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NETASQ and BSD: a success story

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Overview

- Whois netasq.com && finger vanhu
- NETASQ's history (very quickly)
- NETASQ products technical overview
  - What do we provide ?
  - What are R&D constraints ?
- Building/maintaining an appliance firmware HowTo
- Working with Opensource software / OS
  - Using OpenSource ?
  - Why do we contribute ? What ? How ?
  - Social engineering: working with Opensource community

vanhu@darkstar ~$ whois netasq.com

[Verisign terms of use, etc.....]

- ~~Firewalls~~ ~~IPS~~ UTM appliances manufacturer
- HQ based near Lille, in France
- Software (“firmware”) developped by R&D
- Hardware design
  - Externalized production
- About 12 M€ in 2006
- Most of the sales done in EU

vanhu@darkstar ~$ finger vanhu

Login: vanhu Name: VANHULLEBUS Yvan
Directory: /home/vanhu Shell: /bin/bash

- NETASQ R&D
  - VPN project manager
  - Perl / Shell guru for NETASQ :-)
  - LDAP, UNIX, kernel, etc....
- IPSec-tools maintainer
  - NetBSD developer
- FreeBSD contributor (IPSec stack, etc...)
- Google: vanhu+CV+feeling lucky...

NETASQ's history

(very quickly)

1998: Netasq is born !

- Employees: ~5
  - R&D: 2
- First product: F10
  - 3x10 Mbs RJ45+BNC
  - 32Mb RAM
  - FreeBSD 2.2.7
  - Firmware V1.0
  - Stateless packet filtering (using ipf)
  - GUI

NETASQ today (~ 10 years later)

- Still alive !
- Employees: ~ 60
  - R&D: ~ 20
- Appliances for all (SOHO -> huge networks)
  - Same security level for all
- Firmware v7.0
  - FreeBSD 4.11
    - FreeBSD 6.x for the next major release in 2008
  - Lots of features
- ~ 15 000 units sold in 2006
  - Available in +30 countries

