FACE: Automated Digital Evidence Discovery and Correlation

By

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FACE: Automated Digital Evidence Discovery and Correlation

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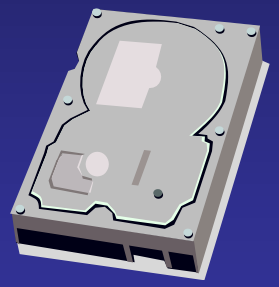
Forensics Challenge ‘08

- 3 Pieces of evidence
  - pcap network capture
  - Linux RAM dump
  - Files from a user home directory
- Object
  - Find user activity
  - Anything suspicious
  - Collaboration?
- Live forensics

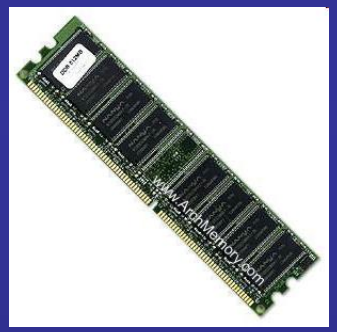
The Problem

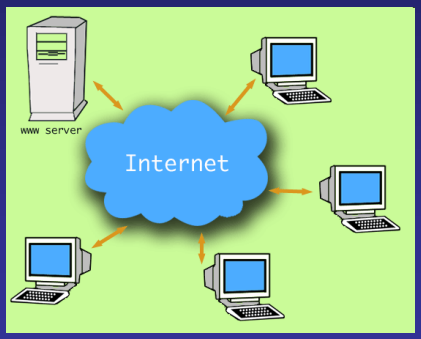


Disk has: filesystem,

files, and MAC times

RAM has info on running processes, loaded modules, and live network connections.



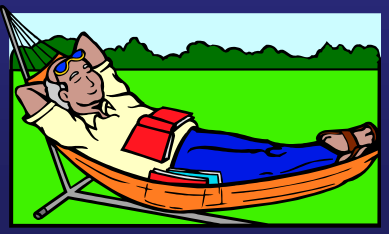


Network capture has data in packets; part of logical network connection.

Plethora of tool exist for each types of data from each source.

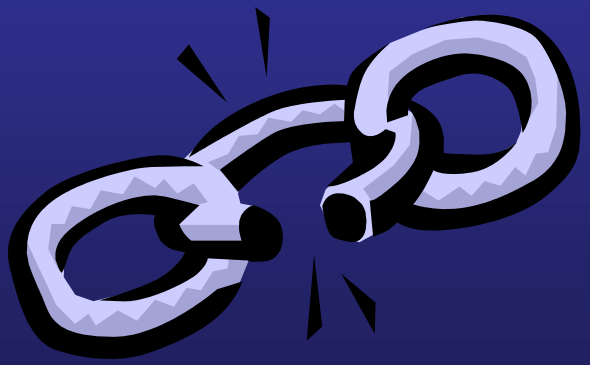
But, the objects of interest (users, processes, network connections) are described in part by each. Investigator must “connect the dots.”

I am far too lazy to do this manually!



Solution

- FACE: Forensic Automated Correlation Engine
  - Correlate data for object across sources
  - Automate some of the “dot-connecting”
  - Penguin Power!
- Good: Have disk and network stuff
  - Wireshark …
  - Sleuthkit, Scalpel (shameless plug: new version soon!)
- Bad: linux RAM tools?
  - Idetect for 2.4
  - Crash and gdb
  - ???



Introducing: *ramparser*

- Overview
  - Linux 2.6, x86 (caveat later)
  - C
  - Processes
  - Loaded modules
  - Network connections
  - More!
  - Focus of this talk

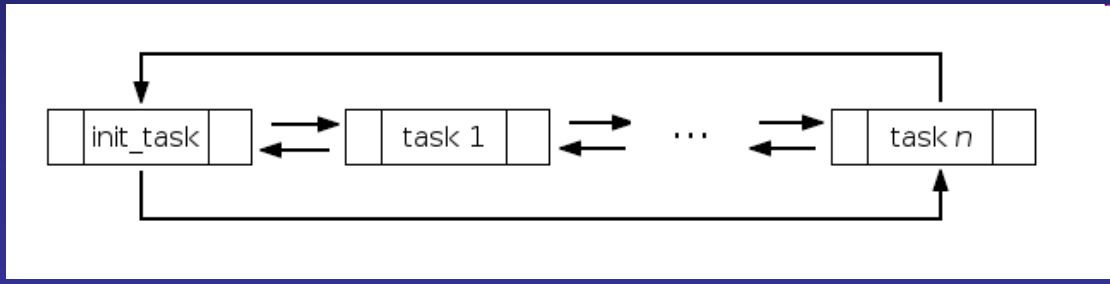
Processes

- The Plan
  - Phase 1: Find task_struct for “init”
  - Phase 2: ?
  - Phase 3: Profit!

