A short introduction to Suricata $I_P^D S$

Éric Leblond

OISF

July 12th 2011

Suricata ?

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SURICATA

OISF

Introduction

Éric Leblond

- Initial and lead developer of NuFW
- Netfilter Contributor (mainly ulogd2 and userpace interaction)
- Suricata core developer (IPS, multicore optimisation, . . .)
- Independant Open Source et security consultant
- . . .

About OISF

Open Information Security Foundation

- `http://www.openinfosecfoundation.org`
- Non-profit foundation organized to build a next generation IDS/IPS engine
- Funded by US Governement (DHS, Navy)
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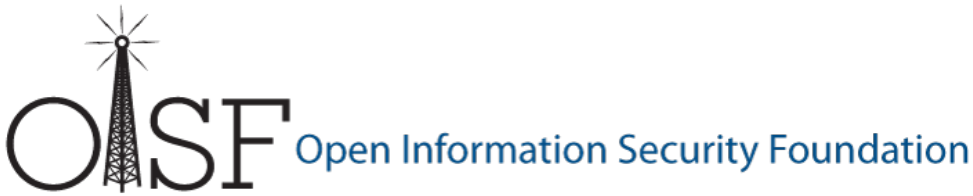

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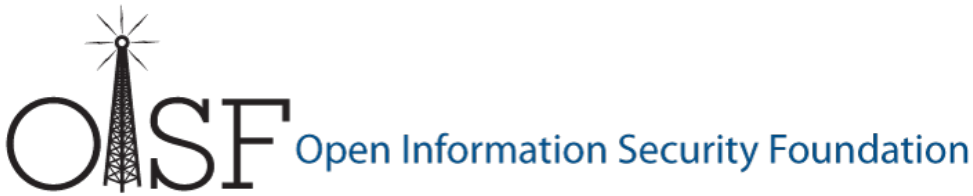

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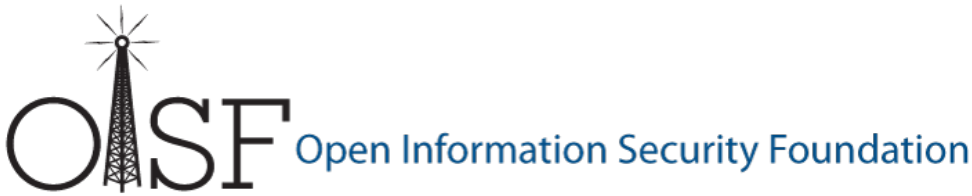

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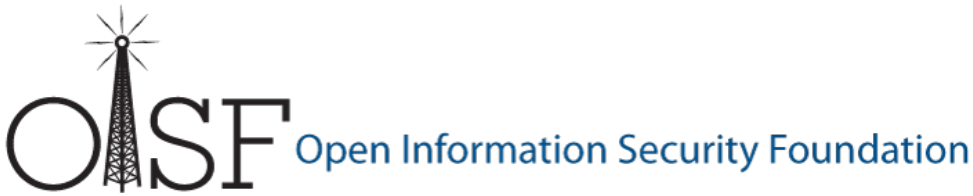

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- Board
  - Matt Jonkmann
  - Richard Bejtlich, Dr. Jose Nazario, Joel Ebrahimi, Marc Norton, Stuart Wilson
  - ...

Goals

- Bring new technologies to IDS
- Performance
  - Multi-threads
  - Hardware acceleration
  - `http://packetchaser.org/index.php/opensource/suricata-10gbps`
- Open source
- Support of Linux / *BSD / Mac OSX / Windows

