Picviz
finding a needle in a haystack

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INL

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The Honeynet
PROJECT

Speaker: Sebastien Tricaud

- I Live and work in Paris (FR)
- Happy Linux user since 1995
- I work for INL as CRO:
  - The company (www.inl.fr), not the lab (www.inl.gov)
  - We work on Netfilter
  - We develop NuFW (GPL) and differenciate users from IP addresses
  - You define what each group is allowed to access, and NuFW enforces it at the network layer
  - We know which packets a given user sent
- Lead the French Honeynet project
- Developer of Linux PAM, Prelude IDS, OSSEC, Wolfotrack and Picviz

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What are logs?

Syslogs

Nov 6 13:12:04 quine avahi-daemon[2285]: Interface eth0.IPv4 no longer relevant for mDNS.
Nov 6 13:12:06 quine ifplugd(eth0)[1811]: Program executed successfully.
Nov 6 13:12:06 quine kernel: ADDRCONF(NETDEV_UP): eth0: link is not ready
Nov 6 13:12:24 quine kernel: Unhandled event received : 0x50

Database

sql> SELECT * FROM logdb WHERE user = "ptc";

Network

08:50:01.522077 arp who-has 10.0.0.254 tell 10.0.0.1 08:50:01.522115 arp reply 10.0.0.254 is-at 00:69:de:ad:be:ef 08:50:01.522210 IP 192.168.0.1.5860 > 172.16.17.235.33373: UDP, length 25 08:50:01.522377 IP 192.168.0.1.5860 > 10.30.254.247.18946: UDP, length 25

Others

stderr, binary/text file, . . .

What (normal) people do with them?

They grep

grep -i "segmentation fault" /var/log/*

They watch

tail -f /var/log/messages

They use tools

OSSEC[a], Prelude LML[b], Sisyphus[c] ...

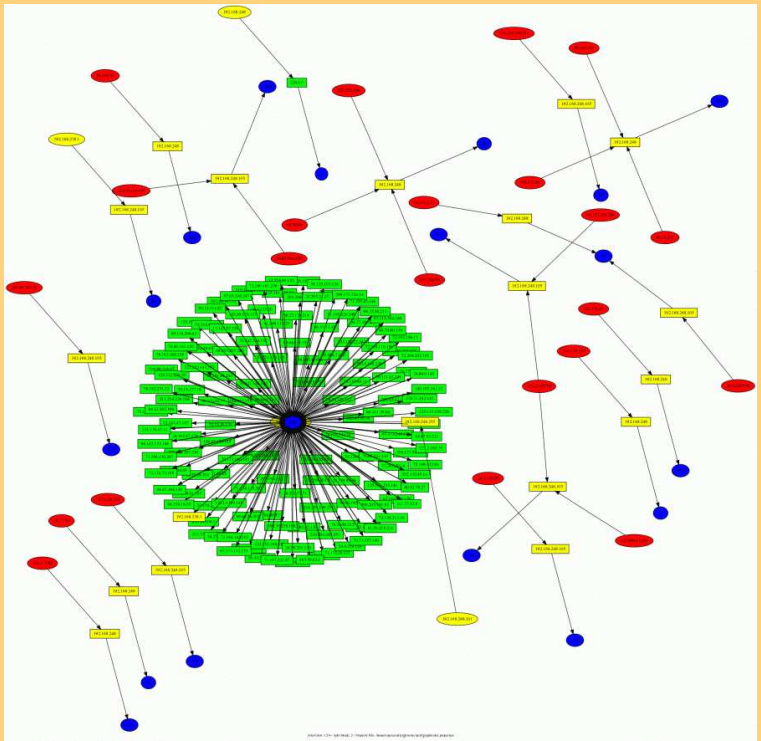
[a] http://www.ossec.net
[b] http://www.prelude-ids.org
[c] http://www.cs.sandia.gov/ jrstear/sisyphus/

They even correlate!

http://security.ncsa.uiuc.edu/research/mithril/Mithril.html

What (normal) people do with them?

They visualize



They even do communities!

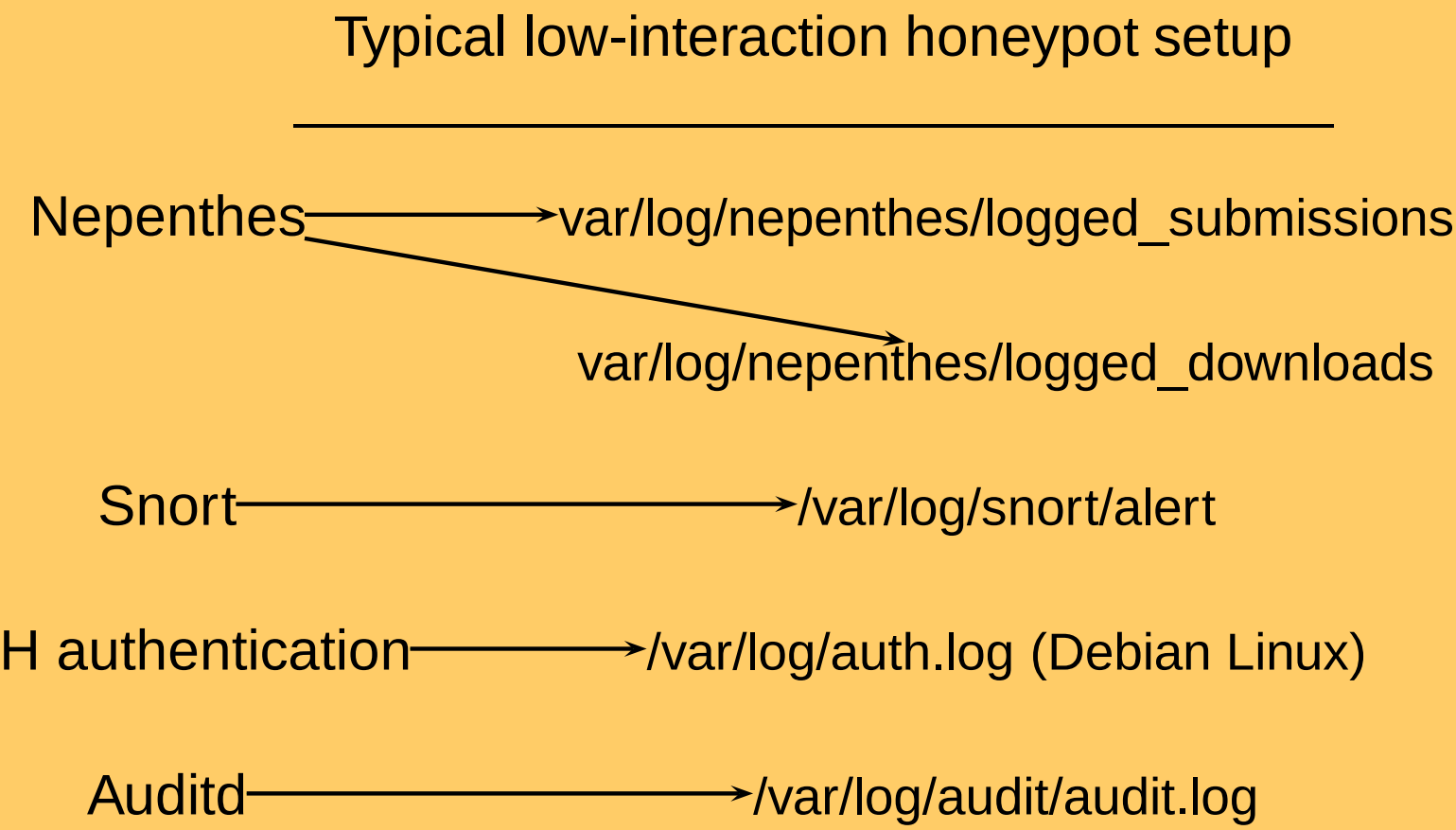
http://www.secviz.org

Actual issue[1]

- A lot of information
- Syslogs are unstructured
- Human interaction needed **after** the problem
- When automated, needs signatures (usually pcre based)
- Overwhelming a single machine

[1] yeah, it is not fixed yet, wait for WASL2009

Picviz and Honeynet



$\Rightarrow$ 220574 lines of logs in total

- This is a log overdose
- Most people are happy just to extract known patterns
- The French honeynet chapter is full of busy (lazy?) people
- Keep the fun where it is, avoid log file slavery

Picviz

Deal with logs a better way. Use Picviz, that:

- Creates a picture of your logs
- Does not interpret anything, just displays logs as they are
- Is not signatures based
- Can deal with an infinity of events

Picviz

Moto

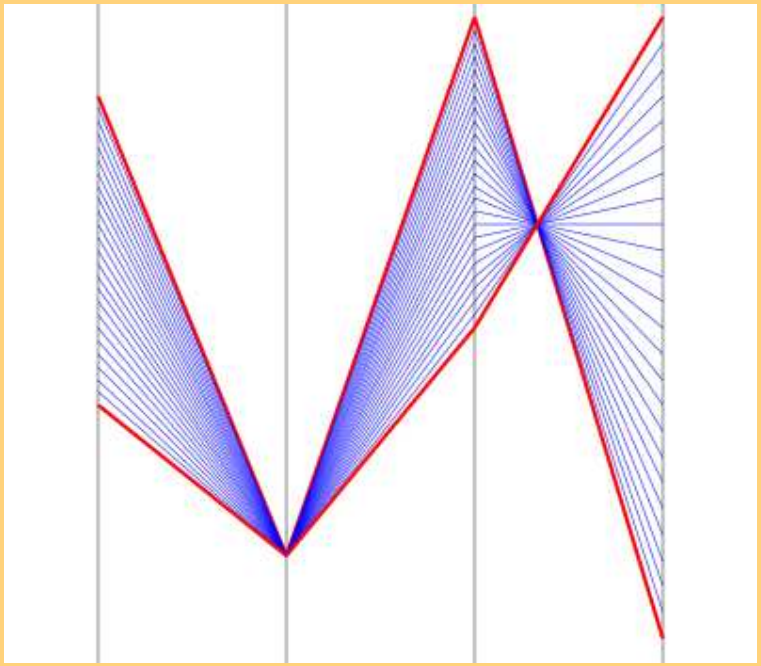
"Finding a needle in a haystack...
when you don’t even know how the needle looks like"

Picviz

Moto

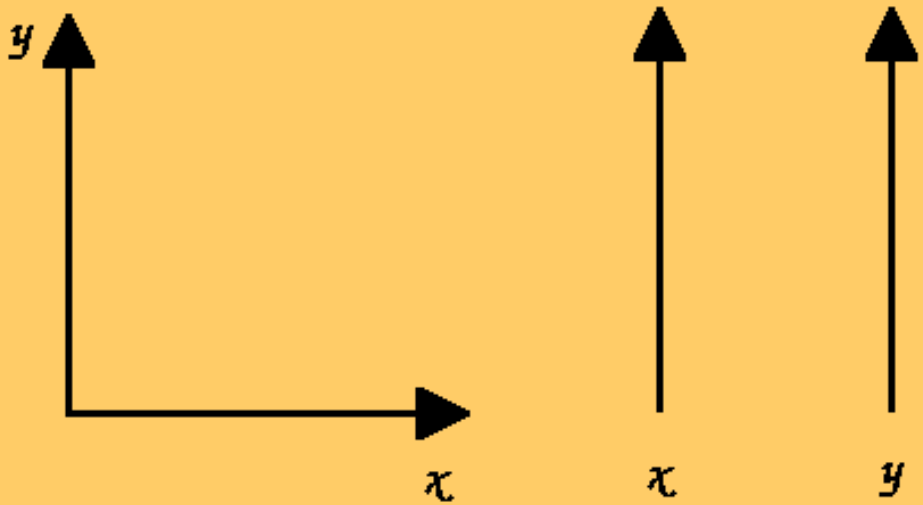
"Finding a needle in a haystack...
when you don’t even know how the needle looks like"

To generate pictures like this



1. Introduction
2. Parallel Coordinates
3. Picviz
4. Analysis

||-coords are

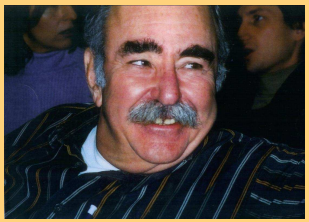


Inventors

Invented by Maurice d'Ocagne in 1885

ISBN 978-1429700979

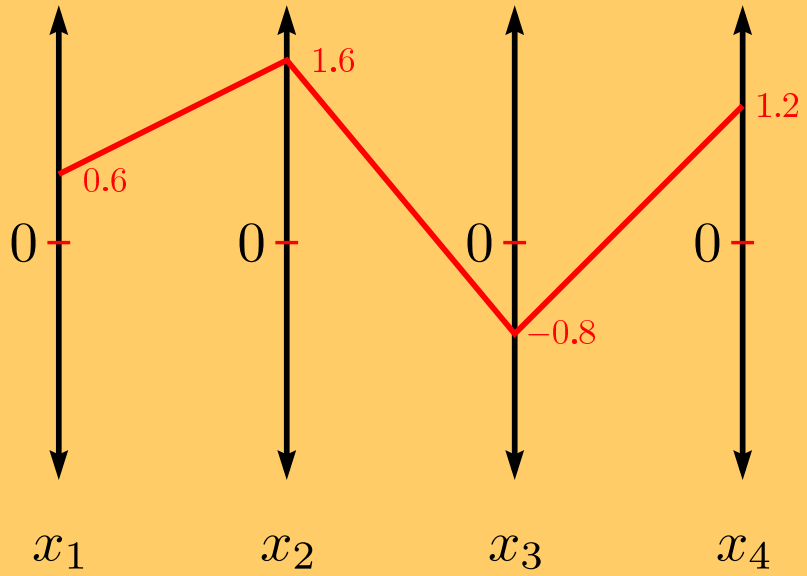
Applied by Alfred Inselberg in 1959



- Senior Fellow San Diego Supercomputing Center and Computer Science and Applied Mathematics Departments Tel Aviv University, Israel
- Conflict Resolution, One-Shot Problem and Air Traffic Control, 1st Canadian Conf. on Comp. Geom., 1989, 26-9

