AIL Framework for Analysis of Information Leaks

Workshop - A generic analysis information leak open source software

CIRCL
Computer Incident
Response Center
Luxembourg

Alexandre Dulaunoy
alexandre.dulaunoy@circl.lu
Sami Mokaddem
sami.mokaddem@circl.lu

info@circl.lu

November 28, 2017

Objectives of the workshop

Our objectives of the workshop

- Demonstrate why data-analysis is critical in information security
- Explain challenges and the design of the AIL framework
- Learn how to install and start AIL
- Learn how to properly feed AIL with custom data
- Learn how to manage current modules
- Learn how to create new modules
- Practical part

Your objectives of the workshop

What are your expectations?

Sources of leaks

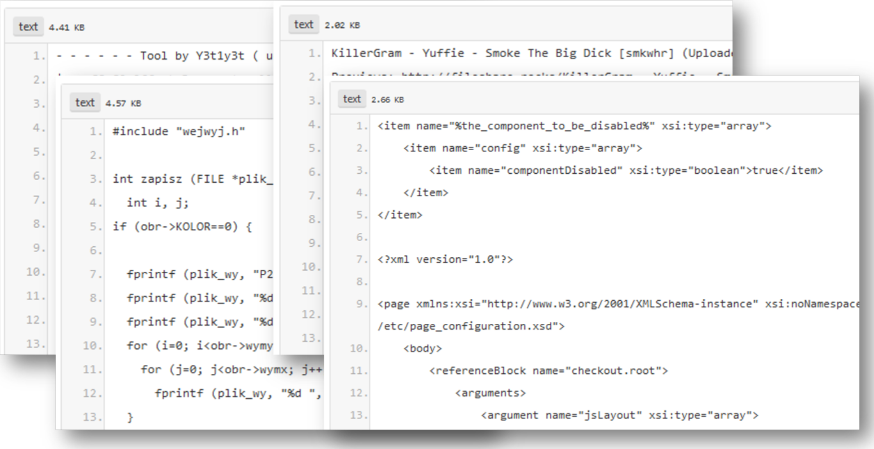
Sources of leaks: Paste monitoring

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

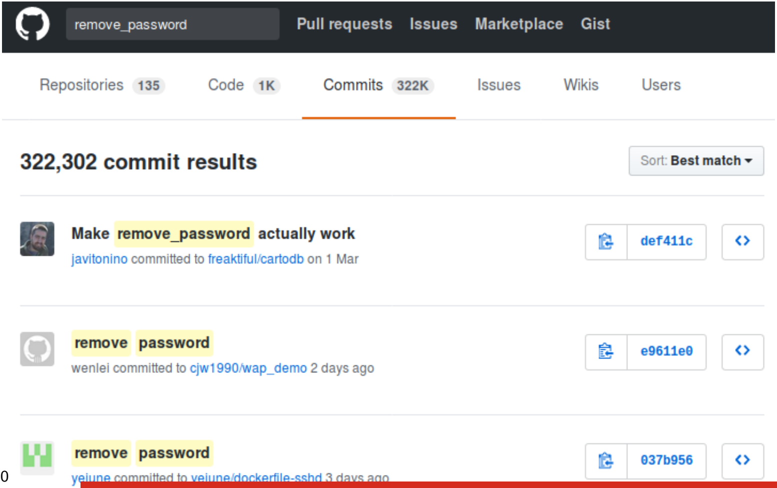
```
<item name="%the_component_to_be_disabled%" xsi:type="array">
    <item name="config" xsi:type="array">
        <item name="componentDisabled" xsi:type="boolean">true</item>
    </item>
</item>

<?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">
```

Sources of leaks: Others

- Mistakes from users
  - https://github.com/search?q=remove_password&type=Commits&ref=searchresults



remove_password

322,302 commit results

Make remove_password actually work
javitonino committed to freaktiful/cartodb on 1 Mar
def411c

