

```
#
# Flow Data Generation Copyright (c) 2018, All rights reserved.
#
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#
```

Instruction Manual : Generating NetFlow-compatible data with labels

SiLK, the System for Internet-Level Knowledge, is a collection of traffic analysis tools developed by the CERT Network Situational Awareness Team (CERT NetSA) to facilitate security analysis of large networks. The SiLK tool suite supports the systematic collection, storage, and analysis of network flow data, enabling network security analysts to rapidly query large historical traffic data sets. SiLK is ideally suited for analyzing traffic on the backbone or border of a large, distributed enterprise or mid- sized ISP.

Installation:

Download silk-3.16.0.tar.gz from <https://tools.netsa.cert.org/silk/download.html>

1. tar -xvzf silk-3.16.0.tar.gz
2. cd silk-3.16.0
3. ./configure --prefix=/usr/local
or ./configure --prefix=/MY_PATH/silk-3.16.0
4. make
5. make install

Note: rwstats only outputs in seconds, not in milliseconds.

To fix this for millisecond, update src/rwstats/rwstatssetup.c for the two lines:

- line 293: SK_OPTION_TIMESTAMP_ALWAYS_MSEC
- line 301: static int bin_time_uses_msec = 1;

And, make and make install to complete.

Note: rwcut outputs in milliseconds.

Making Flow Data:

First download trace and log data:

- Packet trace download: <http://mawi.wide.ad.jp/mawi/>
- Intrusion log download: <http://www.fukuda-lab.org/mawilab/>

And, run rwptoflow and rwstats (or rwcut). rwstats makes summary output and reorders the entries. rwcut preserves the output order.

1. rwptoflow captureFilepath --flow-out=FlowData.rw
2. rwstats FlowDataPath \
 --fields=FieldsList \
 --values=Flows \
 --values=Flows \

- ```

--output-path=yyyymmdd_result.data \
--percentage=0
where FlowDataPath is the output from rwptoflow (FlowData.rw)
3. rwcut FlowDataPath \
 --fields=FieldsList \
 --output-path=yyyymmdd_result.data
where FlowDataPath is the output from rwptoflow (FlowData.rw)

```

For example, download TCPdump file and anomalous\_suspicious.csv

- 201807011400.pcap.gz (1426.45 MB)  
<http://mawi.wide.ad.jp/mawi/samplepoint-F/2018/201807011400.html>
- 20180701\_anomalous\_suspicious.csv  
<http://www.fukuda-lab.org/mawilab/v1.1/2018/07/01/20180701.html>
- Run the following commands (choose either rwstats or rwcut).
  1. rwpmapbuild --input addrtype-templ.txt --output address\_types.pmap
  2. rwstats 20180701.rw \
 --fields=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,20,21,25,26,27,28,29 \
 --values=Flows \
 --output-path=20180701\_result.data \
 --percentage=0
  3. rwcut 20180701.rw \
 --fields=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,20,21,25,26,27,28,29 \
 --output-path=20180701\_result.data

Note: The command rwpmapbuild is to include the fields of sType (#16) and dType (#17) in the output. In that case, address\_types.pmap file is needed, according to <https://tools.netsa.cert.org/silk/addrtype.html>. The file addrtype-templ.txt in \$SILKPATH/share/silk can be used.

- Alternatively, if you do not want to include the fields of sType (16) and dType (17) in the output, you can run the following commands instead. In this case, you should specify “--notypes” when running flowlabeling.py (see the section of “Labeling Flow Data” below).
  1. rwptoflow 201807011400.pcap --flow-out=20180701.rw
  2. rwstats 20180701.rw \
 --fields=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,20,21,25,26,27,28,29 \
 --values=Flows \
 --output-path=20180701\_result.data \
 --percentage=0
  3. rwcut 20180701.rw \
 --fields=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,20,21,25,26,27,28,29 \
 --output-path=20180701\_result.data

Note: Below table shows the available fields to retrieve from the raw trace. The field numbers are specified in the “--fields=” option.

### Labeling Flow Data:

The next step is to combine the flow data with the given anomaly information. We describe how to combine the flow record in the flow table with the anomalous traffic information provided by MAWILab.

For the flow data (15 minutes of a day), it is possible to download the associated attack information in a csv format. For example, a flow records data file (e.g. 20180701\_result.data) and the associated csv file (e.g. 20180701\_anomalous suspicious.csv).