Similar projects

Bro

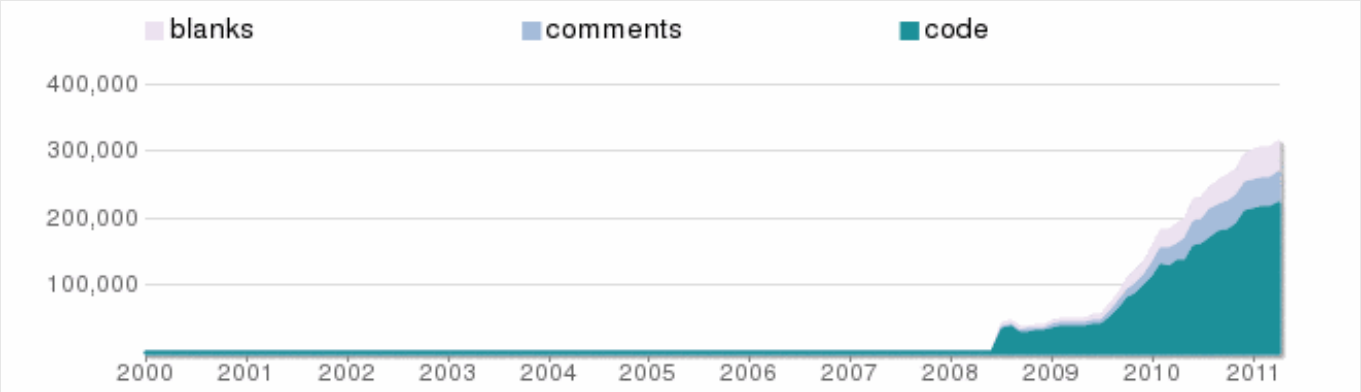
- Different technology (capture oriented)
- Statistical study

Snort

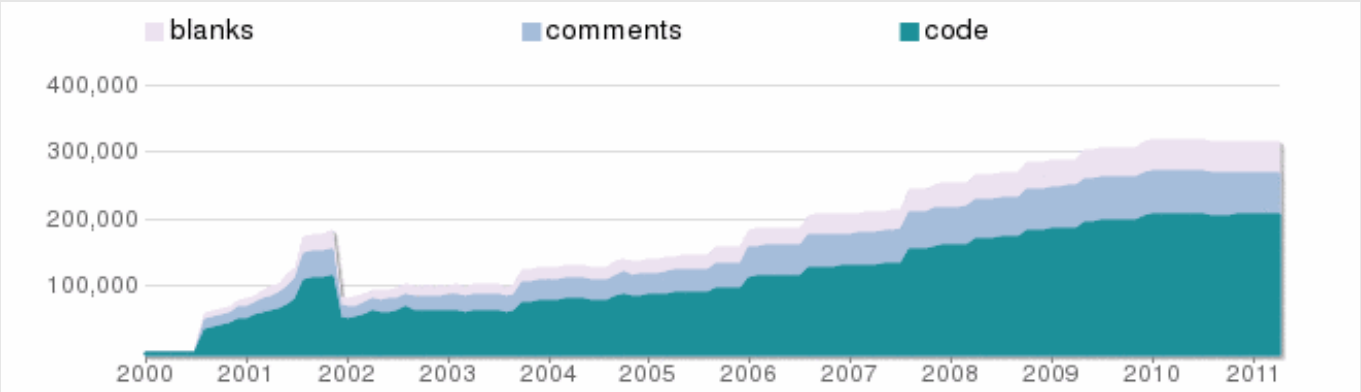
- Equivalent
- Compatible
- Frontal concurrence
- Sourcefire has felt endangered and has been aggressive
- `http://www.informationweek.com/news/software/enterprise_apps/226400079`

Volume of code

Suricata



Snort



Source: ohloh.net

Suricata vs Snort

Suricata

- Drived by a foundation
- Multi-threaded
- Native IPS
- Advanced functions (flowint, libHTP)
- PF_RING support, CUDA support
- Modern and modular code
- Young but dynamic

Snort

- Developed by Sourcefire
- Multi-process
- IPS support
- SO ruleset (advanced logic + perf but closed)
- No hardware acceleration
- Old code
- 10 years of experience

Independant study:

`http://www.aldeid.com/index.php/Suricata-vs-snort`

Fonctionnalities

- Ipv6 native support

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- Native hardware acceleratoin (GPU, PF_RING)
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- Optimized support of IP only tests
- IPS is native (inline mode)

Global architecture

- Chained treatment modules
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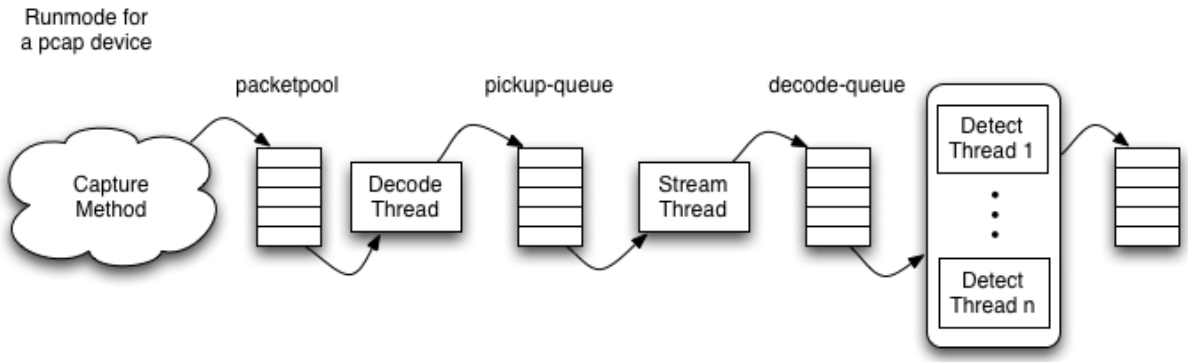
- Architecture of mode "pcap auto v1":



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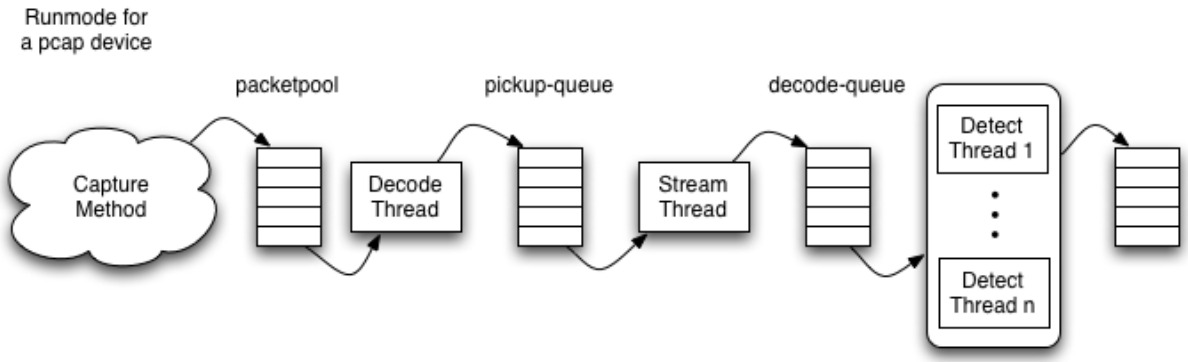

- Fine setting of CPU preferences
  - Attach a thread to a CPU
  - Attach a threads family to a CPU set
  - Allow IRQs based optimisation

Entry modules

IDS

- PCAP
  - live, multi interface
  - offline support
- PF_RING
  - `http://www.ntop.org/PF_RING.html`
  - Multithread, really fast but require modified drivers

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IPS

- NFQueue:
  - Linux: multi-queue, advanced support
  - Windows
- ipfw :
  - FreeBSD
  - NetBSD

Output modules

- Fastlog
- Unified log (Barnyard 1 & 2)
- HTTP log (log in apache-style format)
- Prelude (IDMEF)

Signatures

- Support almost all snort ruleset features
- Exclusive features used by VRT ou Emerging Threats rulesets

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alert tcp any any -> 192.168.1.0/24 21 (content: "USER root"; msg: "FTP root login";)

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Action: alert / drop / pass

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IP parameters

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Motif

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Other parameters

Stream inline

- High level applicative analysis works on a data stream
- TCP data can be messy
  - Packets loss
  - Packets retransmit
  - Out of order packets
- The $I_P^D S$ must reconstruct the TCP flow before doing the applicative analysis

Problem

- IDS must be the closer possible to what's received by the target
  - Packet analysis when reception has been proven
  - ACK reception trigger data analysis
- IPS must block the packets before they reached the target
  - The IDS algorithm will block packet *after* they go through
  - An other approach has to be used

IPS as a control point

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- Details: `http://www.inliniac.net/blog/2011/01/31/suricata-ips-improvements.html`

CUDA

- Offload some computation to GPU through CUDA which is a parallel computation library developed by NVIDIA
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CUDA

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- Now: implementation of a matching algorithm in CUDA
- Work in progress, Nvidia is a technological partner of OISF
- Difficult to use the GPU pipeline in an effective manner
- ... Performance equivalent with and without CUDA (for decent CPUs)

libHTP

- Security oriented HTTP parser
- Written by Ivan Ristić (ModSecurity, IronBee)
- Flow tracking
- Support of keywords
  - http_body
  - http_raw_uri
  - http_header
  - http_cookie
  - ...
- Able to decode gzip compressed flows

Using HTTP features in signature

Signature example: Chat facebook

```
alert http $HOME_NET any -> $EXTERNAL_NET $HTTP_PORTS \
(
 msg:"ET CHAT Facebook Chat (send message)"; \
 flow:established,to_server; content:"POST"; http_method; \
 content:"/ajax/chat/send.php"; http_uri; content:"facebook.com"; http_header; \
 classtype:policy-violation; reference:url,doc.emergingthreats.net/2010784; \
 reference:url,www.emergingthreats.net/cgi-bin/cvsweb.cgi/sigs/POLICY/POLICY_Facebook_Chat; \
 sid:2010784; rev:4; \
)
```

This signature tests:

- The HTTP method: *POST*
- The page: */ajax/chat/send.php*
- The domain: *facebook.com*

Flow variables

Objectives

- Detection of in-multiple-step attack
- Verify condition on a flow
- Modify alert treatment
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Flowint

- Define counter
- Arithmetic operation

Flowint variables

- Permit capture, keep and comparison of data in one variable
- keep and do mathematical operations
- Variable is bound to a given flow

Ex : show an alert if and only if *usernamecount* is greater than 5:

```
alert tcp any any -> any any (msg:"Counting Usernames"; content:"jonkman"; \
flowint: usernamecount, +, 1; flowint:usernamecount, >, 5;)
```

Flowint variables (2)

Ex: Follow logins
Put a login failure counter:

```
alert tcp any any -> any any (msg:"Start a login count"; content:"login failed"; \
flowint:loginfail, notset; flowint:loginfail, =, 1; flowint:noalert;)
alert tcp any any -> any any (msg:"Counting Logins"; content:"login failed"; \
flowint:loginfail, isset; flowint:loginfail, +, 1; flowint:noalert;)
```

Alert if there is a success after 5 failed login:

```
alert tcp any any -> any any (msg:"Login success after file failures"; \
                content:"login successful"; \
flowint:loginfailed, isset; flowint:loginfailed, =, 5;)
```

Suricata in IPS mode

Using a Linux/Netfilter based IPS

- Use NFQUEUE to send decision to userspace
- All packets of a connexion must be seen to Suricata
- The brutal way: iptables -A FORWARD -j NFQUEUE

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Interaction with the firewall

- NFQUEUE is a terminal target
  - An ACCEPT decision will shortcut the whole ruleset
  - This is the only possible decision but DROP
- The previous method is thus incompatible with the existence of a ruleset.