- task_struct: the mother load
  - System.map (init_task)
  - Carving
  - Caveat: task_struct representation
    - Kernel version
    - .config
    - CRAZY distro patches

Processes (more)

- Follow list or carve
- Basic: like ps aux
- Hardcore:
  - Code and data segments
  - Stack and heap
- Open files and network sockets: /proc/<pid>/fd
  - Linkage to disk image and network capture
- Mappings: /proc/<pid>/maps
  - Files
  - libraries
  - anonymous



Process Listing

#./ramparser challenge.mem -x

```
2152                501             501             gnome-session
/usr/bin/gnome-session

2262                501             501             bt-applet
bt-applet --sm-disable

2266                501             501             puplet
/usr/bin/python -tt /usr/bin/puplet

2269                501             501             vmware-user
/usr/lib/vmware-tools/bin32/vmware-user >/dev/null 2>&1 -blockFd 11

3048                501             501             firefox-bin
/usr/lib/firefox-1.5.0.12/firefox-bin
```

sock, socket and sk_buff, Oh my!

- Struct sock, struct socket
- Duplicate basic netstat functionality
- Buffers: struct sk_buff
  - More complete network capture
  - Sockets have per-connection
    - Send queue (more useful)
    - Receive queue (less useful)
    - Still in kernel (so not in network capture)
    - Exfiltration detection anyone?

Netstat Output

#./ramparser challenge.mem -N

Proto	Local Address	Foreign Address	State	PID	Program name
TCP	0.0.0.0:111	0.0.0.0:0	LISTEN	1959	portmap
TCP	0.0.0.0:22	0.0.0.0:0	LISTEN	2311	sshd
TCP	0.0.0.0:60126	0.0.0.0:0	LISTEN	2332	rpc.statd
TCP	192.168.20.128:45351	192.168.20.129:20	ESTABLISHED	2548	ftp
TCP	192.168.20.128:55071	192.168.20.129:80	ESTABLISHED	2521	firefox-bin
TCP	192.168.20.128:59447	192.168.20.129:21	ESTABLISHED	2548	ftp
UDP	0.0.0.0:111	0.0.0.0:0		1959	portmap
UDP	0.0.0.0:32768	0.0.0.0:0		2332	rpc.statd
UNIX				2195	klogd
UNIX				2301	dhclient3

Modules

- struct module
  - Carved or from list
  - Better carved, rootkits!
- Duplicates some lsmod functionality

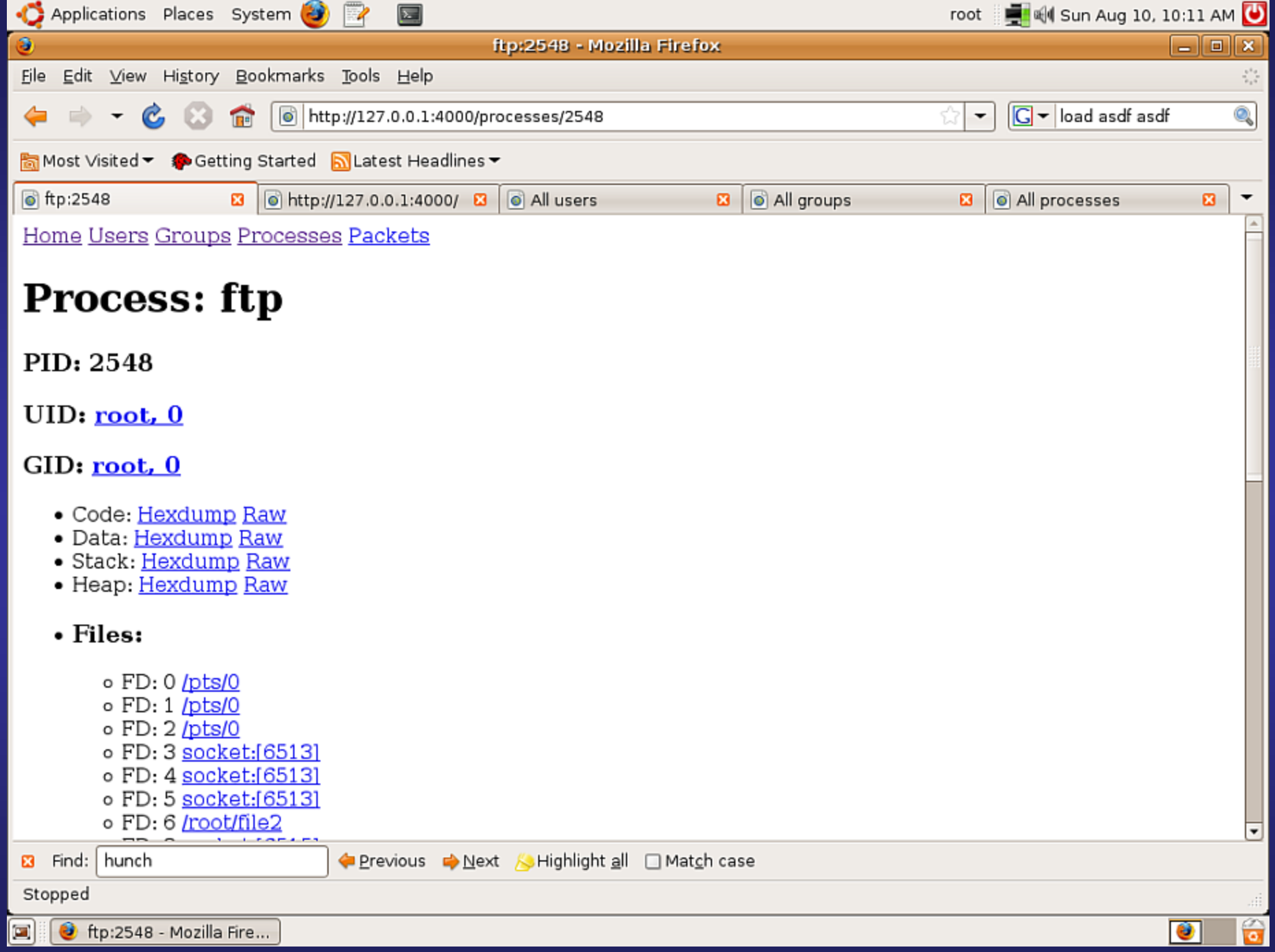
Module Listing

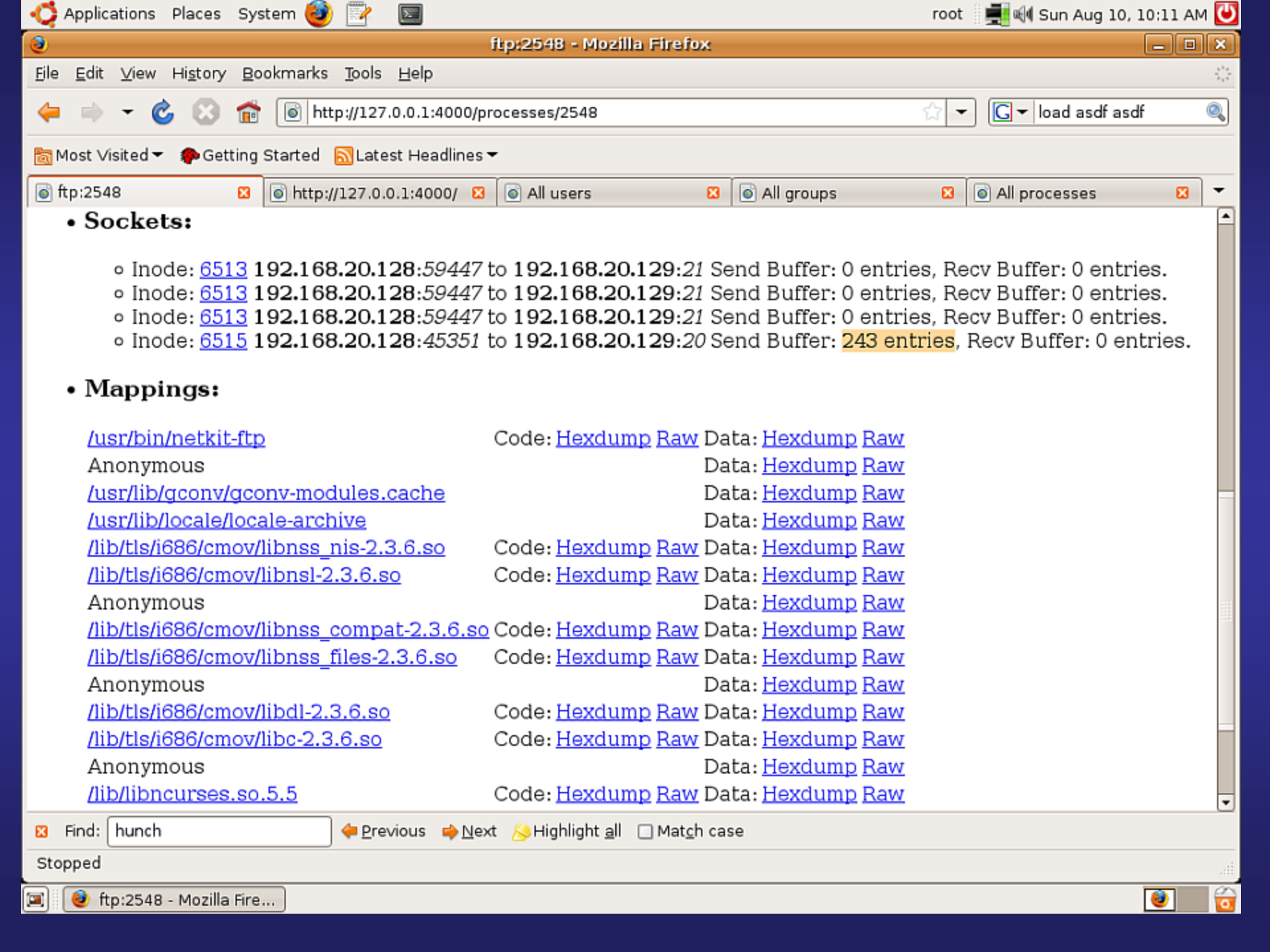
#./ramparser challenge.mem -m

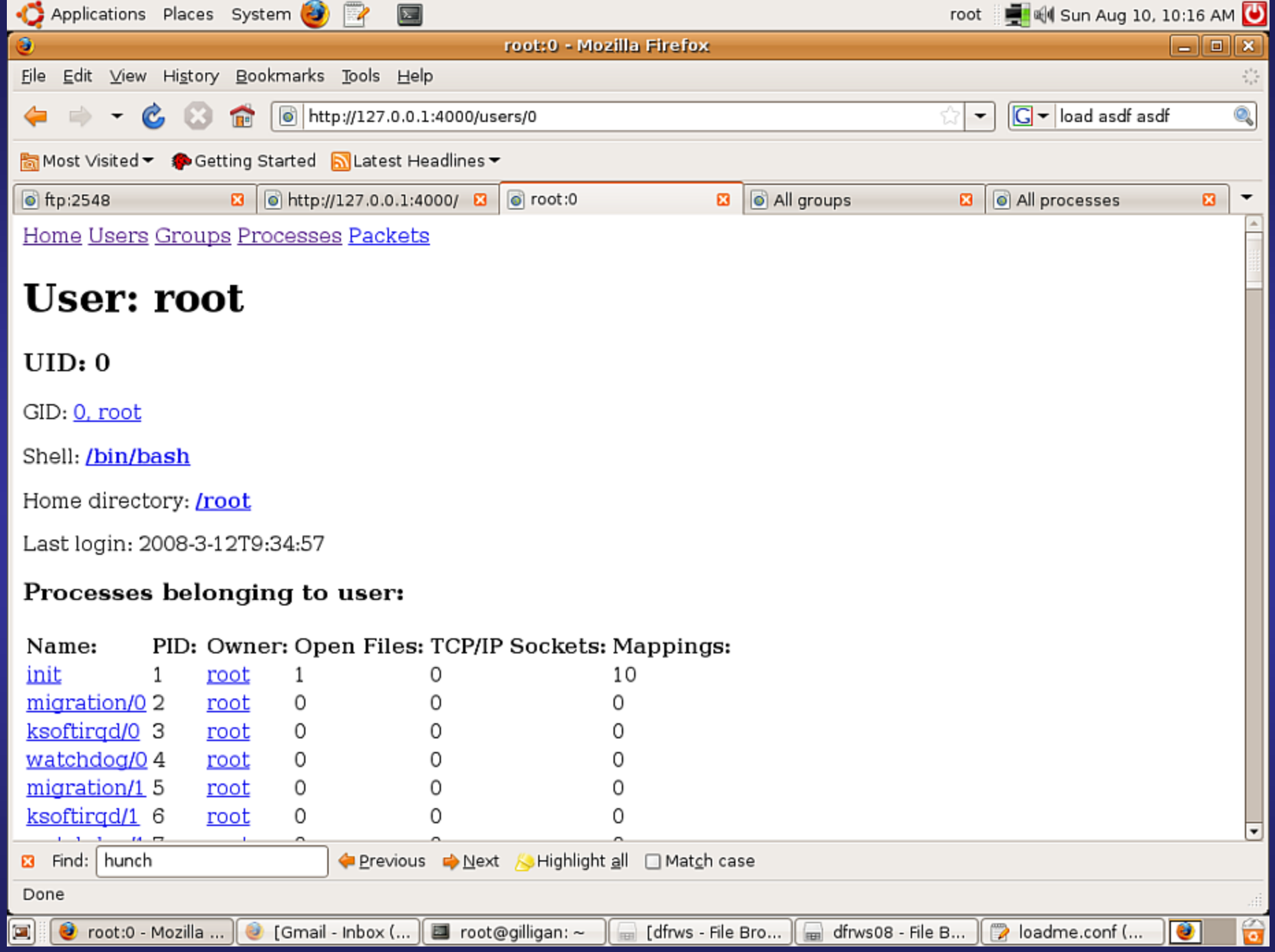
0xd154f100	uhci_hcd	25421	MODULE_STATE_LIVE
0xd1561880	ohci_hcd	23261	MODULE_STATE_LIVE
0xd156ee00	ehci_hcd	32845	MODULE_STATE_LIVE
0xd157cc00	mptspi	20041	MODULE_STATE_LIVE
0xd157f780	sd_mod	22977	MODULE_STATE_LIVE
0xd16a5a80	jbd	56553	MODULE_STATE_LIVE
0xd16c1a80	mptbase	52833	MODULE_STATE_LIVE
0xd170ae80	ext3	123081	MODULE_STATE_LIVE
0xd1735a00	scsi_mod	130637	MODULE_STATE_LIVE
0xd1805a00	sg	35933	MODULE_STATE_LIVE