To combine those two files, we implemented a new Python3 program of “flowlabeling.py”, which is based on the old internal program combineFlow\_1003.py. The program is executed based on priority rules defined below. Option “--sec” is when the records are in seconds. Without source modifications, outputs from rwstats are in seconds. By default, it assumes records in milliseconds.

| Priority            | # matches | sIP   | sPort | dIP   | dPort |
|---------------------|-----------|-------|-------|-------|-------|
| <b>41 (highest)</b> | 4         | match | match | match | match |
| <b>34</b>           | 3         | match | null  | match | match |
| <b>33</b>           | 3         | match | match | match | null  |
| <b>32</b>           | 3         | null  | match | match | match |
| <b>31</b>           | 3         | match | match | null  | match |
| <b>26</b>           | 2         | match | null  | match | null  |
| <b>25</b>           | 2         | null  | null  | match | match |
| <b>24</b>           | 2         | null  | match | match | null  |
| <b>23</b>           | 2         | match | null  | null  | match |
| <b>22</b>           | 2         | match | match | null  | null  |
| <b>21</b>           | 2         | null  | match | null  | match |
| <b>14</b>           | 1         | null  | null  | match | null  |
| <b>13</b>           | 1         | match | null  | null  | null  |
| <b>12</b>           | 1         | null  | null  | null  | match |
| <b>11</b>           | 1         | null  | match | null  | null  |
| <b>0 (lowest)</b>   | 0         | null  | null  | null  | null  |

With the assumption that the flow and attack files are located in the same directory, the program is being executed with the following command:

```
% python flowlabeling.py -t YYYYMMDD
```

```
e.g. python flowlabeling.py -t 20180701
```

```
python flowlabelling.py -t 20180701
```

```
python flowlabelling.py -t 20180701 --sec
```

```
python flowlabelling.py -i ./20180701_result.data
```

```
python flowlabelling.py -i ./20180701_result.data -c 20180701_anomalous suspicious.csv
```

```
python flowlabelling.py -i ./20180701_result.data -o output5
```

```
% python flowlabeling.py -h
```

```
usage: flowlabeling.py [-h] [-i INPUTFILE] [-c CLASSIFIER] [-o OUTPUTDIR] [-t DATESTR] [--sec]
Tool to combine the flow and classifier
optional arguments:
 -h, --help show this help message and exit
 -i INPUTFILE, --input INPUTFILE Input file path. e.g. *_result.data
 -c CLASSIFIER, --classifier CLASSIFIER Input classifier file path. e.g. *_anomalous_suspicious.csv
 -o OUTPUTDIR, --output OUTPUTDIR Output directory path
 -t DATESTR, --time DATESTR Datetime of the file. When used, -i and -o are ignored.
 --sec Flow times in seconds, rather than milliseconds. default False.
 --notypes Flag for input data without types fields 16 (sType) and 17 (dType). Default False.
```

Note: If the input data file does not contain two fields of sType (16) and dType (17), use the option of “—notypes” to flowlabeling. To add the two fields in the data file, you should execute rwpmapbuild and run either rwstats or rwcut with “16,17” in the –fields option (see the section of “Making Flow Data” above).

To break the outputs into multiple files with designated time windows, use the Python3 program “flowsplitter.py”.

```
% python flowsplitter.py -t YYYYMMDD
```

```
e.g. python flowsplitter.py -t 2018070101 -n 5
 python flowsplitter.py -t 2018070101 -n 5 --sec
 python flowsplitter.py -t 2018070101 -n 15
 python flowsplitter.py -t 2018070101 -n 30
 python flowsplitter.py -i ./2018070101_result/2018070101_mawilab_flow.csv -n 5
 python flowsplitter.py -i ./2018070101_result/2018070101_mawilab_flow.csv -o output5 -n 5
```

```
% python flowsplitter.py -h
```

```
usage: flowsplitter.py [-h] [-i INPUTFILE] [-o OUTPUTDIR] [-t DATESTR] [-n SPLITSEC]
Tool to split the flow files in timed order
optional arguments:
 -h, --help (show this help message and exit)
 -i INPUTFILE, --input INPUTFILE (input flow file path. e.g. *_mawilab_flow.csv)
 -o OUTPUTDIR, --output OUTPUTDIR (output directory path)
 -t DATESTR, --time DATESTR (datetime of the file. When used, -i and -o are ignored.)
 -n SPLITSEC (time separation in seconds. default 5 sec.)
 --sec (flow times from rwstats in seconds, rather than milliseconds. default False.)
```

## The output:

Note that feature #26 class is the label for anomaly detection.