||-coords

$$\vec{u} = (0.6, 1.6, -0.8, 1.2) \in \mathbb{R}^4$$

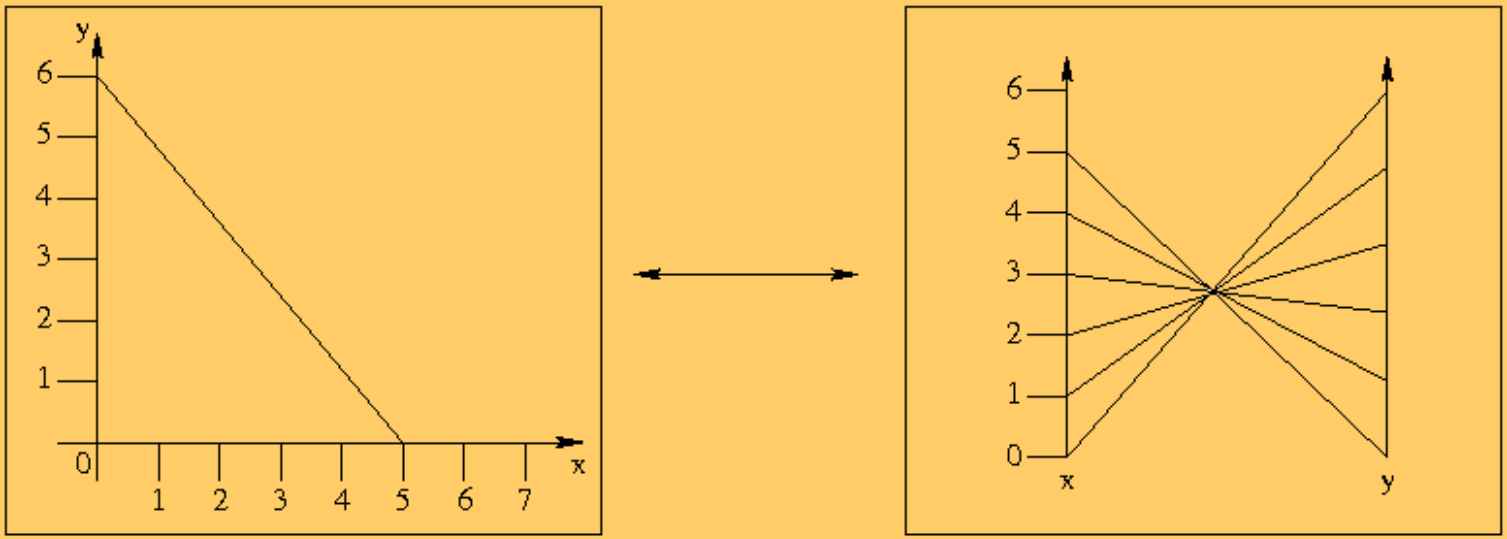


Properties

- N-dimensions: one axis per dimension
- Axes are equidistants
- ∞ of events: one line per event
- Lowest value at each axis bottom

||-coords correlation

x and y are linked by an affine relationship $y = \alpha x + \beta$



Cartesian coordinate system

Parallel plot coordinate system

Todays objectives

Apply ||-coords to logs:

- Focus on security
- See if by doing this we succeed in finding things

1 Introduction

2 Parallel Coordinates

3 Picviz

4 Analysis

Picviz goals

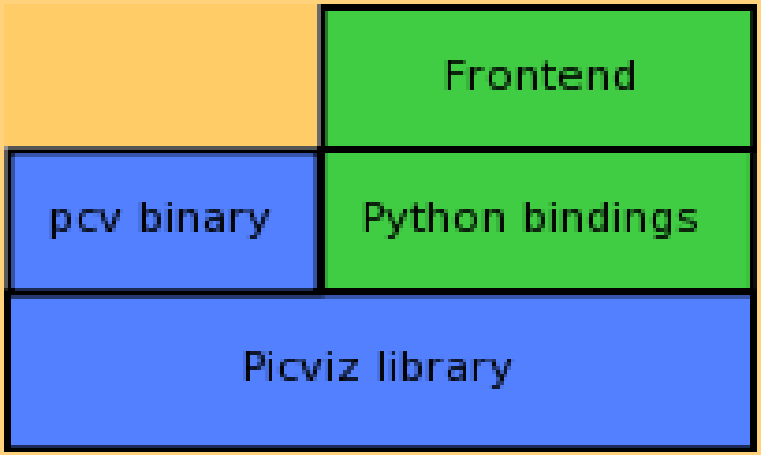
- Help to generate ||-coords images
- Scalable architecture (filters, real-time, . . .)
- Provide an interface to query lines and reorganize axes
- Mainly security oriented

Picviz world

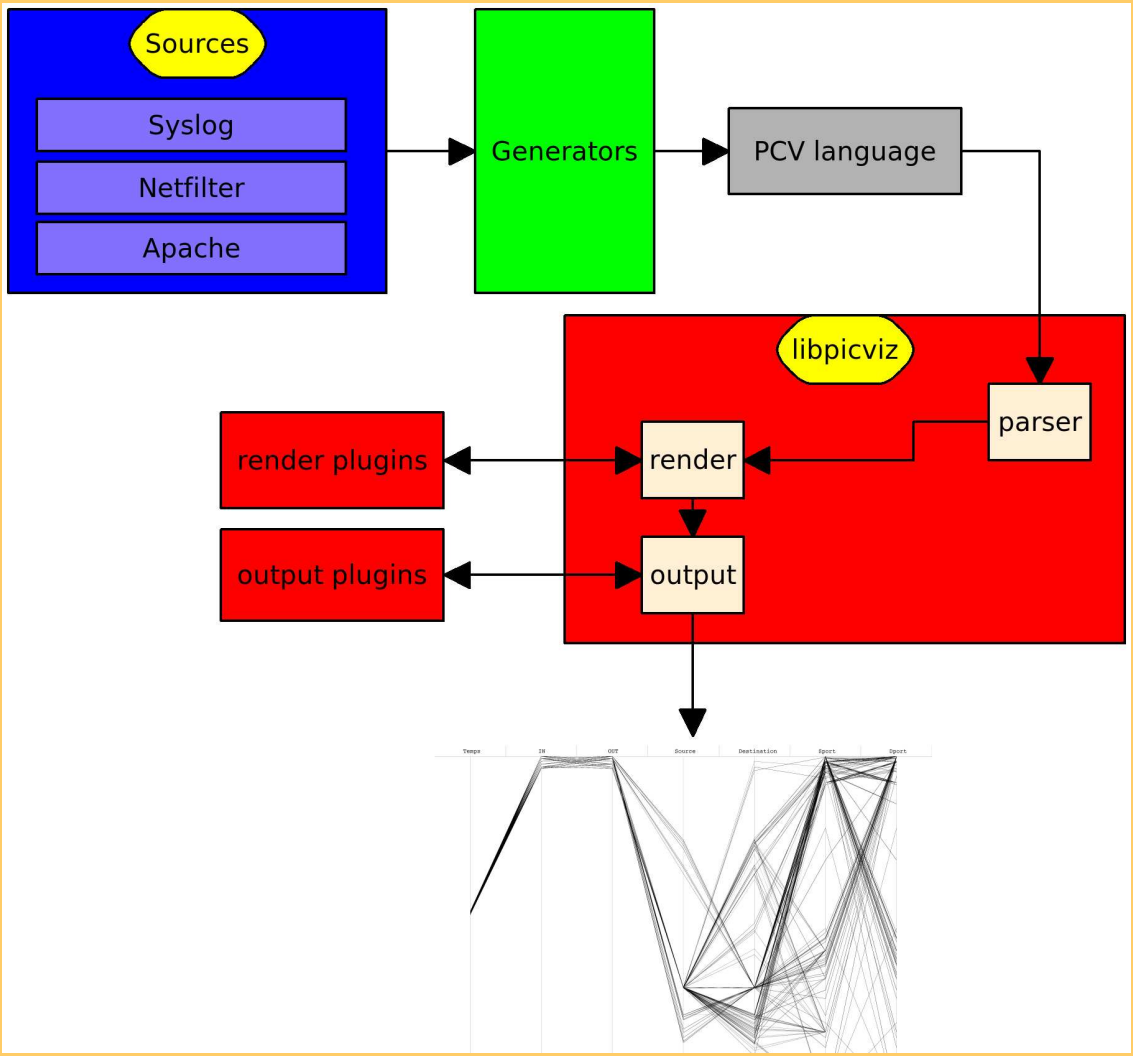
Three main parts

- **Perl scripts**: Transforms your logs into Picviz graph description language (PGDL)
- **pcv**: CLI to transforme PGDL into an image
- **picviz-gui**: Frontend