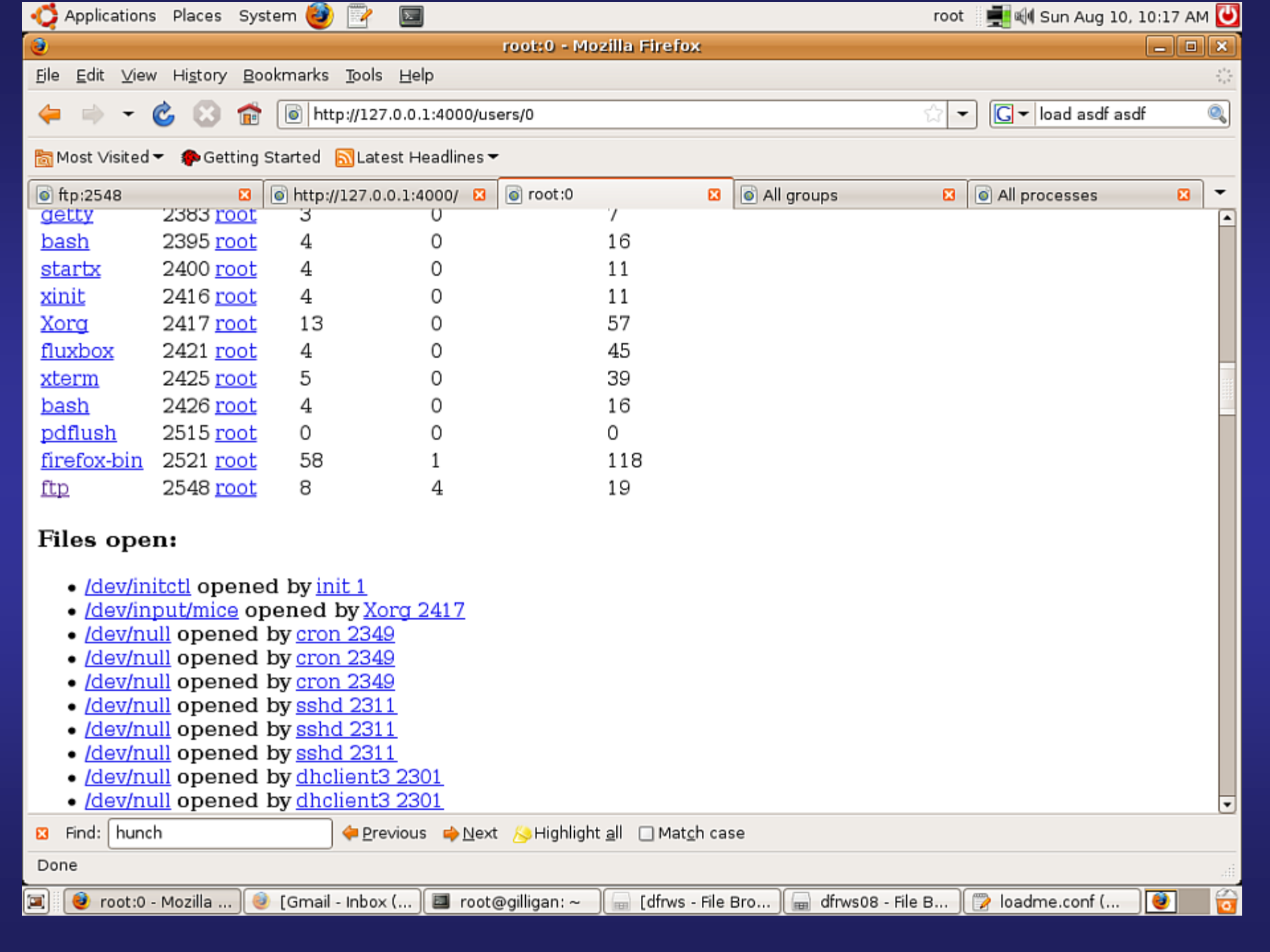
Now what?

- Have overview of ram contents
- Disk <-> RAM <-> network linkage
- *ramparser* dump mode
- Feeds FACE correlation engine
  - Also simple network capture parsing
  - And some key config files
    - /etc/passwd
    - /etc/group
    - /var/log/wtmp
- Lookee here! (just a taste)


Applications Places System
root Sun Aug 10, 10:11 AM
ftp:2548 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:4000/processes/2548
load asdf asdf
Most Visited Getting Started Latest Headlines
ftp:2548
http://127.0.0.1:4000/
All users
All groups
All processes
Home Users Groups Processes Packets
Process: ftp
PID: 2548
UID: root, 0
GID: root, 0
Code: Hexdump Raw
Data: Hexdump Raw
Stack: Hexdump Raw
Heap: Hexdump Raw
Files:
FD: 0 /pts/0
FD: 1 /pts/0
FD: 2 /pts/0
FD: 3 socket:[6513]
FD: 4 socket:[6513]
FD: 5 socket:[6513]
FD: 6 /root/file2
Find: hunch
Previous
Next
Highlight all
Match case
Stopped
ftp:2548 - Mozilla Fire...


