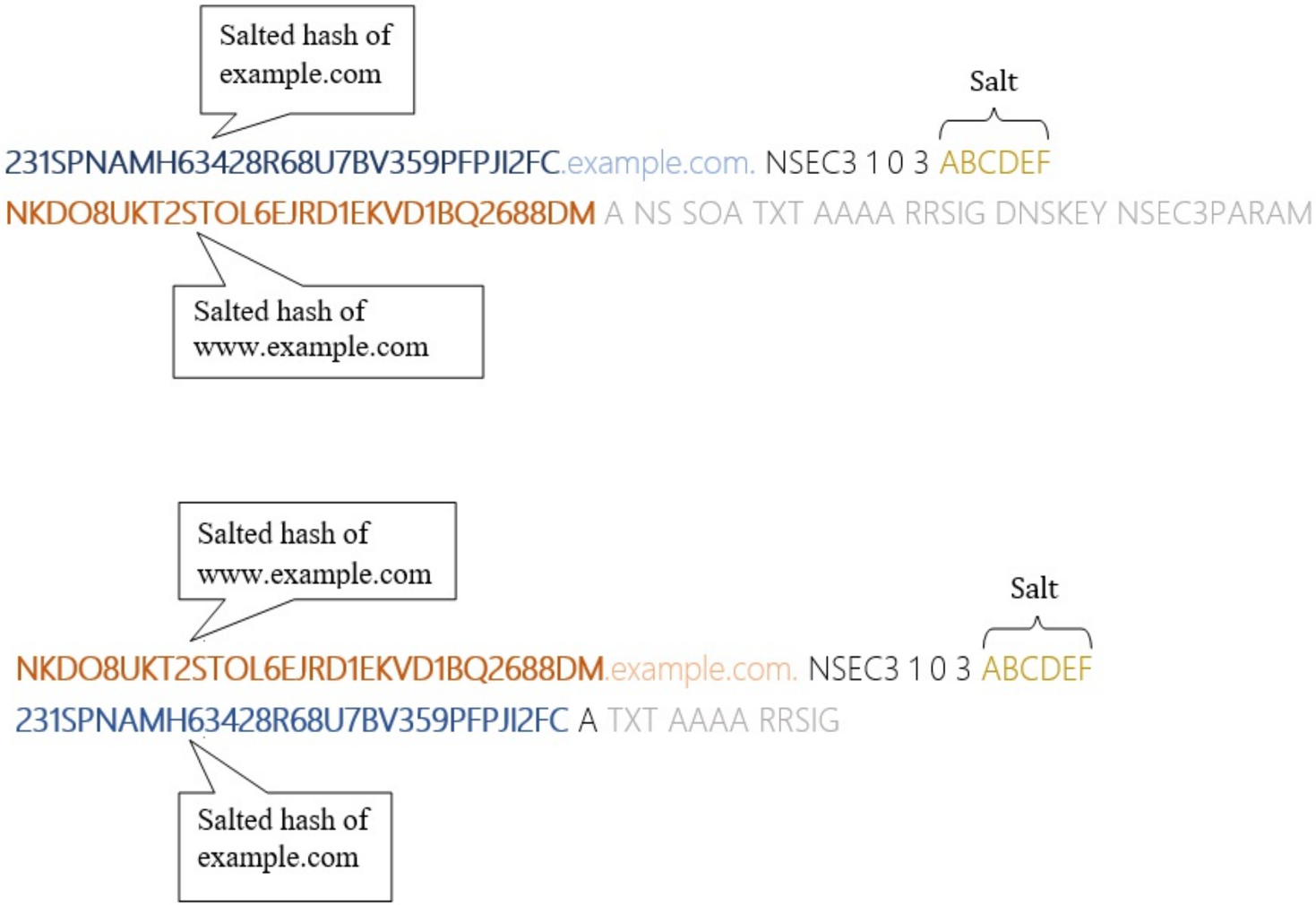
NSEC3

- The NSEC3 record is like an NSEC record, but, NSEC3 provides a signed gap of **hashes of domain names**.
- Returning hashes was intended to prevent zone enumeration(or make it expensive).

```
231SPNAMH63428R68U7BV359PFPJI2FC.example.com. NSEC3 1 0 3 ABCD
NKDO8UKT2STOL6EJRD1EKVD1BQ2688DM A NS SOA TXT AAAA RRSIG DN
```

```
NKDO8UKT2STOL6EJRD1EKVD1BQ2688DM.example.com. NSEC3 1 0 3 AB
231SPNAMH63428R68U7BV359PFPJI2FC A TXT AAAA RRSIG
```