Code architecture



Global architecture



Use

PGDL source

```
header { title = "Usenix WASL 2008"; }
axes {
    timeline t;
    integer  in;
}
data {
   t="14:42", in="12" [color="red"];
   t="14:45", in="432";
}
```

Genererate the image

```
pcv -Tpngcairo file.pcv 'filter' > out.png
```

Axes

Types

- Time: timeline, years
- Numbers: integer, short, gold, char
- Addresses: ipv4, ipv6
- Strings: string
- Specials: enum, ln

Properties

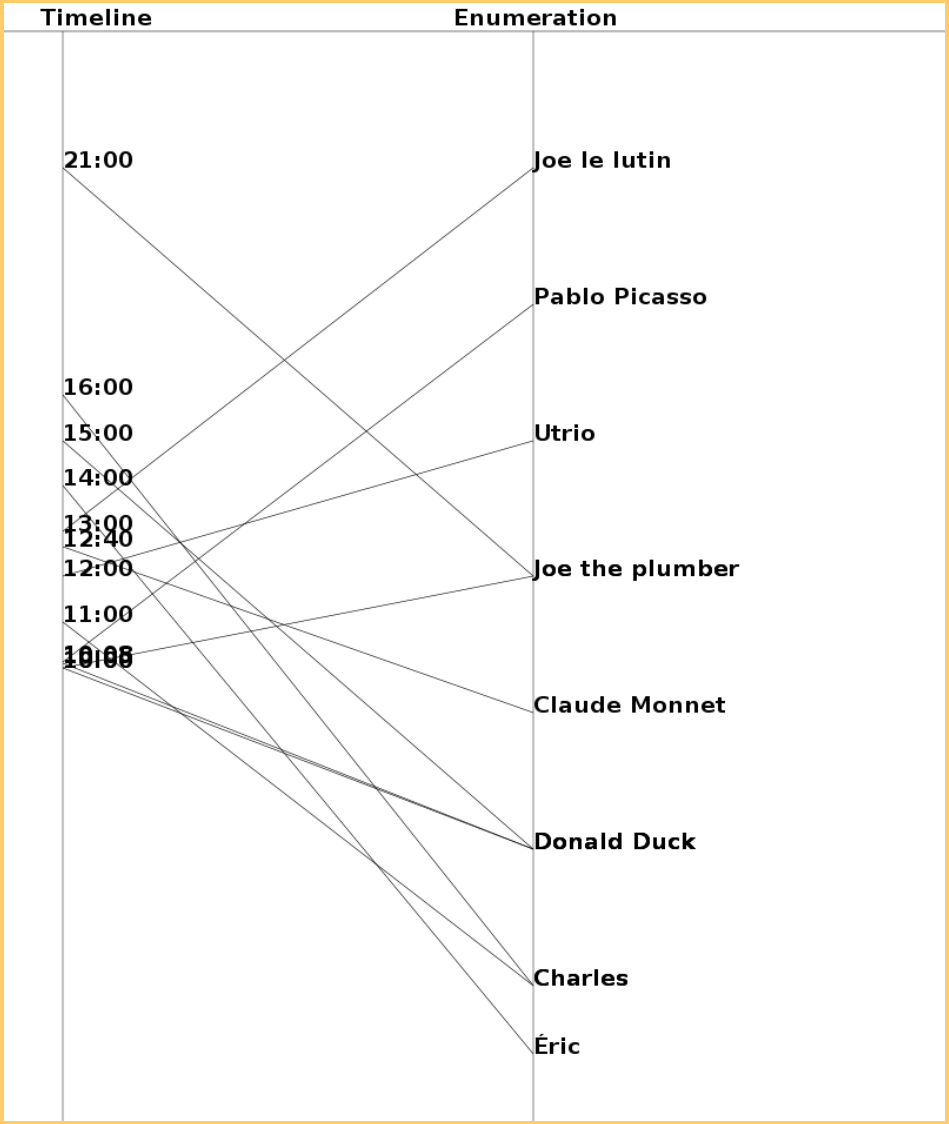
- relative: to place data relatively to each other
- print: to turn off data value printing
- label: display this name

Strings

- The hardest variable to place
- Two algorithms can be chosen:
  - Basic: Ascii value addition and place the string compared to a famous quote[2]
  - Prefix: strings are placed collision-safe with their first 4/8 characters (prefix size is architecture dependent)

[2] The competent programmer is fully aware of the limited size of his own skull. He therefore approaches his task with full humility, and avoids clever tricks like the plague.

Enumerations



Lines

Properties

- color: line color
  - red
  - #ff0000
  - (1,0,0)
- penwidth: line width

Why a custom format? why not CSV?

- Flipping the axis order is as simple as moving the axis declaration order
- Line properties are aready computed by generators
- Actually CSV can be used as input, it is simply converted into PGDL

Some CLI options

- **-r..r**: Increase the image height and width
- **-a**: Display lines values
- **-Ln**: Display value every n lines
- **-Tplugin**: Output plugin
- **-Rplugin**: Rendering plugin
- **-Astuff**: Plugins argument

Filter

- Plot filtering: show plot > 250 on axis 2
- Plot percentage filtering: show plot > 50% on axis 2
- String filtering: hide value = ".*[fF]oo.*" on axis 1

Eg.: Display only lines going < 10% on the axis 2 and carrying the value "denied" on the axis 4

pcv -Tpngcairo fichierlog.pcv 'show plot < 10% on axis 2 and value = "denied" on axis 4' >filtered.png

Frequency analysis

- The more an event appears, the higher the frequency is
- Break lines color to do a gradient
- from green (low) to red (high) via yellow (medium)
- Two modes:
  - Axes pair (standard)
  - Infection (virus)

Create an image with the virus frequency analysis mode

```
pcv -Tpngcairo -Rheatline -Avirus file.pcv > out.png
```

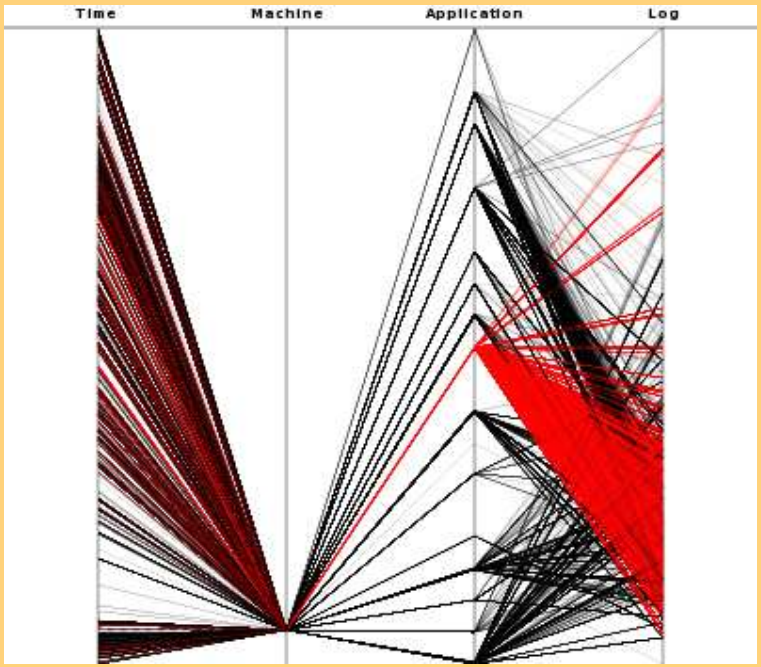
Let's see my syslog in ||-coords

We run

```
syslog2picviz.pl /var/log/syslog* > syslog.pcv
pcv -Tpngcairo syslog.pcv > syslog.png
```

We have

red = kernel logs



Real-time

Start Picviz with a socket to listen at and a template to use

pcv -Tpngcairo -s local.sock -t samples/test1.pcv -o out.png ”

Client

echo "t=’12:00’, i=’100’, s=’Hello, World!’;" > local.sock

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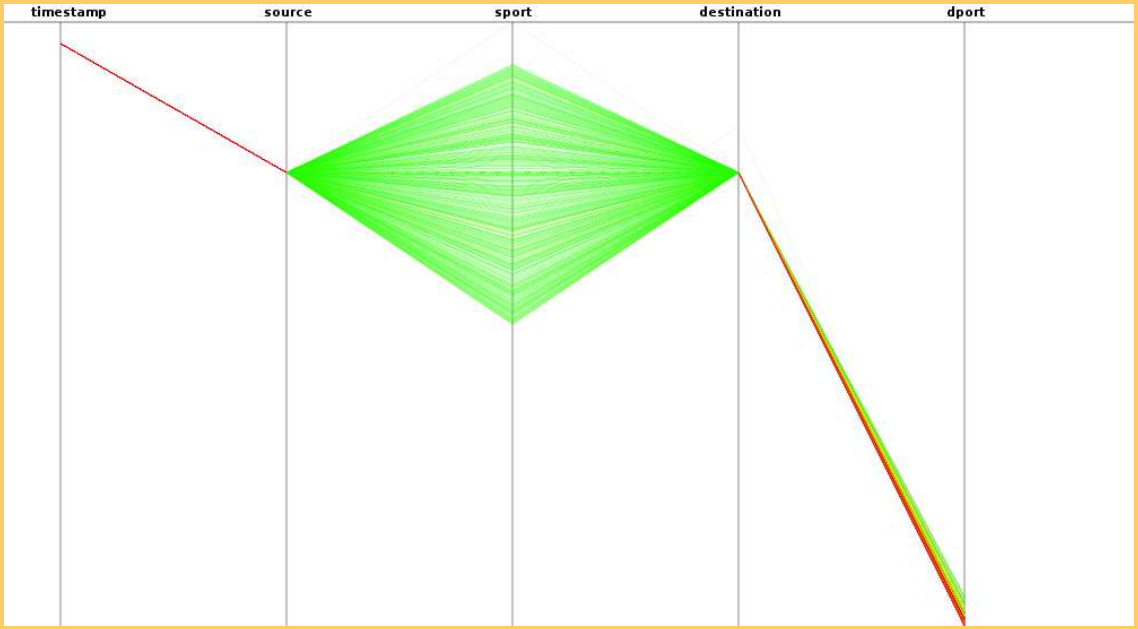
Nmap

