AIL Framework for Analysis of Information Leaks

data mining - website and darkweb correlation

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Objectives

Our objectives

- Show how to use and extend an open source tool to monitor web pages, pastes, forums and hidden services
- Explain challenges and the design of the AIL open source framework
- Learn how to create new modules
- Learn how to use, install and start AIL
- **Supporting investigation using the AIL framework**

AIL Framework

From a requirement to a solution: AIL Framework

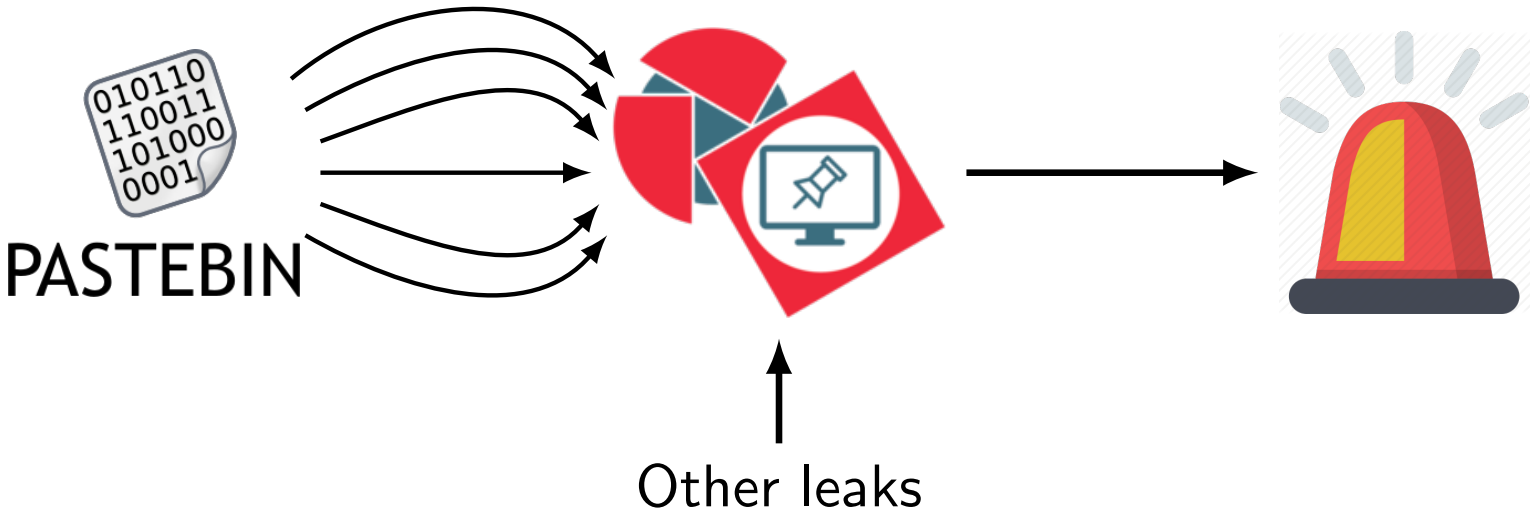
History:

- AIL[1] initially started as an **internship project** (2014) to evaluate the feasibility to automate the analysis of (un)structured information to find leaks.
- In 2019, AIL framework is an **open source software** in Python. The software is actively used (and maintained) by CIRCL and many organisations.

[1] `https://www.github.com/CIRCL/AIL-Framework`

AIL Framework: A framework for Analysis of Information Leaks

"AIL is a modular framework to analyse potential information leaks from unstructured data sources."



Capabilities Overview

Common usage

- **Check** if mail/password/other sensitive information (terms tracked) leaked
- **Detect** reconnaissance of your infrastructure
- **Search** for leaks inside an archive
- **Monitor** and crawl websites

Support CERT and Law Enforcement activities

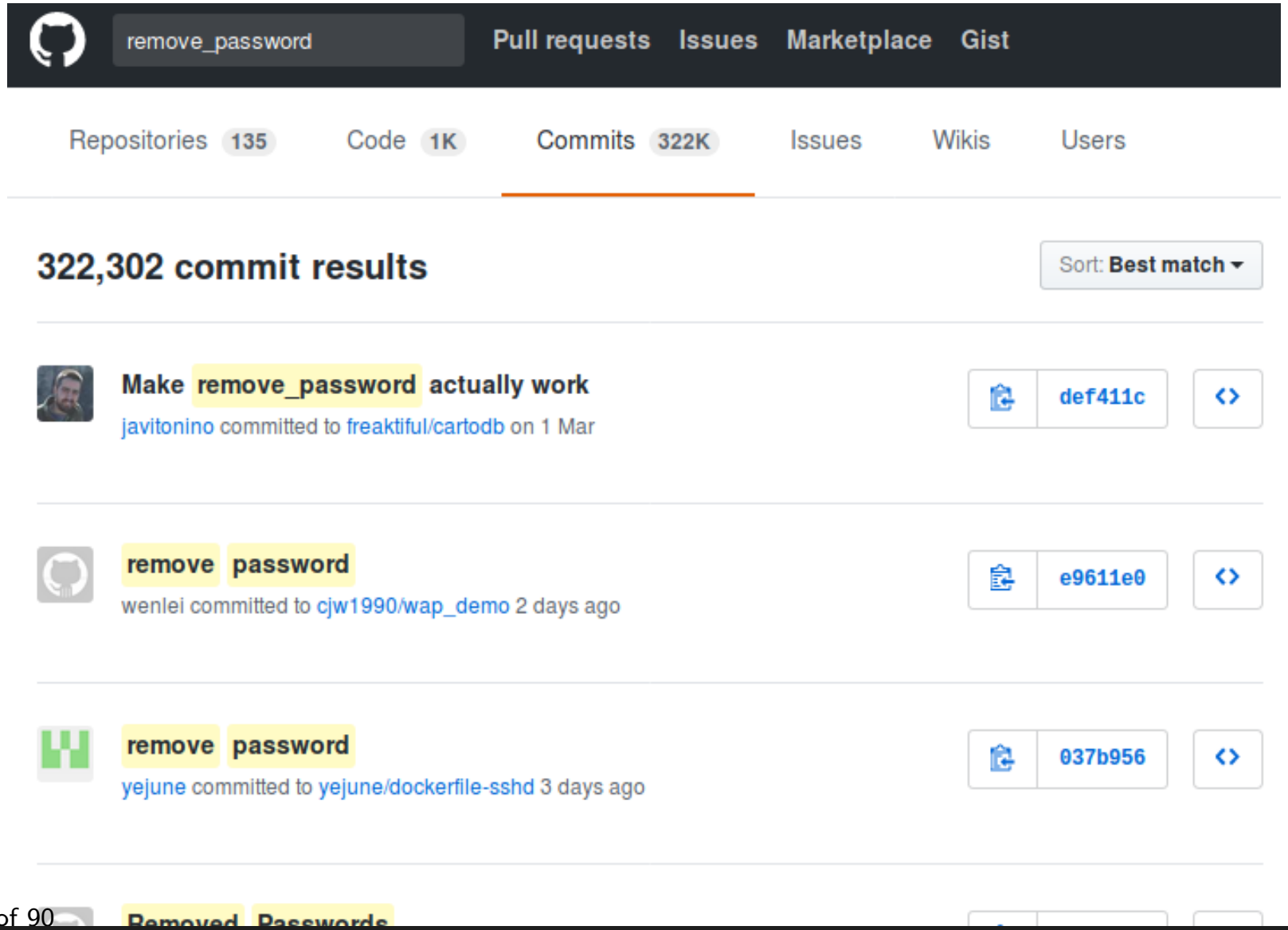
- Proactive investigation: leaks detection
  - List of emails and passwords
  - Leaked database
  - AWS Keys
  - Credit-cards
  - PGP private keys
  - Certificate private keys
- Feed Passive DNS or any passive collection system
- CVE and PoC of vulnerabilities most used by attackers

Support CERT and Law Enforcement activities

- Website monitoring
  - monitor DDoS "booters"
  - Detect encoded exploits (WebShell, malware encoded in Base64, ...)
  - SQL injections against new targets
- Automatic and manual submission to threat sharing and incident response platforms
  - MISP
  - TheHive
- Term/Regex monitoring for local companies/government

Sources of leaks

Mistakes from users:



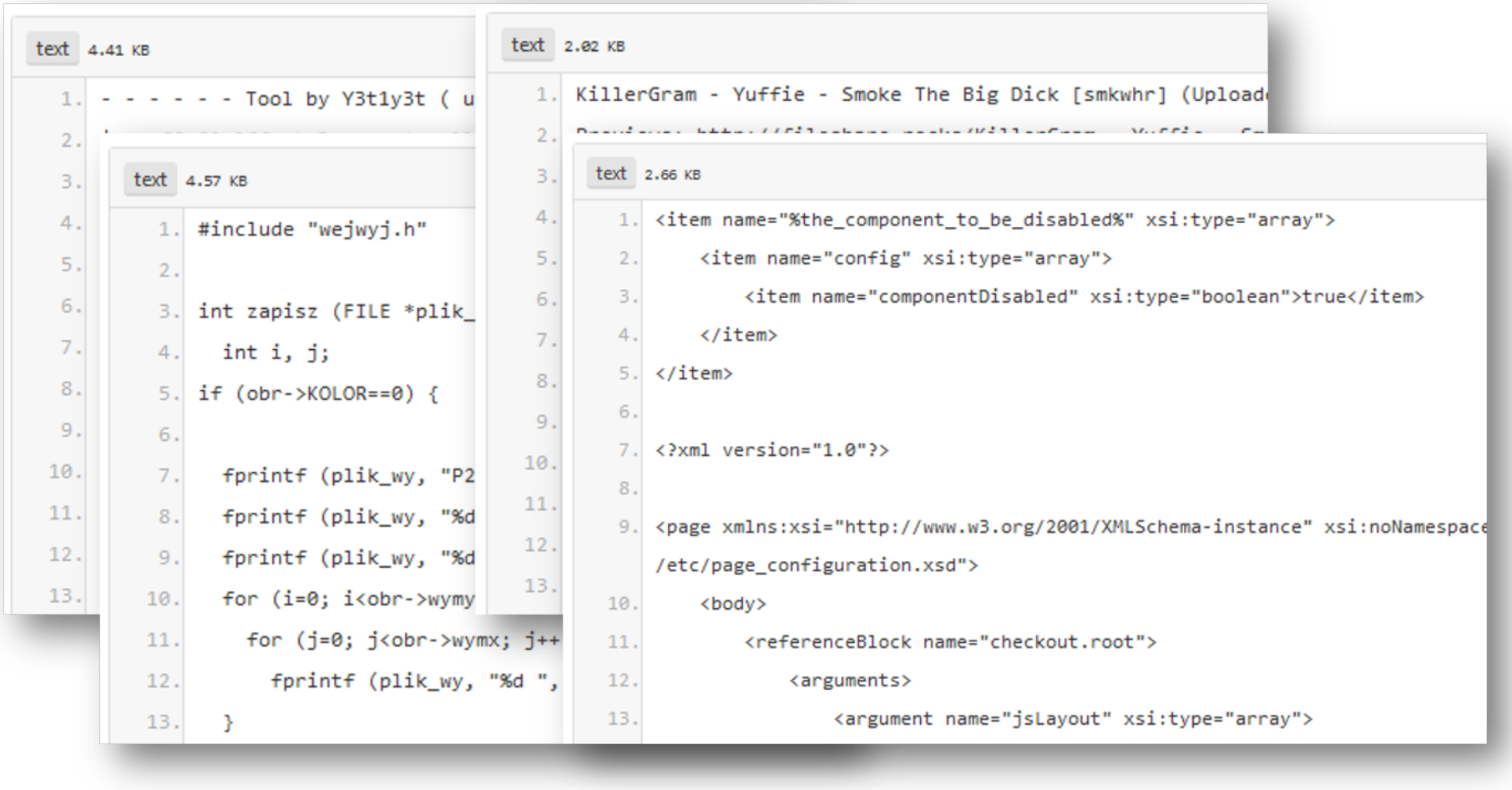
Sources of leaks: Paste monitoring

- Example: `http://pastebin.com/`
  - Easily storing and sharing text online
  - Used by programmers and legitimate users
    $\rightarrow$ Source code & information about configurations

Sources of leaks: Paste monitoring

- Example: `http://pastebin.com/`
  - Easily storing and sharing text online
  - Used by programmers and legitimate users
    $\rightarrow$ Source code & information about configurations
- Abused by attackers to store:
  - List of vulnerable/compromised sites
  - Software vulnerabilities (e.g. exploits)
  - Database dumps
    $\rightarrow$ User data
    $\rightarrow$ Credentials
    $\rightarrow$ Credit card details
  - More and more ...