NSEC3 - LINKED LIST OF HASHES



GENERATING NSEC3 HASH FOR A DOMAIN NAME

- ldns-nsec3-hash(part of ldnsutils) generates NSEC3 hash of domain name for a given salt value and number of iterations
- Number of iterations & salt value is available as part of NSEC3 record.

```
$ ldns-nsec3-hash -t 3 -s ABCDEF example.com
231spnamh63428r68u7bv359pfpji2fc.
```

```
$ ldns-nsec3-hash -t 3 -s ABCDEF www.example.com
nkdo8ukt2stol6ejrd1ekvd1bq2688dm.
```

ZONE WALKING NSEC3

- An attacker can collect all the sub-domain hashes and crack the hashes offline
- Tools like *nsec3walker*, *nsec3map* help us automate collecting NSEC3 hases and cracking the hashes

ZONE WALKING NSEC3

Zone walking NSEC3 protected zone using *nsec3walker*:

```
# Collect NSEC3 hashes of a domain
$ ./collect insecuredns.com > insecuredns.com.collect
```

```
# Undo the hashing, expose the sub-domain information.
$ ./unhash < insecuredns.com.collect > insecuredns.com.unhash
```

ZONE WALKING NSEC3

```
# Checking the number of sucessfully cracked sub-domain hashes
$ cat icann.org.unhash | grep "icann" | wc -l
182
```

```
# Listing only the sub-domain part from the unhashed data
$ cat icann.org.unhash | grep "icann" | awk '{print $2;}'
del.icann.org.
access.icann.org.
charts.icann.org.
communications.icann.org.
fellowship.icann.org.
files.icann.org.
forms.icann.org.
mail.icann.org.
maintenance.icann.org.
new.icann.org.
public.icann.org.
research.icann.org.
rs.icann.org.
```

INSTALLING NSEC3WALKER

- Installation instructions are available at https://dnscurve.org/nsec3walker.html
- I used following commands to install nsec3walker on Ubuntu 16.04.
  - build-essential package is a prerequisite.

```
# Installing nsec3walker
$ wget https://dnscurve.org/nsec3walker-20101223.tar.gz
$ tar -xzf nsec3walker-20101223.tar.gz
$ cd nsec3walker-20101223
$ make
```

FEW THINGS THAT CHANGED WITH THE ADVENT OF APIS/DEVOPS

1. Storage
2. Authentication
3. More and more code
4. CI/CD pipelines

CLOUD STORAGE

- Cloud storage has gotten inexpensive, easy to setup and gained popularity
- Especially object/block storage
- Object storage is ideal for storing static, unstructured data like audio, video, documents, images and logs as well as large amounts of text.

1. AWS S3 buckets
2. Digital Ocean Spaces

WHAT'S THE CATCH WITH OBJECT STORAGE?

- Due to the nature of object storage, it is a treasure trove of information from an attacker/penetration tester perspective.
- In our experience, given an chance, users will store anything on third-party services, from their passwords in plain text files to pictures of their pets.

AMAZON S3 BUCKETS

- AWS S3 is an object storage service by Amazon
- Buckets allow users to store and serve large amounts of data.

Attack on Accenture(Sep, 2017)- AWS S3 buckets as attack surface

https://www.upguard.com/breaches/cloud-leak-accenture

AWS S3 buckets as attack surface - The trend

Javvad Malik, security advocate at AlienVault, added: "Massive breaches through unsecured AWS S3 buckets continue to be a troubling trend. While cloud providers take care of certain aspects of security, it is

AWS S3 buckets as attack surface - The trend

AWS S3 leaks, due to customer configuration blunders, are becoming the flavour of 2017. Verizon leaked 14 million customer records, and other open buckets researchers have spotted include those belonging to Dow Jones, voting machine supplier ES&S (both found by former MacKeeper security bod Chris Vickery).

HUNTING FOR PUBLICLY ACCESSIBLE S3 BUCKETS

- Users can store Files(Objects) in a Bucket
- Each Bucket will get an unique, predictable URL and each file in a Bucket will get an unique URL as well
- There are Access controls mechanisms available at both Bucket and Object level.

HUNTING FOR PUBLICLY ACCESSIBLE S3 BUCKETS

- Good old Google dorks

```
site:s3.amazonaws.com file:pdf
```

```
site:s3.amazonaws.com password
```

HUNTING FOR PUBLICLY ACCESSIBLE S3 BUCKETS

- As buckets have predictable URL it is trivial to do a dictionary based attack
- Following tools help run a dictionary attack to identify S3 buckets

1. AWSBucketDump
2. Bucket finder

DIGITAL OCEAN SPACES

- Spaces is an object storage service by DigitalOcean
- It is similar to AWS S3 buckets
- Spaces API aims to be interoperable with Amazon’s AWS S3 API.