remove password
wenlei committed to cjw1990/wap_demo 2 days ago
e9611e0

remove password
yejune committed to yejune/dockerfile-sshd 3 days ago
037b956

Sources of leaks: Others

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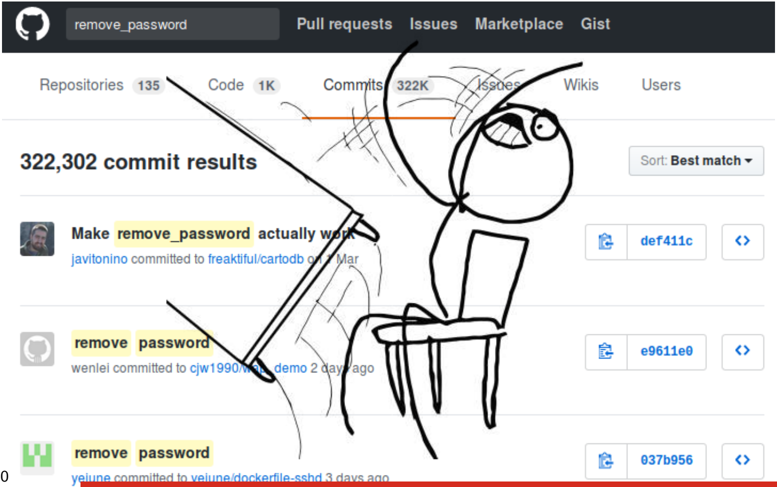

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e9611e0

remove password
yejune committed to yejune/dockerfile-sshd 3 days ago
037b956

Are leaks frequent?

Yes!

And it's important to detect them.

Paste monitoring at CIRCL: Statistics

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

Table: Statistics for 2016

Pastes 2016	Monthly average	Total
Fetched pastes	1 547 094	18 565 124
Security related (TR-46)	21	252
Incidents & investigations	54	649

AIL Framework

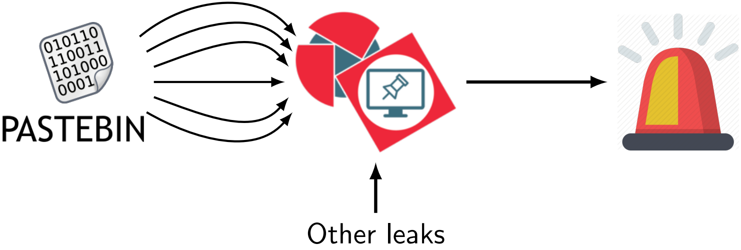
From a requirement to a solution: AIL Framework

History:

- AIL initially started as an internship project (2014) to evaluate the feasibility to automate the analysis of (un)structured information to find leaks.
- In 2017, AIL framework is an open source software in Python. The software is actively used (and maintained) by CIRCL.

AIL Framework: A framework for Analysis of Information Leaks

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



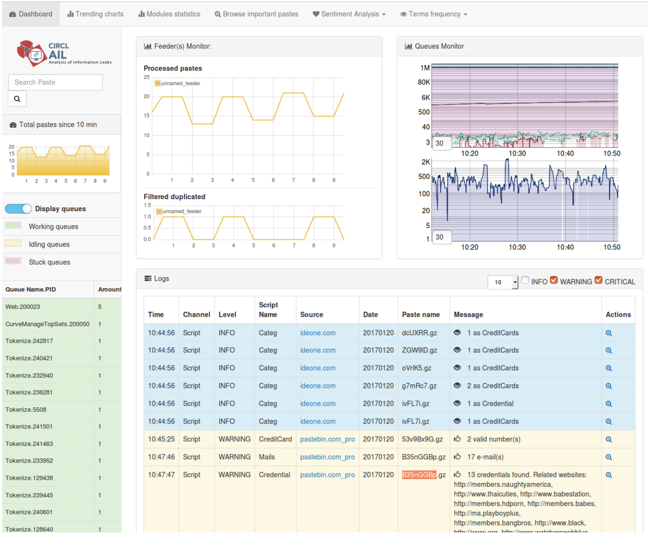
AIL Framework: Current capabilities

- 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**

AIL Framework: Current features

- Extracting **credit cards numbers, credentials, phone numbers, ...**
- Extracting and validating potential **hostnames**
- Keeps track of **duplicates**
- **Full-text indexer** to index unstructured information
- Terms, sets and regex **tracking and occurences**
- **Sentiment/Mood analyser** for incoming data
- Modules manager
- And many more

Example: Following a notification (0) - Dashboard



🟩	Working queues
🟨	Idling queues
🟥	Stuck queues

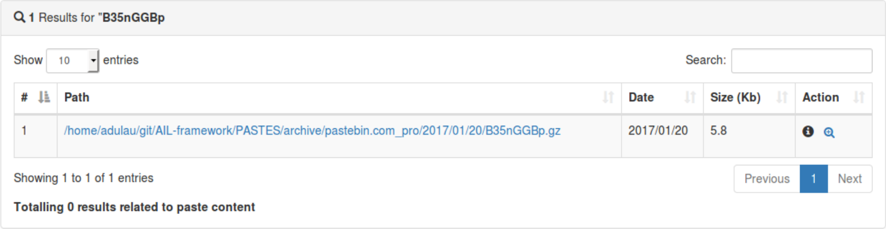
Queue Name.PID	Amount
Web.200023	5
CurveManageTopSets.200050	1
Tokenize.242817	1
Tokenize.240421	1
Tokenize.232940	1
Tokenize.236281	1
Tokenize.5508	1
Tokenize.241501	1
Tokenize.241463	1
Tokenize.233952	1
Tokenize.129438	1
Tokenize.239445	1
Tokenize.240601	1
Tokenize.128640	1