Examples of pastes



text 4.41 KB

```
- - - - - - Tool by Y3t1y3t ( u
```

text 4.57 KB

```
#include "wejwyj.h"

int zapisz (FILE *plik_
  int i, j;
if (obr->KOLOR==0) {

  fprintf (plik_wy, "P2
  fprintf (plik_wy, "%d
  fprintf (plik_wy, "%d
  for (i=0; i<obr->wymy
    for (j=0; j<obr->wymx; j++
      fprintf (plik_wy, "%d ",
  }
```

text 2.02 KB

```
KillerGram - Yuffie - Smoke The Big Dick [smkwhr] (Upload
```

text 2.66 KB

```
<item name="%the_component_to_be_disabled%" xsi:type="array">
    <item name="config" xsi:type="array">
        <item name="componentDisabled" xsi:type="boolean">true</item>
    </item>
</item>

<?xml version="1.0"?>

<page xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespace
/etc/page_configuration.xsd">
    <body>
        <referenceBlock name="checkout.root">
            <arguments>
                <argument name="jsLayout" xsi:type="array">
```

Why so many leaks?

- Economical interests (e.g. Adversaries promoting services)
- Political motives (e.g. Adversaries showing off)
- Collaboration (e.g. Criminals need to collaborate)
- Operational infrastructure (e.g. malware exfiltrating information on a pastie website)
- Mistakes and Errors

Are leaks frequent?

Yes!

and we have to deal with this as a CSIRT.

- **Contacting companies or organisations** who did specific accidental leaks
- **Discussing with media** about specific case of leaks and how to make it more practical/factual for everyone
- Evaluating the economical market for cyber criminals (e.g. DDoS booters[2] or reselling personal information - reality versus media coverage)
- Analysing collateral effects of malware, software vulnerabilities or exfiltration

$\rightarrow$ And it's important to detect them automatically.

[2] `https://github.com/D4-project/`

Paste monitoring at CIRCL: Statistics

- Monitored paste sites: 27
  - *pastebin.com*
  - *ideone.com*
  - *...*

	2016	2017	08.2018
Collected pastes	18,565,124	19,145,300	11,591,987
Incidents	244	266	208

Table: Pastes collected and incident[3] raised by CIRCL

[3] `http://www.circl.lu/pub/tr-46`

MISP

MISP Taxonomies

- **Tagging** is a simple way to attach a classification to an event or attribute.
- **Classification must be globally used to be efficient.**
- Provide a set of already defined classifications modeling estimative language
- Taxonomies are implemented in a simple JSON format [4].
- Can be easily cherry-picked or extended

[4] `https://github.com/MISP/misp-taxonomies`

Taxonomies useful in AIL

- **infoleak**: Information classified as being potential leak.
- **estimative-language**: Describe quality and credibility of underlying sources, data, and methodologies.
- **admiralty-scale**: Rank the reliability of a source and the credibility of an information
- **fpf**[5]: Evaluate the degree of identifiability of personal data and the types of pseudonymous data, de-identified data and anonymous data.

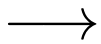
[5] Future of Privacy Forum

Taxonomies useful in AIL

- **tor**: Describe Tor network infrastructure.
- **dark-web**: Criminal motivation on the dark web.
- **copine-scale**[6]: Categorise the severity of images of child sex abuse.

[6] Combating Paedophile Information Networks in Europe

threat sharing and incident response platforms



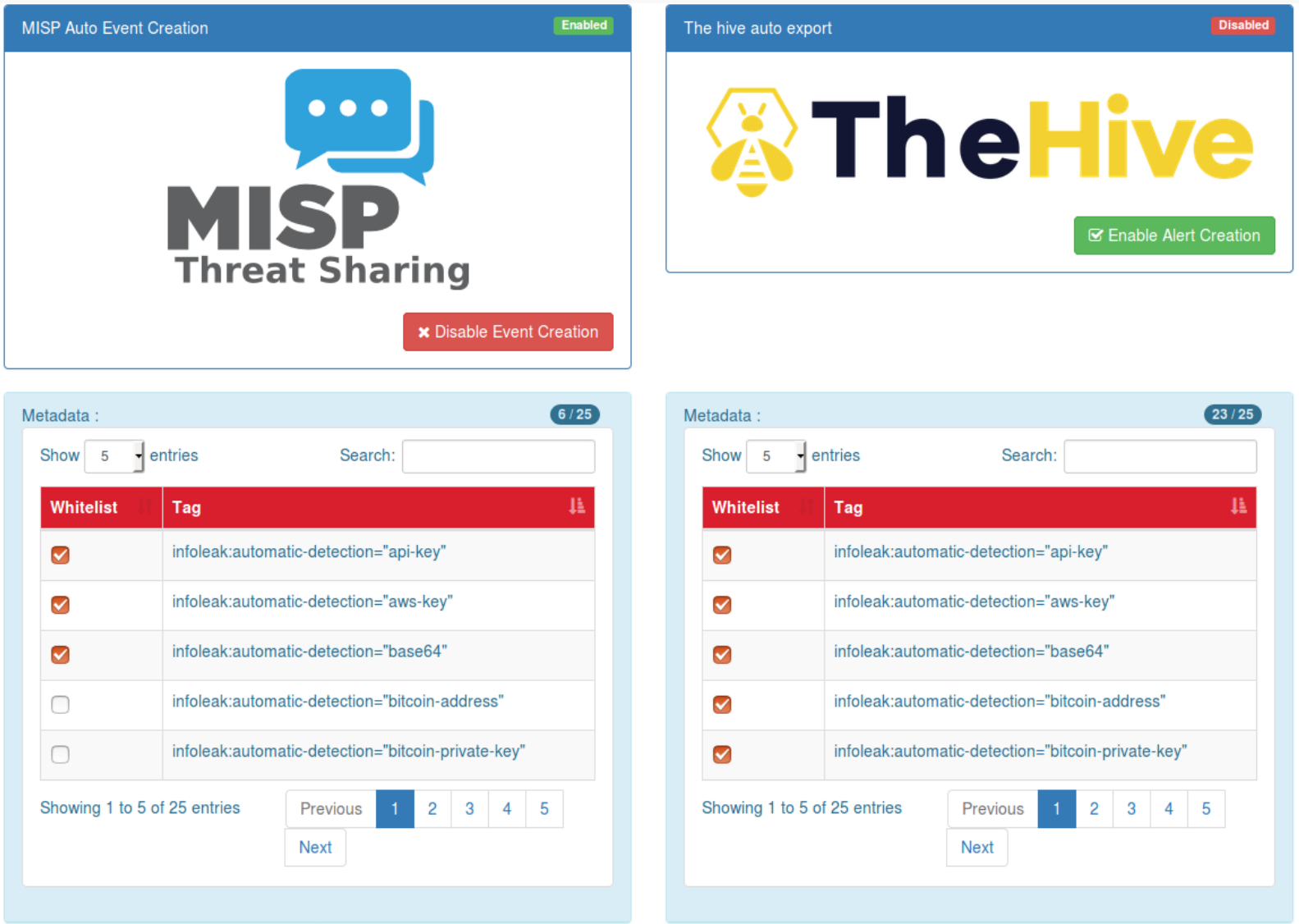
Goal: submission to threat sharing and incident response platforms.

threat sharing and incident response platforms

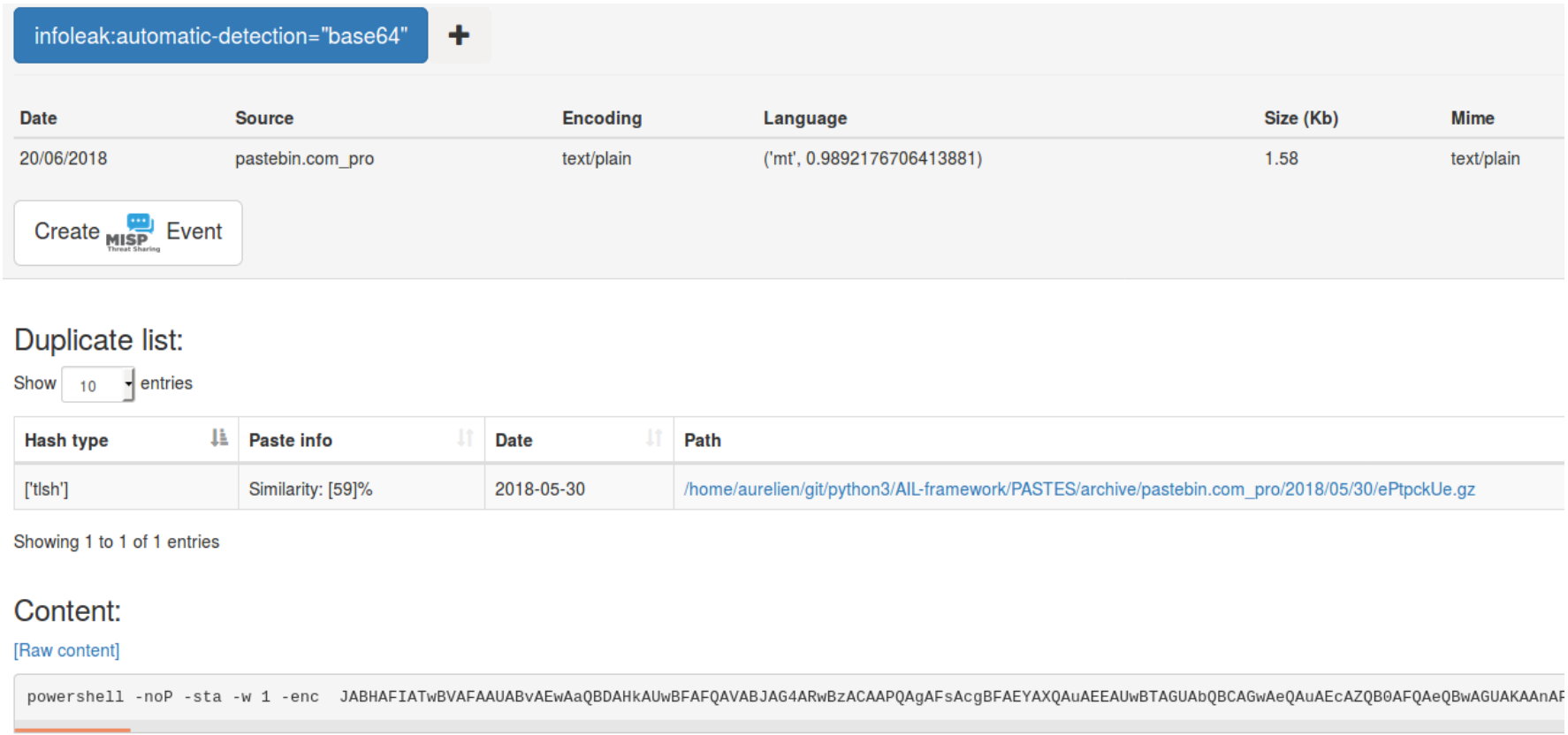
1. Use infoleak taxonomy[7]
2. Add your own tags
3. Create an event on a paste

[7] `https://www.misp-project.org/taxonomies.html`

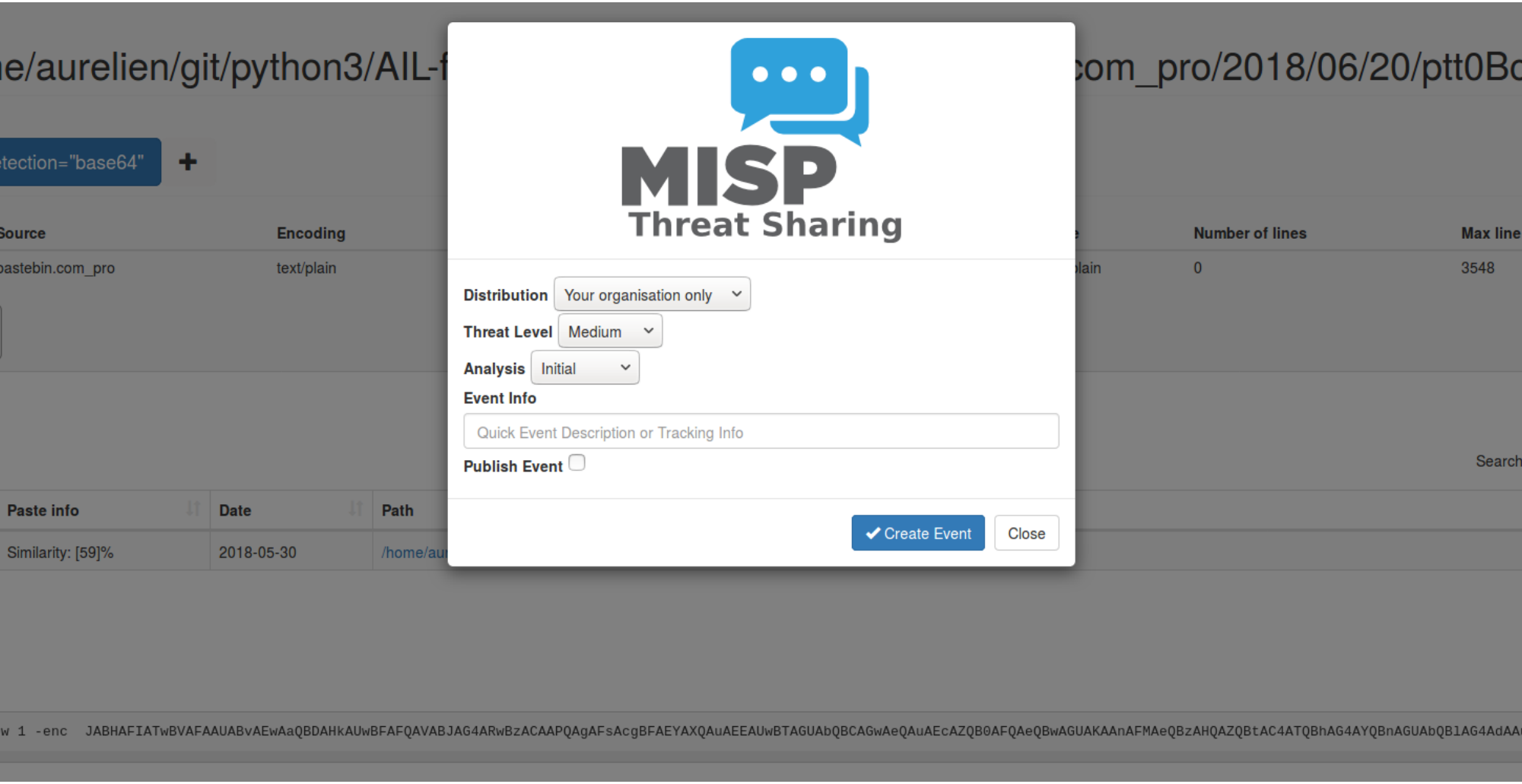
Automatic submission on tags



Create a MISP event



Create a MISP event



Current capabilities

AIL Framework: Current capabilities

- Extending AIL to add a new **analysis module** can be done in 50 lines of Python
- The framework **supports multi-processors/cores by default**. Any analysis module can be started multiple times to support faster processing during peak times or bulk import
- **Multiple** concurrent **data input**
- Tor Crawler