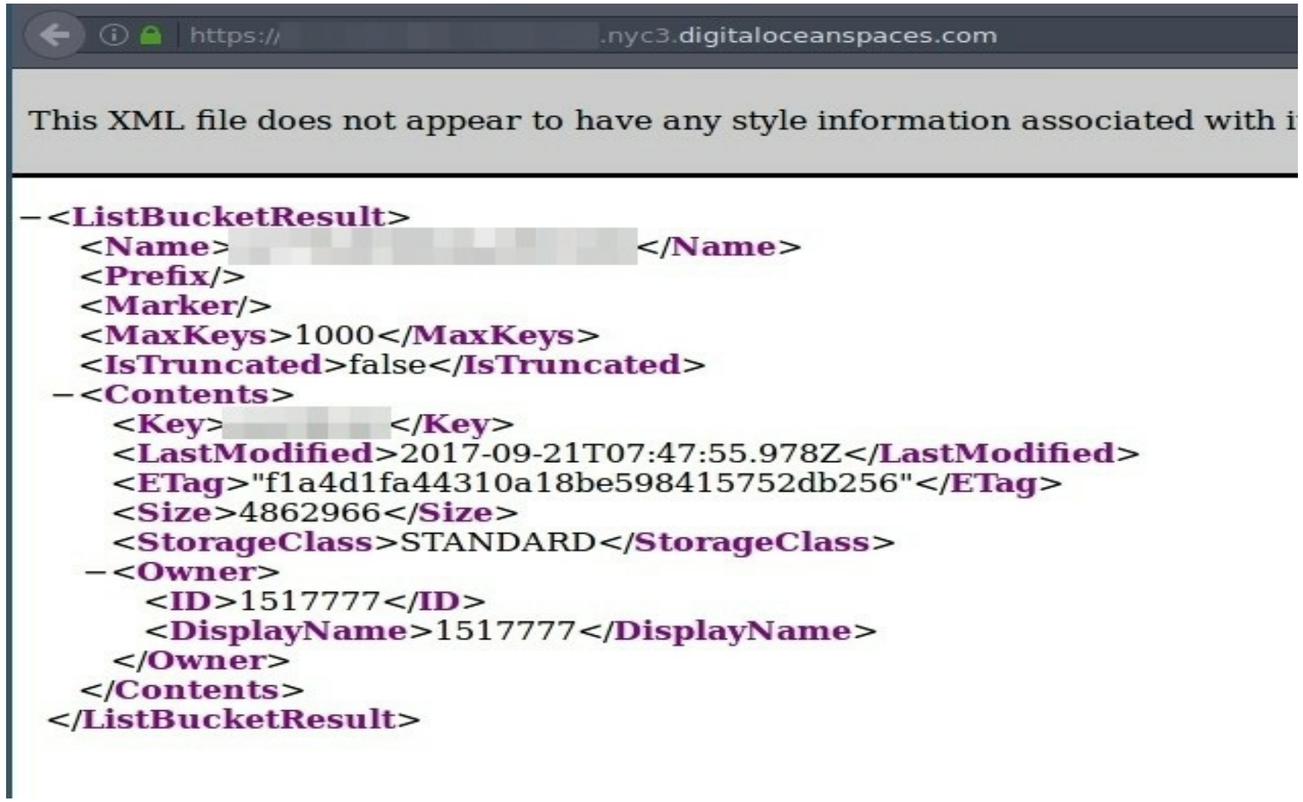
SPACES URL PATTERN

- Users can store Files in a “Space”
- Each Space will get an unique, predictable URL
- Each file in a Space will get an unique URL as well.
- Access controls mechanisms are available at Space and file level.