Logs

10 □ INFO ☑ WARNING ☑ CRITICAL

Time	Channel	Level	Script Name	Source	Date	Paste name	Message	Actions
10:44:56	Script	INFO	Categ	ideone.com	20170120	dcUXRR.gz	1 as CreditCards	
10:44:56	Script	INFO	Categ	ideone.com	20170120	ZGW9ID.gz	1 as CreditCards	
10:44:56	Script	INFO	Categ	ideone.com	20170120	oVrlK5.gz	1 as CreditCards	
10:44:56	Script	INFO	Categ	ideone.com	20170120	g7mRc7.gz	2 as CreditCards	
10:44:56	Script	INFO	Categ	ideone.com	20170120	ivFL7i.gz	1 as Credential	
10:44:56	Script	INFO	Categ	ideone.com	20170120	ivFL7i.gz	1 as CreditCards	
10:45:25	Script	WARNING	CreditCard	pastebin.com_pro	20170120	53v9Bx9G.gz	2 valid number(s)	
10:47:46	Script	WARNING	Mails	pastebin.com_pro	20170120	B35nGGBp.gz	17 e-mail(s)	
10:47:47	Script	WARNING	Credential	pastebin.com_pro	20170120	B35nGGBp.gz	13 credentials found. Related websites: http://members.naughtyamerica, http://www.thaicuties, http://www.babestation, http://members.hdporn, http://members.babes, http://ma.playboyplus, http://members.bangbros, http://www.black, http://www.org, http://www.watchersweblue	

Example: Following a notification (1) - Searching



1 Results for "**B35nGGBp**

Show 10 entries

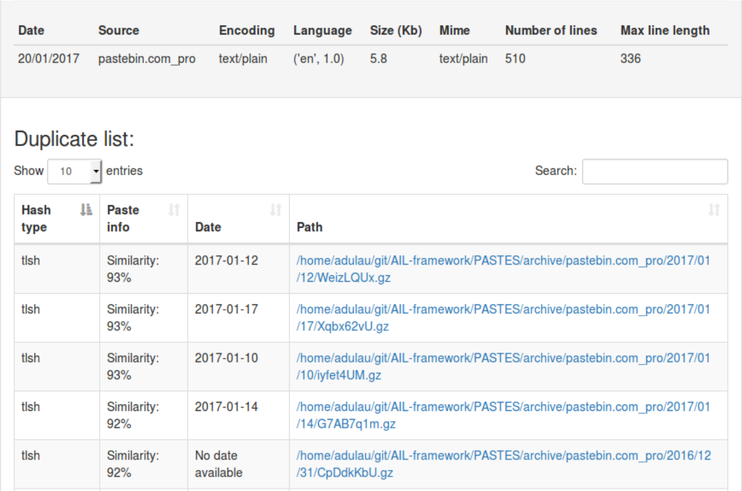
Search:

#	Path	Date	Size (Kb)	Action
1	/home/adulau/git/AIL-framework/PASTES/archive/pastebin.com_pro/2017/01/20/B35nGGBp.gz	2017/01/20	5.8	ℹ 🔍

Showing 1 to 1 of 1 entries

Totalling 0 results related to paste content

Example: Following a notification (2) - Metadata



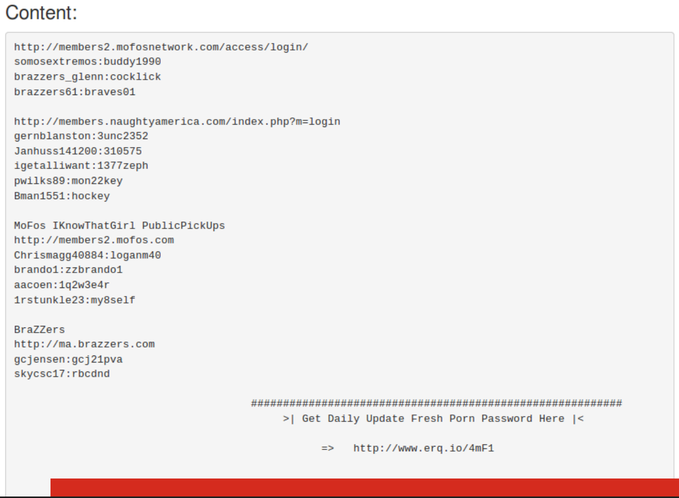
Date	Source	Encoding	Language	Size (Kb)	Mime	Number of lines	Max line length
20/01/2017	pastebin.com_pro	text/plain	('en', 1.0)	5.8	text/plain	510	336

Duplicate list:

Show 10 entries Search:

Hash type	Paste info	Date	Path
tlsh	Similarity: 93%	2017-01-12	/home/adulau/git/AIL-framework/PASTES/archive/pastebin.com_pro/2017/01/12/WeizLQUx.gz
tlsh	Similarity: 93%	2017-01-17	/home/adulau/git/AIL-framework/PASTES/archive/pastebin.com_pro/2017/01/17/Xqbx62vU.gz
tlsh	Similarity: 93%	2017-01-10	/home/adulau/git/AIL-framework/PASTES/archive/pastebin.com_pro/2017/01/10/iyfet4UM.gz
tlsh	Similarity: 92%	2017-01-14	/home/adulau/git/AIL-framework/PASTES/archive/pastebin.com_pro/2017/01/14/G7AB7q1m.gz
tlsh	Similarity: 92%	No date available	/home/adulau/git/AIL-framework/PASTES/archive/pastebin.com_pro/2016/12/31/CpDdkKbU.gz

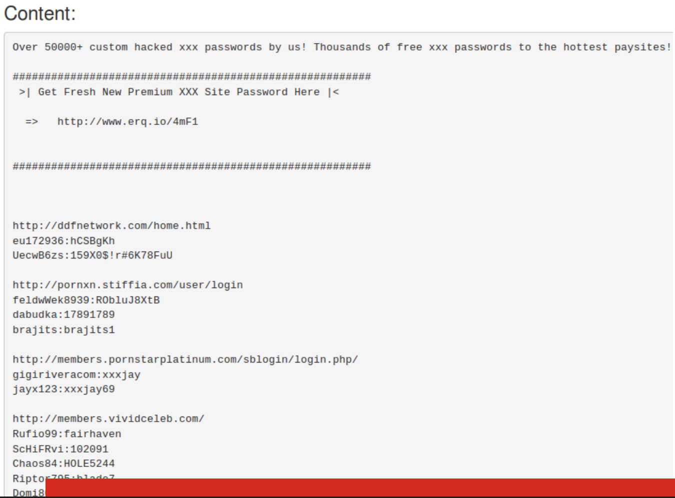
Example: Following a notification (3) - Browsing content



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: Following a notification (3) - Browsing content

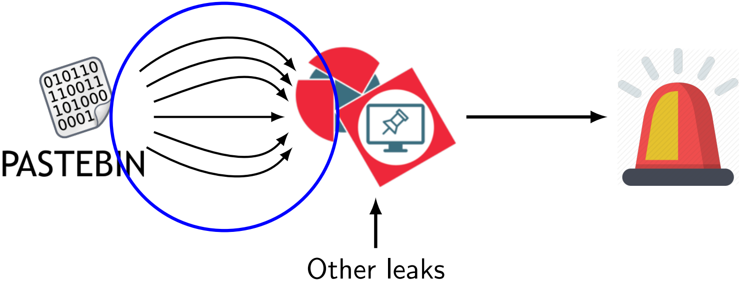


Content:

```
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
Domi8
```

Pystemon

Pystemon: A monitoring tool for PasteBin-alike sites



Pystemon: Current capabilities

- Flexible design, minimal effort to add another paste* site
- Use custom download functions for complex pastie sites
- Uses multiple threads per unique site to download the pastes
- (optional) Uses random User-Agents
- (optional) Uses random proxies
- Removes a proxy if it is unreliable (fails 5 times)
- (optional) Compress saved files with Gzip. (no zip to limit external dependencies)
- And more...

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
cd var/www/
./update_thirdparty.sh
```

Using the virtual machine:

1. Download `https://www.circl.lu/assets/files/ail-training/AIL_v@4986352.ova`
2. Start virtualbox
3. File → import appliance → select AIL_v@4986352.ova
4. (for now) Prevent the automatic launch and `git pull` the changes

AIL ecosystem - Challenges and design

AIL ecosystem: Technologies used

Programing language: Essentially python2 (slowly migrating to python3)

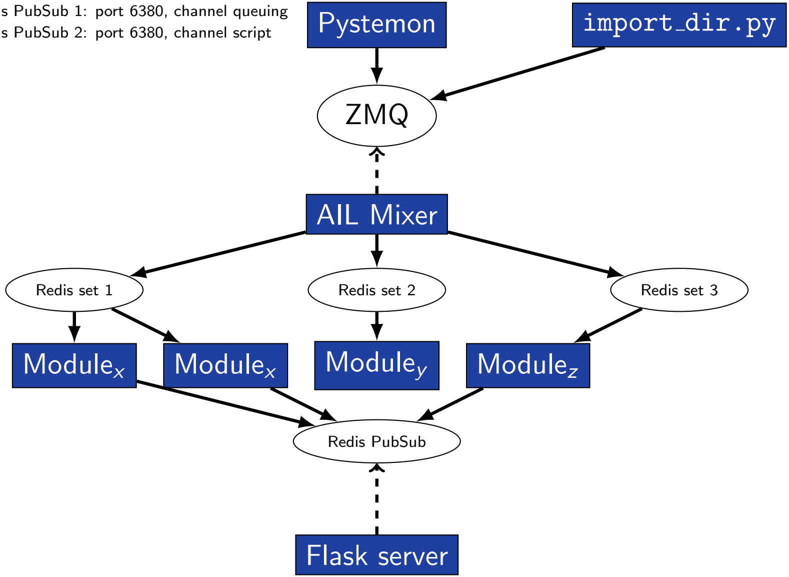
Databases: Redis and Redis-levelDB

Server: Flask

Data message passing: ZMQ and Redis Publisher/Subscriber

AIL global architecture

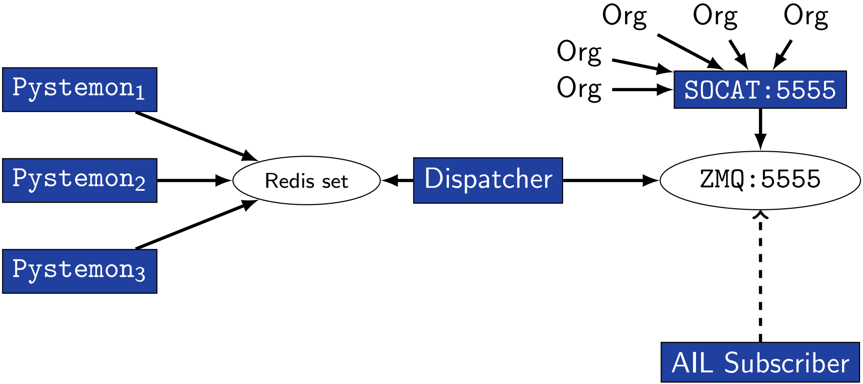
Redis PubSub 1: port 6380, channel queuing
Redis PubSub 2: port 6380, channel script



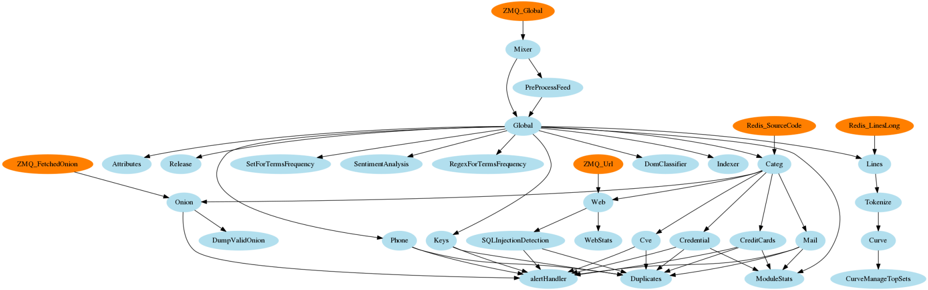
Data feeder: Gathering pastes with pystemon

Pystemon global architecture

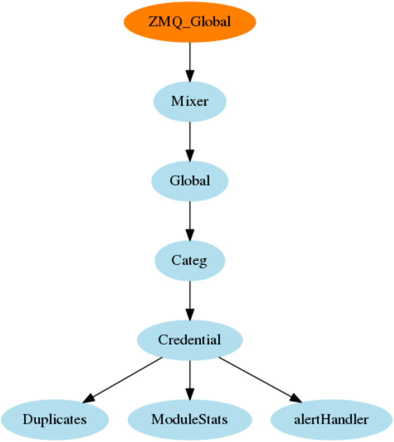
Redis PubSub 1: port 6380, channel queuing
Redis PubSub 2: port 6380, channel script



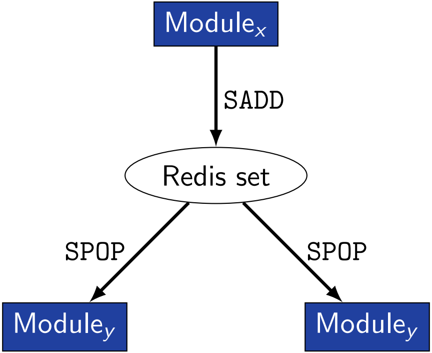
AIL global architecture: Data streaming between module



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 bin/package/config.cfg

Accessing the environment and starting AIL