AIL Framework: Current features

- Extracting **credit cards numbers, credentials, phone numbers, ...**
- Extracting and validating potential **hostnames**
- Keeps track of **duplicates**
- Submission to threat sharing and incident response platform (**MISP** and **TheHive**)
- **Full-text indexer** to index unstructured information
- **Tagging** for classification and searches
- Terms, sets and regex **tracking and occurences**
- Archives, files and raw **submission** from the UI
- PGP and Decoded (Base64, ...) Correlation
- And many more

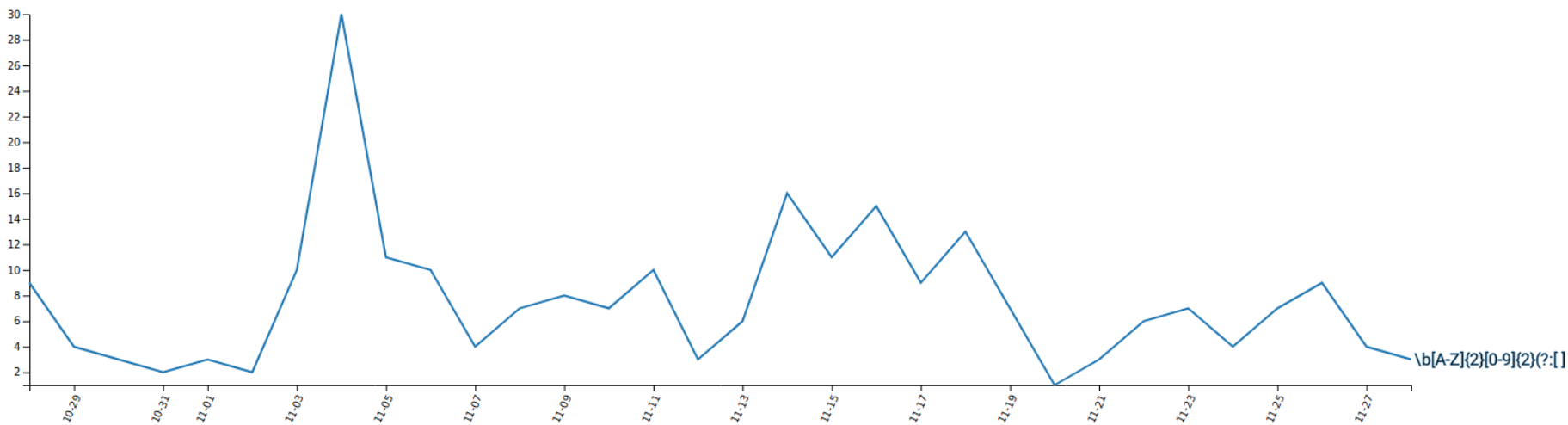
Terms Tracker

- Search and monitor specific keywords
  - Automatic Tagging
  - Email Notifications
- Track Term
  - ddos
- Track Set
  - booter,ddos,stresser;2
- Trag Regex
  - circl\.lu

Terms Tracker:

82a87a6a-88f1-4ab1-ba53-1bf15211b4b8

Type	Tracker	Date added	Level	Created by	First seen	Last seen	Tags	Email
regex	\b[A-Z]{2}[0-9]{2}(?:[ ]?[0-9]{4}){4}(?!(?:[ ]?[0-9]){3})(?:[ ]?[0-9]{1,2})?\b	2019/09/12	1	admin@admin.test	2018/08/31	2019/11/28		



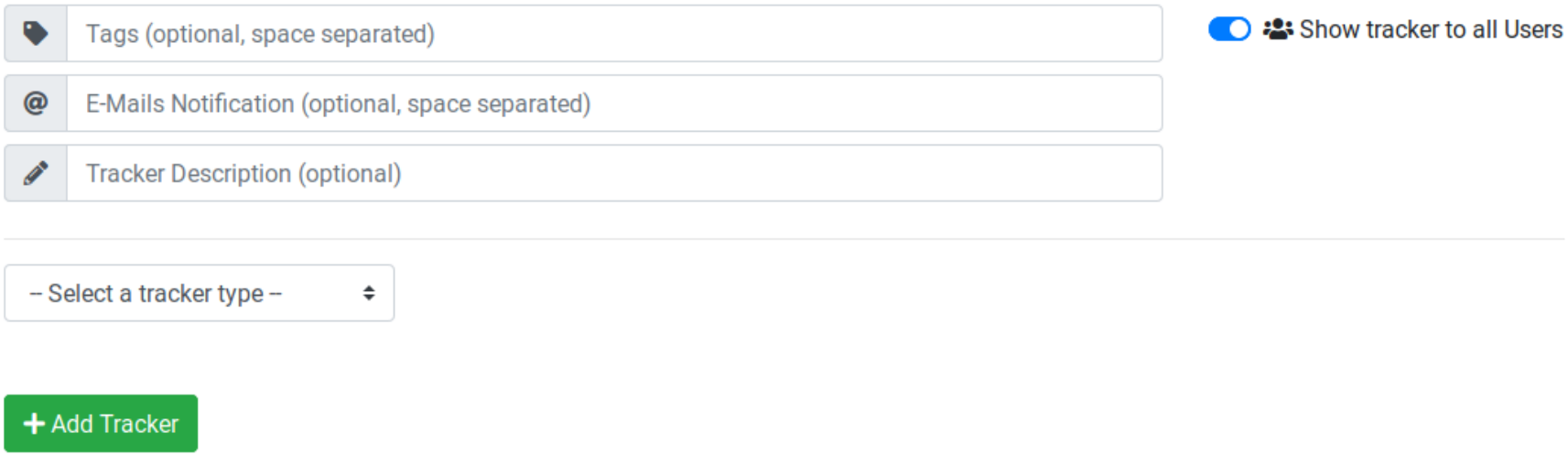
yyyy-mm-dd

yyyy-mm-dd

Search Tracked Items

Terms Tracker - Practical part

- **Create and test** your own term tracker



Recon and intelligence gathering tools

- **Attacker also share informations**
- Recon tools detected: 94
  - sqlmap
  - dnscan
  - whois
  - msfconsole (metasploit)
  - dnmap
  - nmap
  - ...

Recon and intelligence gathering tools

```
###############################################################################
===============================================================================
Hostname        www.pabloquintanilla.cl                 ISP     Wix.com Ltd.
Continent       North America           Flag
US
Country         United States           Country Code    US
Region  Unknown                 Local time      19 Nov 2019 07:59 CST
City    Unknown                 Postal Code     Unknown
IP Address      185.230.60.195          Latitude        37.751
                        Longitude       -97.822
===============================================================================
###############################################################################
> www.pabloquintanilla.cl
Server:         38.132.106.139
Address:        38.132.106.139#53

Non-authoritative answer:
www.pabloquintanilla.cl canonical name = www192.wixdns.net.
www192.wixdns.net       canonical name = balancer.wixdns.net.
Name:   balancer.wixdns.net
Address: 185.230.60.211
>
###############################################################################
Domain name: pabloquintanilla.cl
Registrant name: SERGIO TORO
Registrant organisation:
Registrar name: NIC Chile
Registrar URL: https://www.nic.cl
```

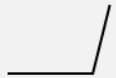
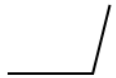
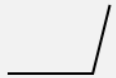
Decoder

- Search for encoded strings
  - Base64
  - Hexadecimal
  - Binary
- Guess Mime-type
- Correlate paste with decoded items

Decoder: Practical Part

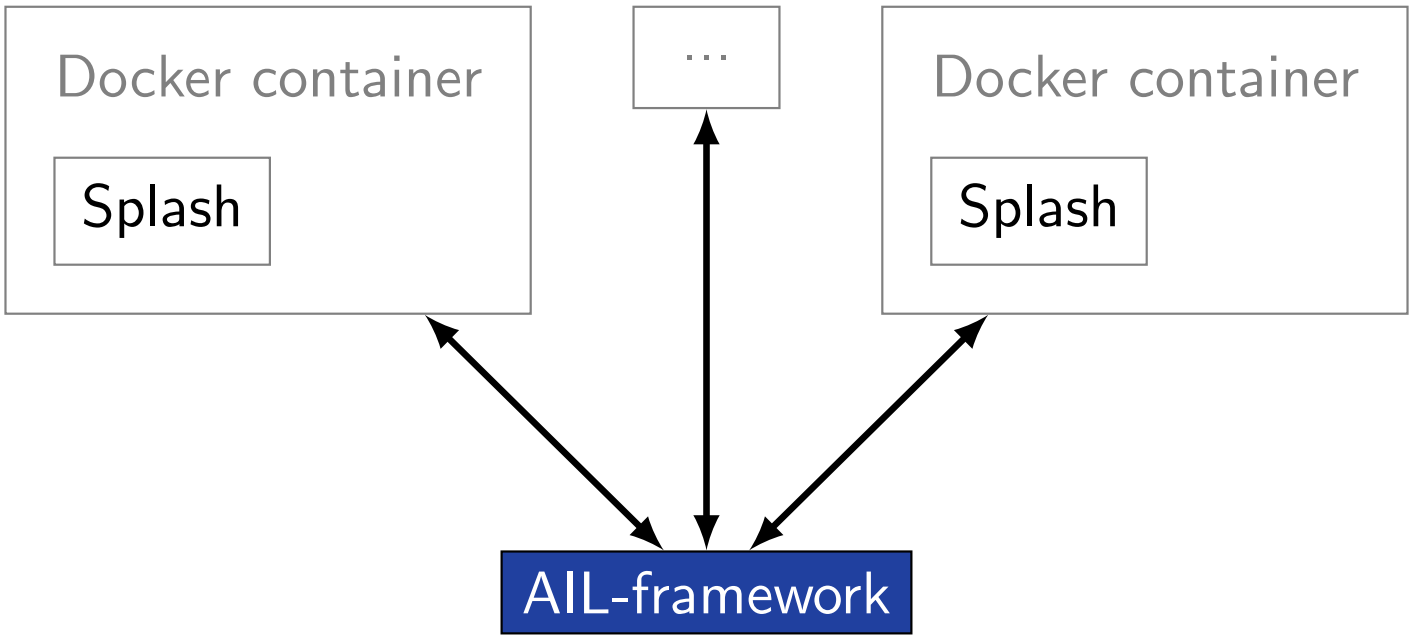
Which type of decoded file have the highest size ?