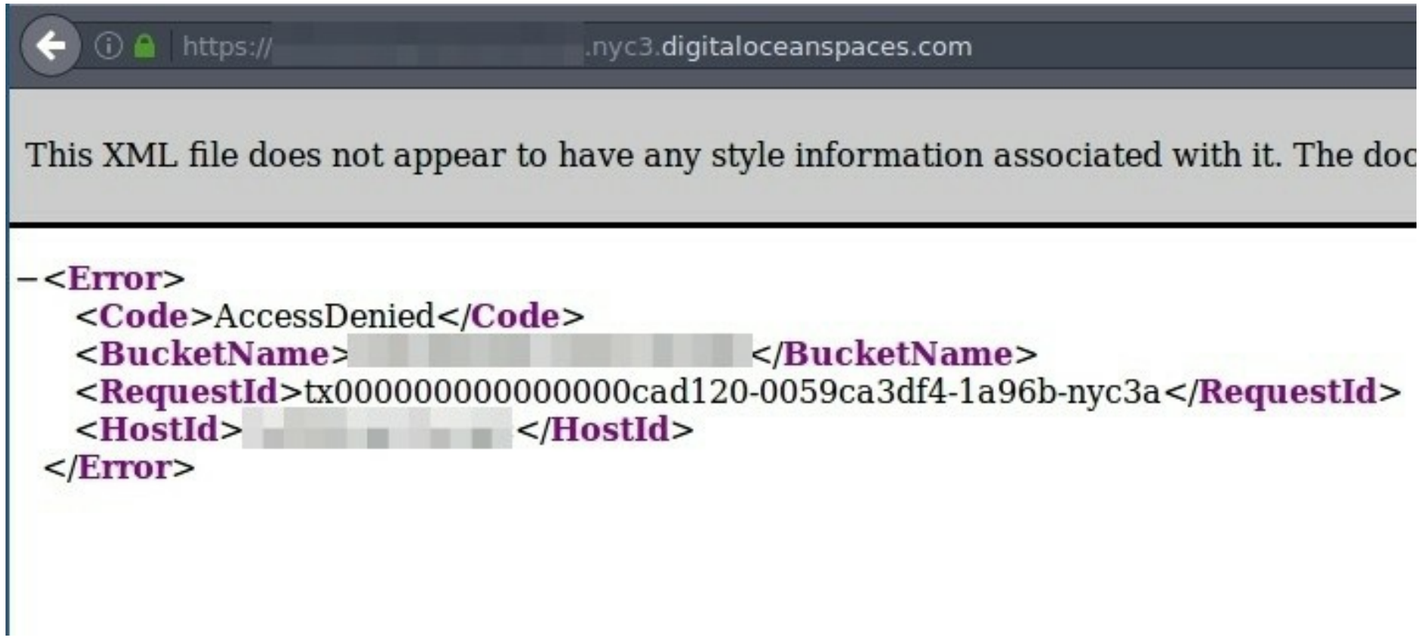
- **Regional Availability:** At launch, Spaces are available in the NYC3 region.
- **Supported Protocols:** HTTPS.
- **URL Naming Pattern:** `spacename.region.digitaloceanspaces.com` or `region.digitaloceanspaces.com/spacename`

HUNTING FOR PUBLICLY ACCESSIBLE S3 BUCKETS

A Space is typically considered “public” if any user can list the contents of the Space



A Space is typically considered “private” if the Space’s contents can only be listed or written by certain users