```
# Activate the virtualenv
. ./AILENV/bin/activate

# Launch the system
cd bin/
./LAUNCH
    # check options 1->5

# Start web interface
cd var/www/
./Flask_server.py
    # -> Browse http://localhost:7000/
```

Running your own instance using the virtual machine

Login and passwords:

```
Web interface (default network settings):
    http://192.168.56.51:7000/
Shell/SSH:
    ail/Password1234

```

Managing the framework

Managing AIL: Old fashion way

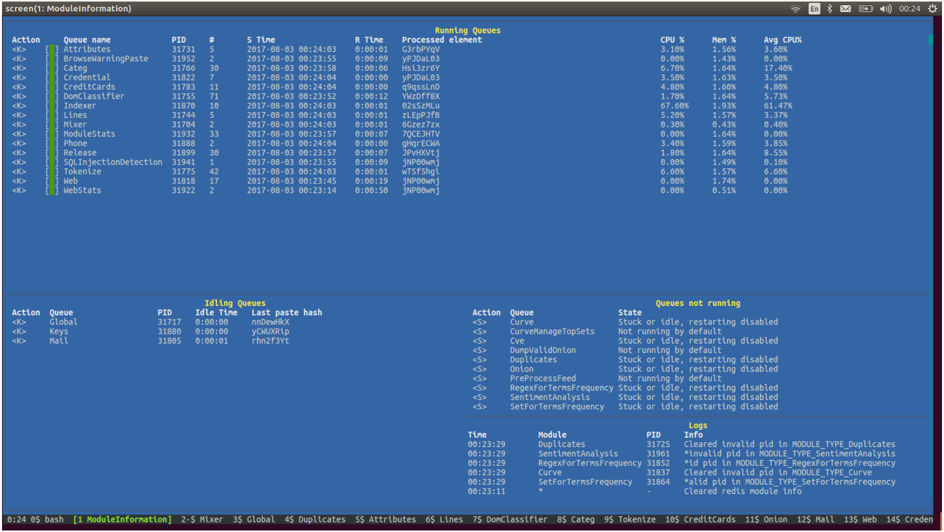
Access the script screen