Decoder: Practical Part

estimated type	hash	first seen	last seen	nb item	size	Virus Total	Sparkline
application/x-dosexec	c11c2be8d9ba4e86c8effaa411aa6b867ba75abe	2019/11/28	2019/11/28	1	191	Send this file to VT	
application/x-dosexec	a50cba731204ecce193b40178399a250b5ce6f67	2019/11/28	2019/11/28	1	32768	Send this file to VT	
application/x-dosexec	cc5f2f0da71f443ec12ae1b3cb6ab8bad80f22c4	2019/11/28	2019/11/28	1	203	Send this file to VT	
application/x-dosexec	eed67e8fa9cb9a43fea21ae653983a8e0a174f63	2019/11/26	2019/11/28	6	83	Send this file to VT	

Crawler

- Crawlers are used to navigate on regular website as well as .onion addresses (via automatic extraction of urls or manual submission)
- Splash ("scriptable" browser) is rending the pages (including javascript) and produce screenshots (HAR archive too)

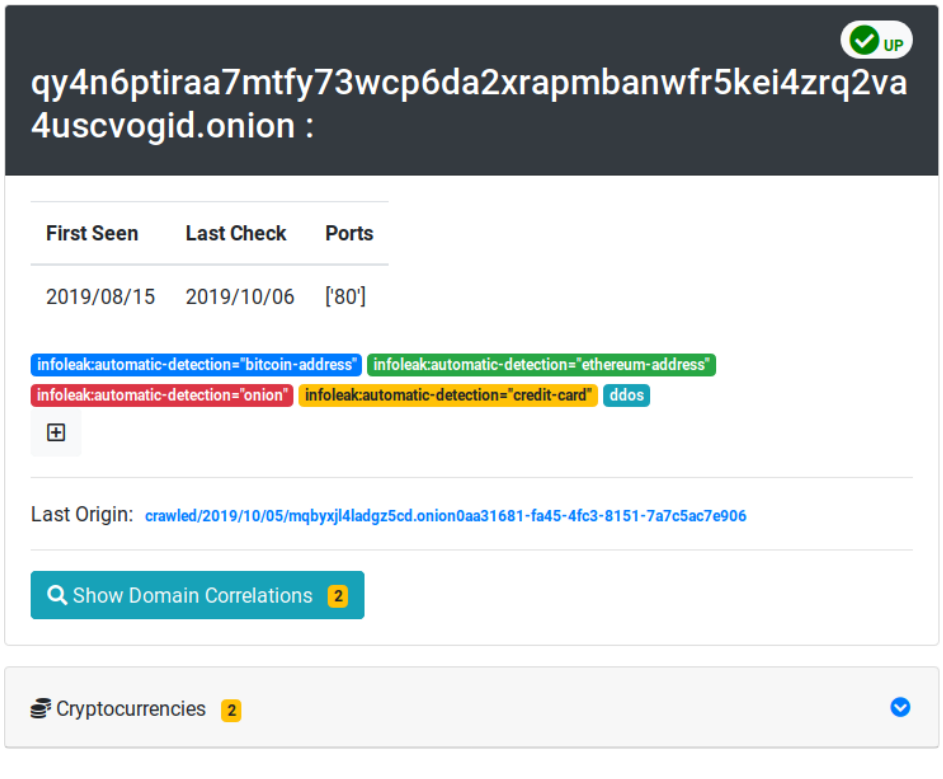


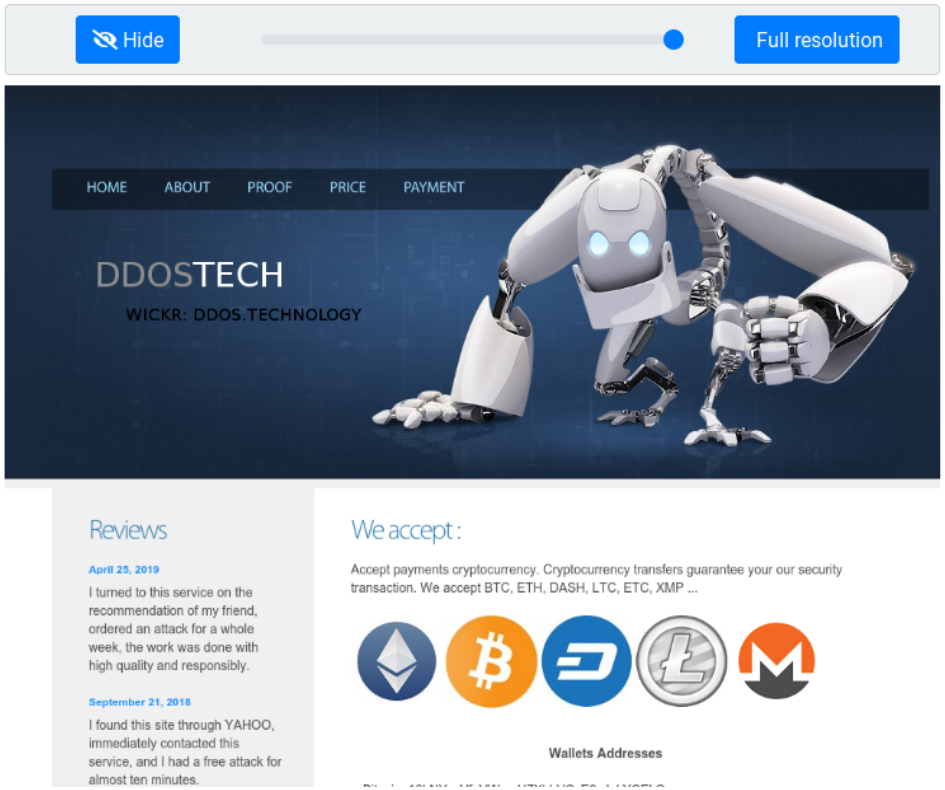
Crawler

How a domain is crawled by default

1. Fetch the first url
2. Render javascript (webkit browser)
3. Extract all urls
4. Filter url: keep all url of this domain
5. crawl next url (max depth = 1)

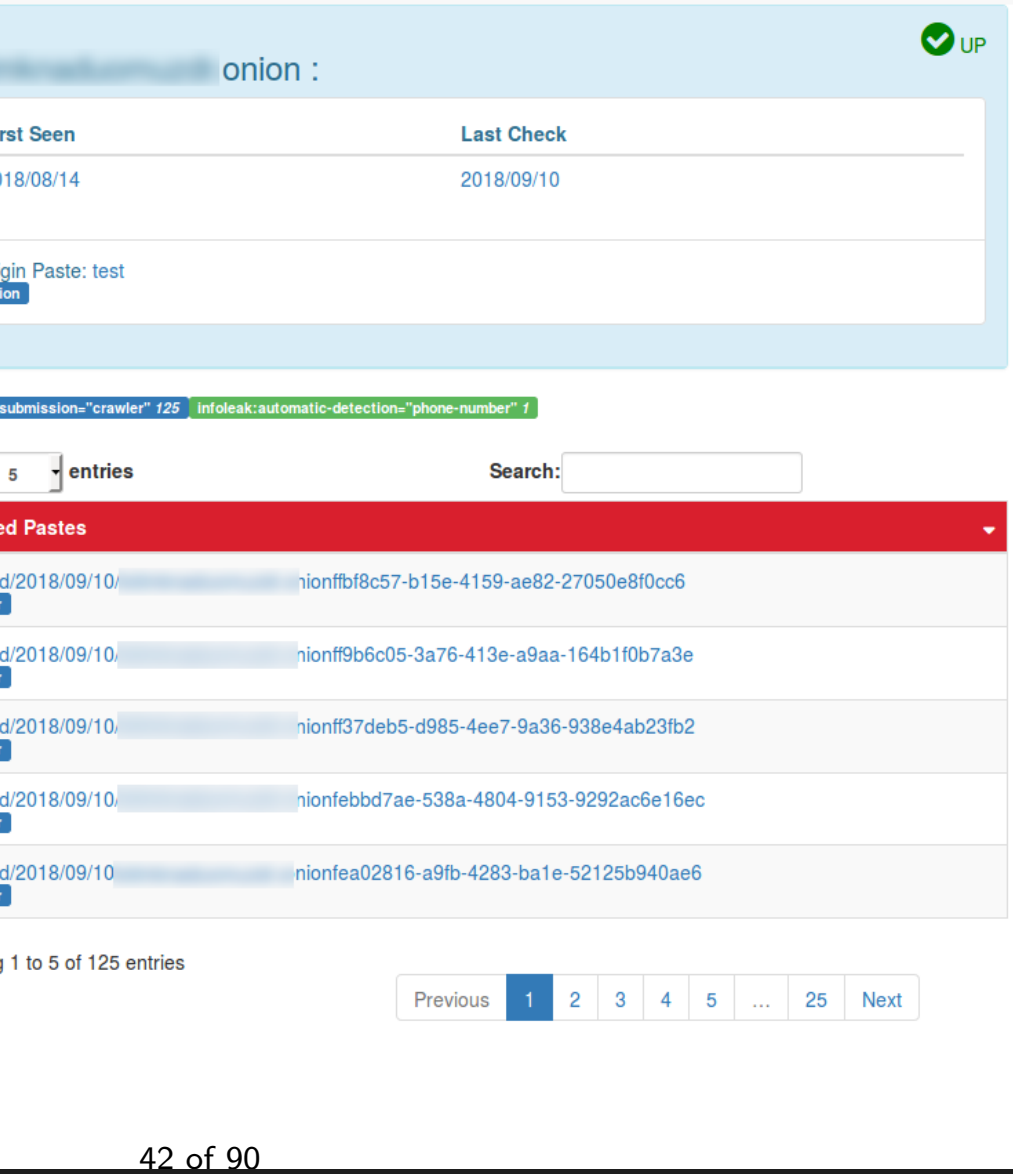
Crawler: DDoS Booter

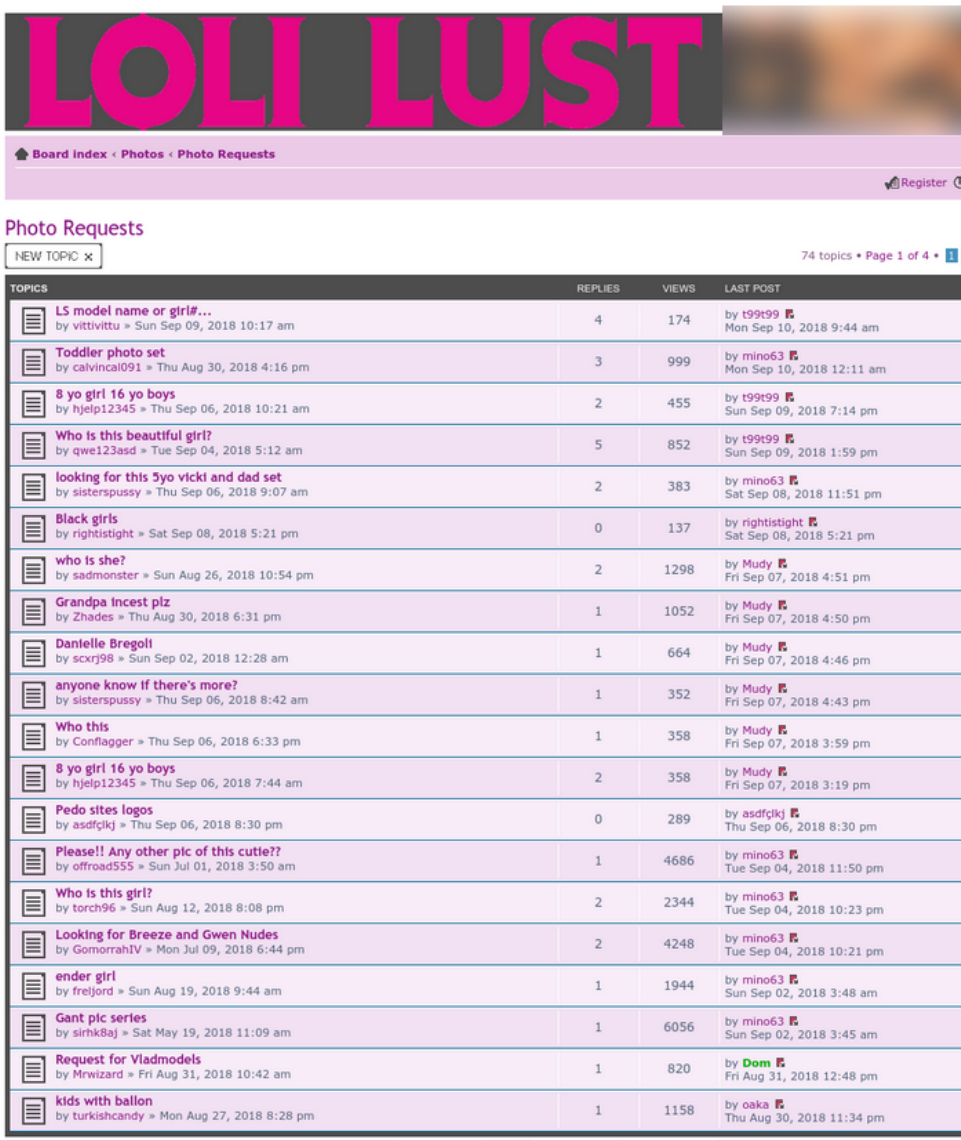




Child Sexual Abuse Material (CSAM)

Child Sexual Abuse Material (CSAM)





Child Sexual Abuse Material: Challenges

- **Lack of automatic exchange with law enforcement**
- Missing a list of keywords related to some sensitive topics such as CSAM
  - Optimise the detection
  - Could bootstrap integration of machine learning (supervised learning)

Temporary solution: manual incremental construction of a corpus

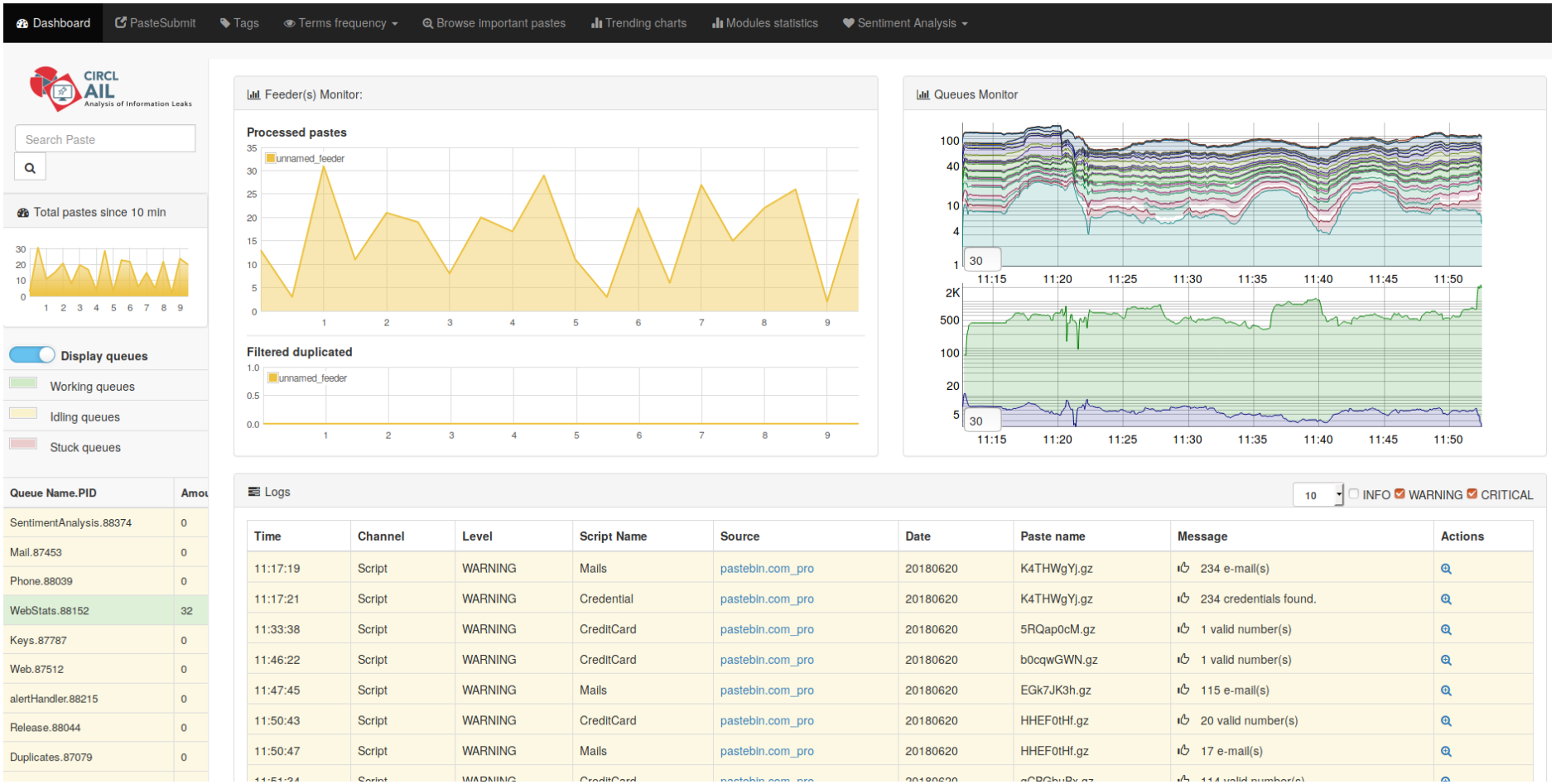
$\rightarrow$ Not always optimal

$\rightarrow$ Not our expertise

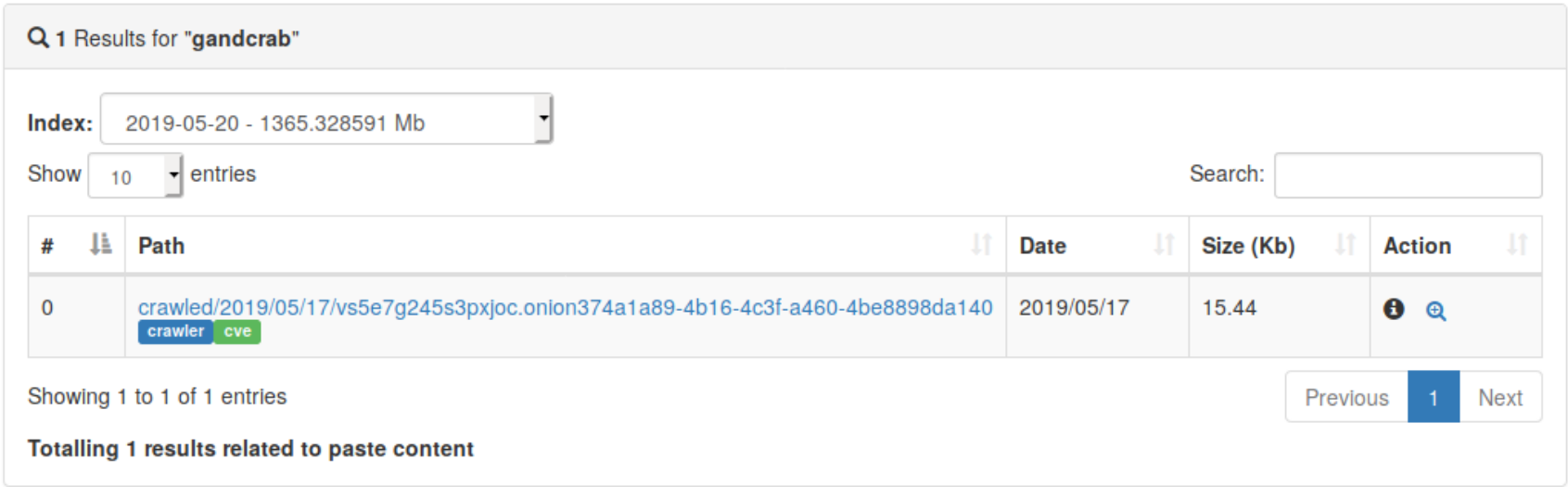
Correlations and relationship

Live demo!

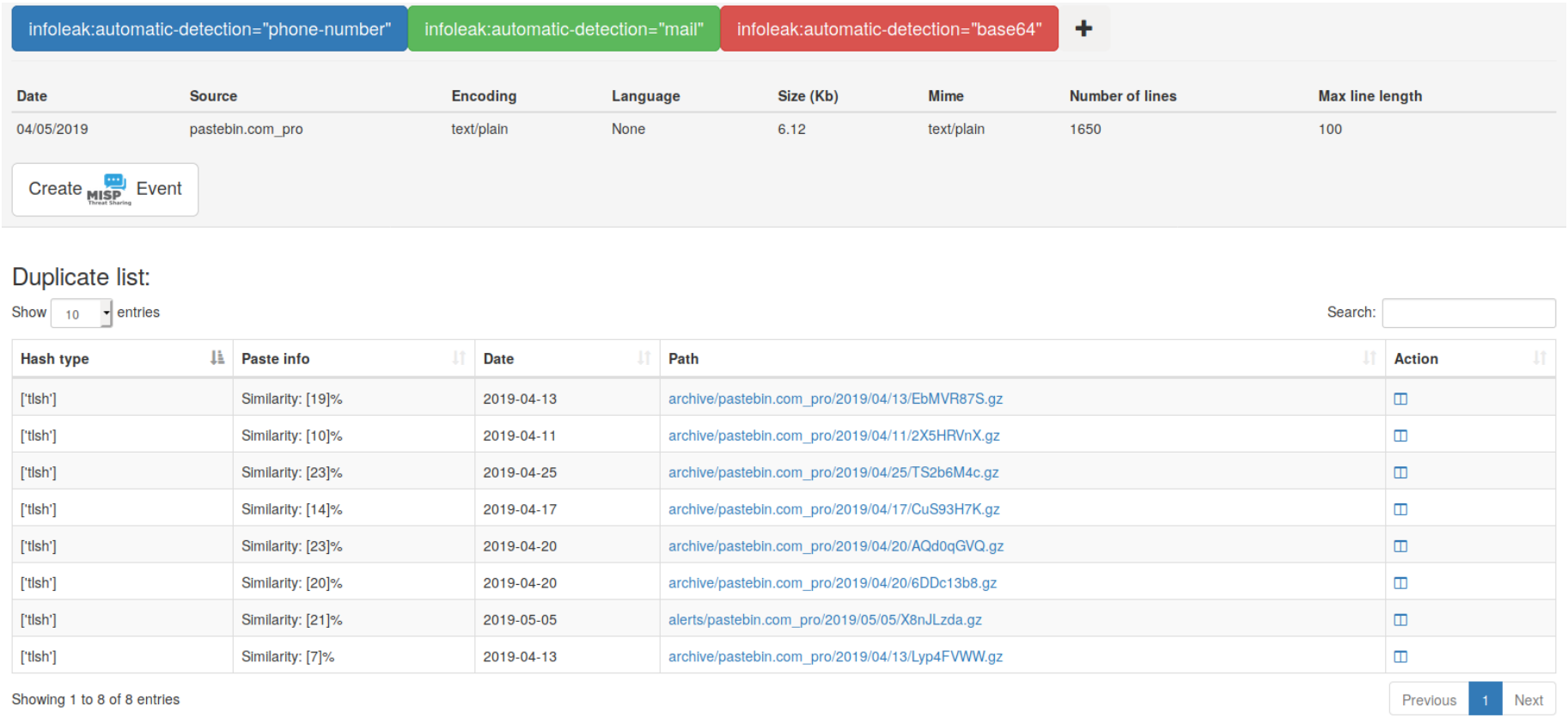
Example: Dashboard



Example: Text search



Example: Pastes Metadata (1)



Example: Pastes Metadata (2)

Hash files:

Show 5 entries

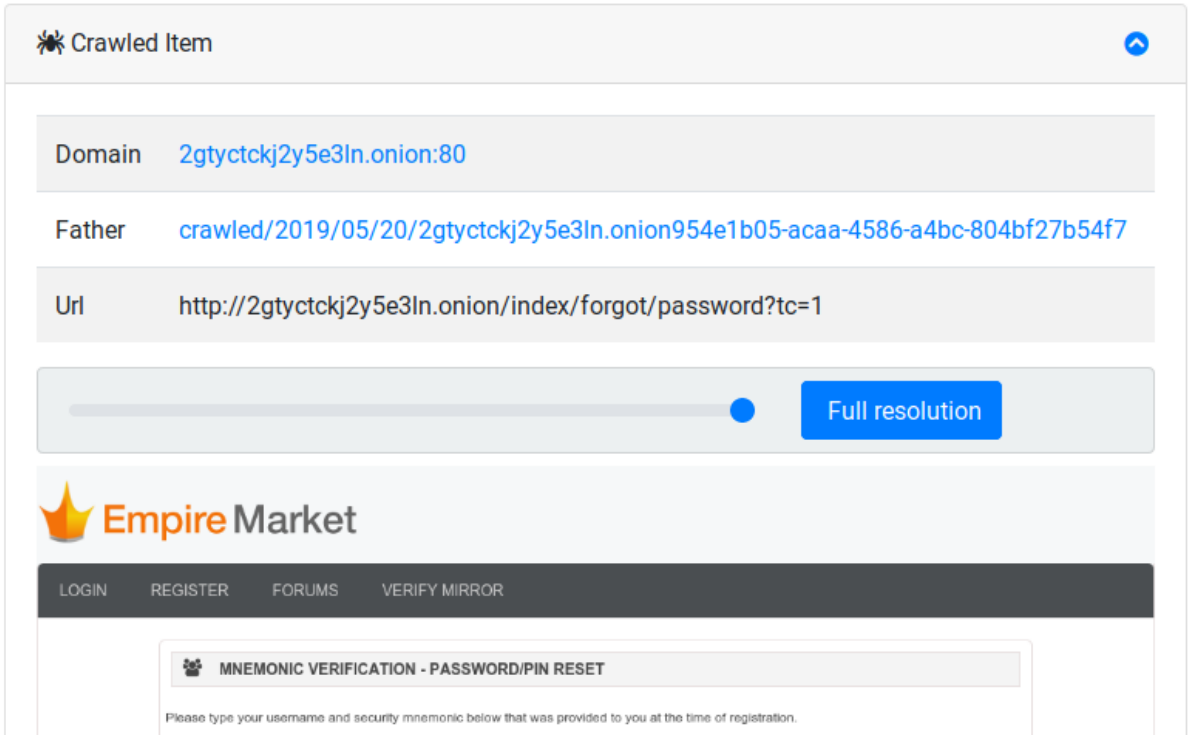
Search:

estimated type	hash	saved_path	Virus Total
application/octet-stream	3975f058bb0d445b60c10a11f1a5d88e19e4fa84 (1)	HASHS/application/octet-stream /39/3975f058bb0d445b60c10a11f1a5d88e19e4fa84	Send this file to VT
application/octet-stream	fed93c1753270fc849a4db37027b569cdd9a6108 (1)	HASHS/application/octet-stream /fe/fed93c1753270fc849a4db37027b569cdd9a6108	Send this file to VT

Showing 1 to 2 of 2 entries

Previous 1 Next

Example: Pastes Metadata (3)



Example: Browsing content

Content:

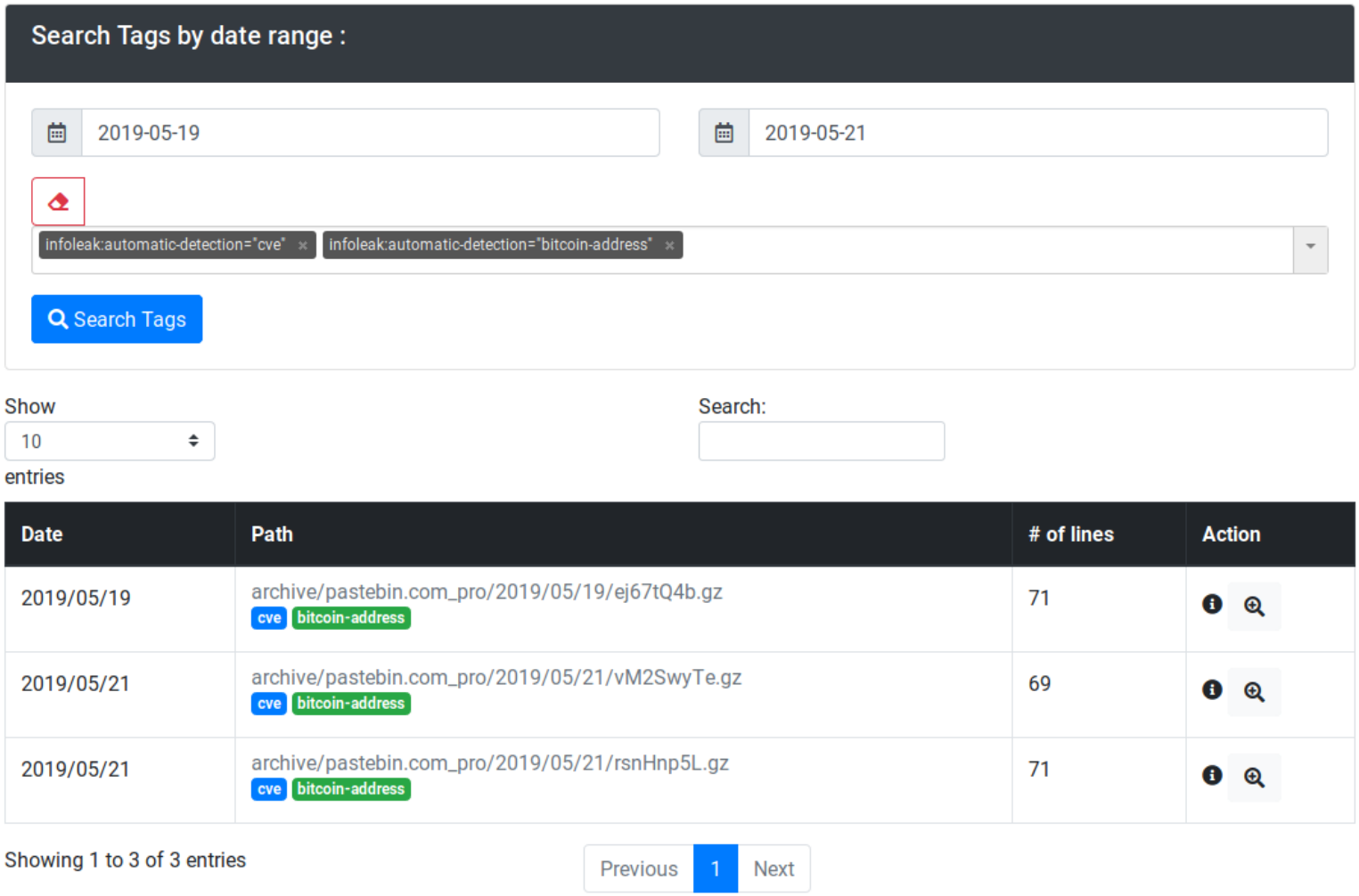
```
http://members2.mofosnetwork.com/access/login/
somosextremos:buddy1990
brazzers_glenn:cocklick
brazzers61:braves01

http://members.naughtyamerica.com/index.php?m=login
gernblanston:3unc2352
Janhuss141200:310575
igetalliwant:1377zeph
pwilks89:mon22key
Bman1551:hockey

MoFos IKnowThatGirl PublicPickUps
http://members2.mofos.com
Chrismagg40884:loganm40
brando1:zzbrando1
aacoen:1q2w3e4r
1rstunkle23:my8self

BraZZers
http://ma.brazzers.com
gcjensen:gcj21pva
skycsc17:rbcdnd

                                    ############################################################
                                        >| Get Daily Update Fresh Porn Password Here |<

                                              =>   http://www.erq.io/4mF1
```

Example: Browsing content

Content:

```
Over 50000+ custom hacked xxx passwords by us! Thousands of free xxx passwords to the hottest paysites!

########################################################
 >| Get Fresh New Premium XXX Site Password Here |<

  =>   http://www.erq.io/4mF1


########################################################



http://ddfnetwork.com/home.html
eu172936:hCSBgKh
UecwB6zs:159X0$!r#6K78FuU

http://pornxn.stiffia.com/user/login
feldwWek8939:RObluJ8XtB
dabudka:17891789
brajits:brajits1

http://members.pornstarplatinum.com/sblogin/login.php/
gigiriveracom:xxxjay
jayx123:xxxjay69

http://members.vividceleb.com/
Rufio99:fairhaven
ScHiFRvi:102091
Chaos84:HOLE5244
Riptor795:blade7
Domi80:harkonnen
GaggedUK:a1k0chan

http://www.ariellaferrera.com/
```

Example: Search by tags



API

Setting up the framework

Setting up AIL-Framework from source or virtual machine

Setting up AIL-Framework from source

```
git clone https://github.com/CIRCL/AIL-framework.git
cd AIL-framework
./installing_deps.sh
```

AIL ecosystem - Challenges and design

AIL ecosystem: Technologies used

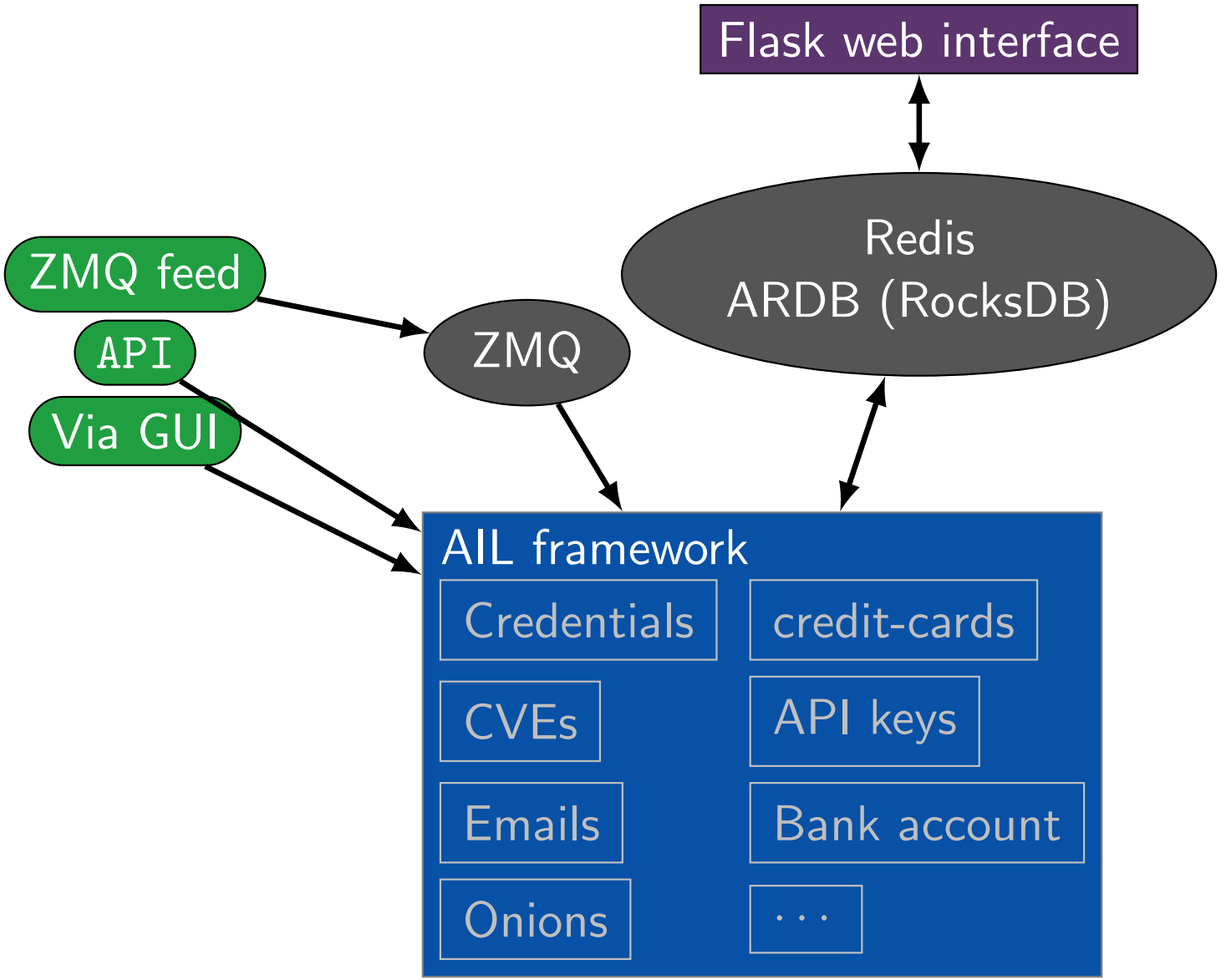
Programming language: Full python3

Databases: Redis and ARDB

Server: Flask

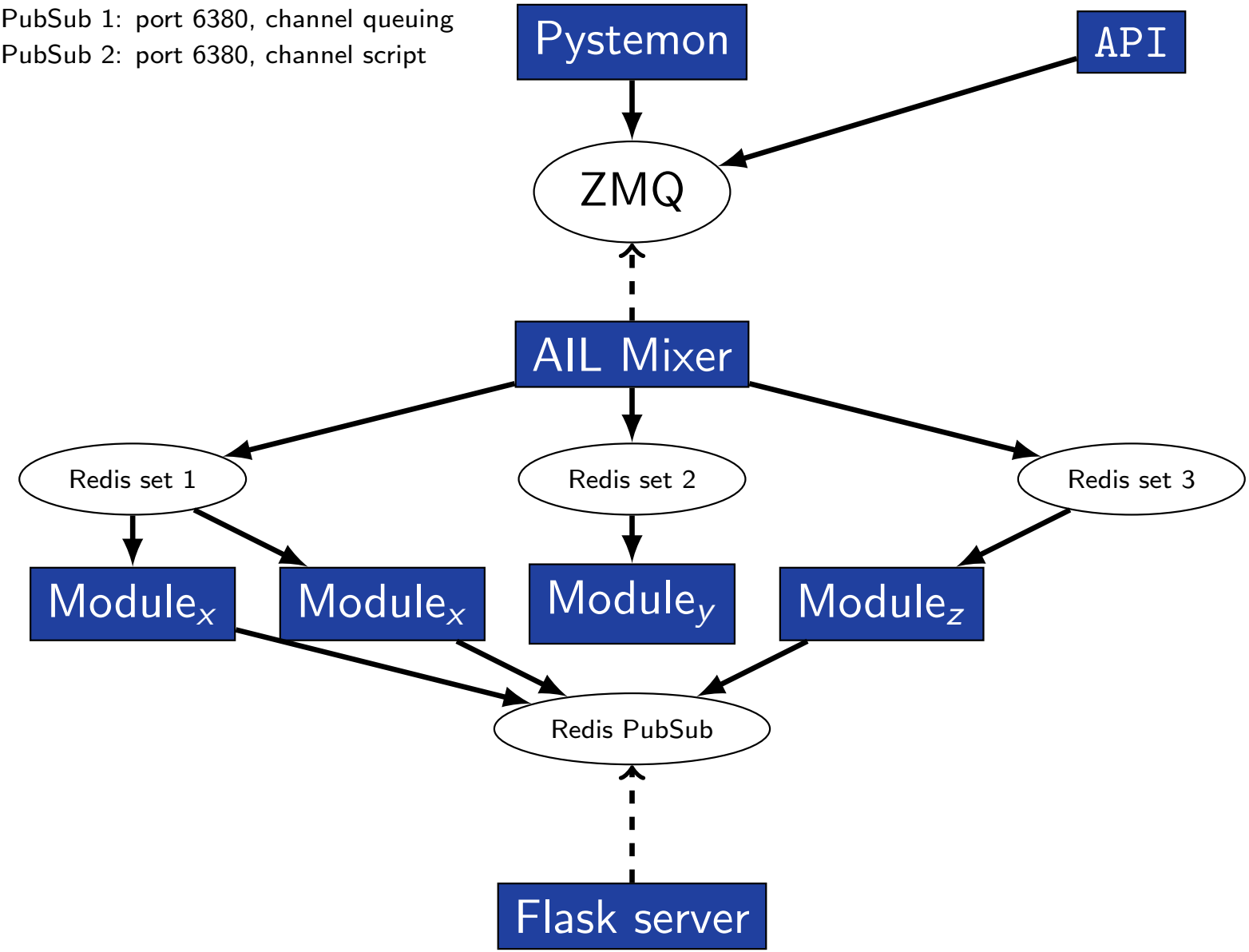
Data message passing: ZMQ, Redis list and Redis Publisher/Subscriber

AIL global architecture 1/2



AIL global architecture 2/2

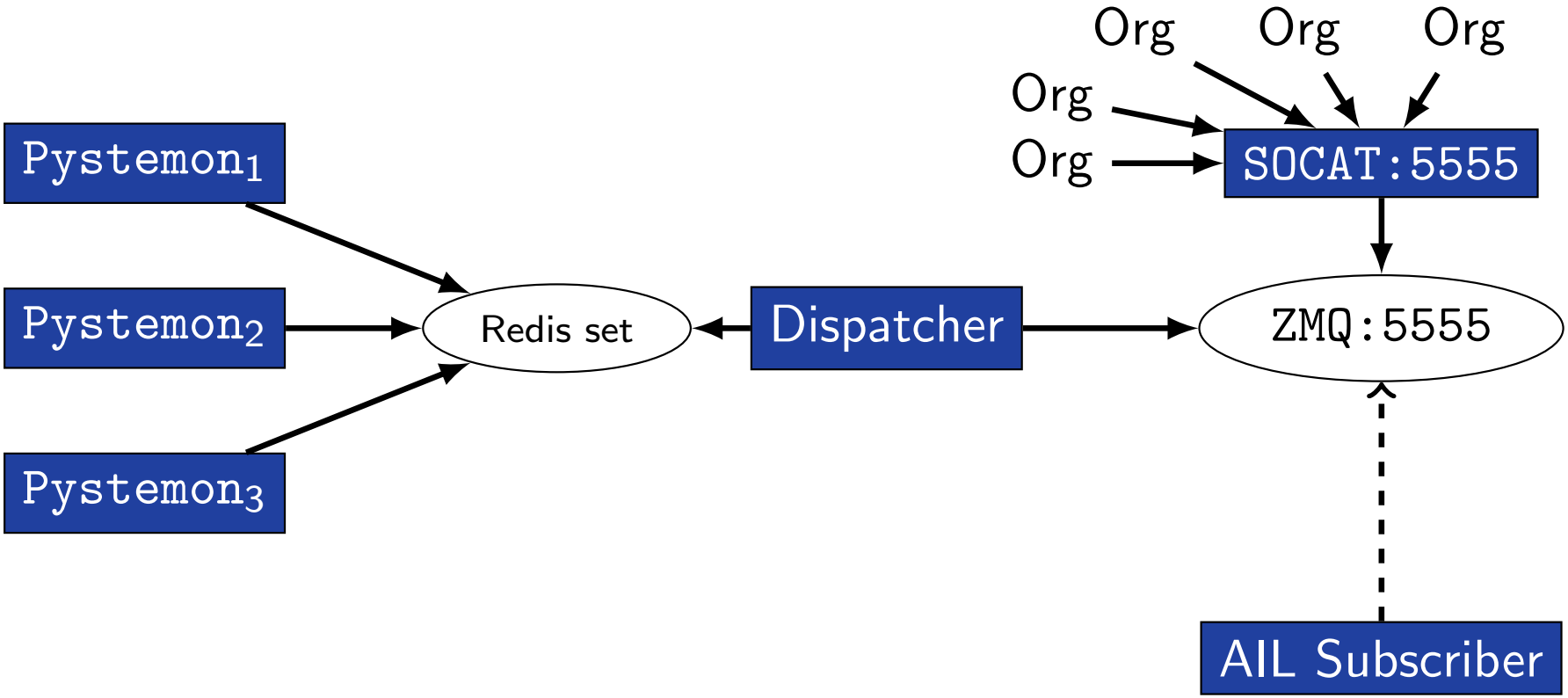
Redis PubSub 1: port 6380, channel queuing
Redis PubSub 2: port 6380, channel script



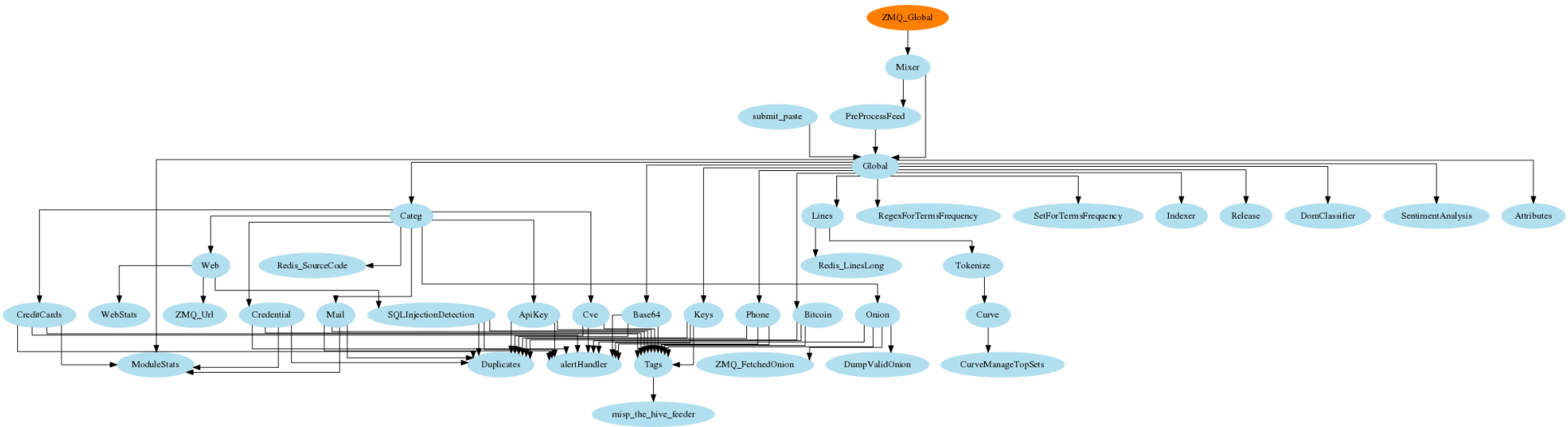
Data feeder: Gathering pastes with pystemon

Pystemon global architecture

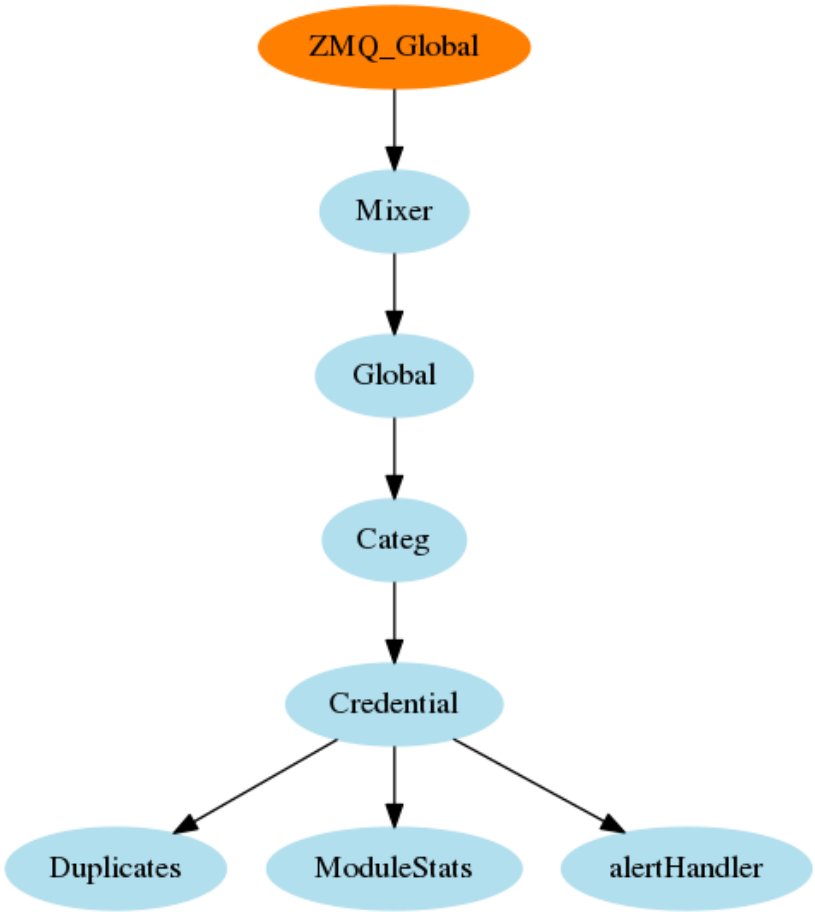
Redis PubSub 1: port 6380, channel queuing
Redis PubSub 2: port 6380, channel script



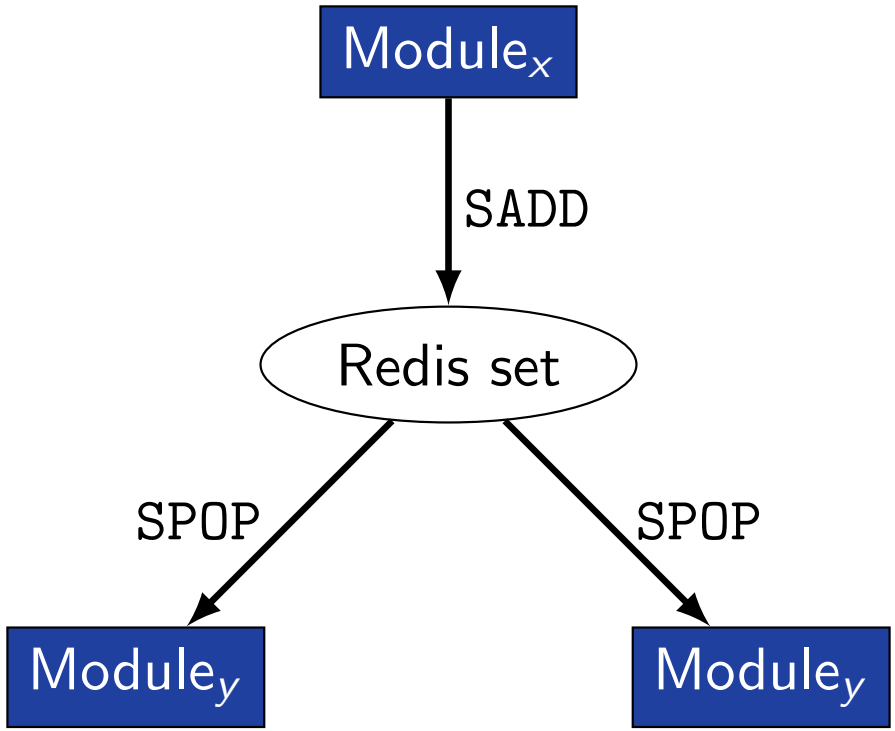
AIL global architecture: Data streaming between module



AIL global architecture: Data streaming between module (Credential example)



Message consuming



→ No message lost nor double processing

→ Multiprocessing!

Starting the framework

Running your own instance from source

Make sure that ZMQ_Global→address = `tcp://crf.circl.lu:5556,tcp://127.0.0.1:5556` in configs/core.cfg

Accessing the environment and starting AIL

```
1
2 # Launch the system and the web interface
3 cd bin/
4 ./LAUNCH -l
```

Feeding the framework

Feeding AIL

There are different way to feed AIL with data:

1. Be a trusted partner with CIRCL and ask to get access to our feed

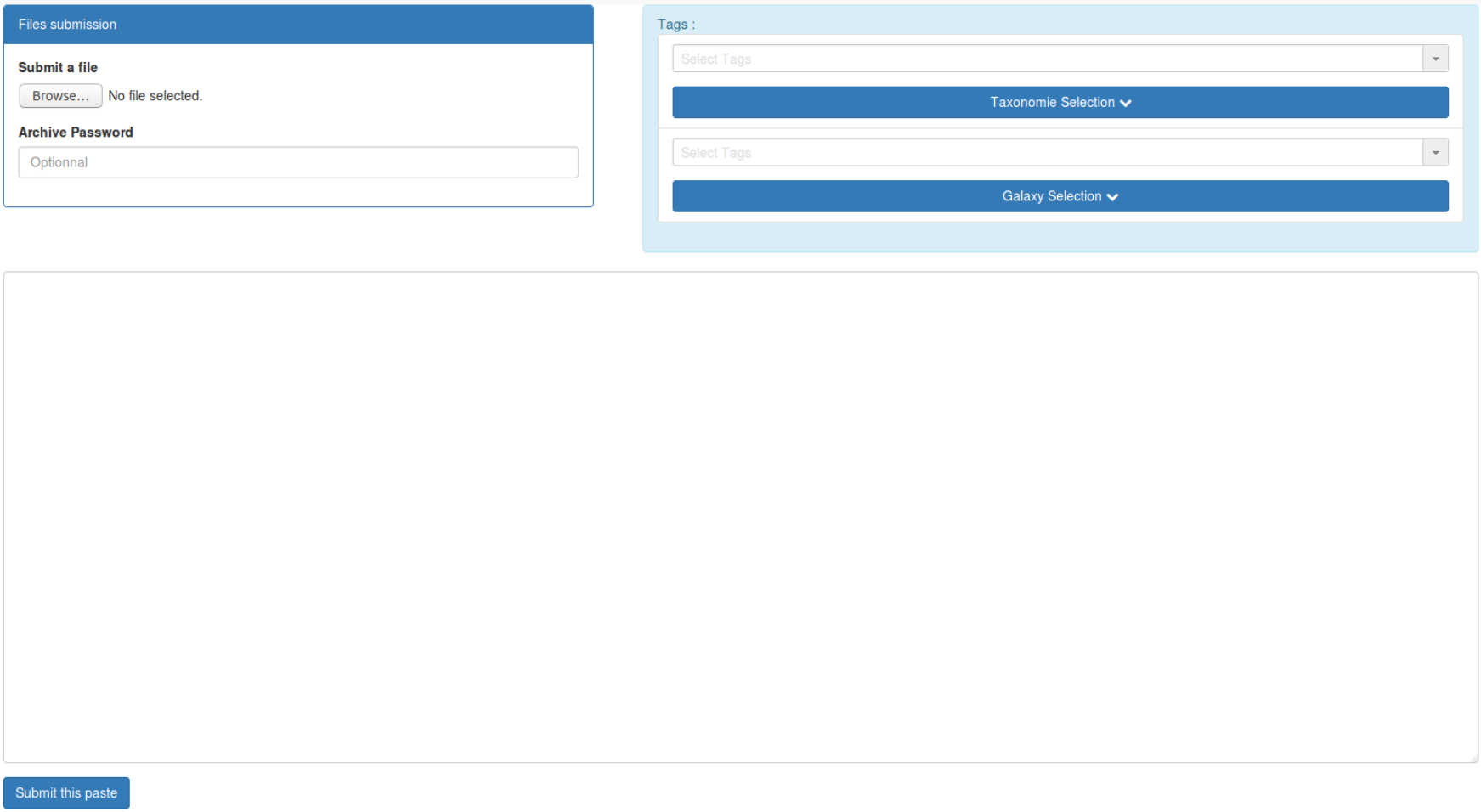
   info@circl.lu
2. Setup *pystemon* and use the custom feeder
   - *pystemon* will collect pastes for you
3. Feed your own data using the API or the `import_dir.py` script
4. Feed your own file/text using the UI (`Submit section`)

Feeding AIL

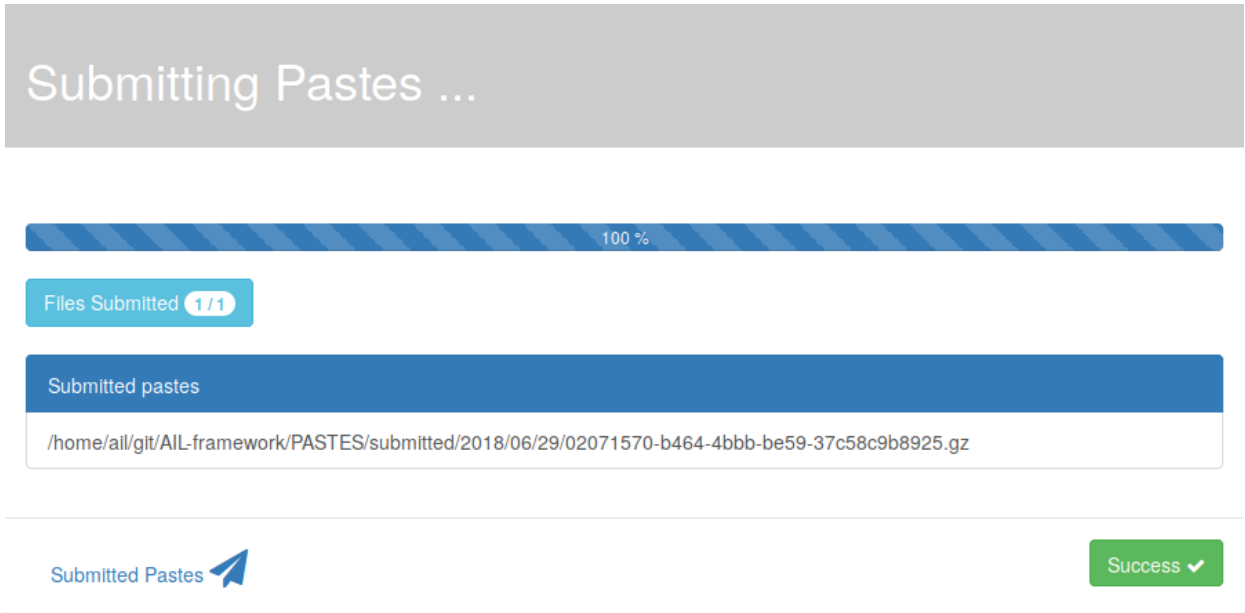
There are different way to feed AIL with data:

1. CIRCL trusted partners can ask to access our feed info@circl.lu
   - ▷ You already have access
2. ~~Setup *pystemon* and use the custom feeder~~
   - ~~*pystemon* will collect pastes for you~~
3. Feed your own data using the API or `import_dir.py` script
4. Feed your own file/text using the UI (`Submit section`)

Via the UI (1)


Files submission
Submit a file
Browse...
No file selected.
Archive Password
Optionnal
Tags :
Select Tags
Taxonomie Selection
Select Tags
Galaxy Selection
Submit this paste

Via the UI (2)


Submitting Pastes ...
100 %
Files Submitted 1 / 1
Submitted pastes
/home/ail/git/AIL-framework/PASTES/submitted/2018/06/29/02071570-b464-4bbb-be59-37c58c9b8925.gz
Submitted Pastes
Success

Feeding AIL with your own data - API

api/v1/import/item

```
{
  "type": "text",
  "tags": [
    "infoleak:analyst-detection=\"private-key\""
  ],
  "text": "text to import"
}
```

Feeding AIL with your own data - `import_dir.py` (1)

/!\ requirements:

- Each file to be fed must be of a reasonable size:
  - $\sim$ `3 Mb` / file is already large
  - This is because some modules are doing regex matching
  - If you want to feed a large file, better split it in multiple ones

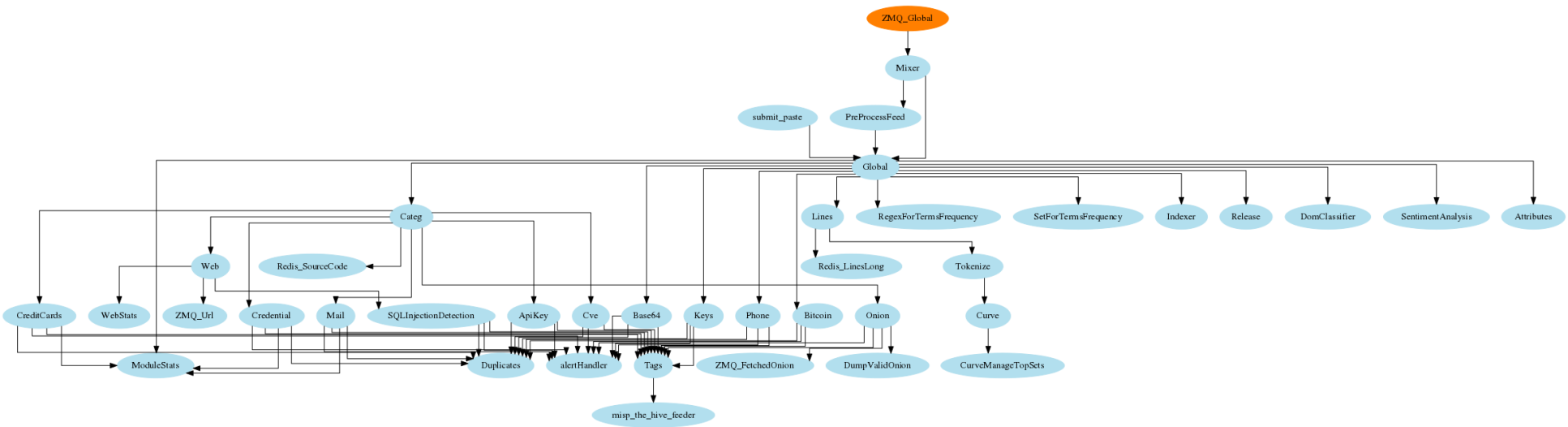
Feeding AIL with your own data - `import_dir.py` (2)

1. Check your local configuration `bin/package/config.cfg`
   - In the file `bin/package/config.cfg`,
   - Add `127.0.0.1:5556` in `ZMQ_Global`
   - (should already be set by default)
2. Launch `import_dir.py` with de directory you want to import
   - `import_dir.py -d dir_path`

Creating new features

Developing new features: Plug-in a module in the system

Choose where to put your module in the data flow:



Then, modify `bin/package/modules.cfg` accordingly

Writing your own modules - /bin/template.py

```
1  import time
2  from pubsublogger import publisher
3  from Helper import Process
4  if __name__ == '__main__':
5      # logger setup
6      publisher.port = 6380
7      publisher.channel = 'Script'
8      # Section name in configs/core.cfg
9      config_section = '<section name>'
10     # Setup the I/O queues
11     p = Process(config_section)
12     # Endless loop getting messages from the input queue
13     while True:
14         # Get one message from the input queue
15         message = p.get_from_set()
16         if message is None:
17             publisher.debug("{} queue is empty, waiting".format(config_section))
18             time.sleep(1)
19             continue
20         # Do something with the message from the queue
21         something_has_been_done = do_something(message)
22
```

Practical part

Practical part: Pick your choice

1. Update support of docker/ansible
2. Graph database on `Credential.py`
   - Top used passwords, most compromised user, ...
3. Webpage scrapper
   - Download html from URL found in pastes
   - Re-inject html as paste in AIL
4. Improvement of `Phone.py`
   - Way to much false positive as of now. Exploring new ways to validate phone numbers could be interesting
5. **Your custom feature**

Contribution rules

How to contribute

Glimpse of contributed features

- Docker
- Ansible
- Email alerting
- SQL injection detection
- Phone number detection

How to contribute

- Feel free to fork the code, play with it, make some patches or add additional analysis modules.

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- Feel free to fork the code, play with it, make some patches or add additional analysis modules.
- Feel free to make a pull request for your contribution
- That's it!

〈(^.^)ノ

Final words

- Building AIL helped us to find additional leaks which cannot be found using manual analysis and **improve the time to detect duplicate/recycled leaks**.

  $\rightarrow$ Therefore quicker response time to assist and/or inform proactively affected constituents.

Ongoing developments

- Python API wrapper
- **Data retention (export/import)**
- MISP format support (MISP modules expansion)
- auto Classify content by set of terms
  - CE contents
  - DDOS booters
  - ...
- Crawled items
  - add screenshot correlation
  - duplicate crawled domains
  - tor indexer
  - crawler cookie authentication

Annexes

Privacy, AIL and GDPR

- Many modules in AIL can process personal data and even special categories of data as defined in GDPR (Art. 9).
- The data controller is often the operator of the AIL framework (limited to the organisation) and has to define **legal grounds for processing personal data**.
- To help users of AIL framework, a document is available which describe points of AIL in regards to the regulation[8].

[8] `https://www.circl.lu/assets/files/information-leaks-analysis-and-gdpr.pdf`

Potential legal grounds

- **Consent of the data subject** is in many cases not feasible in practice and often impossible or illogical to obtain (Art. 6(1)(a)).
- Legal obligation (Art. 6(1)(c)) - This legal ground applies mostly to CSIRTs, in accordance with the powers and responsibilities set out in CSIRTs mandate and with their constituency, as they may have the legal obligation to collect, analyse and share information leaks without having a prior consent of the data subject.
- Art. 6(1)(f) - Legitimate interest - Recital 49 explicitly refers to CSIRTs' right to process personal data provided that they have a legitimate interest but not colliding with fundamental rights and freedoms of data subject.

Managing AIL: Old fashion way

Access the script screen

```
screen -r Script
```

Table: GNU screen shortcuts

Shortcut	Action
C-a d	detach screen
C-a c	Create new window
C-a n	next window screen
C-a p	previous window screen

Managing your modules: Using the helper