PANGOLIN publicly available permanent version

PANGOLIN publicly available permanent version - Zhipeng Jia, Xiaokang Yin, Shuitao Gan, Chao Zhang, Hangtian Liu, Jiangan Ji, Enzhou Song, Ruijie Cai, Jinglei Tan, Shengli Liu, Figshare.

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Content

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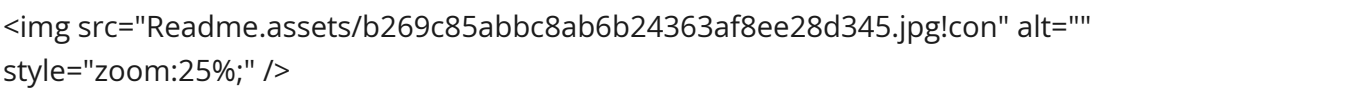
PANGOLIN



1. Introduction

This is an efficient fuzzing tool, **Fuzzing Multilingual IoT Firmware with LLM-Driven Code Analysis**, which automates the generation of URIs and parameter specifications from backend programs to guide fuzzing and achieve effective vulnerability discovery.

2. Installation

2.1 Python

We strongly recommend using venv to install package dependencies.

```
python -m venv myenv
source myenv/bin/activate
python -V
    Python 3.9.20
pip install -r requirements.txt
```

2.2 binwalk

```
cargo install binwalk
```

2.3 IDA 9.0

```
https://hex-rays.com/ida-pro
```

2.4 DeepSeek-V3

Other LLMs can also be used, and this requires updating the model invocation URI and API key accordingly.

```
https://platform.deepseek.com/api_keys
```

2.5 Physical devices

Ensure that the host running the code can communicate with the physical device.

3. Usage

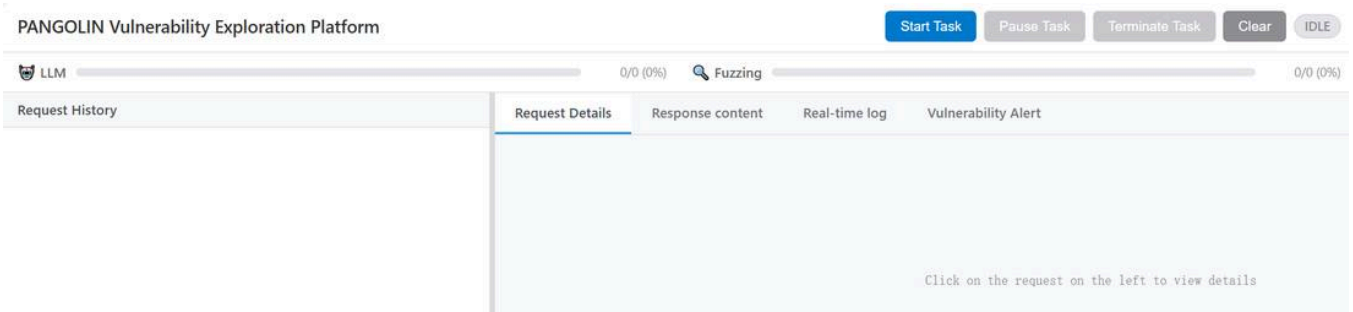
Below, we present the components of PANGOLIN following the structure of the paper.

3.0 Frontend display

We designed a frontend interface to dynamically visualize the entire PANGOLIN workflow, but it requires running the code below to display correctly.

```
source myenv/bin/activate && uvicorn src.webui_server:app --host 127.0.0.1 --port 8000 --reload

http://127.0.0.1:8000
```



3.1 Format Standardizing

Binary Format Standardizing, We use idat to decompile all binaries in the specified directory, optimize the decompiled output, and write the results to a designated directory.

```
cd FormatStandardizing
python  batch_export_decompiled.py [-h] --ida IDA --input INPUT --output OUTPUT
```

Script Format Standardizing, we traverse script language files and split and standardize them based on their function definitions.

```
python Format_Script_Functions.py
```

3.2 Entry Map Construction

First, we obtain the frontend traffic information through a man-in-the-middle approach, which is used to locate the backend dispatch function corresponding to the entry URI.

```
cd src/scripts/


mitmdump --set validate_inbound_headers=false --set normalize_outbound_headers=false --ssl-insecure --set tls_versi
```

Then, we can run the following script to inspect the deduplicated packet data that has already been collected.

```
python viewrequestDB.py
```

```
Problems  Output  Debug Console  Terminal  Ports
ed1': Request(GET 192.168.31.6:80/webui/rest/routingDayZeroDetails?type=checkIP&interfaceName=GigabitEthernet0/0/1)
shooting/logAnalysis/webserverLog?limit=100)}
HTTP Request/Response Viewer
1. View Requests Database
2. View Responses Database
3. Analyze Request Signatures
4. Exit

Enter choice (1-4): 3
```

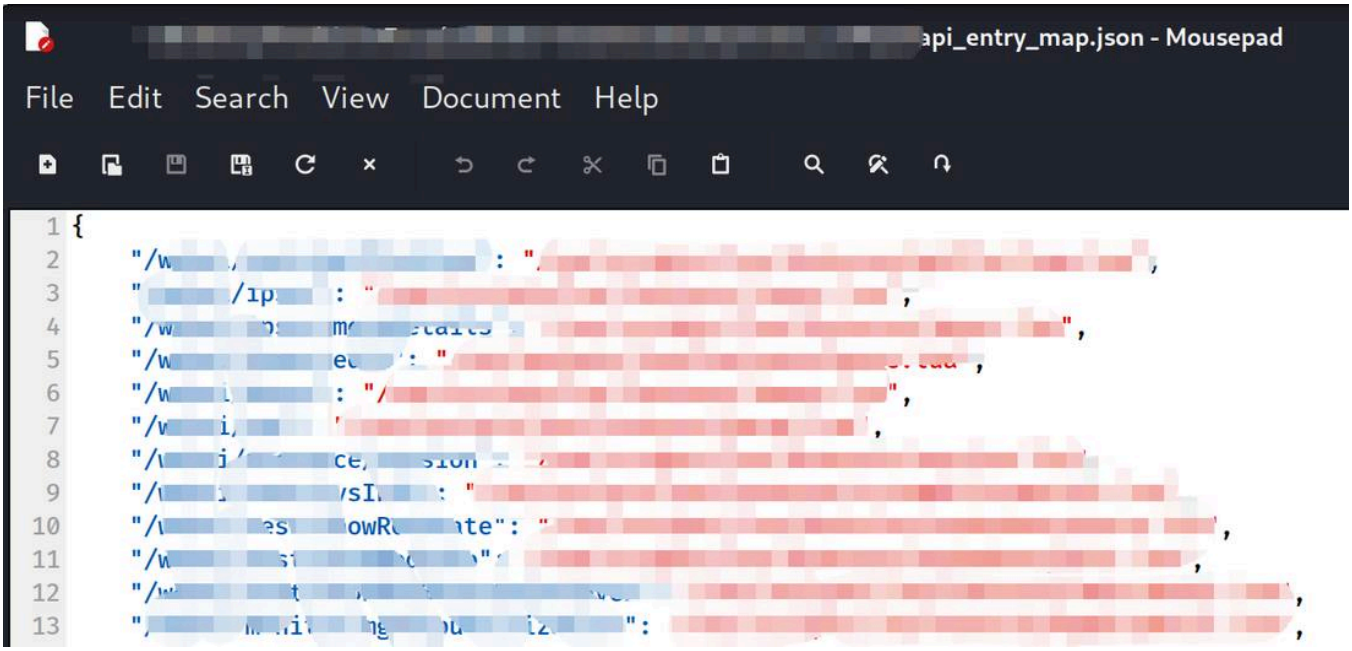
At this stage, you should be able to obtain a large amount of frontend information. If no data is collected, please check your configuration; I can confirm that the code itself is correct.

If this step works correctly, we will next use the traffic to locate the backend dispatch functions and construct the entry map.

```
python Entry_Map_Construction.py
```

This script extracts entry URIs from network traffic, performs segmentation and deduplication, and prioritizes the top 20 functions based on hit frequency distribution. You need to examine the frequency distribution to select an appropriate top N functions as input. The script then automatically infers their hierarchical structure and uses an LLM to generate the entry map in the following format.

```
{"entry uri": "handler point", ...}
```



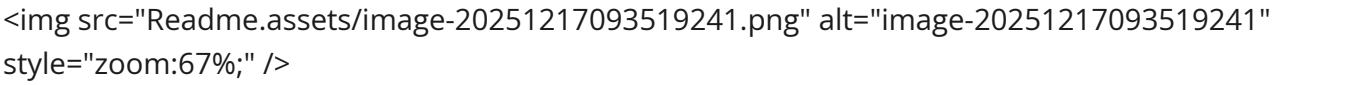
3.3 Parameter Specification Generation and Correction

```
python ParameterSpecificationGeneration.py
```

Before execution, ensure that all parameters are properly configured in env_fuzzer.py.

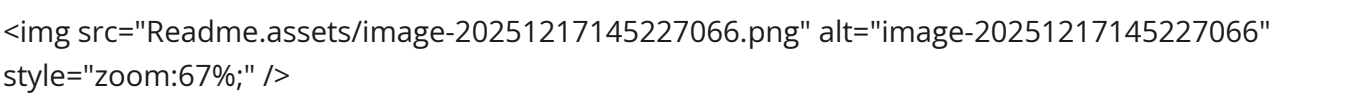
```
/data/api/"brand"
```

During the parameter specification generation phase, all caches are stored in this directory, and storage paths for each brand and model are created automatically. Of course, you can also make further changes based on the code logic.




```
/data/db/"brand"
```

All generated initial seeds will be stored in a standardized manner in the corresponding brand-specific folders within this directory.



3.4 Fuzzing

3.4.1 Obtain the Smart Plug Token

Need to purchase a Xiaomi smart plug and connect it to the local Wi-Fi network.

```
cd Smart_Plug_Token_EX/
python3 token_extractor.py

pip3 install pycryptodome pybase64 requests
```


```
open

miiocli -d device --ip YOUR_DEVICE_IP --token YOUR_DEVICE_TOKEN raw_command
set_properties "[{'did': 'MYDID', 'siid': 2, 'piid': 1, 'value':True}]"

close
miiocli -d device --ip YOUR_DEVICE_IP --token YOUR_DEVICE_TOKEN raw_command
set_properties "[{'did': 'MYDID', 'siid': 2, 'piid': 1, 'value':False}]"
```

3.4.2 Start Monitor

```
cd Monitor
make
sudo ./test_server
```

3.4.3 Start Fuzzing

```
python fuzzer.py  -u http://IP:port -v 2 -a ci -k ./kernel.log -c ./Monitor/ci.log
```

3.4.4 Exploit

All generated alarm information will be stored in separate folders created based on brand names and models, which will appear in this directory. For the sake of security, we have cleared the cache of all alarm information.

```
cd exploited/
```