Applications Places System
root Sun Aug 10, 10:11 AM
ftp:2548 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:4000/processes/2548
load asdf asdf
Most Visited Getting Started Latest Headlines
ftp:2548
http://127.0.0.1:4000/
All users
All groups
All processes
• Sockets:
◦ Inode: 6513 192.168.20.128:59447 to 192.168.20.129:21 Send Buffer: 0 entries, Recv Buffer: 0 entries.
◦ Inode: 6513 192.168.20.128:59447 to 192.168.20.129:21 Send Buffer: 0 entries, Recv Buffer: 0 entries.
◦ Inode: 6513 192.168.20.128:59447 to 192.168.20.129:21 Send Buffer: 0 entries, Recv Buffer: 0 entries.
◦ Inode: 6515 192.168.20.128:45351 to 192.168.20.129:20 Send Buffer: 243 entries, Recv Buffer: 0 entries.
• Mappings:
/usr/bin/netkit-ftp Code: Hexdump Raw Data: Hexdump Raw
Anonymous Data: Hexdump Raw
/usr/lib/gconv/gconv-modules.cache Data: Hexdump Raw
/usr/lib/locale/locale-archive Data: Hexdump Raw
/lib/tls/i686/cmov/libnss_nis-2.3.6.so Code: Hexdump Raw Data: Hexdump Raw
/lib/tls/i686/cmov/libnsl-2.3.6.so Code: Hexdump Raw Data: Hexdump Raw
Anonymous Data: Hexdump Raw
/lib/tls/i686/cmov/libnss_compat-2.3.6.so Code: Hexdump Raw Data: Hexdump Raw
/lib/tls/i686/cmov/libnss_files-2.3.6.so Code: Hexdump Raw Data: Hexdump Raw
Anonymous Data: Hexdump Raw
/lib/tls/i686/cmov/libdl-2.3.6.so Code: Hexdump Raw Data: Hexdump Raw
/lib/tls/i686/cmov/libc-2.3.6.so Code: Hexdump Raw Data: Hexdump Raw
Anonymous Data: Hexdump Raw
/lib/libncurses.so.5.5 Code: Hexdump Raw Data: Hexdump Raw
Find: hunch
Previous Next Highlight all Match case
Stopped
ftp:2548 - Mozilla Fire...


Applications Places System
root
Sun Aug 10, 10:16 AM
root:0 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:4000/users/0
load asdf asdf
Most Visited
Getting Started
Latest Headlines
ftp:2548
http://127.0.0.1:4000/
root:0
All groups
All processes
Home Users Groups Processes Packets
User: root
UID: 0
GID: 0, root
Shell: /bin/bash
Home directory: /root
Last login: 2008-3-12T9:34:57
Processes belonging to user:
Name: PID: Owner: Open Files: TCP/IP Sockets: Mappings:
init 1 root 1 0 10
migration/0 2 root 0 0 0
ksoftirqd/0 3 root 0 0 0
watchdog/0 4 root 0 0 0
migration/1 5 root 0 0 0
ksoftirqd/1 6 root 0 0 0
Find: hunch
Previous
Next
Highlight all
Match case
Done
root:0 - Mozilla ...
[Gmail - Inbox (...
root@gilligan: ~
[dfrws - File Bro...
dfrws08 - File B...
loadme.conf (...


Applications Places System
root
Sun Aug 10, 10:17 AM
root:0 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:4000/users/0
load asdf asdf
Most Visited
Getting Started
Latest Headlines
ftp:2548
http://127.0.0.1:4000/
root:0
All groups
All processes
getty 2383 root 3 0 7
bash 2395 root 4 0 16
startx 2400 root 4 0 11
xinit 2416 root 4 0 11
Xorg 2417 root 13 0 57
fluxbox 2421 root 4 0 45
xterm 2425 root 5 0 39
bash 2426 root 4 0 16
pdflush 2515 root 0 0 0
firefox-bin 2521 root 58 1 118
ftp 2548 root 8 4 19
Files open:
/dev/initctl opened by init 1
/dev/input/mice opened by Xorg 2417
/dev/null opened by cron 2349
/dev/null opened by cron 2349
/dev/null opened by cron 2349
/dev/null opened by sshd 2311
/dev/null opened by sshd 2311
/dev/null opened by sshd 2311
/dev/null opened by dhclient3 2301
/dev/null opened by dhclient3 2301
Find: hunch
Previous
Next
Highlight all
Match case
Done
root:0 - Mozilla ...
[Gmail - Inbox (...
root@gilligan: ~
[dfrws - File Bro...
dfrws08 - File B...
loadme.conf (...

Conclusions

- DFRWS challenge
  - I'm too lazy to connect all the dots
- *ramparser:*
  - processes including …
  - netstat and socket buffers
  - Modules
- FACE for automatic correlation

Future Work

- Really “present” work (half done)
- Generic 2.6 version
  - Dynamically build task_struct representation
  - Static symbols in System.map
  - From scratch
- Timestamp madness
- More RAM parsing fun
  - Block cache
  - Integrate swap

Questions / Comments?

This is the end
Beautiful friend
This is the end
My only friend, the end

- JM

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