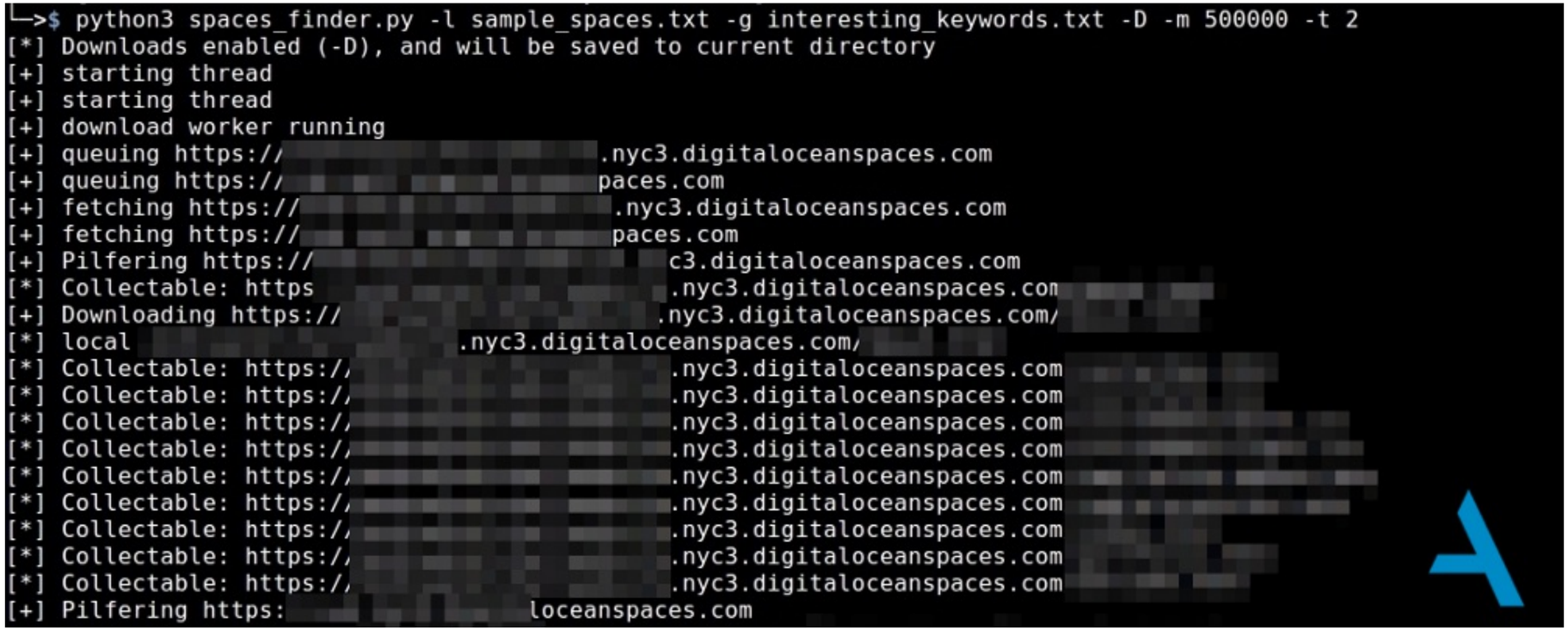


SPACES FINDER

- Spaces API is interoperable with Amazon's S3 API, we tweaked AWSBucketDump to work with DO Spaces
- *Spaces finder* is a tool that can look for publicly accessible DO Spaces using a wordlist, list all the accessible files on a public Space and download the files.

https://github.com/appsecco/spaces-finder

SPACES FINDER IN ACTION



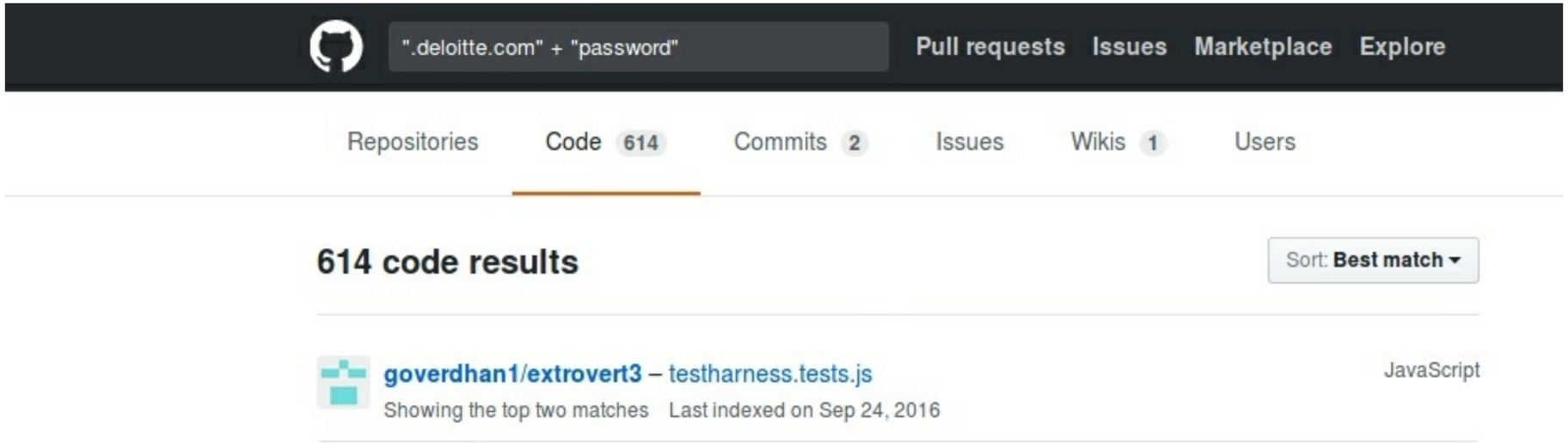
AUTHENTICATION

- With almost every service exposing an API, keys have become critical in authenticating
- API keys are treated as keys to the kingdom
- For applications, API keys tend to be achilles heel

https://danielmiessler.com/blog/apis-2fas-achilles-heel/

CODE REPOS FOR RECON

- Code repos are a treasure trove during recon
- Code repos can reveal a lot from credentials, potential vulnerabilities to infrastructure details



GITHUB FOR RECON

- GitHub is an extremely popular version control and collaboration platform
- Code repos on github tend to have all sorts of sensitive information
- Github also has a powerful search feature with advanced operators
- Github has a very well designed REST API
- edoverflow has a neat little guide on GitHub for Bug Bounty Hunters

THINGS TO FOCUS ON IN GITHUB

There are 4 main sections to look out for here.

- Repositories
- Code
- Commits(My fav!)
- Issues

delete the private ssh

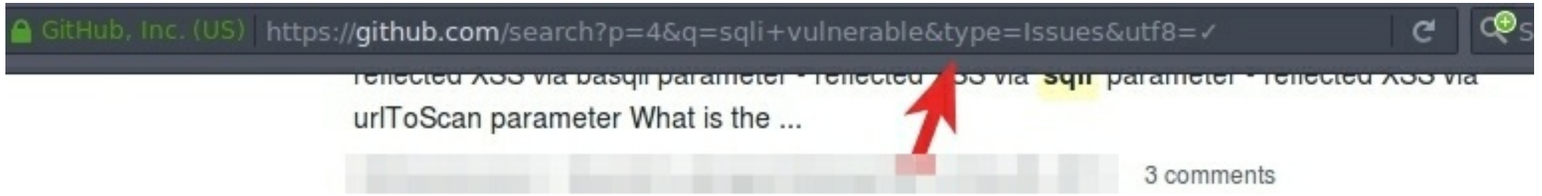
master

[redacted] committed on Sep 26

Showing 1 changed file with **0 additions** and **30 deletions**.

30 [redacted]

```
...  @@ -1,30 +0,0 @@
1  ------BEGIN RSA PRIVATE KEY-----
2  -Proc-Type: 4,ENCRYPTED
3  -DEK-Info: AES-128-CBC,6FC5A5E8A9D000A76763C69F363F493B
4  -
5  -0tYn1QBU94+y3C0+rjTctqiO3xrX3hWC501wiN0Waj7rYKWPSoVDV621501ILp0P
6  -OHZIhrhz0C6uqxlODiCg+MaVylyRl6eDWdzKrRLNkX2ov0ZdGC14Cfl05L2iBO48
7  -/5hmrkdFFlwu/0vNs5Ku2zkrKfoM4KHnRVJaz7+wQJNWYKTb1RIFONbgmncWc7gm
```



SQL injection vuln in data.views

Multiple XSS **vulnerabilities**

... **vulnerabilities** for scanner.php resource - reflected XSS via autoc parameter - reflected XSS via basqli parameter - reflected XSS via **sqli** parameter - reflected XSS via urlToScan parameter What is the ...

3 comments

MASS CLONING ON GITHUB

- You can ideally clone all the target organization's repos and analyze them locally
- GitHubCloner by @mazen160 comes very handy to automate the process

```
$ python githubcloner.py --org organization -o /tmp/output
```

https://gist.github.com/EdOverflow/922549f610b258f459b219a32f92d10b

STATIC CODE ANALYSIS

- Once the repos are cloned, you can do a static code analysis
- There are language specific tools to speed up and automate the process

1. Brakeman for Ruby
2. Bandit for Python

MANUAL SEARCH

- Once you have the repos cloned. You can understand the code, language used and architecture
- Start looking for keywords or patterns

```
- API and key. (Get some more endpoints and find API keys.)
- token
- secret
- vulnerable
- http://
```

GITHUB DORKS

- Github dorks are the new Google dorks
- Github search is quite powerful feature & can be used to find sensitive data on the repos
- **A collection of Github dorks**
  https://github.com/techgaun/github-dorks/blob/master/github-dorks.txt
- **Tool to run Github dorks against a repo**
  https://github.com/techgaun/github-dorks

PASSIVE RECON USING PUBLIC DATASETS

- There are various projects that gather Internet wide scan data and make it available to researchers and the security community.
- This data includes port scans, DNS data, SSL/TLS cert data and even data breach dumps that they can find.
- Find your needle in the haystack.

WHY USE PUBLIC DATA SETS FOR RECON?

- To reduce dependency on 3rd party APIs and services
- To reduce active probing of target infrastructure
- More the sources better the coverage
- Build your own recon platforms

LET'S LOOK AT SOME PUBLIC DATASETS

Name	Description	Price
Sonar	FDNS, RDNS, UDP, TCP, TLS, HTTP, HTTPS scan data	FREE
Censys.io	TCP, TLS, HTTP, HTTPS scan data	FREE
CT	TLS	FREE

https://github.com/fathom6/inetdata

LET'S LOOK AT SOME PUBLIC DATASETS

Name	Description	Price
CZDS	zone files for "new" global TLDs	FREE
ARIN	American IP registry information	FREE
CAIDA PFX2AS IPv4	Daily snapshots of ASN to IPv4 mappings	FREE

LET'S LOOK AT SOME PUBLIC DATASETS

Name	Description	Price
US Gov	US government domain names	FREE
UK Gov	UK government domain names	FREE
RIR Delegations	Regional IP allocations	FREE