Command line

pcv -Tpngcairo nmap-scan.pcv -Rheatline -r >nmap.png

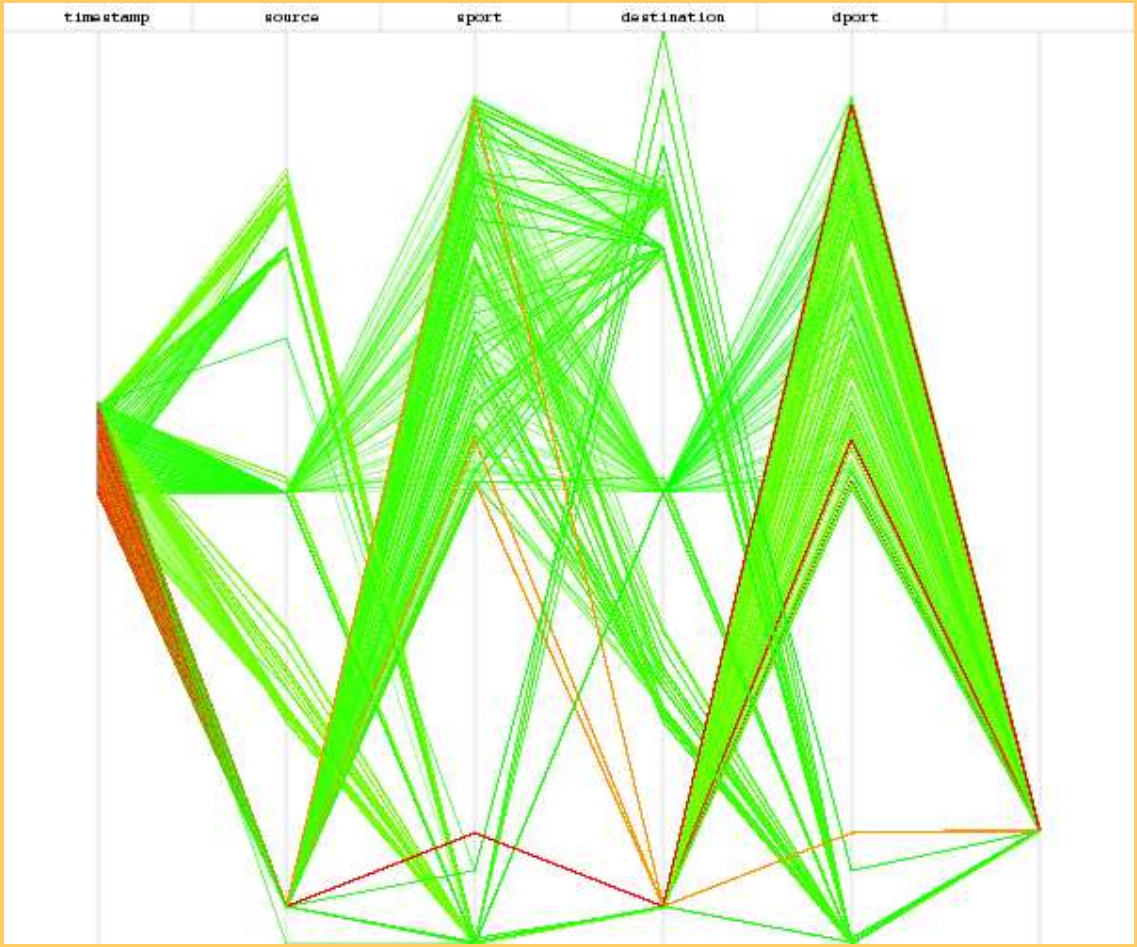
Nmap: only lowest ports



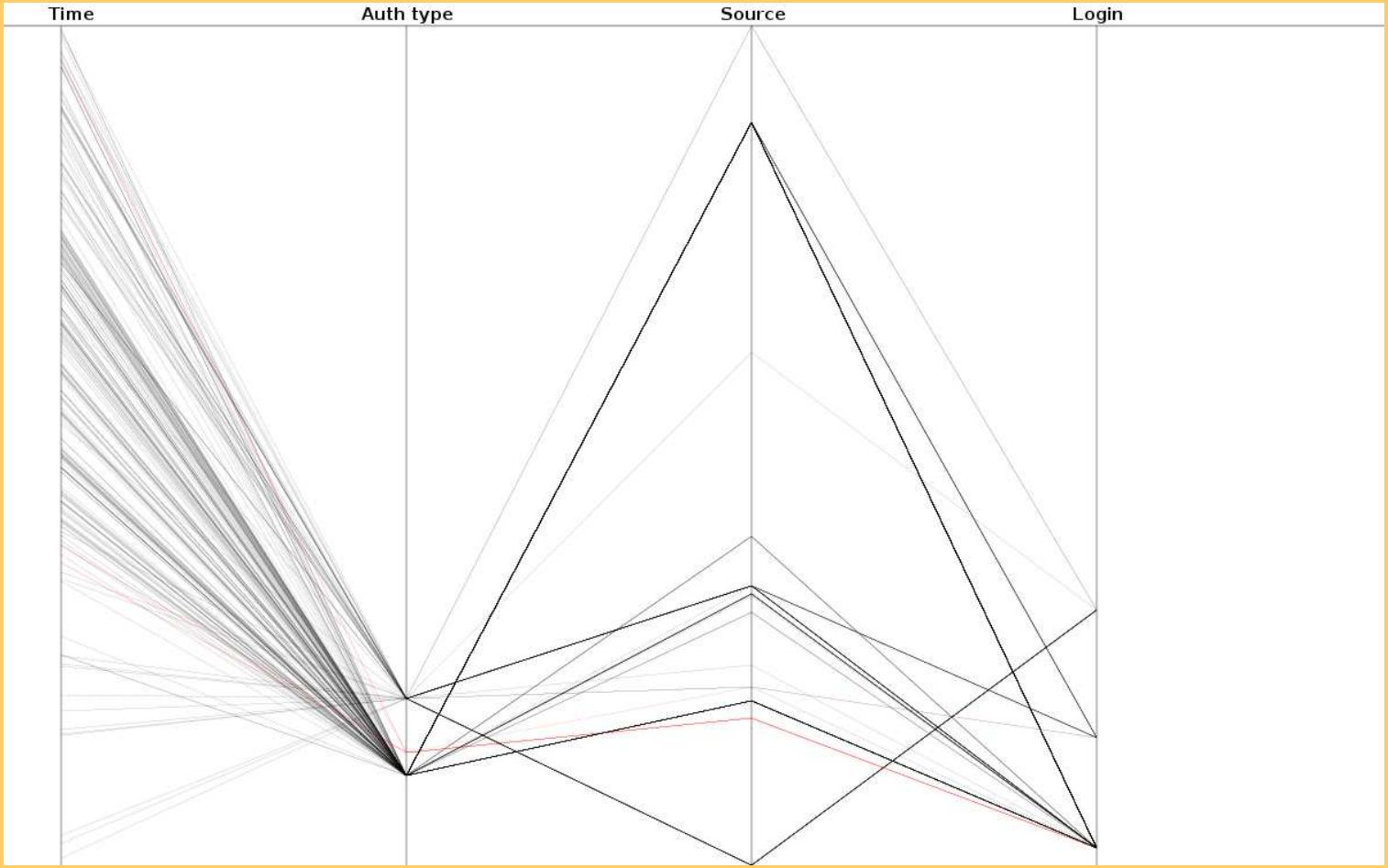
Commnd line

pcv -Tpngcairo nmap-scan.pcv -Rheatline -r 'show plot < 5% on axis 5' >nmap2.png

OpenVPN Traffic



SSH authentication



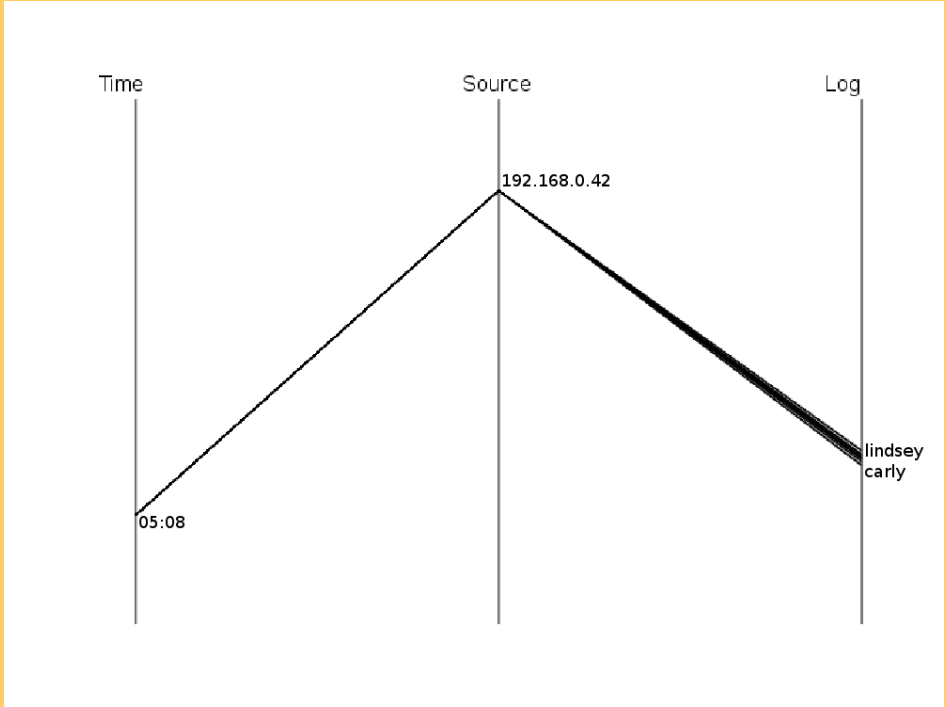
Detect a weird behavior

It is sometime simple to automate a behavior we don't want that ||-coord helped to see.

- Based on SSH authentication log, We alert the administrator if:
  - Many different IP log on the same account
  - If a user authenticated in different maners
  - A login IP address matches the Dshield database[3]
- http://www.wallinfire.net/files/artcore.pl