NETASQ products today

Appliances for all

2006
U.T.M. Appliance
F200 1st

Security Product of the year

2005
U.T.M. Appliance
F800 1st

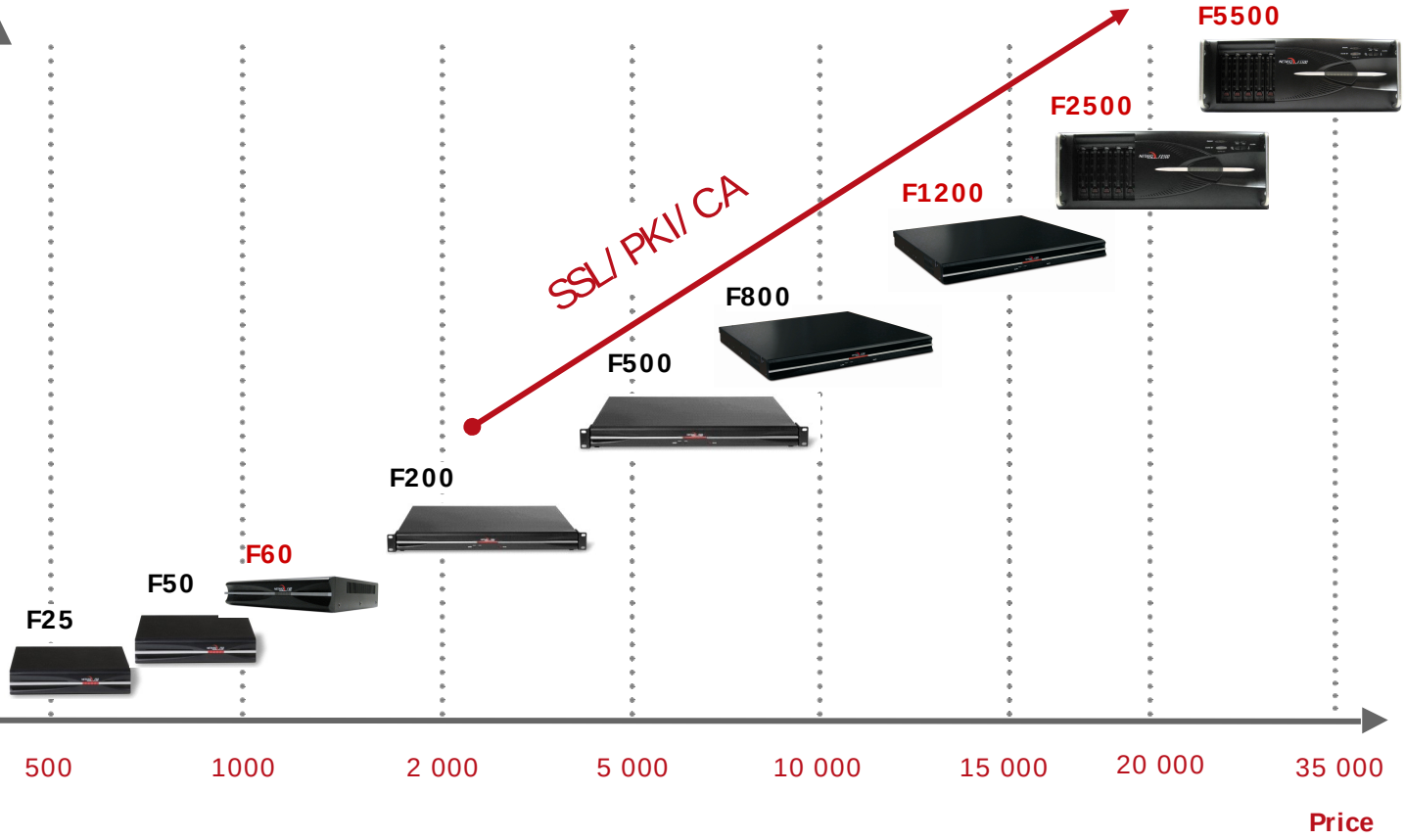
Security Product of the year

TOLLY Up to Spec CERTIFIED

common criteria EAL2+ CERTIFIED

TESTED with SPIRENT

High level security from the SMB to the largest Enterprise



F25 hardware

- ~ 500Mhz CPU
- 2 x 100Mbs ethernet
- 128Mb RAM
  - 64 Mb two years ago
- 128Mb flash
  - Also 64 Mb two years ago
  - Not so much disk space....
  - Quite slow
  - Must limit write access to flash !

F5500 hardware

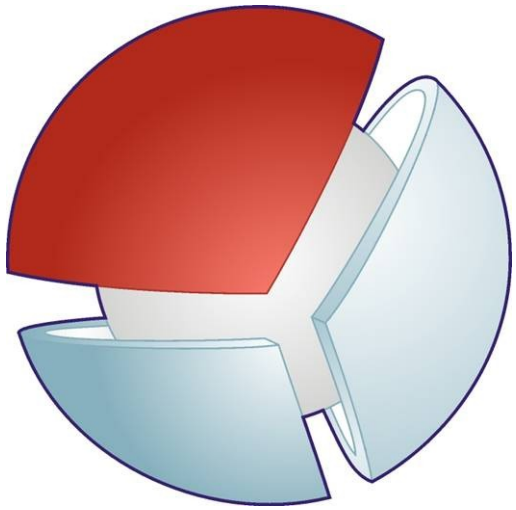
- 2 x ~3.5Ghz CPU
- 1Gb RAM
- 140Gb RAID1 SCSI (hotplug)
- Up to 24 Gigabit Ethernet interfaces
- ~ 35Kg :-)

NETASQ Offers *Unified Security*

Risk Management

Antivirus

IPsec VPN



Antiphishing

SSL VPN

Antispyware

Web Filtering

Antispam

Application Firewall

ASQ for Real-time *Intrusion Prevention*

UTM
Unified Threat Management

What's provided....

- Firewall+Intrusion Prevension System (ASQ)
  - Advanced plugins for some protocols
  - HTTP filtering
- NAT
- VPN (IPSec, SSL)
- LDAP (including server if needed)
  - PKI for F200+
- Antivirus / Antispam
- SNMP, NTP, DNS, DHCP features
- [some other internal stuff]
- Probably some other things I forgot....

What's running behind...

- “NSBSD” (NETASQ Secure BSD)
  - FreeBSD
  - ~ 700k of kernel patches+some userland patches
- ~ 10Mb of NETASQ sources (binaries + libs)
  - Mostly in C
- ~30 “contribs” + ~ 650K patches
  - Ipsec-tools
  - OpenLDAP
  - Isc-dhcp
  - Ntpd
  - P7zip
  - .....

Almost everything is provided on all products, from F25 to F5500....

Some #ifdef NETASQ_MODEL in the sources, mainly for memory usage

R&D constraints....

- Security (of course.....)
  - Security of the code itself
  - Secure the network !
- Memory constraints, for F25 / F50
- MB/s for all products
- Avoid writing to /
- Compatibility with older products

  (No, we don't support F10 anymore :-)
- New features !

NETASQ

Okay, let's log on it:
ssh admin@firewall

Ssh admin@firewall : WARNING !!!!!

```
F100XD012170200701> echo $SHELL
/bin/csh
F100XD012170200701> echo $EDITOR
joe
F100XD012170200701> ls -l vi # On some older versions
vi -> joe
F100XD012170200701> emacs
emacs: Command not found.
```

- Forget ifconfig/route/etc... : they do NOT configure ASQ !!!
- Lots of bins/libs are NOT here

Ssh admin@firewall

```
F100XD012170200701> mount
/dev/ad0s1a on / (ufs, local, noatime, synchronous)
[ad0 or md0] on /tmp
/dev/md0c on /var (ufs, local)
/dev/ad0s1f on /log (ufs, local, noatime)
```

- / is synchronous
  - Not so much writes
  - More reliable than softupdates
- /var is on RAM
  - Lots of generated /etc/* are links to /var/tmp/*
- Logs for F200+

Ssh admin@firewall

```
F100XD012170200701> ls -l | grep -i interesting
```

- /COPYRIGHT :-)
- /kernel[.gz]
- /usr/Firewall
  - User's configuration / datas
  - NETASQ binaries/libraries
  - Firewall specific informations
- /var
  - Generated configurations for contribs
  - Generated hosts, networks, etc...

Ssh admin@firewall

```
F100XD012170200701> du -h Update/update.tgz
9,2M   Update/update.tgz
F100XD012170200701> df -m
Filesystem  1M-blocks  Used Avail Capacity  Mounted on
/dev/ad0s1a      256     38   218    15%    /
```

- Used size can be much more
  - URL groups: ~ 35Mb
  - AntiVirus: up to ~ 15Mb
  - Appliance's configuration: up to 5-10Mb ?
- Size of / is model dependant
  - 1 Gb for High end products
  - 128 Mb for low end products
- Size of update.tgz is almost the same for all

NETASQ

Building and maintaining a firmware HowTo

What do we need ?

- A good editor (Out of topic: no time for trolls)
- A repository for our work
- A Programming-Howto (Out of topic)
- An easy way to manage contributions
- An unified way to build our sources
  - Binaries
  - Libraries
  - Default configuration, scripts, etc...
- An easy way to manage a patched kernel
- Get a minimal FreeBSD system (userland)
- One command to rule them all.....

A repository for our work

- CVS used for some years
  - cvs annotate was useful :-)
  - Commit per file can be problematic
  - checkout.sh needed to get the complete sources
- SVN used now
  - r1: 2006-02-22 21:42:55 +0100
  - One commit by feature (or by fix :-)
  - Easy to import CVS tree
  - Easy to use for CVS users
  - “Externals” obsoleted checkout.sh
  - svn blame is great :-)

An easy way to manage contributions

- Fetch / build / clean contribs
  - We can “install” what we need by simple cp
- Updating contribs must be easy
- Some contribs are patched
  - Patches must be stored “somewhere”
  - Patches must be used by build process
- Having our copy of patches sources is NOT a good solution !
  - Updating the contrib won't be easy !
- FreeBSD's ports system is perfect for such stuff !

An unified way to build our sources

- Binaries / libraries
  - Build, with shared options and specific options
  - Install in a specific location
  - Compile again only when needed
- That's Makefile's job !
  - Lots of make commands
  - Lots of syntaxs, Makefile styles, etc....
  - bsd.*.mk are good: our Makefiles are small
- Cmake is needed for crossplatform works

An easy way to manage patched kernel

- Build / clean kernel
  - We'll have to handle various kernel config files
- Updating kernel sources must be easy
- Kernel is patched
  - Patches must be stored “somewhere”
  - Patches must be used by build process
- Having our copy of kernel sources is NOT a good solution !
  - Updating kernel sources will really not be easy !
- FreeBSD's ports system is perfect for such stuff !

Get a minimal FreeBSD system

- Only a few userland files are patched
  - We can apply those patches on the build host
- We know the list of needed binaries
  - We can get them from the build host
- We have to check needed libraries
  - Dangerous to forget a new important lib !
  - Interesting to remove everything except what's really needed
- We generated a FreeBSD.tgz for those files
  - File name + MD5 known for each tagged revision
  - FreeBSD.tgz files are archived for years
  - ~ 3.8Mb for FreeBSD.tgz actually

One command to rule them all....

- [make clean &&] ./build.sh
- Generates all shell env (CFLAGS, ...)
- Knows firmware revision, model, etc...
- Extracts/builds everything
  - Knows what needs to be done first
- Checks FreeBSD.tgz MD5 sum
- Calls all clean/check/etc... scripts
- Generates a tarball for the whole firmware
  - Generates dynamic informations used by update process

NETASQ

Working with OpenSource: Using OpenSource code ?

Using an Opensource project ?

- Does it provide the needed features ?
  - Or would it be easy to add them ?
- What is the project's licence ?
  - We sometime cannot use “GPL style” licensed programs
- Is the code stable enough ?
  - And is it secure enough ?
- How much would it cost us to rewrite it from scratch ?
- How much would it cost to use a 3rd party program ?

NETASQ

Working with OpenSource: Using FreeBSD...

Why did we make the good choice

- Of course: the BSD licence !
- Of course: robust and efficient network stack
  - Polling works for years
  - Netgraph / MPD
- At the beginning: IPF
  - We replaced it easily by ASQ when it was ready
- Lots of ports
- FreeBSD is also usable as a workstation....
- When one BSD is supported by 3rd parties, it's FreeBSD !

Drawbacks.....

- People knows “Linux”, not ???BSD
  - Our shareholders, CEO, etc... are “people”....
- Drivers are often not available
  - Hardware RAID
  - Actually, the soundcard of my workstation :-)
- Some 3rd parties only support Linux

Drawbacks: From FreeBSD 4.x to 6.x

- FreeBSD.tgz: +25%
- Network performances: ~ -25% on first tests
  - Polling
- We also had to migrate ASQ from spl*() to mutexes
- Some kernel crashes in first versions
  - FreeBSD bugs (fixed by FreeBSD most of the time)
  - Some NETASQ patches who needed some changes
- Some savecore / kgdb problems
- Problems with GEOM (remounting / ro)
  - “Geom is in the kernel”...

Don't worry: FreeBSD 6.x is great !

- Maintained version :-)
  - Security fixes
  - Hardware support
  - Ports
- Better SMP support
  - Will be even better in FreeBSD 7.x

NETASQ

Working with OpenSource: (some) past and future contributions

Why do we contribute ?

- Because it's fair
  - Our shareholders don't care about that....
- Because we won't have to update our patches when we'll upgrade
- Because we can have some feedback from the community
  - Bugs reports, improved versions, etc...
- To become a member of the community

NETASQ and ipsec-tools

- Racoon used in NETASQ appliances
  - racoon20011215a really lacks features, stability, ...
- We needed to do lots of patches
  - Internal patches (logs, etc...)
  - Features, fixes, etc...: mostly reported to KAME
- Ipsec-tools fork was far more reactive
  - DPD and other patches reported quickly
  - Manu@NetBSD.org was already in the place :-)
  - Commit bit since late 2004

Past contributions to ipsec-tools

- Bugfixing / cleanups / optimizations !
  - We have **lots** of customers running racoon...
  - We do some non-regression tests for each version
- DPD (RFC 3706) support
- Configuration reload
  - No needs to kill racoon, Only flush what is obsolete
- Functional road-warrior mode
- Some works on NAT-T
- Finds netipsec/ipsec.h for FreeBSD 7 ;-)
- Contributor's patches audit/report
- Release engineering, support, etc...

Ipsec-tools: being a member of the team

- Gets security reports before everyone !
  - And also get the patches beore everyone !
  - More easy to synchronize both ipsec-tools and NETASQ releases
  - Of course, we also need to synchronize with others
- More easy to report my work for NETASQ
- Needs some time to do that work !
- Direct contributions to NetBSD ?
  - Interesting, but would need some extra time
  - According to Manu@NetBSD.org, I already contribute to NetBSD :-)

Some past contributions: FreeBSD

- FreeBSD's port of ipsec-tools
- Some patches to IPSec stack
  - OpenBSD's enc0 (still not completely reported)
  - IPIP decapsulation problem in FAST_IPSEC stack
  - Fixes, etc...
- Some other kernel bug reports
  - VIA padlock: i386/114331 (+patch)
  - Broadcast forward problems: kern/103950 (+patch)
  - Em driver hardlock: kern/66634
- A few other reports/patches for userland and ports

Expected future contributions

- More works on IPSec, of course :-)
  - NAT-T (wait a few more slides for details...)
  - High number of SPD/SA entries (next slide)
  - Feedbacks on FAST_IPSEC
- Feedbacks on network performances
  - We have the needed hardware for benchs !
  - Pollng (also in a few slides)
- Some pr for ports ?
- Other things ? I hope so !

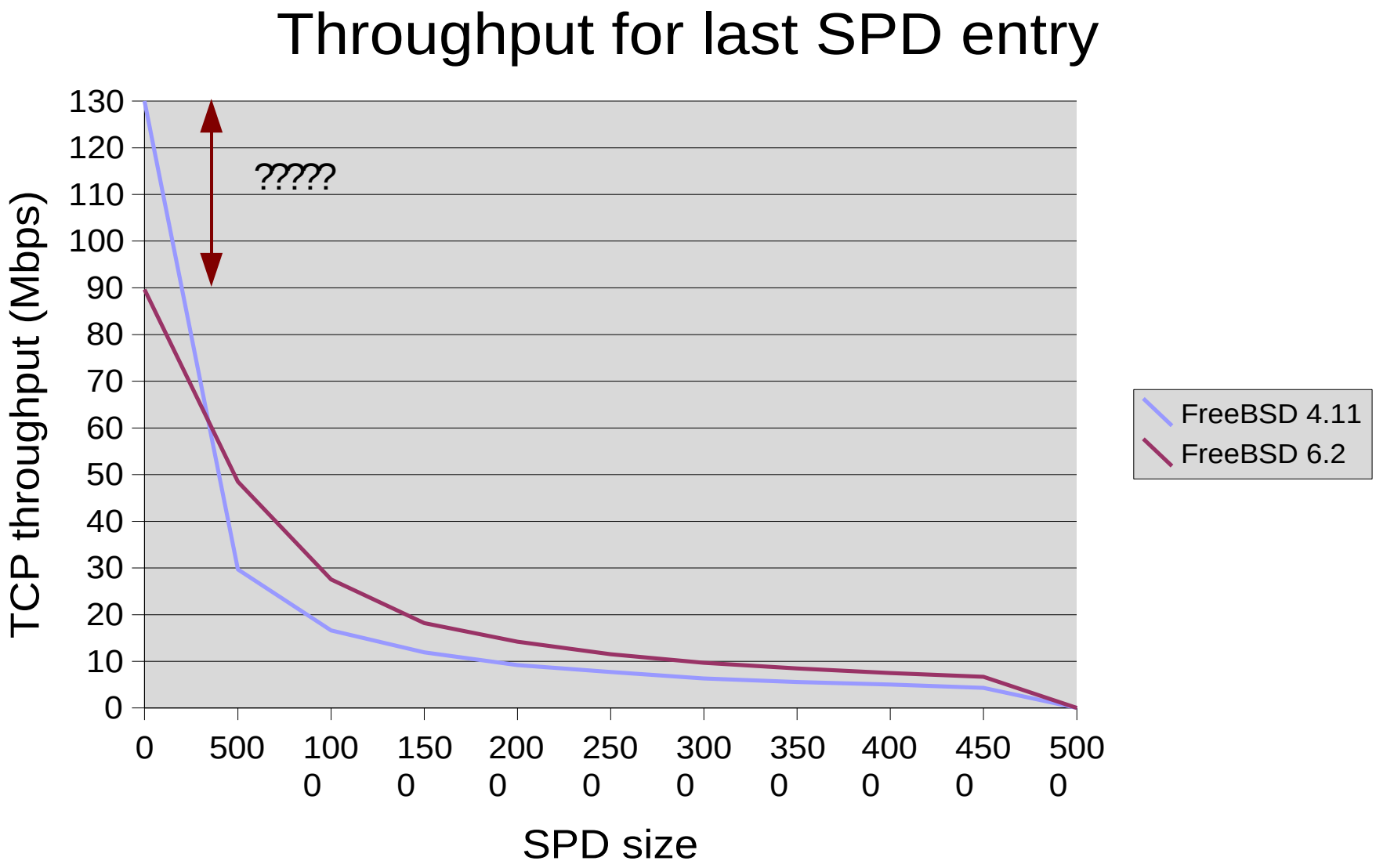
IPSec and lot of SPD/SA entries (1)

- “Lot of” means something like 1 000++
  - Some of our customers want that (and much more)
- First problem: Pfkey interface
  - One PFKey request to dump SPD/SAD
  - One message by answer
  - The buffer of PFKey's socket will fill quickly
  - Also old problems with sbspace() macro (fixed in 6.x ?)
- IPSec-tools problems: fast negociations....
  - Will need some optimizations
  - Threaded racoon ? It may be faster to rewrite it !
  - Actually, it can work.... with long lifetimes !

IPSec and lot of SPD/SA entries (2)

- Performance issues with huge SPD/SADB
  - Huge list, we have to find one entry…
- Solutions for SAs
  - Put used SAs at the beginning of the list
  - Use an SA cache ?
- Solutions for SPD ?
  - Common solutions for routing tables won't work
  - Order **is** important
  - FreeBSD6/FAST_IPSEC: spdcache (see graph)
  - We'll have to do “something”

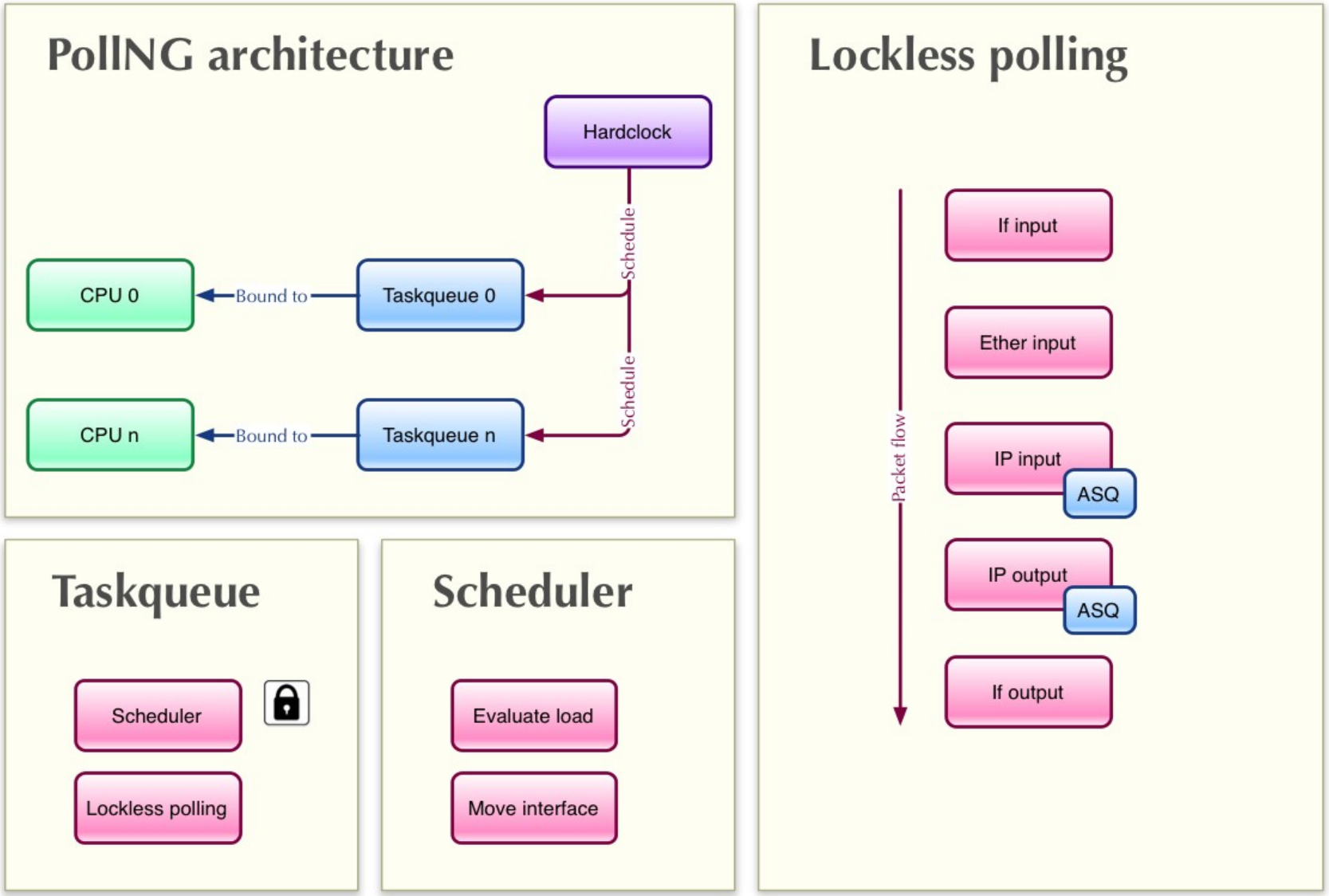
Benchmark with huge SPD



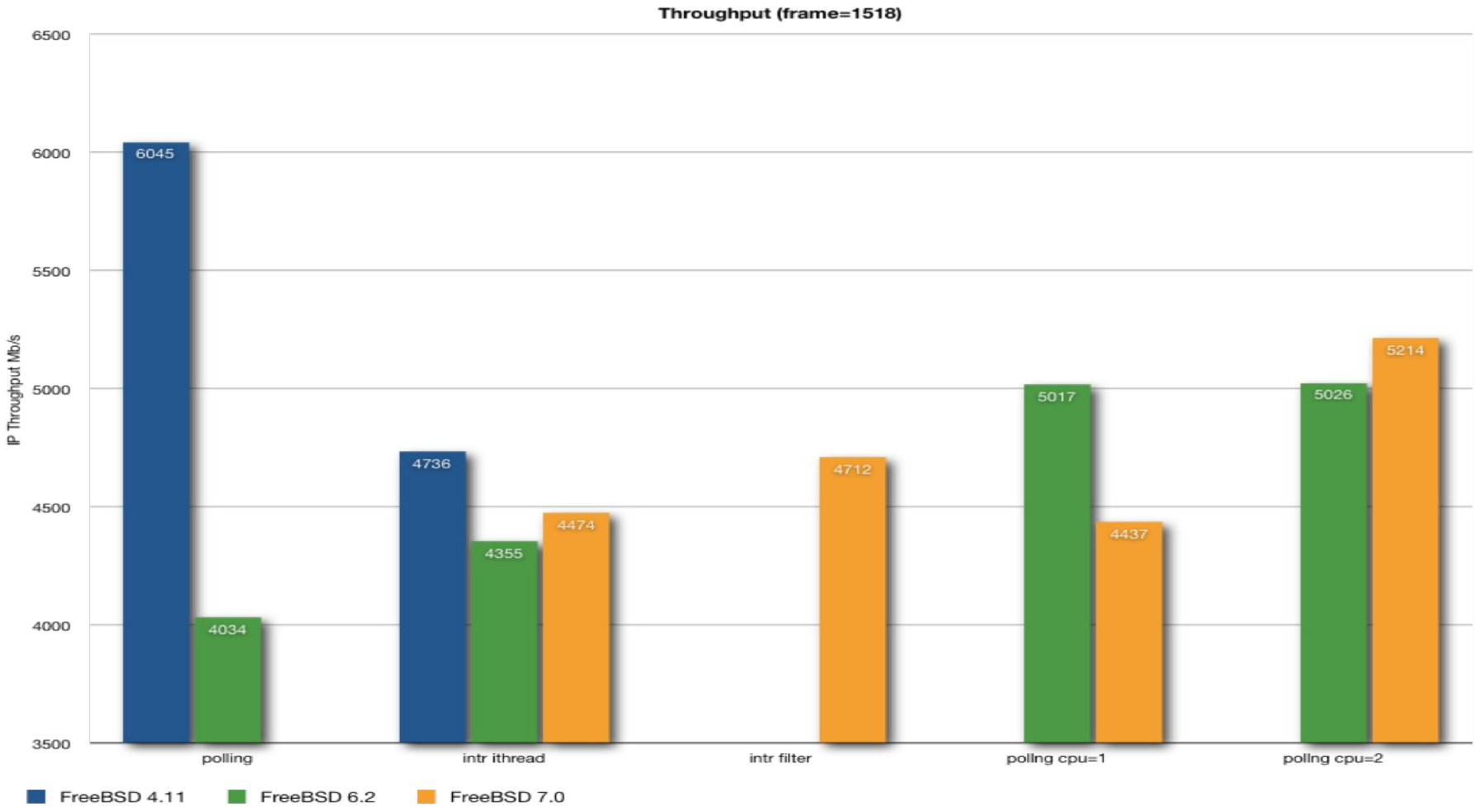
In progress: Pollng

- Performances loss on FreeBSD6 with polling
- Mail sent last week on freebsd-net@
  - http://www.netasq.com/opensource/pollng-rev1-freebsd.tgz
- Each NIC is attached to a specific CPU
  - More scalable
  - Attaching all NICs to a single CPU can also be interesting
- Each polling queue is processed by a specific thread
  - More easy to monitor
- Also interesting with a single CPU
- Differences between FreeBSD 6.2 and 7

Polling


PollNG architecture
Hardclock
Schedule
Schedule
CPU 0
Bound to
Taskqueue 0
CPU n
Bound to
Taskqueue n
Taskqueue
Scheduler
Scheduler
Evaluate load
Lockless polling
Move interface
Lockless polling
Packet flow
If input
Ether input
IP input
ASQ
IP output
ASQ
If output

Pollng: some benchs



Still pending: NAT-T kernel support...

- IPSec NAT-T encapsulation: RFC 3948
  - RFC3947 support already in ipsec-tools
- First patch submitted years ago for 4.11
  - Patent problems
  - Looking at the patch again, it was quite ugly :-)
- Patch maintained, and provided for 6.x/HEAD
  - I know, Bz's patch have been reported late
- May be reported in FreeBSD 8 ???

NETASQ

Working with OpenSource: Some social engineering....

Questions