LET'S LOOK AT SOME PUBLIC DATASETS

Name	Description	Pri
PremiumDrops	DNS zone files for com/net/info/org/biz/xxx/sk/us TLDs	$24.95/m
WWWS.io	Domains across many TLDs (~198m)	$9/m
WhoisXMLAPI.com	New domain whois data	$109/m

https://github.com/fathom6/inetdata

RAPID7 FORWARD DNS DATASET

- Rapid7 publishes its Forward DNS study/dataset on scans.io project(it's a massive dataset, 20+ GB compressed & 300+ GB uncompressed)
- This dataset aims to discover all domains found on the Internet

HUNTING SUB-DOMAIN IN FDNS DATASET

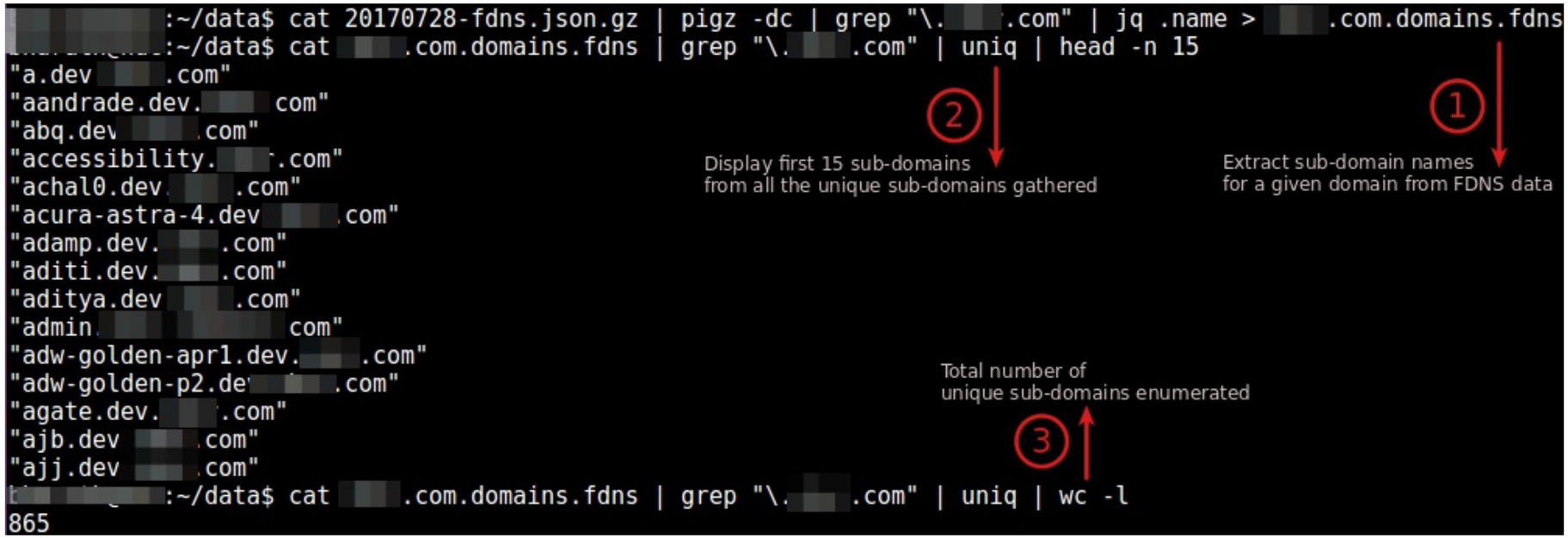
- The data format is a gzip-compressed JSON file so we can use jq utility to extract sub-domains of a specific domain:

```
curl --silent  https://scans.io/data/rapid7/sonar.fdns_v2/20170417-fdns.jso
```

```
cat 20170417-fdns.json.gz | pigz -dc | grep "\.example\.com" | jq .name
```

https://sonar.labs.rapid7.com/

HUNTING SUB-DOMAIN IN FDNS DATASET



Subdomain enumeration cheat sheet

Certificate Transparency logs - search engines

https://crt.sh/

https://censys.io/

https://google.com/transparencyreport/https/ct/

Extracting sub-domains from Rapid7 FDNS dataset

$ zcat <dataset_name> | jq -r 'if (.name | test("\\.example\\.com$")) then .name else empty end'

```
$ zcat 20170204-fdns.json.gz | jq -r 'if (.name | test("\\.example\\.com$")) then .name else empty end'
```

Rapid7 · Forward DNS dataset
https://scans.io/study/sonar.fdns_v2

Zone walking - NSEC

$ ldns-walk @<nameserver> <domain>

```
$ ldns-walk @ns1.insecuredns.com insecuredns.com
```

Installing ldns utilities

```
$ sudo apt-get install ldnsutils # On Ubuntu/Debian
$ yum install ldns # On Redhat/CentOS
```

Zone transfer

$ dig AXFR @<nameserver> <domain>

```
$ dig AXFR @ns1.insecuredns.com insecuredns.com
```