[3] http://www.dshield.org

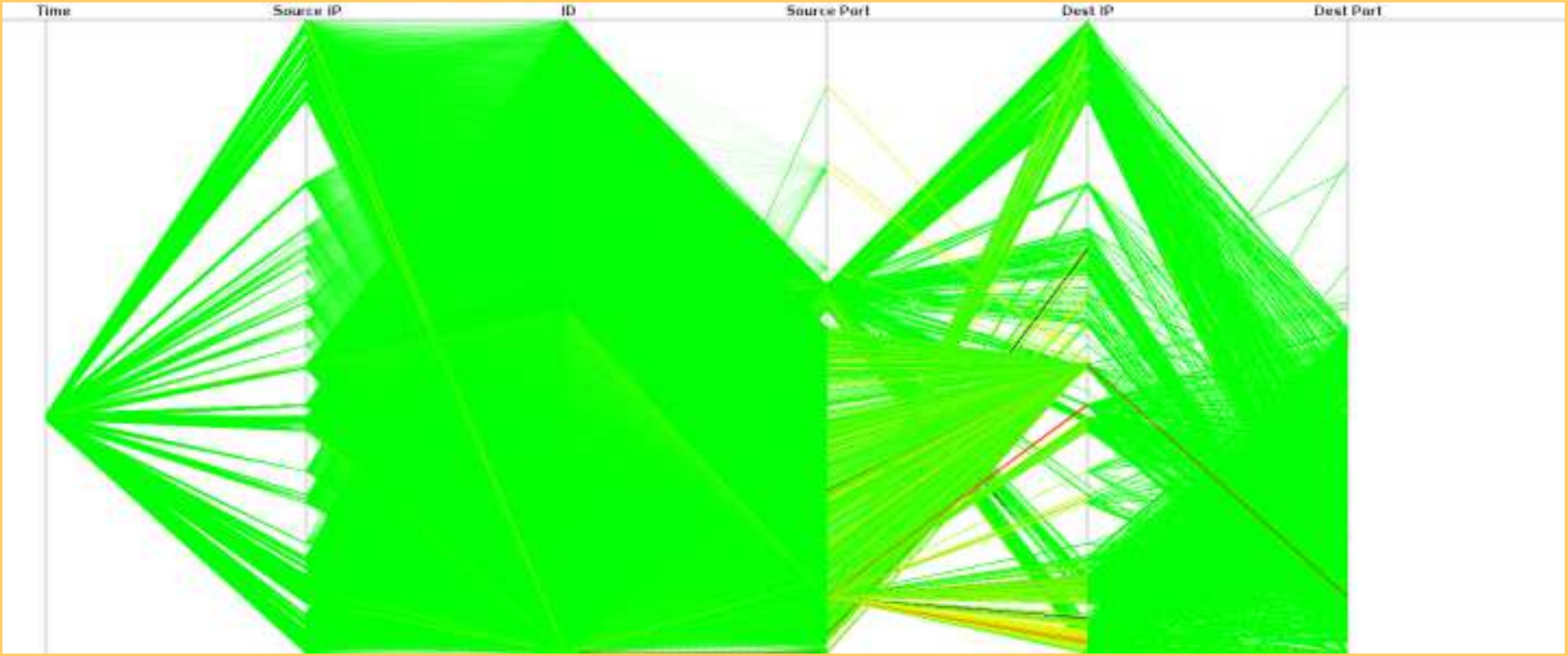
SSH scan



PGDL source

time="05:08", source="192.168.0.42", log="Failed keyboard-interactive/pam for invalid user lindsey";
time="05:08", source="192.168.0.42", log="Failed keyboard-interactive/pam for invalid user ashlyn";
...

Botnet



Analysis objectives

On my webserveur, Apache access.log has 412429 lines:

1. How to easily understand those logs?
2. How to detect attacks?

Create the picture

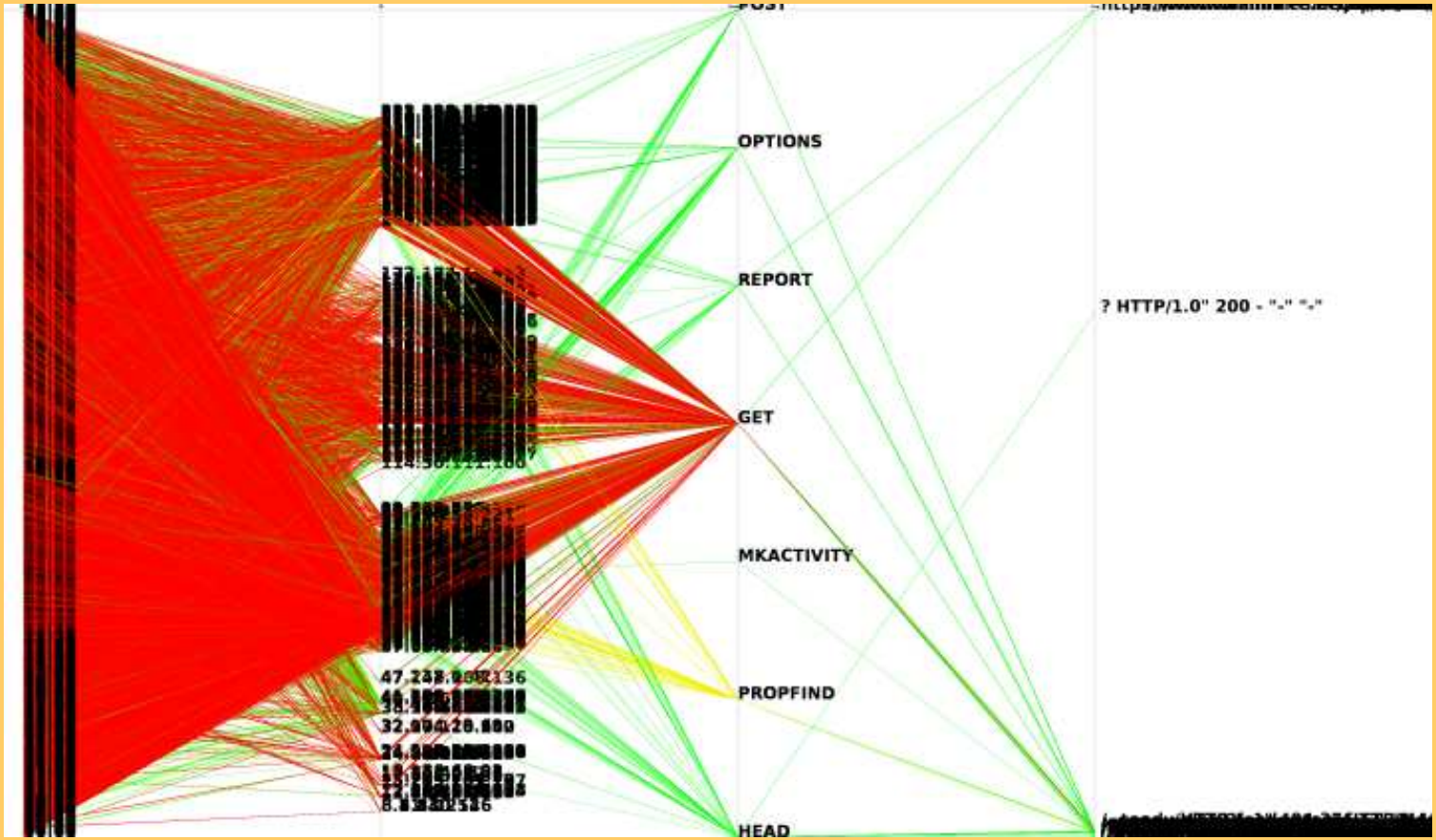
Generate the PGDL

perl apache-access2picviz /var/log/apache2/access.wallinfire.net.log >access-wallinfire.net.pcv

Generate an image with frequencies, high resolution + text

pcv -Tpngcairo -Rheatline -Avirus -rrrrrrrra access-wallinfire.net.pcv >access.png