```
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



```
                                                                Running Queues
Action     Queue name               PID     #        S Time                R Time     Processed element                        CPU %      Mem %      Avg CPU%
<K>      [ ] Attributes             31731   5        2017-08-03 00:24:03   0:00:01    G3rbPYqV                                 3.10%      1.56%      3.60%
<K>      [ ] BrowseWarningPaste     31952   2        2017-08-03 00:23:55   0:00:09    yPJDaL03                                 0.00%      1.43%      0.00%
<K>      [ ] Categ                  31766   30       2017-08-03 00:23:58   0:00:06    Hsi3zr6Y                                 6.70%      1.64%      17.40%
<K>      [ ] Credential             31822   7        2017-08-03 00:24:04   0:00:00    yPJDaL03                                 3.50%      1.63%      3.50%
<K>      [ ] CreditCards            31783   11       2017-08-03 00:24:04   0:00:00    q9qssLnD                                 4.80%      1.60%      4.80%
<K>      [ ] DomClassifier          31755   71       2017-08-03 00:23:52   0:00:12    YWzDff8X                                 1.70%      1.64%      5.73%
<K>      [ ] Indexer                31870   10       2017-08-03 00:24:03   0:00:01    02sSzMLu                                 67.60%     1.93%      61.47%
<K>      [ ] Lines                  31744   5        2017-08-03 00:24:03   0:00:01    zLEpPJfB                                 5.20%      1.57%      3.37%
<K>      [ ] Mixer                  31704   2        2017-08-03 00:24:03   0:00:01    6Gzez7zx                                 0.30%      0.43%      0.40%
<K>      [ ] ModuleStats            31932   33       2017-08-03 00:23:57   0:00:07    7QCEJHTV                                 0.00%      1.64%      0.00%
<K>      [ ] Phone                  31888   2        2017-08-03 00:24:04   0:00:00    gHqrECWA                                 3.40%      1.59%      3.85%
<K>      [ ] Release                31899   30       2017-08-03 00:23:57   0:00:07    JPvHXVtj                                 1.80%      1.64%      8.55%
<K>      [ ] SQLInjectionDetection  31941   1        2017-08-03 00:23:55   0:00:09    jNP00wmj                                 0.00%      1.49%      0.10%
<K>      [ ] Tokenize               31775   42       2017-08-03 00:24:03   0:00:01    wTSf5hgi                                 6.60%      1.57%      6.60%
<K>      [ ] Web                    31818   17       2017-08-03 00:23:45   0:00:19    jNP00wmj                                 0.00%      1.74%      0.00%
<K>      [ ] WebStats               31922   2        2017-08-03 00:23:14   0:00:50    jNP00wmj                                 0.00%      0.51%      0.00%
```

```
                      Idling Queues
Action  Queue                PID    Idle Time   Last paste hash
<K>     Global               31717  0:00:00     nnDewHkX
<K>     Keys                 31880  0:00:00     yCWUXRip
<K>     Mail                 31805  0:00:01     rhn2f3Yt
```

```
                                          Queues not running
Action  Queue                  State
<S>     Curve                  Stuck or idle, restarting disabled
<S>     CurveManageTopSets     Not running by default
<S>     Cve                    Stuck or idle, restarting disabled
<S>     DumpValidOnion         Not running by default
<S>     Duplicates             Stuck or idle, restarting disabled
<S>     Onion                  Stuck or idle, restarting disabled
<S>     PreProcessFeed         Not running by default
<S>     RegexForTermsFrequency Stuck or idle, restarting disabled
<S>     SentimentAnalysis      Stuck or idle, restarting disabled
<S>     SetForTermsFrequency   Stuck or idle, restarting disabled
```

```
                                                Logs
Time         Module                 PID    Info
00:23:29     Duplicates             31725  Cleared invalid pid in MODULE_TYPE_Duplicates
00:23:29     SentimentAnalysis      31961  *invalid pid in MODULE_TYPE_SentimentAnalysis
00:23:29     RegexForTermsFrequency 31852  *id pid in MODULE_TYPE_RegexForTermsFrequency
00:23:29     Curve                  31837  Cleared invalid pid in MODULE_TYPE_Curve
00:23:29     SetForTermsFrequency   31864  *alid pid in MODULE_TYPE_SetForTermsFrequency
00:23:11     *                      -      Cleared redis module info
```

```
0:24 0$ bash  [1 ModuleInformation]  2-$ Mixer  3$ Global  4$ Duplicates  5$ Attributes  6$ Lines  7$ DomClassifier  8$ Categ  9$ Tokenize  10$ CreditCards  11$ Onion  12$ Mail  13$ Web  14$ Creden
```

Feeding the framework

Feeding AIL

There are differents way to feed AIL with data:

1. Be a 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 `import_dir.py` script

Feeding AIL

There are differents way to feed AIL with data:

1. CIRCL partners and 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 `import_dir.py` script

Plug-in AIL to the CIRCL feed

You can freely access the CIRCL feed during this workshop!

- In the file `bin/package/config.cfg`,
- Set `ZMQ_Global->address` to `tcp://crf.circl.lu:5556`

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

/!\ 2 requirements:

1. Data to be fed must have the path hierarchy as the following:
   1. `year/month/day/(textfile/gzfile)`
   2. This is due to the inner representation of paste in AIL
2. Each file to be fed must be of a raisonable size:
   1. $\sim$ `3 Mb` is already large
   2. This is because some modules are doing regex matching
   3. 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. Change 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)

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

1. Change 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`

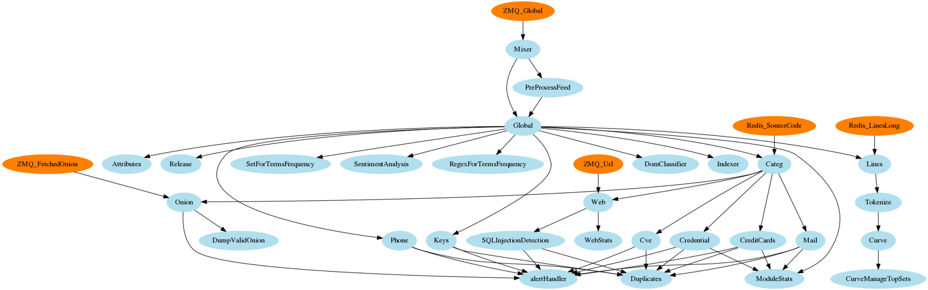
Feeding AIL with your own data - `import_dir.py` (2)

1. Change 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`
3. Watch your data being feed to AIL

Creating new features

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

Choose where to locate your module in the data flow:



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

Writing your own modules - /bin/template.py

```python
import time
from pubsublogger import publisher
from Helper import Process
if __name__ == ’__main__’:
    # Port of the redis instance used by pubsublogger
    publisher.port = 6380
    # Script is the default channel used for the modules.
    publisher.channel = ’Script’
    # Section name in bin/packages/modules.cfg
    config_section = ’<section name>’
    # Setup the I/O queues
    p = Process(config_section)
    # Sent to the logging a description of the module
    publisher.info("<description of the module>")
    # Endless loop getting messages from the input queue
    while True:
        # Get one message from the input queue
        message = p.get_from_set()
        if message is None:
            publisher.debug("{} queue is empty, waiting".format(config_section))
            time.sleep(1)
            continue
        # Do something with the message from the queue
        something_has_been_done = do_something(message)

```

AIL - Add your own web interface

1. Launch `var/www/create_new_web_module.py`
2. Enter the module's name
3. A template and flask skeleton has been created for your new webpage in `var/www/modules/`
4. You can start **coding** server-side in:

   var/www/modules/*your_module_name*/Flask_*your_module_name.py*

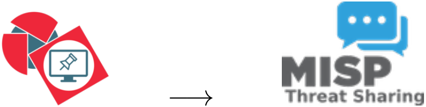
5. You can start **coding** client-side in:

   var/www/modules/*your_module_name*/templates/*your_module_name.html*

   var/www/modules/*your_module_name*/templates/header_*your_module_name.html*

Case study: Push alert to MISP

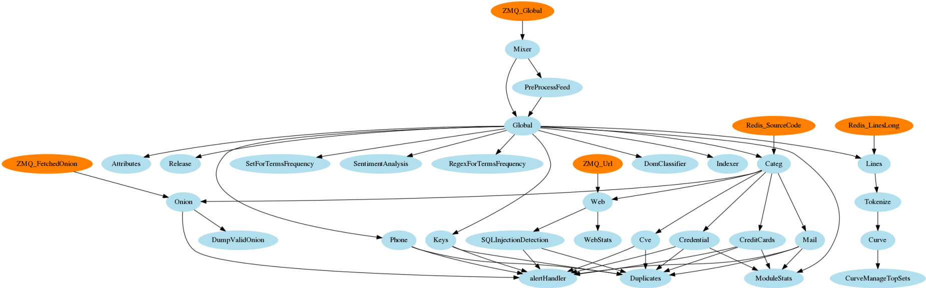
Push alert to MISP



Goal: Every alert concering `Credential.py` and `CreditCards.py` are pushed to MISP

Case study: Finding the best place in the system

Best place to put it?



Case study: Finding the best place in the system

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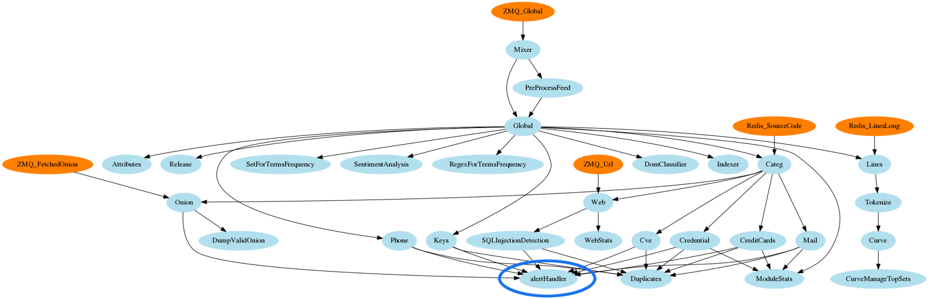

Case study: Updating alertHandler.py

alertHandler.py - commit 83e082e62a20a49e1ca2d546e4f19209135ac59d

```
[...]
if message is not None:
    message = message.decode('utf8') #decode because of python3
    module_name, p_path = message.split(';')
[...]

# Create MISP AIL-leak object and push it
if flag_misp: # MISP is connected
    allowed_modules = ['credential', 'creditcards']
    if module_name in allowed_modules:
         # create and setup the MISP object
        wrapper.add_new_object(module_name, p_path)
        wrapper.pushToMISP()
    else:
        print('not pushing to MISP:', module_name, p_path)

```

Practical part

Practical part: Pick your choice

1. Improve module `keys.py` to support other type of keys (ssh, ...)
   - `https://github.com/veorq/blueflower/blob/master/blueflower/constants.py`
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. Integration of *truffleHog*
   - Searches through git repositories for high entropy strings and secrets, digging deep into commit history
   - `https://github.com/dxa4481/truffleHog`
5. Your custom feature

Contribution rules

How to contribute

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- That's it!

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Conclusion

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

  → Therefore quicker response time to assist and/or inform proactively affected constituents.