Living together: the IPS and the firewall case

Classic solution

Use mangle in the PREROUTING or FORWARD chains

- The rule is an isolated table
- Thus no interaction with the rest of the ruleset
- This mean we can do "nothing" in theses mangle chains

Details: `http://home.regit.org/2011/01/building-a-suricata-compliant-ruleset/`

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Alternative solution

- Use advanced functionalities of NFQUEUE
- Simulate a non terminal decision (© Patrick Mchardy)

Details: `http://home.regit.org/2011/01/building-a-suricata-compliant-ruleset/`

Alternate decision and packet marking

Alternate decisions

- NF_REPEAT : send the packet back to the start of the table
- NF_QUEUE : send the packet to another queue (chain software using NFQUEUE)

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nfq_set_mark

- New keyword that can be used in signature
- Put a Netfilter mark on the packet if the signature match
- Can be used in every network stack (QoS, routing, Netfilter)

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Logging of a suspect connexion (1/2)

Objective

- Detect a suspect behaviour
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- Detect a suspect behaviour
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Method

- The alert put a Netfilter mark on the packet
- Netfilter propagate the mark to all packets of the related connexion
- Netfilter log every marked packets

Logging of a suspect connexion (2/2)

The alert in Suricata

```
pass tcp any any -> any any (msg:"We were expecting you"; content:"Mr Bond"; \
nfq_set_mark:0x007/0xfff;)
```

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```

Netfilter settings

```
iptables -I PREROUTING -t mangle -j CONNMARK --restore-mark
iptables -A POSTROUTING -t mangle -j CONNMARK --save-mark
iptables -A POSTROUTING -t mangle -m mark --mark 0x007/0xfff -j NFLOG --nflog-prefix "Dr No log"
```

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```

Next you can have ulogd2 to send everything in pcap ou SQL

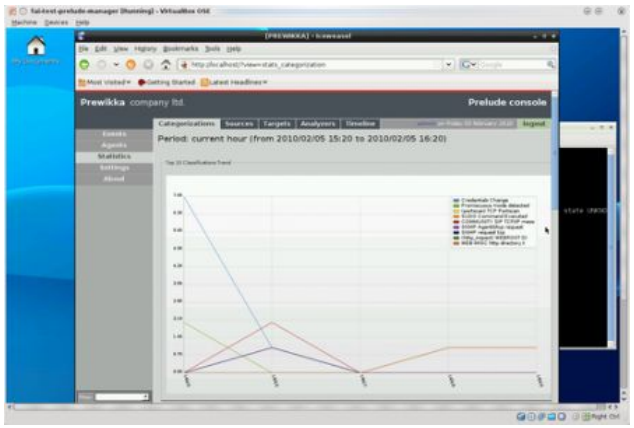
Roadmap

- Finalize CUDA acceleration
- IP and DNS reputation
- Extract files and inspect their content
- SCADA Preprocessor (thanks to Digital Bond)
- Keyword *replace*
- Keyword *geoip*
- Reload ruleset without breaking the flow analysis
- Stateful Pattern Matching/Transaction-Aware Detections

Details: `http://www.openinfosecfoundation.org/index.php/component/content/article/1-latest-news/116-oisf-state-of-the-project-report-phase-two`

How to test it fast and easy?

- Already available in Debian, Ubuntu, Gentoo, Freebsd
- Live distribution:
  - SIEM live (Suricata + Prelude + Openvas) : `https://www.wzdftpd.net/redmine/projects/siem-live/wiki`



  - Smooth-Sec (Suricata + Snorby) : `http://bailey.st/blog/smooth-sec/`

Questions

Do you have questions ?

- Big thanks:
  - Pierre Chifflier : `http://www.wzdftpd.net/blog/`
  - The whole OISF team and especially Victor Julien
- Related read:
  - OISF website: `http://www.openinfosecfoundation.org/`
  - Suricata devel site: `https://redmine.openinfosecfoundation.org/`
  - Victor Julien's blog: `http://www.inliniac.net/blog/`
  - Regit's blog: `http://home.regit.org`
- Join me:
  - Mail: `eric@regit.org`
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