| Feature # | Field#<br>(in Silk) | Feature | NetFlow field | Description |
|-----------|---------------------|---------|---------------|-------------|
| 1         | 1                   | sIP     | IPV4_SRC_ADDR | Source IP   |
| 2         | 2                   | dIP     | IPV4_DST_ADDR | Dest IP     |
| 3         | 3                   | sPort   | L4_SRC_PORT   | Source Port |

|    |    |          |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----|----|----------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4  | 4  | dPort    | L4_DST_PORT     | Dest port                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 5  | 5  | proto    | PROTOCOL        | IP protocol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 6  | 6  | packets  | IN_BYTES        | Packet count                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 7  | 7  | bytes    | IN_PKTS         | Byte count                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 8  | 8  | flags    | TCP_FLAGS       | Bit-wise or of TCP flags over all packets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 9  | 9  | sTime    | UNIX_Seconds    | Starting time of flow (in sec)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 10 | 10 | durat    |                 | Duration of flow (in sec)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11 | 11 | eTime    |                 | End time of flow (in sec)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 12 | 12 | sen      | FLOW_SAMPLER_ID | Name or ID of the sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 13 | 13 | in       | SRC_VLAN        | Router SNMP input interface                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 14 | 14 | out      | DST_VLAN        | Router SNMP output interface                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 15 | 15 | nhIP     | IPV4_NEXT_HOP   | Router next hop ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 16 | 16 | sType    | SRC_TOS         | Type of source IP address (pmap required)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 17 | 17 | dType    | DST_TOS         | Type of destination IP address (pmap required)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 18 | 20 | senClass |                 | Class of sensor that collected flow (SiLK-specific)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 19 | 21 | typeFlow |                 | Type of flow for this sensor class (SiLK-specific)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 20 | -- | iType    | ICMP_TYPE       | ICMP type value for ICMP flows                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 21 | -- | iCode    |                 | ICMP code value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 22 | 26 | initialF |                 | TCP flags on first packet in flow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 23 | 27 | sessionF |                 | Bit-wise OR of TCP flags over all packets except the first in the flow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 24 | 28 | attribut |                 | Flow attributes set by the flow generator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 25 | 29 | appli    |                 | Guess as to the content of the flow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 26 | -- | class    |                 | {Normal, Anomaly, Unsure}<br>-- Records labeled Unsure may be excluded for anomaly detection experiments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 27 | -- | taxonomy |                 | category assigned to the anomaly using the taxonomy for backbone traffic anomalies<br><br><ol style="list-style-type: none"> <li>1. <i>Unknown</i> are labels starting with the prefixes "unk" and "empty"</li> <li>2. <i>Other</i> are labels starting with the prefixes "ttl_error", "hostout", "netout", and "icmp_error"</li> <li>3. <i>HTTP</i> are labels starting with the prefixes "alphflHTTP", "ptmpHTTP", "mptpHTTP", "ptmplaHTTP" and "mptplaHTTP"</li> <li>4. <i>Multi. points</i> are labels starting with the prefixes "ptmp", "mptp" and "mptmp"</li> <li>5. <i>Alpha flow</i> are labels starting with the prefixes "alphfl", "malphfl", "salphfl", "point_to_point" and "heavy_hitter"</li> <li>6. <i>IPv6 tunneling</i> are labels starting with the prefixes "ipv4gretun" and "ipv46tun"</li> <li>7. <i>Port scan</i> are labels starting with the prefixes "posca" and "ptpposca"</li> <li>8. <i>Network scan ICMP</i> are labels starting with the prefixes "ntscIC" and "dntscIC"</li> <li>9. <i>Network scan UDP</i> are labels starting with</li> </ol> |

|    |    |             |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----|----|-------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |    |             |  | <p>the prefixes "ntscUDP" and "ptpposcaUDP"</p> <p>10. <i>Network scan TCP</i> are labels starting with the prefixes "ntscACK", "ntscSYN", "sntscSYN", "ntscTCP", "ntscnull", "ntscXmas", "ntscFIN" and "dntscSYN"</p> <p>11. <i>DoS</i> are labels starting with the prefixes "DoS", "distributed_dos", "ptpDoS", "sptpDoS", "DDoS" and "rflat"</p>                                                                                                                                                                                                                                                                                                                                                                |
| 28 | -- | label       |  | <p>Label information defined in MAWILab log:</p> <ul style="list-style-type: none"> <li>• The label <i>anomalous</i> is assigned to all abnormal traffic and should be identified by any efficient anomaly detector.</li> <li>• The label <i>suspicious</i> is assigned to all traffic that is probably anomalous but not clearly identified by our method.</li> <li>• The label <i>notice</i> is assigned to all traffic that is not identified anomalous by our method but that has been reported by at least one anomaly detector. This traffic should not be identified by any anomaly detector, we do not label them as benign in order to trace all the alarms reported by the combined detectors.</li> </ul> |
| 29 | -- | heuristic   |  | code assigned to the anomaly using simple heuristic based on port number, TCP flags and ICMP code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 30 | -- | distance    |  | difference <i>Dn-Da</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 31 | -- | nbDetectors |  | number of configurations (detector and parameter tuning) that reported the anomaly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |