# *Lessons Learned Reimplementing an ISP Mail Service Infrastructure to Cope with Spam*

Doug Hughes

Platforms

- engineering mail platform
  - ~200 active users
- ISP
  - 4150 primary dns domains
  - Hosted mail platform (POP/IMAP/SMTP)
    - 81 domains
    - 1096 users
  - globalcrossing.net – ISP, store&forward
    - 427 MX records
    - 5000 dialup users
  - primenet.com – legacy ISP, store&forward
   - 653 MX records
    - 1800 email aliases

A word on SPAM
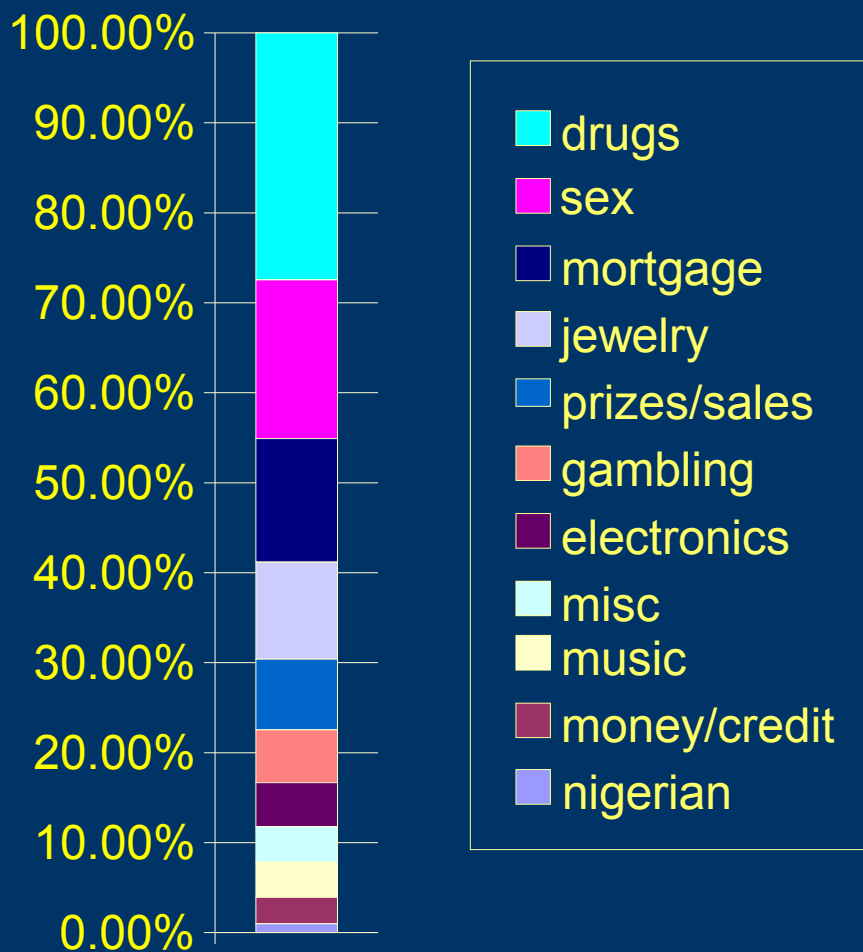
- Legal and illegal drugs and herbal supplements
- Sex and drugs are sometimes hard to tell apart
- Did you know that interest rates are low?
- Rolex watches & sunglasses
- You may have already won!
- Bingo anyone?
- Get a free ipod! (maybe)
- Need some golf clubs?
- Swap some tunes
- Improve credit rating
- My uncle is the oil minister, but I need your money so you can have some of his money
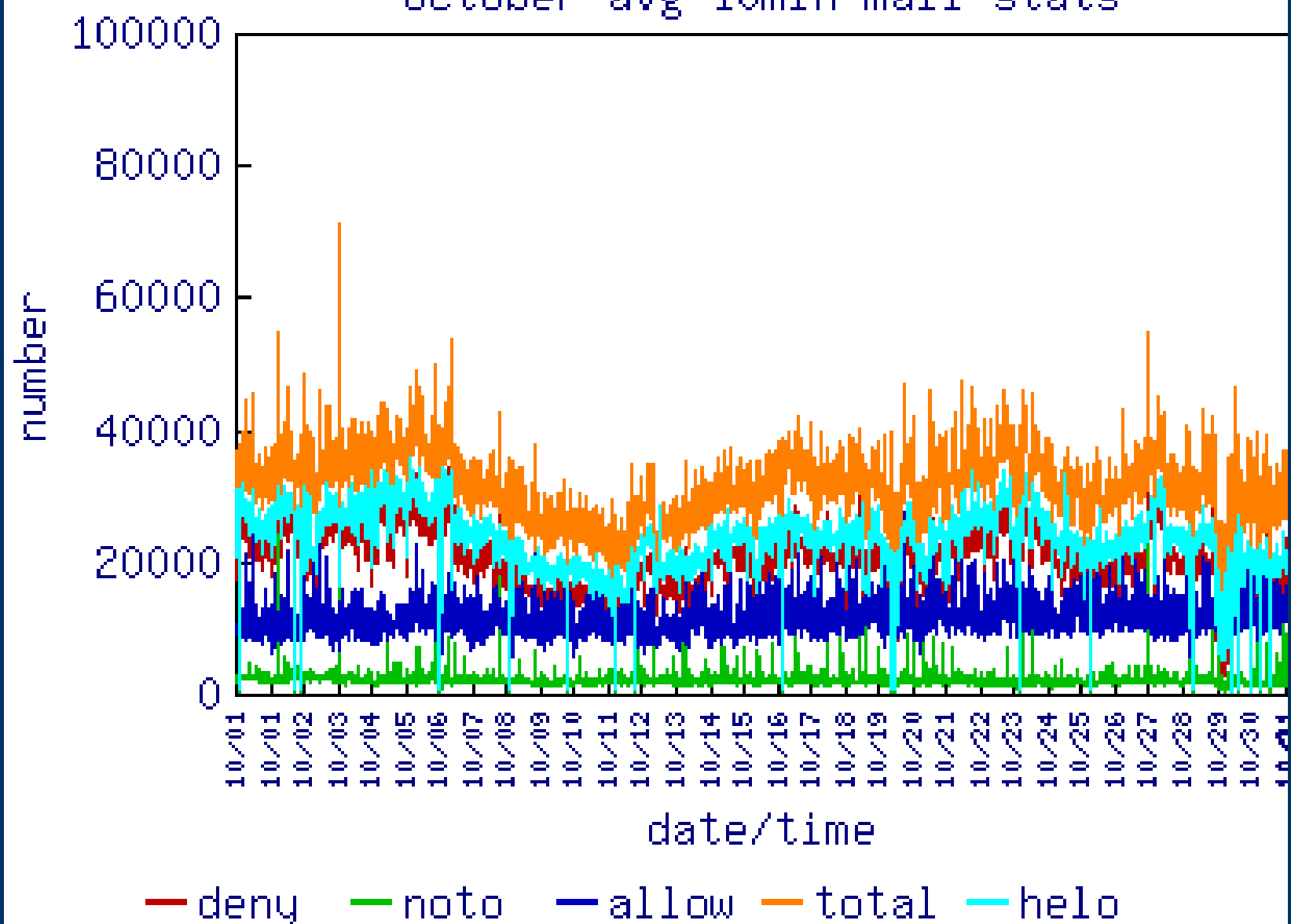
October aggregate daily stats
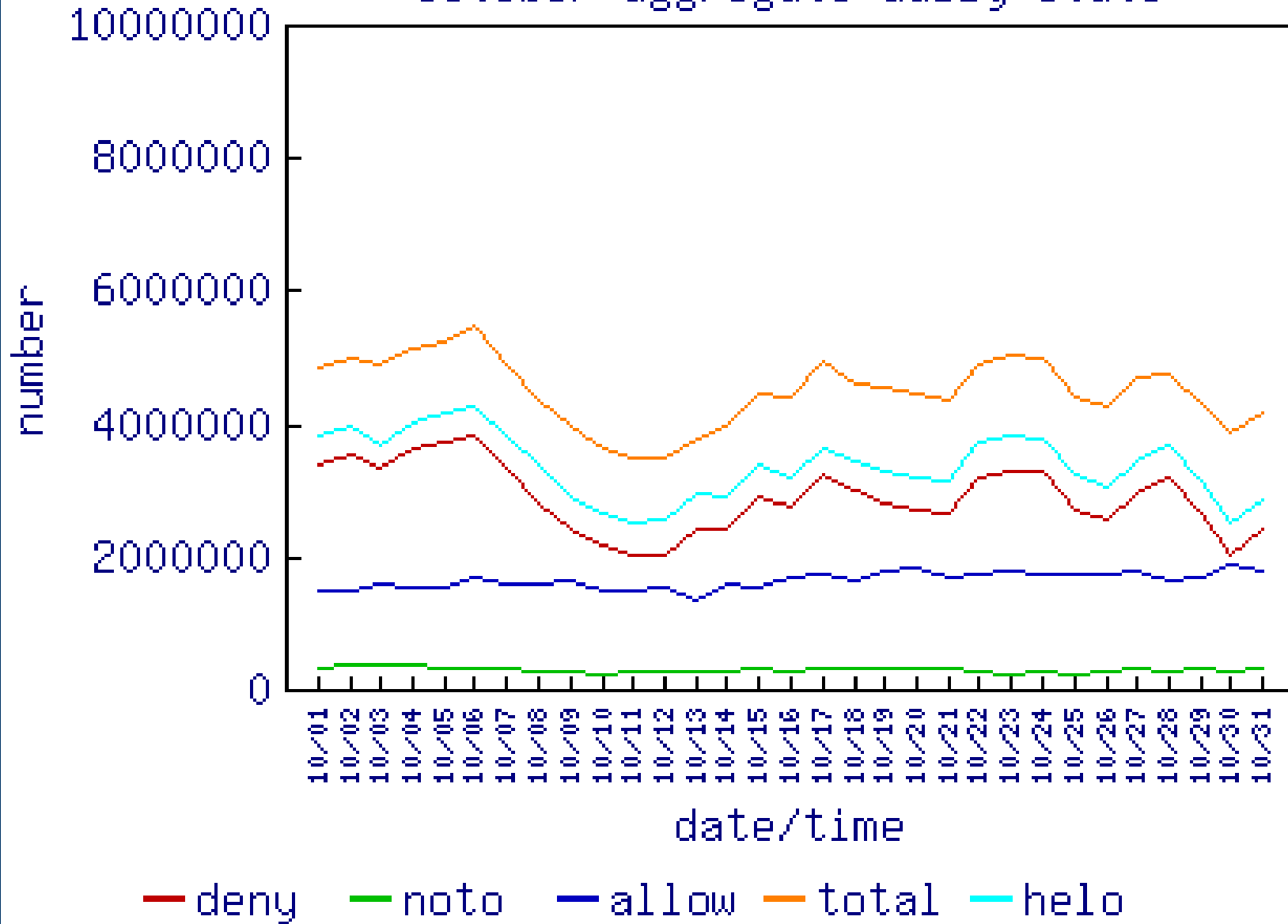
October hourly daily mail stats
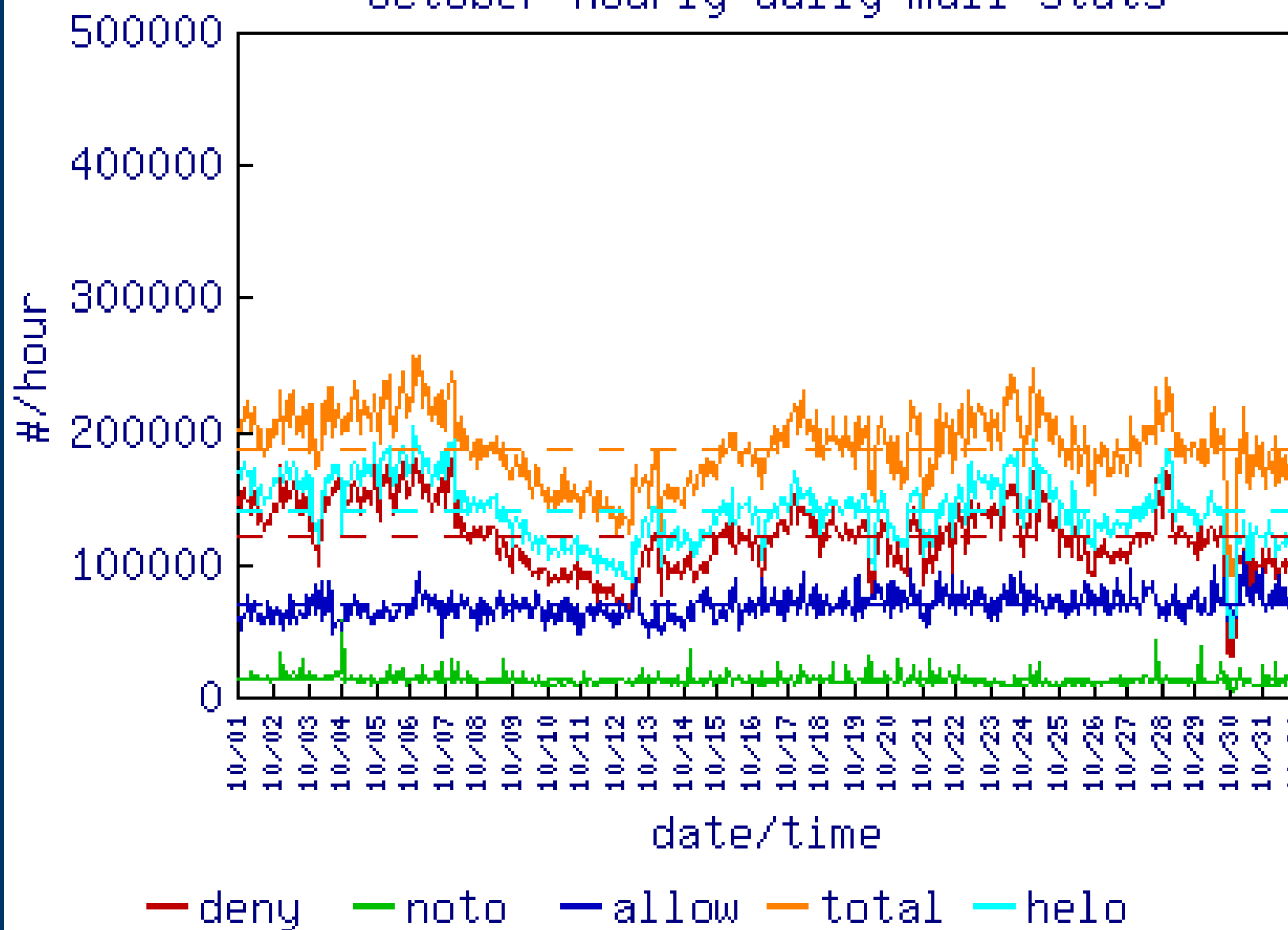
October avg 10min mail stats

October weekly, hourly mail stats
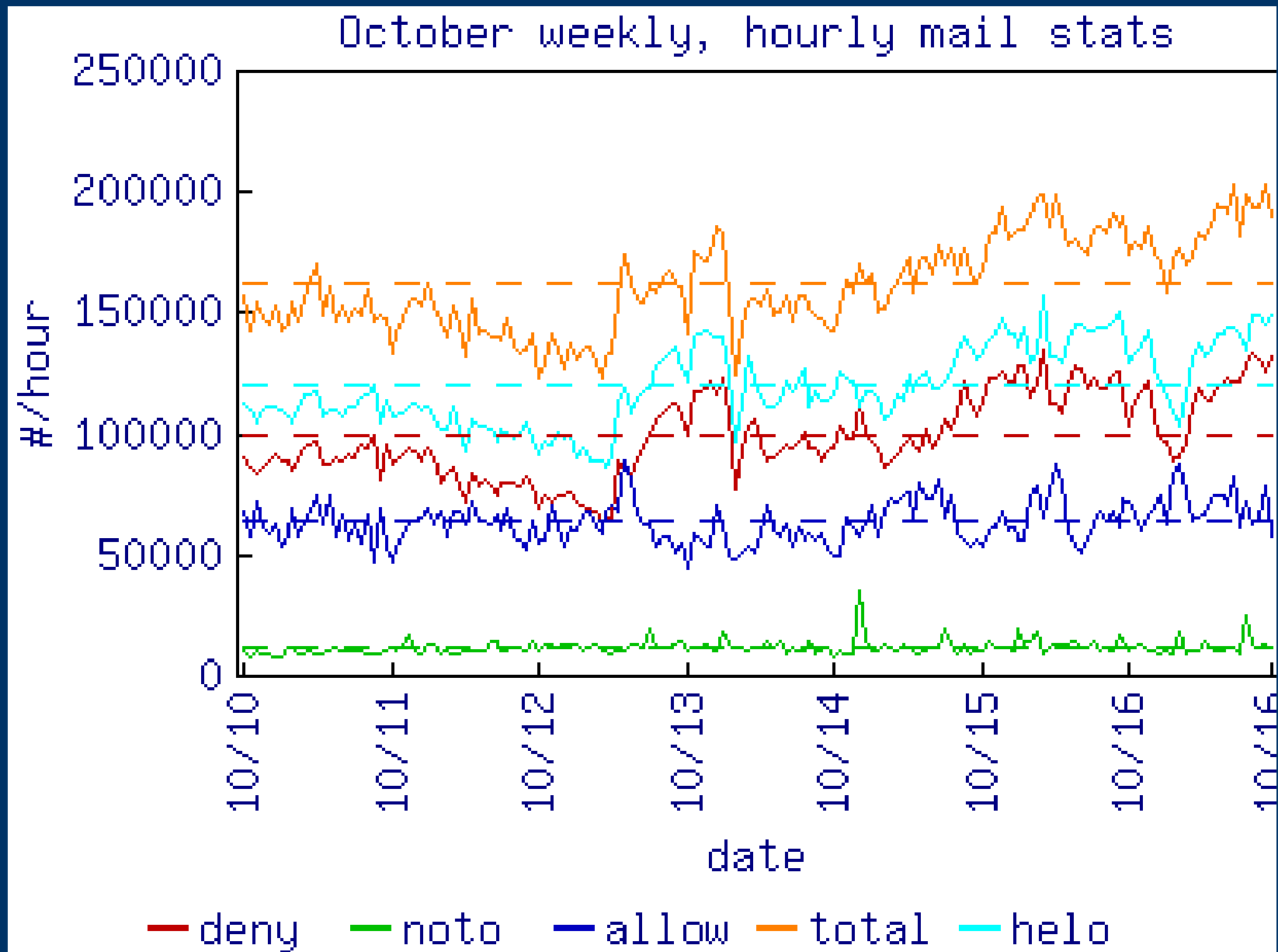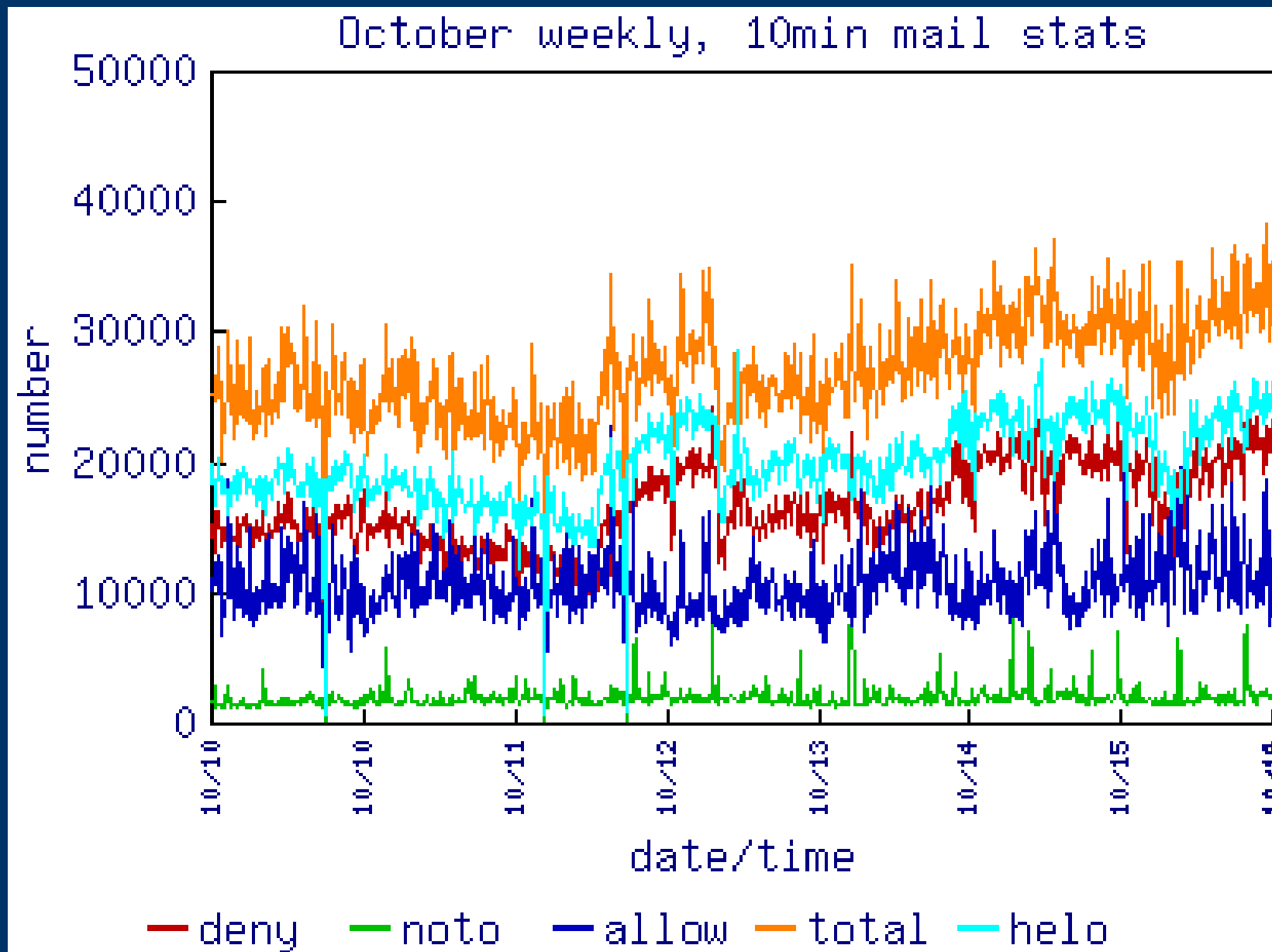
Nov 6 weekly 10min mail stats
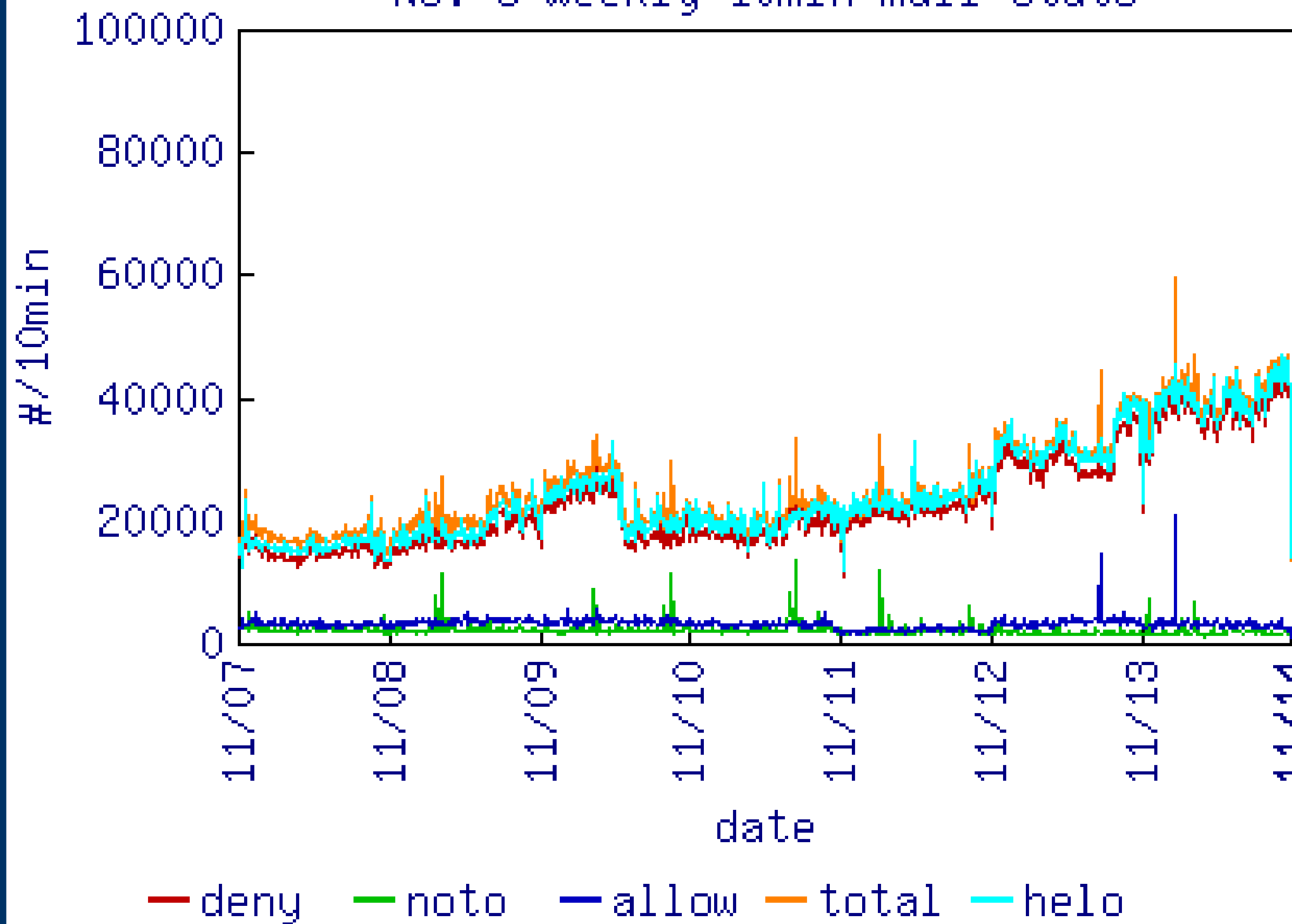
October daily, 10min mail stats

tld helo per day
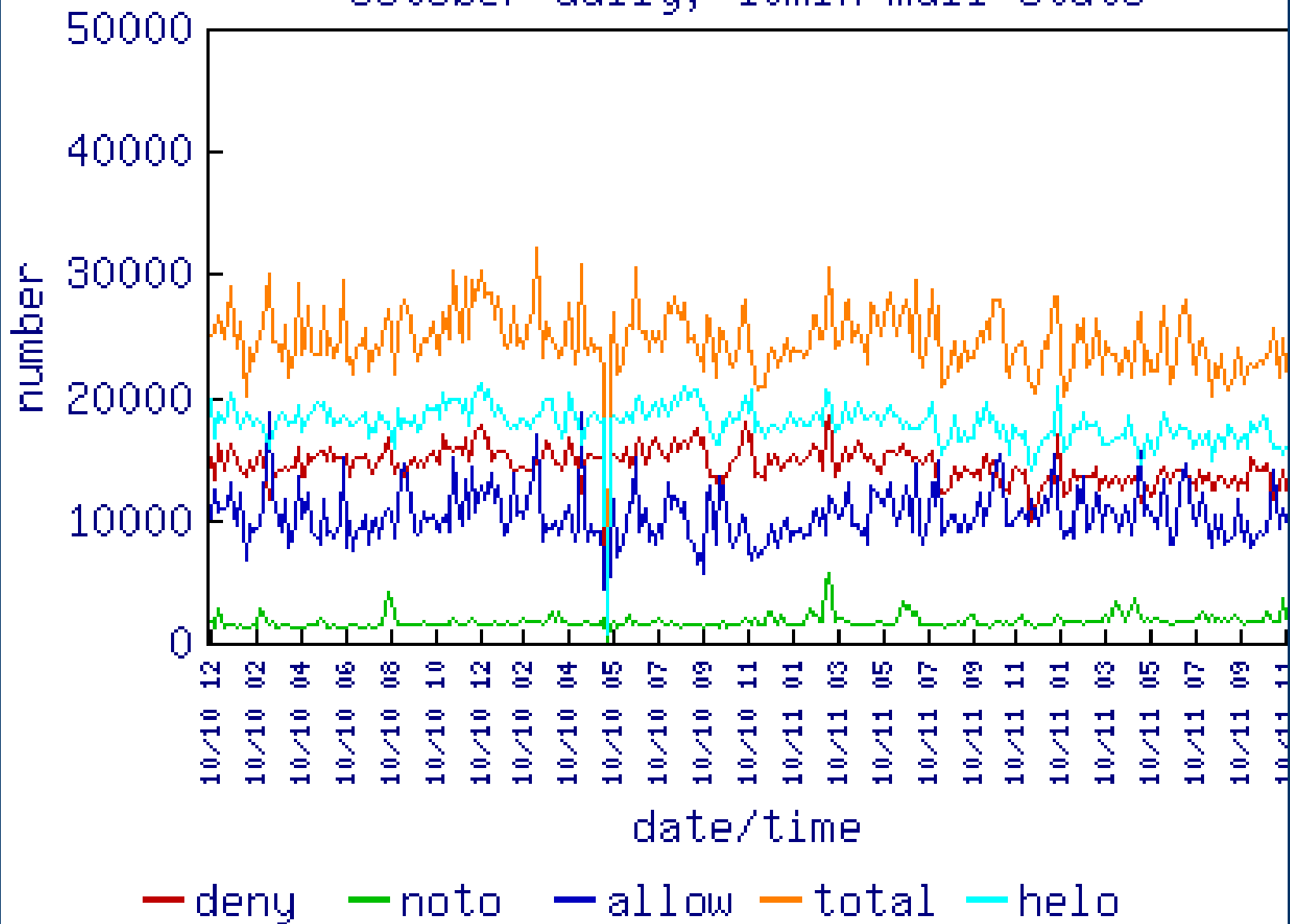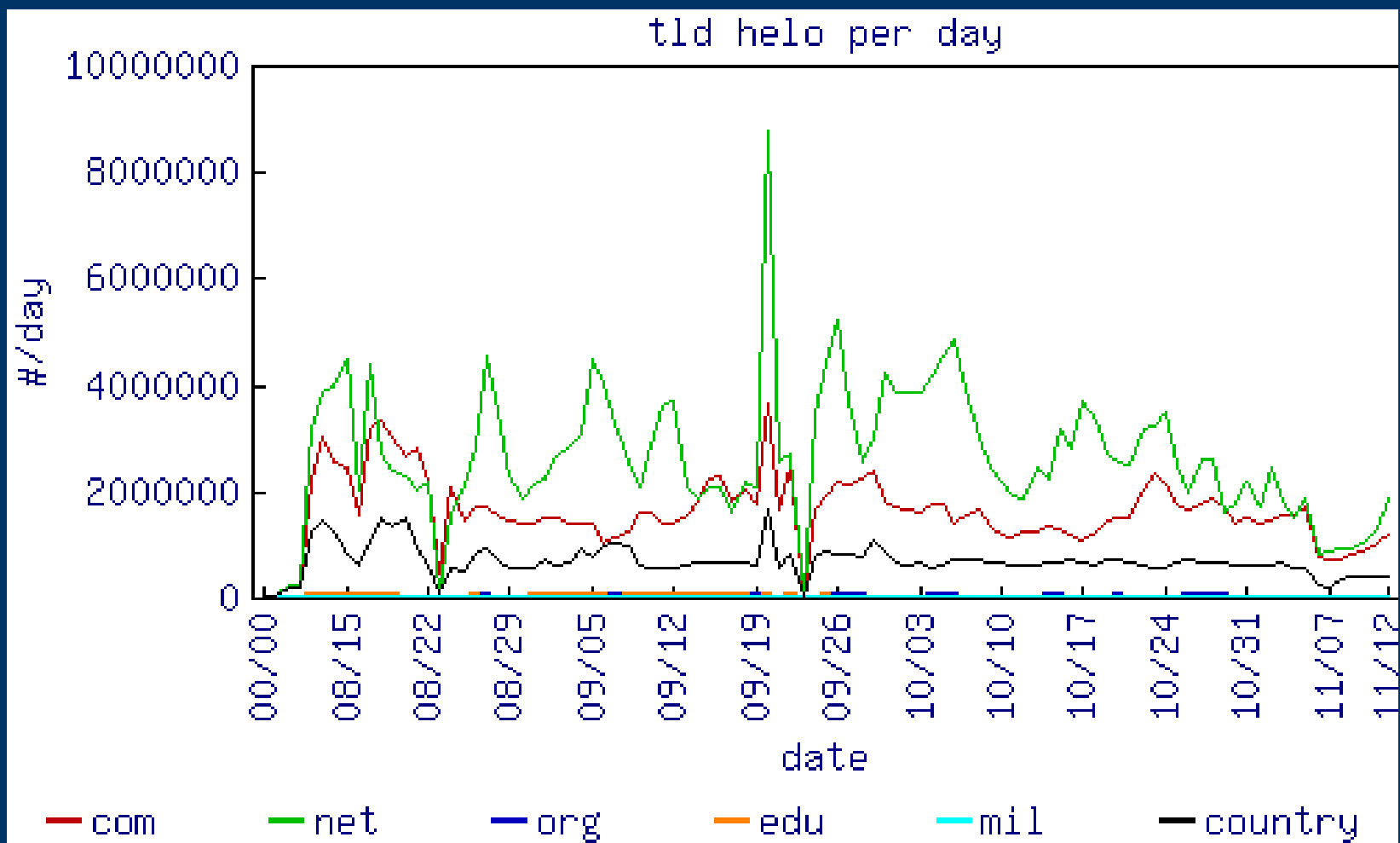
CCTLD Broadband/dynamic connects

percent vs connects

date

— dsl/cctld%   — cable/cctld% — both
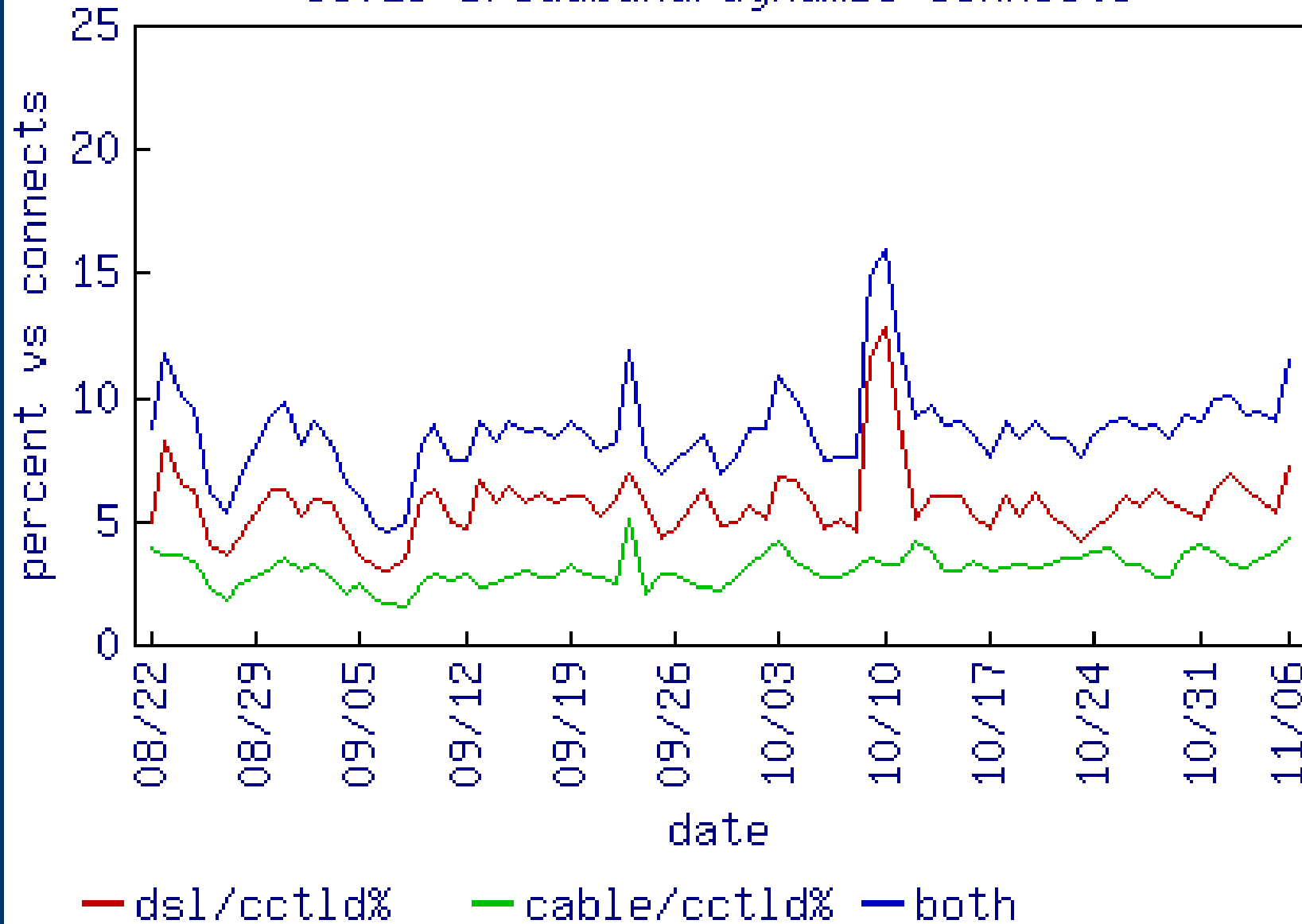
Top helo cctld
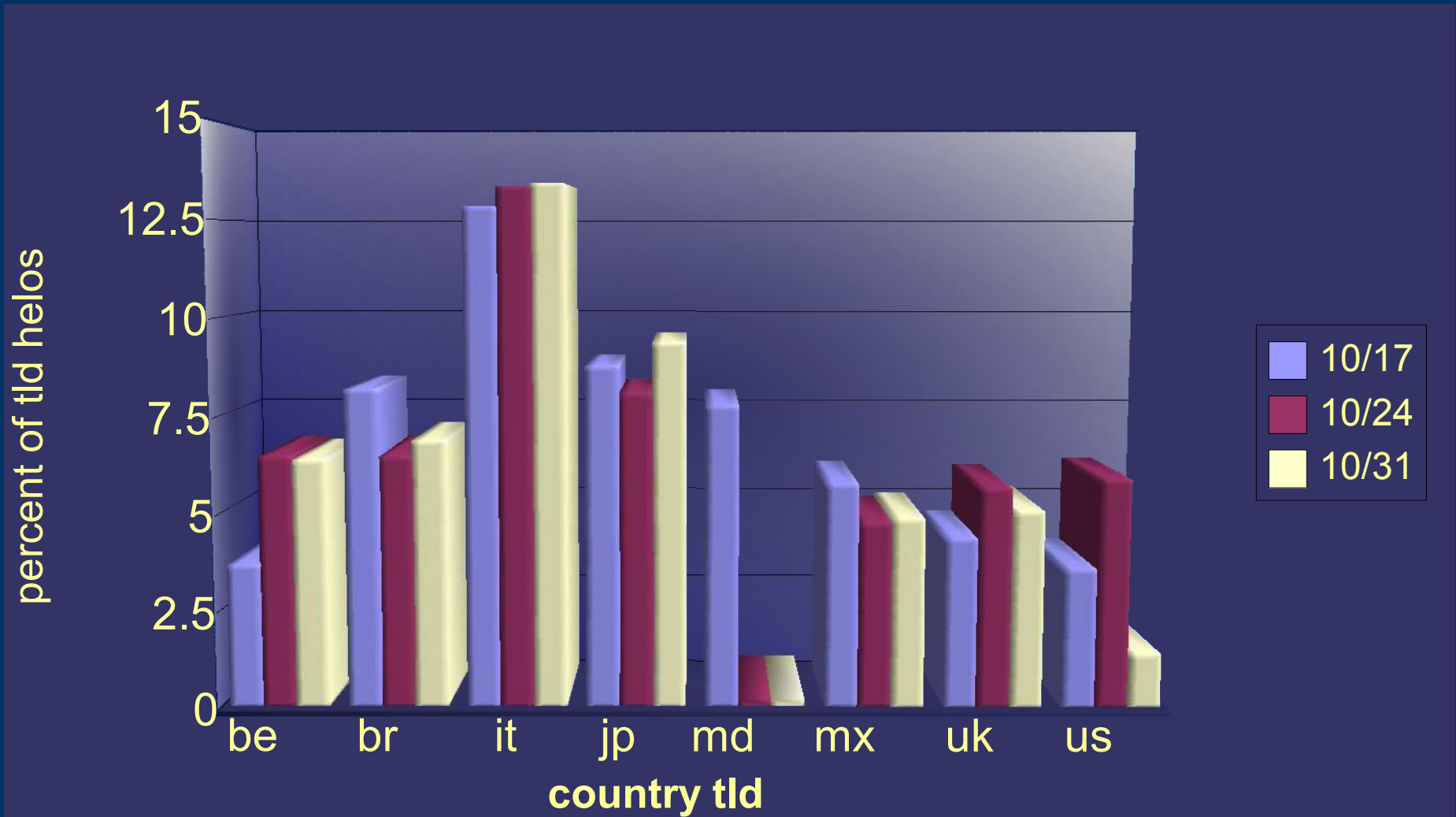
A digression – Nov 6 – Nov 12 (HELO fecundity cctld/countrytotal)
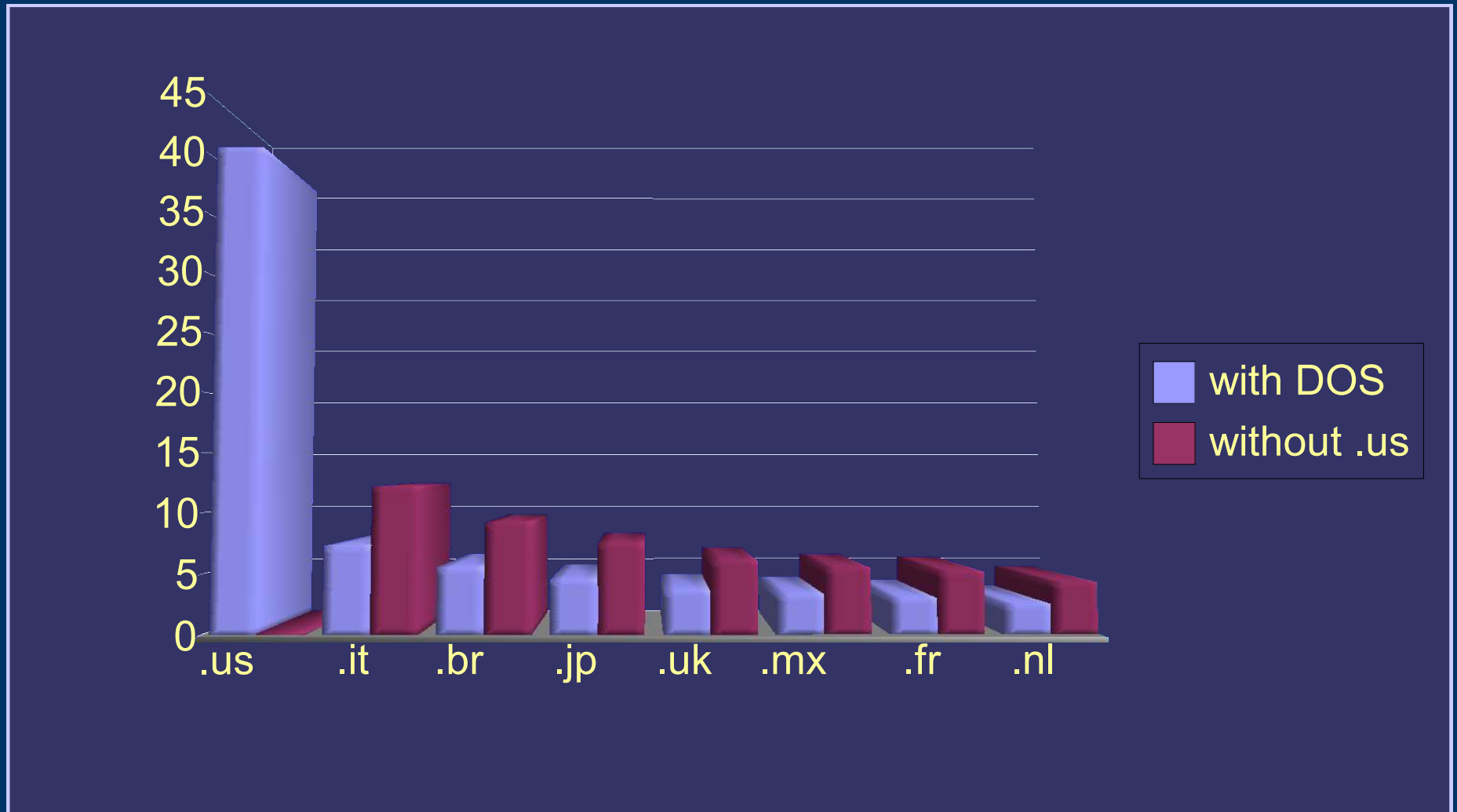
Whither .us 11/12?

- 54329 .us
- 53502 - www.iss.k12.nc.us
- Poor recipient (but no!)
- 100 allowed
- all spam *
- `fgrep '.us(' /tmp/ml12 | nawk 'BEGIN {FS=`
`"[ (]+"} {d[$12]++}; END {for (a in d) {print`
` a, d[a]}}' | sort -nr +1 | head`
  - www.iss.k12.nc.us 53502
  - smtp.cfcc.cc.fl.us 190
  - mail.academy.k12.tx.us 58
  - mx20.rateetin.us 48
  - mail.archie.k12.mo.us 35
  - www.advertisingbiz.us 33

Should I stay or Should I go
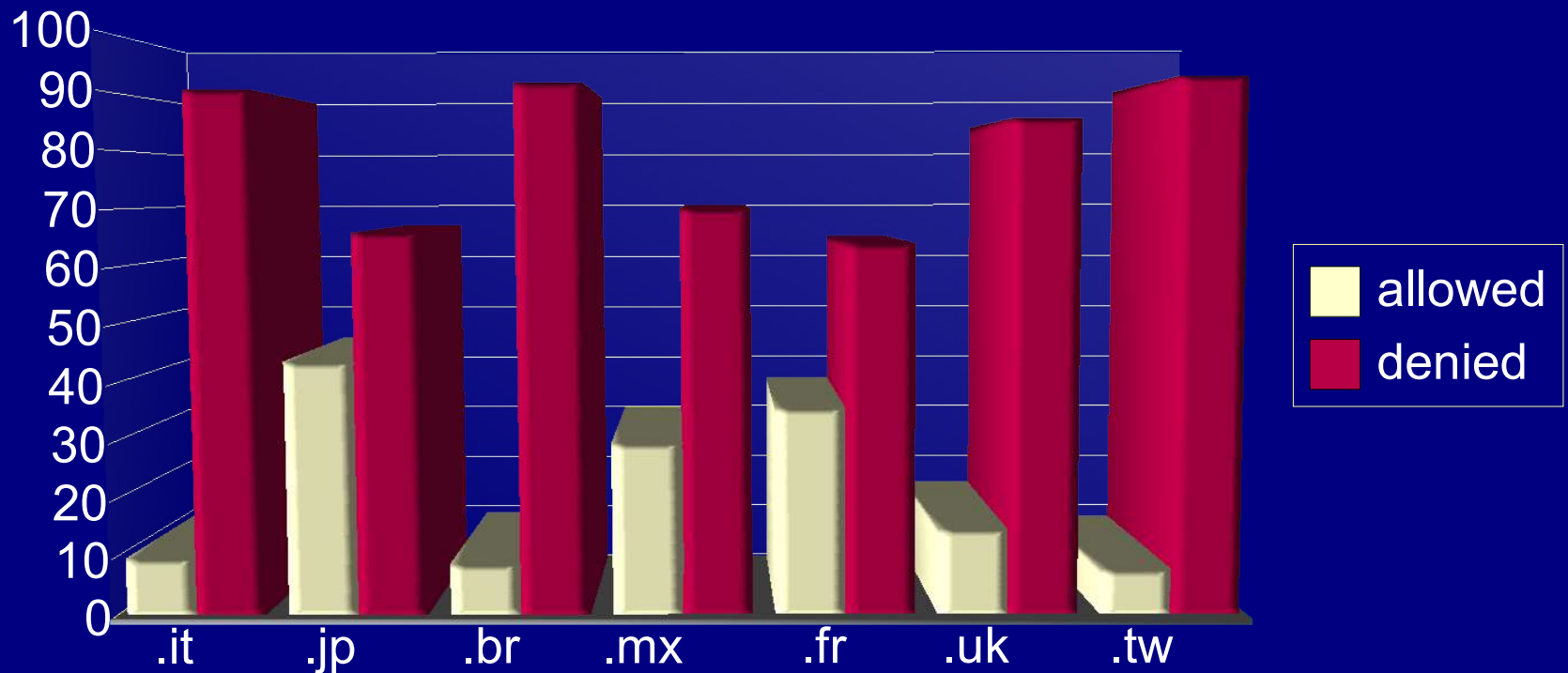
Dynamic 11/6/04 - 11/13/04
% dynamic vs all helo per cctld

TLD	HELOs/ week	%cab total	TLD	HELOS/ week	%dsl/ total	%of all helo
.ca	163M	8.5	.it	205M	0.7	2-4%
.jp	120M	0.3	.ca	163M	0.3	1%
.br	106M	0.3	.jp	120M	1.4	1-3%
.be	84M	2.1	.br	105M	26.8	1-2%
.uk	61M	43	.be	84M	5.1	1%
.nl	53M	9	.uk	61M	3.4	
.mx	49M	2.5	.nl	53M	56.8	1%
.fr	46M	4.9	.mx	49M	0.3	
.tw	47M	0.3	.fr	49M	17.6	

What about Italy?
(one machine – one day)

3326	outgoing1.jumpy.it
141	81-174-10-241.f5.ngi.it
123	host147-103.pool82186.interbusiness.it
121	ns2.mclink.it
90	host4.coind.it
89	host36-42.pool8023.interbusiness.it
88	vsmtp3alice.tin.it
64	host2-225.pool8018.interbusiness.it
60	vsmtp2alice.tin.it
60	host3-220.pool81118.interbusiness.it

The Good and the Bad

- Good News
  - Bayesian Filters make a difference
  - DNSrbls make a difference
  - Common sense makes a difference

- The Bad News
  - Italy, Canada, Japan, and Brazil are threats
  - Mexico/South America are emerging threats
  - Dynamic/Broadband space is a big threat
  - Spammers are adaptive

Mail flow

- Engineering mail
  - Smtpd
  - Sendmail
  - Local delivery machine
  - Procmail
  - Spamprobe
  - Mailbox

- Customer Mail Hosting
  - Smtpd
  - Sendmail
  - Mirapoint
  - POP/IMAP

- ISP platform
  - Smtpd
  - Sendmail
  - Store&forward
  - ISP mail host
  - Dspam
  - POP/IMAP

MAKE THE SPAM STOP!!!!

- Smtpd Traffic Cop
  - Reject
  - Adapt
  - Track
  - Refine
  - Automate

What we can't do

- Lose email
- Block whole countries
- Provide SPF
- Greylisting
- Spend a lot of money
- Use dnsbls

Smtpd Features

- Chroot execution
- Relatively simple
- Spool
  - Smtpfwdd scan and execute sendmail
- Sanitize unusual characters
- Size restrictions
- Geometric backoff capability
- Inetd or daemon
- Filters
- Logs

Smtpd logs

Nov 12 06:11:56 smtp9 smtpd[28151]: [ID 992256 mail.notice] smtp connection from UNKNOWN@al-217-129-156-213.netvisao.pt(217.129.156.213) attempted MAIL FROM: <wrojas_mf@evidence.fr> RCPT TO: <xxxx@sqinc.com>, **denied by line 7** of /etc/smtpd_check_rules

Nov 12 06:11:58 smtp9.roc2.gblx.net smtpd[**28079**]: [ID 895413 mail.notice] smtp connection from UNKNOWN@ppp322.tc-1.roc-pt.ny.localnet.com(66.153.11.68) attempted MAIL FROM: <support@citibank.com> RCPT TO: <xxxxx@unitelgroup.com>, **noto by line 144** of /etc/smtpd_check_rules

Nov 12 06:15:56 smtp9.roc2.gblx.net smtpd[29126]: [ID 313078 mail.notice] smtp connection from UNKNOWN@mia19.ediets.com(69.25.52.19) MAIL FROM: <bounce-cnibeeuhlcgiun@customer.ediets.com> RCPT TO: <xxxxx@unitelgroup.com>, **allowed by line 143** of /etc/smtpd_check_rules

7:deny:CDB=/dbs/cbl.abuseat.org:ALL:ALL:451 5.7.1 %I found in cbl.abuseat.org/lookup.cgi
143:allow:ALL:ALL:VALIDUSERS=/dbs/mirausers
144:noto:ALL:ALL:HASH=/dbs/miradomains:550 no such user/domain

Smtpd compressed log size
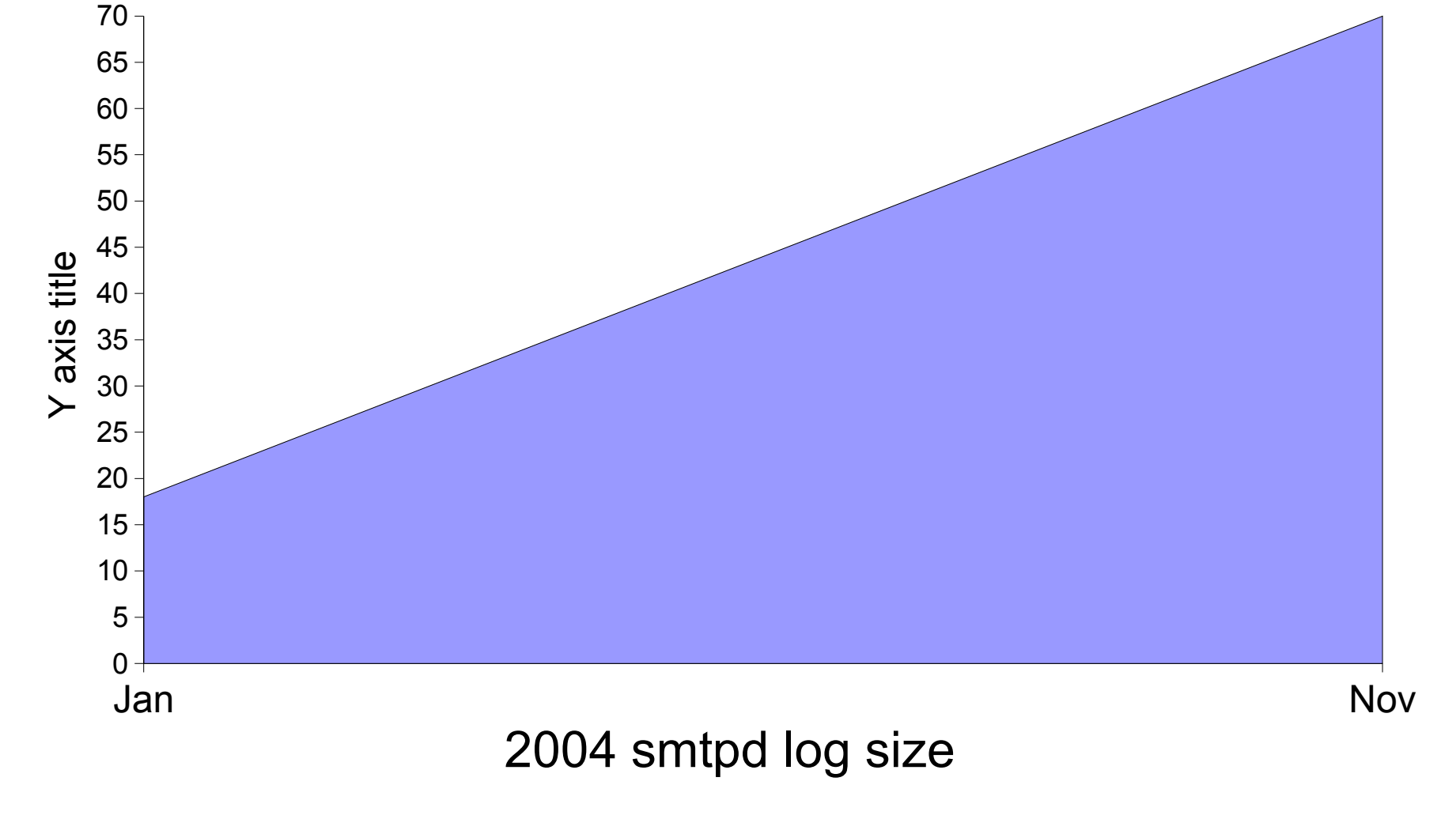
SMTPD Basics

allow|deny|noto:From_ip:mail_from:rcpt_to[:return msg]

- Name and IP/Block basics
- Deny vs Noto
- Make them wait! noto-delay, deny-delay
- Custom return codes
- External filter capability
- NS/MX rules
    - KNOWN/UNKNOWN [EXCEPT]
    - Ident
    - Glob matching (NS=*saveinternet.net
- regexp

Rules examples

deny:ALL:*.cyberpromo.com:ALL
deny:ALL:ALL@NS=127.0.0.1 ALL@NS=0.0.0.0 ALL@127.0.0.1:ALL:571 NO
    NS/MX records = 127.0.0.1
deny:ALL:ALL:MX=127.0.0.1 MX=0.0.0.0:571 NO MX records where = 127.0.0.1
    %H (%I)
deny:80.48.0.0/13:ALL:ALL:571 spam source tpnet.pl
allow:64.215.231.16/29:ALL:ALL
deny:ALL:NS=UNKNOWN:ALL:550 must supply valid source with MX or A
deny:ALL:/.+@$/:ALL:550 message must supply domain
deny:ALL:/^@.+$/:ALL:550 message must supply valid user name.
deny:ALL:/^@$/:ALL:550 message must supply valid user name and domain.
deny:ALL:NS=*classoffers.com:ALL:571 spam hosting classoffers.com
noto:ALL:ALL:*@*@*:571 Sorry %H (%I), I don't allow unauthorized relaying.
noto-delay:ALL:ALL:*@primenet.com *@*.primenet.com:550 no such user

allow:*.mci.net:NS=*mci.net:NS=gblx.net
deny:ALL EXCEPT NS=*.mci.net:*@mci.net:ALL:571 no forged mci.net email

Smtpd extensions

- CDB=
  - Binary search tree
  - Low memory
    - CBL 1.3M lines; 200+ MB BDB; 18MB raw file; 5MB search tree
  - No DNS lookups
  - deny:CDB=/dbs/cbl.abuseat.org:ALL:ALL:451 5.7.1 %I found in cbl.abuseat.org/lookup.cgi
- HASH=
  - Shared lib (Berkeley DB)
  - deny:HASH=/dbs/norelayfromip:ALL:ALL:450 no relaying from %I.
- VALIDUSERS=
  - allow-filter|allow:ALL:ALL:VALIDUSERS=/dbs/pnet_users
  - noto:ALL:ALL:*@primenet.com *@*.primenet.com:550 no such user
- IPBLOCK=
- MX=

IPBLOCK

- ISM
- Sparse address tree

```
struct addrtree {
        addrtree_t **addresses;        /* array of 256 pointers to nodes */
        in_addr_t addr;
        in_addr_t mask;
};
```

- Most specific match
- Tested but unused

IP block Automation

- Mail from large providers without popb4smtp
- Check queue run output for unknown users
  - Noto
- 15 minute cron
  - Tail last 30000 log lines
  - Check for noto lines (email to illegitimate users)
  - Store address matches in a hash
  - Thresholds
    - \> 250 allowed hits to valid user, add to norelayfromip list
    - \> 150 denied hits to valid user, add to norelayfromip list
    - Listed in combined.njabl.org – added to list
- Allowing legit users
  - /cgi-bin/mailblock?DSL=%I&From=%F
  - /cgi-bin/mailblock?DSL=%I&From=%F&To=%T

Before and After

- smtp.globalcrossing.net
  - Load 18-25 over 4 IBM B50s
  - Plain smtpd
    - 12% denied
    - 4756 hand-maintained rules
  - New smtpd with hashes – 1 month behind sbl-xbl
    - 20% denied
  - New smtpd with up to date cdb
    - After 10 minutes of application – 31% denied (over 20 minute sample)
    - After 20 minutes – 45% denied
    - Njabl + OPM add another 1%
    - Currently 50-60% denied

Before and After ...

- Hosted email
  - Overrun mail spool
  - Rejection of unknown domains only
  - Multi-hour delivery time
  - New smtpd front-end
    - 85-98% blocked
    - Outbound relay

- Primenet.com
  - High spam load
    - Avg 30 over 8 machines
  - Long delivery times
  - Smtpd upgrade
    - Avg 4 load over 2 x 2 machines
  - 80-98% rejection
  - 80K over 15 minutes (90/s) 12/14/04

Smtpd logs

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143:allow:ALL:ALL:VALIDUSERS=/dbs/mirausers
144:noto:ALL:ALL:HASH=/dbs/miradomains:550 no such user/domain

Analyzing smtpd hits

```
# /usr/local/admin/maildenied
from  Nov 12 05:37:29
to  Nov 12 06:03:27
83 allowed; 3590 denied; 3673 total; 97% denied
Allowed hits:
line    47 1
line   143 82
Denied hits:
line     7 230
line    11 5
line    13 3
line    15 2979
line    16 134
line    19 4
line    26 4
line    32 1
line    38 4
line   144 217
line   146 9
```

Tracing a rule

/usr/local/admin/grepruleip 143
...
65.244.90.181 36
66.201.92.133 59
208.50.66.182 64
64.215.96.112 64
64.214.13.82 73

/usr/local/admin/grepruledomain 143
yahoo.com 21
aol.com 33
tbnonline.com 34
BOUNCE.FACHEMO.COM 60
nsm2.jfk1.gblx.net 74
jefferies 93

More tracing

- primenet.com
  - jpdatabase.com 9
  - mezanmi.com 9
  - n2mail.com 9
  - teleadapt.com 10
  - email.ru 11
  - bangkok.com 14
  - cari.com.my 15
  - marchmail.com 15
  - iqiq.net 16
  - comcast.net 23
  - adelphia.net 32
  - rr.com 58

Denied effectiveness

- globalcrossing.net
  - Line 12   5015   60.5%   cbl.abuseat.org
  - Line 15   148   1.8%   dnsbl.njabl.org
  - Line 17   34   0.4%   opm.blitzed.org
  - Line 49   1782   21.5%   norelayfromip
  - Line 54   257   3.1%   norelayfrom
  - Line 271   168   2.0%   /(\.[ashx]?dsl|^[ashdx]?dsl)\..*\.([a-z][a-z]|net)$/
  - Line 293   134   1.6%   invalid globalcrossing.net user
  - Line 310   189   2.3%   default deny
- primenet.com
  - Line 7   2610   16.6%   cbl.abuseat.org
  - Line 11   248   1.6%   dnsbl.njabl.org
  - Line 13   16   0.1%   opm.blitzed.org
  - Line 25   2590   16.5%   norelayfromip
  - Line 26   271   1.7%   norelayfrom
  - Line 27   6609   42.1%   norelayto
  - Line 28   352   2.2%   norelaytouser
  - Line 256   2531   16.1%   invalid primenet user

Denied Effectiveness

- gblx.net
  - Line   7   4304   50.9%   cbl.abuseat.org
  - Line 10   140   1.7%   dnsbl.njabl.org
  - Line 15   53   0.6%   unknown domain
  - Line 19   447   5.3%   norelayfromip
  - Line 20   362   4.3%   norelayfrom (domain)
  - Line 49   1   0.0%   spam domain specific
  - Line 55   6   0.1%   spam ipblock specific
  - Line 97   5   0.1%   cust specific
  - Line 167   2810   33.3%   invalid local user
  - Line 170   10   0.1%   default deny

Future Thoughts

- Targeted SPF reception (aol, hotmail)
- Finish IPBLOCK
- Check into DCC

Smtpd deficiencies

- No MAIL FROM caching
- fork/spool ; scan/fork/exec
- NS rules don't work on whois valid but timeout

Introducing Spamprobe

- Pure Bayesian filter
- Inspired by Paul Graham
- C++
- Headers and body
- Flexible scoring and weighting
- BDB or PBL ISAM
- Handles MIME, quoted-printable, base64
- Multi-word phrases
- Skip HTML tags
- MD5 classification

Does it work?

- ~7-10K caught spam per day (~200 users)
- ~20-35K msgs per day
- 10-40% post smtpd spam
- < .01% false positives
- Friday 11/12 – doug
  - 672 delivered messages
  - ~4 spam
  - 76 caught by spamprobe
  - 0 false positives
  - 10% post smtpd spam
  - 95% effectiveness

Spamprobe keys to effectiveness

- Using spam
- Using ham
- Multiple users
- Multiple servers
  - Neutralization
- Modes of Operation
  - Constant training
    - +keeps learning
    - -huge DB
  - Hand training
    - +keep DB smallish
    - -occassional maintenance

Spamprobe procmail rules

```
:0 W
* < 30000
SCORE=|/usr/local/bin/spamprobe -d /usr/local/etc/spamprobe -r 5 -w 25 -x score

:0 wf
| formail -I "X-SpamProbe: $SCORE" -A "X-Delivered-To: $1@gblx.net"

# catch spam, but ignore certain things that would be
# very difficult to white list like certain mail lists.
:0 a: /usr/procmail/spamlock
* ^X-SpamProbe: SPAM
* ! ^From:.*@whackamole.com
* ! ^(X-Mailman-Version|X-Yahoo-nmail)
* ! ^From: newsalerts-noreply@google.com
```

Procmail execution

- -x   scale probabilities based upon occurrences of high and low spamminess of terms
- -r 5   more frequent words give higher weight (up to 5 occurrences)
- -w 25   use up to 25 terms for scoring

- Add a Score header
- Add a Delivered header

Spamprobe Maintenance: mailreview

- Mailreview
  - X-SpamProbe: GOOD 0.0000000 <md5sum>
  - X-SpamProbe: SPAM 1.0000000 <md5sum>
  - C code
    - mmap/madvise
    - Mbox format
    - SPAM < .99999
  - 348 messages for review out of 38245 total
  - 26 seconds

Phase 2

- spamprobe -d *spamdb* find-good > tmpfile
    - 44 minutes
    - 167 messages (of 38K)

File: ./tspam.1
Message Num: 75
Message-ID: <794526n475q0434z24n5122t1f4149_1@hotmail.com>
Digest: 0fc48916b7b63beba16c33fe33627f7e
Subject: Harvard review: adult urology treatment
NumTerms: 376
Score: 0.5902889

Fixing false positives

- Save the 'good' message to a file
- Why it do dat?
  - spamprobe -d <db> -r 5 -w 25 -T summarize /tmp/good
- Use 'good' to train
  - spamprobe -d <db> good /tmp/good
- Use edit-term to rebalance
  - spamprobe -d <db> edit-term "fancy pants" 100 0
- Use 'export' to rebalance headers
  - spamprobe -d <db> export | egrep '"Hrecv_(smtp6|smtp7)"' > /tmp/x
  - Edit and import

Adjusting weighting

```
# spamprobe  -r 5 -w 25 -x -T summarize /tmp/good
File: /tmp/good
Message-ID: <419389A6.327307E2@globalcrossing.net>
Subject: [isp-support] Primenet????
NumTerms: 195
Score: 1.0000000
   Spam Prob    Count     Good     Spam    Word
   0.0126719        1       26        1    Hmessage-id_globalcrossing
   0.9836018        1        8     1438    Hcc_primenet.com
   0.9828352        1       17     2917    Hto_primenet
   0.9828352        1       17     2917    Hto_primenet.com
   0.9815897        1        9     1438    Hcc_primenet
   0.8724486        7     1316   114538    Hrecv_nov
   0.9651531        2       57     4731    Hrecv_thu nov
   0.9520325        1      176    10468    Hreply-to_com
   0.9101423        2       34     1032    Hsender_isp
   0.9101423        2       34     1032    Hsender_isp-support
   0.9101423        2       34     1032    Hsender_support
   0.9101423        1       17      516    Hsender_isp-support gblx.net
   0.9101423        1       17      516    Hsender_isp-support isp-support
   0.8999522        1      776    20918    Hfrom_com
```

Staging a spamprobe install

- Build a personal dictionary
  - 1000s of messages
- Share with a friend
- Get a test-group
  - Analyse every few hours for 1st week
  - Analyse 1-2 times per day 2nd week
- Deployment
  - Analyse every hour for first couple days
    - Rebalance
  - Week1 1-2hours; Week2 3-4 hours; Week3 2x/day
  - 2 months; analyse once per day
  - Maintenance tasks
  - Long term 1-2 times/week

Spamprobe deficiencies

- Editing header terms is unwieldy
  - Export, edit, balance, import
- find-good slow
  - Maintenance
- Requires local delivery agent
  - Procmail, maildrop
- Images
- ISP fiasco

ISP SPAM Post-Analysis

- Sunday11/7
  - 10987 messages in ~ 5 hours
  - 24670 recipients
  - 10339 identified as SPAM by spamprobe
  - 95% spam

SPAM Tuesday analysis

- Tuesday 11/9
  - 15846 allowed to local and isp users over 8 hours
  - 33573 recipients
  - 14421 SPAM classified by spamprobe
  - 1449 dialup users
  - 91% spam of classified
  - Hand analysis shows 56% of remaining are SPAM
    - 100 sample

Bloody Vikings...

- The effects of secondary MX
  - Spam rules
  - Invalid users
- Evil spammer tricks
  - Secondary MX, 127.0.0.1, 0.0.0.0 A, rfc1918
- Using queue run output
  - /usr/sbin/sendmail -C /etc/mail/globalcrossing-despool.cf -qf -O QueueDirectory=/var/spool/mqueue/mqueue$i

  <walker_be@cica.ca>... User unknown

  <s_crameruz@carleton.ca>... User unknown

  <fernandobroussard_rr@oricom.ca>... User unknown

  <lhollidayde@openface.ca>... User unknown

Summary

- Fractal nature of spam
  - 95, 91, 60
- Multi-stage reduction
- Know your users
- Reject, Adapt, Track, Refine, Automate
- Do
  - Only accept valid addresses (the firewall paradox)
  - Constantly refine
  - Use an rbl (or two)
  - Find a Bayesian that you like
  - Front-load deny rules
- Don't
  - Accept things with invalid from
  - Accept things with bogus NS or MX or A
  - Lose email

I didn't know my slut was broken.. You must be very proud?

From: Agrana <momcashfalcons@comcast.net>
To: doug@eng.auburn.edu
Subject: my mom is such a slut mender 08/30/04

The liniment and courtesan could be interesting. Staying upwind from skunks is always prudent. I could do without the monsoon, slogging effluent and the dead president.

From: Glen Person <NUBHI@care-mail.com>
To: doug@gblx.net
Subject: celebrate Doug's birthday today
Parts/Attachments:
    1.1 Shown   27 lines Text (charset: ISO-8859-1)
    1.2   OK   58 lines Text (charset: ISO-8859-1)
    2   11 KB   Image
    3   8.7 KB   Image
----

liniment moraine silicon mellon agatha monsoon
euphemist abase **upwind skunk**
vexation **courtesan** afoul dynast slogging effluent
aerospace **reagan** seaweed

You could say that..

From: "Aaron Compton" <avjattarwzgw@hotmail.com>
To: <adam@nojes.com>
Subject: Get too much SPAM?

Spelling support, I think..

From: Bud <xwqbb@letsjam.com>
To: mixilplig@gblx.net
Subject: Re: Re: Support Info
Parts/Attachments:
  1.1 Shown   63 lines Text
  2   10 KB   Image
----

uvoexhtzb ezbpegwmh xcvcbnkr. iswltrbj isxuu mzamibui sgxrx aqzslfx.
mqizszprk qilklinq rpmfct nzmzkfk jslwbqyw lguwfttu sjbxxg anaksv esibr

Whattheheckishetalkingabout?

Hellodearhomeowner,

Wehavebeennotifiedthatyourmortgage rateisfixedataveryhighinterestrate. Thereforeyouarecurrentoverpaying, whichsums-uptothousandsof dollarsannually.

Stacy. Are you out there? About your mom...

Message-ID: <iowarablondovkha@mail.teadrive.com>
Subject: Stacy's Mom Has Got It Going On seanmb

Message-ID: <eknikvvsouuikydn@mail.teadrive.com>
Subject: Stacy's Mom Has Got It Going On mgainey

Message-ID: <qdzytahvjjavdxzw@mail.teadrive.com>
Subject: [ncc] Stacy's Mom Has Got It Going On ncc

Message-ID: <utsyyisfnrzhyleb@mail.teadrive.com>
Subject: [ice] Stacy's Mom Has Got It Going On peering

A very happy peering customer?

Subject: [bgp] Can't forget our first time bgp!

That must have been some first time..

To: "Lana Peterson" <watermellon@emogame.com>
Subject: [bgp] I need the hairdryer back

And I don't even do BGP..

Subject: Can't forget our first time doug!
From: First Timer <FirstTimer@basicclub.com>
To: doug@gblx.net

What do non-provocative men do? What does it have to do with the barnyard? On second thought, I don't want to know.

From: Lance Schmidt <dorotheos.laudeman@gblx.net>
To: Dorotheos.laudeman <dorotheos.laudeman@gblx.net>
Subject: barnyard

Email loading... %

[g0.gif]

aspirate dimension orography conn basso teeing io anchoritism bewilder
procyon provocative men rudder

A big "rudder"?

From: "Dick Nealth" <kascgrfxzlj@yahoo.com>
To: "Rip"
Subject: get it big, guys

Obviously they haven't met the ncc or they wouldn't need to ask..

Subject: [ncc] Are You Lonely or Horney?

Condotion? Does c1@lis cure that?

From: Cornellfomvr@montevideo.com.uy
To: Aubrey
Subject: does your boyfriend suffer from your urology condotion

Well, not if you shared it with Antony and the clubhouse..

From: "Chuck Eaton" <khbrsduigrmge@btopenworld.com>
To: "Ben"
Subject: Our little secret

cannot cognizant artistry afterimage bassett **antony** abrasive
committing cz crucible concept cotman apple cupid censor amp
colon coagulate adsorb dewitt bavaria byrne bite briggs declare
cohosh bounty astronautic abo alfredo **clubhouse** bechte

Amen, brother.

From: "Andy" <Andy@gdataz.com>
Reply-To: "Andy" <Andy@gdataz.com>
Subject: Stop the Porn. Stop Spam.