Result

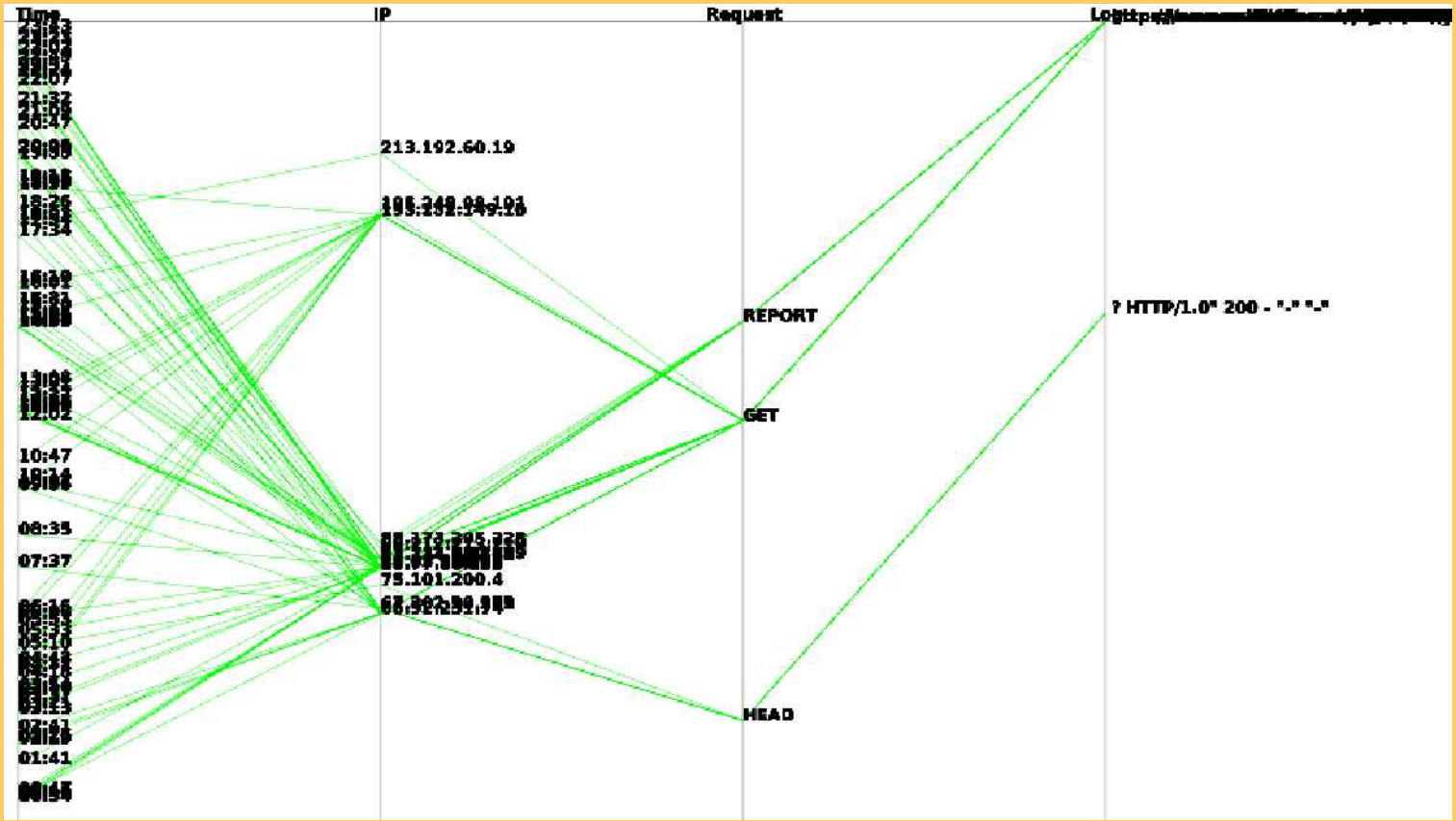


Filter weird urls

Generate an image with frequences, high resolution, text + filter

pcv -Tpngcairo -Rheatline -Avirus -rrrrrrrra 'show plot > 50% on axis 4' access-wallinfire.net.pcv >urls-abnormals.png

Result


Time
IP
Request
Logtype
213.192.60.19
REPORT
GET
HEAD
? HTTP/1.0" 200 - "-" "-"
75.101.200.4
10:47
08:35
07:37
01:41

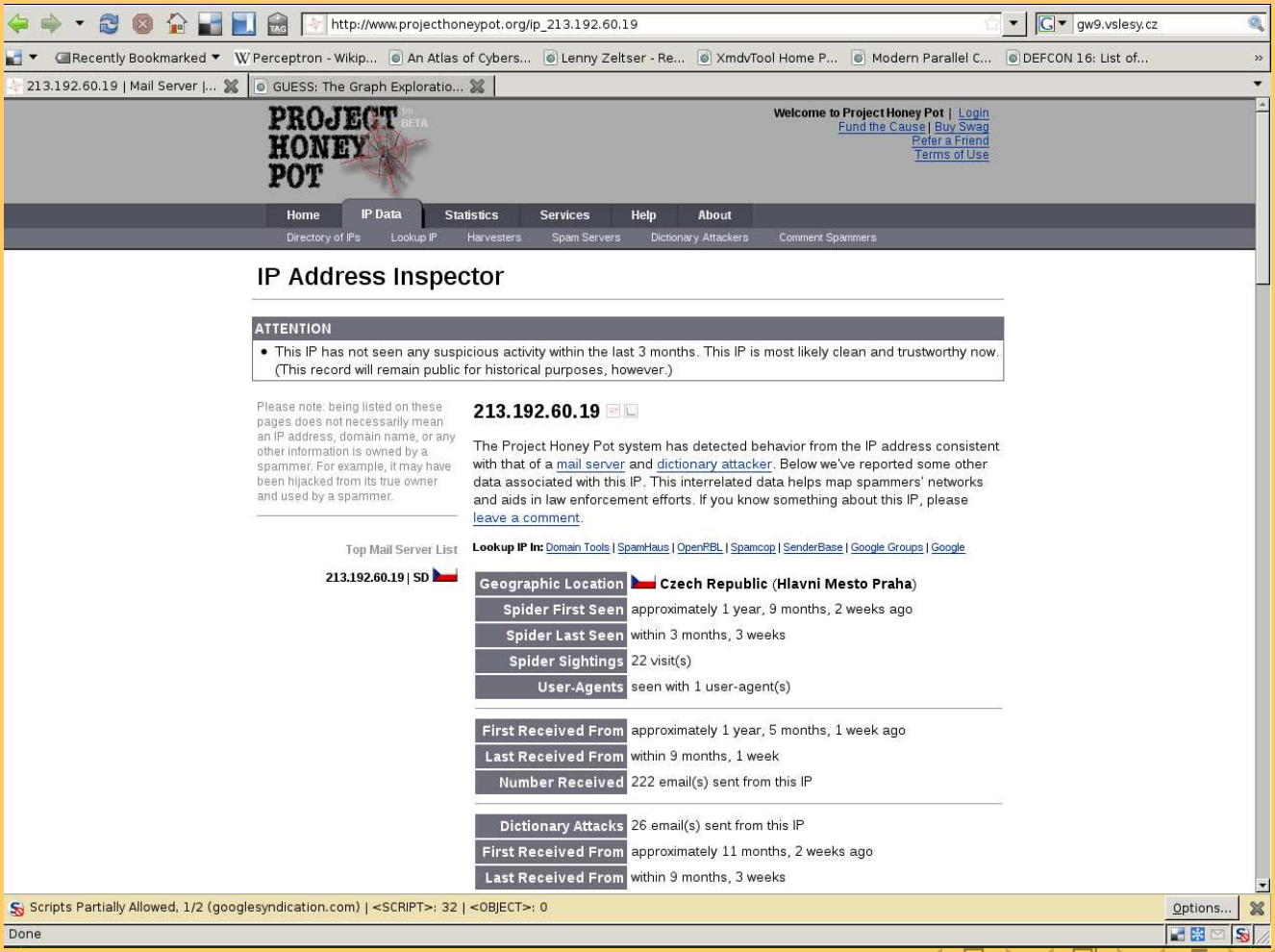
Every IP is suspicious

We take to easy to read IP: 213.192.60.19

```
$ host 213.192.60.19
19.60.192.213.in-addr.arpa domain name pointer gw9.vslesy.cz.
```

Who is it?

- We search on http://www.dshield.org: nothing
- We search on Google: ***tada***



Roadmap

- 0.5 version going to be released very soon
- Windows port, anyone?
- Add more frequencies types
- Share the work among several machines
- More work is needed on the frontend
- Divider type, to split a string into several axes and put more than an axis per variable

Questions?

- Email: stricaud@inl.fr
- Blog: http://www.gscore.org/blog
- Get the sources: svn co http://www.wallinfire.net/svn-picviz