Zone walking - NSEC3 - nsec3walker

```
$ ./collect insecuredns.com > insecuredns.com.collect
$ ./unhash < insecuredns.com.collect > insecuredns.com.unhash
```

Installing nsec3walker on Ubuntu 16.04:

```
$ wget https://dnscurve.org/nsec3walker-20101223.tar.gz
$ tar -xzf nsec3walker-20101223.tar.gz
$ cd nsec3walker-20101223
$ make
```

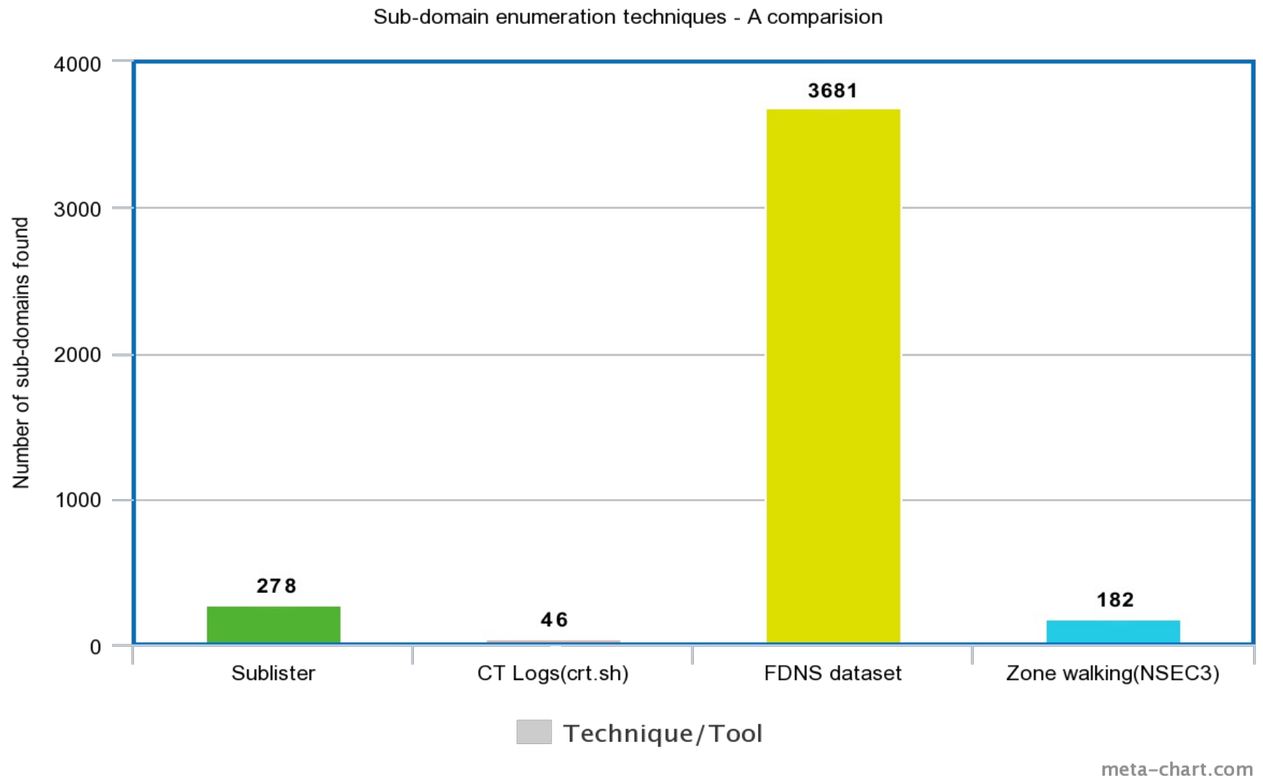
appsecco.com

Bharath
@yamakira_

https://github.com/appsecco/bugcrowd-levelup-subdomain-enumeration

ICANN.ORG SUBDOMAINS

Number of **unique, resolvable sub-domains** each enumeration technique found independently against icann.org



REFERENCES

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- https://www.cloudflare.com/dns/dnssec/how-dnssec-works/
- https://www.cloudflare.com/dns/dnssec/dnssec-complexities-and-considerations/
- http://info.menandmice.com/blog/bid/73645/Take-your-DNSSEC-with-a-grain-of-salt
- https://github.com/rapid7/sonar/wiki/Forward-DNS

About Appsecco

- Pragmatic, holistic, business-focused approach
- Specialist Application Security company
- Highly experienced and diverse team
  - Commercial
  - Security; Gold Standards

OWASP chapter leads

Certified Hackers

Assigned multiple CVEs

Def Con speakers

THANKS

@yamakira_