Network Exploitation with Ncrack

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sock-raw.org

whoami

- Network security researcher (sock-raw.org)
- Exploiting TCP and the Persist Timer Infiniteness (Phrack #66)
- Abusing Network Protocols (stealthy portscanning through XMPP exploitation)
- Nmap/Ncrack development

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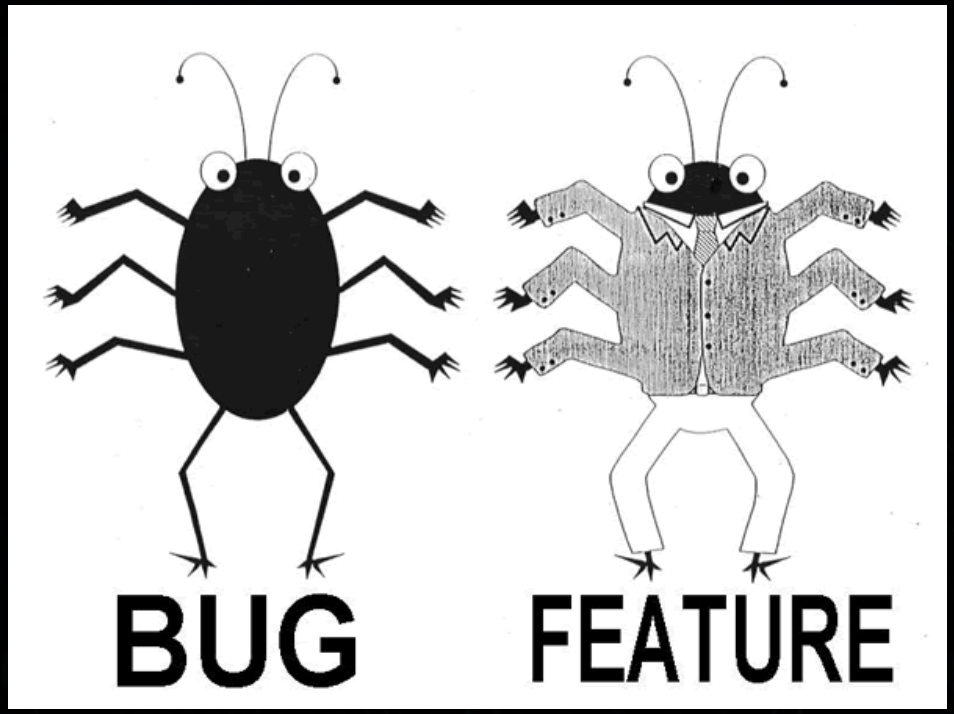
http://sock-raw.org/gpgkey

How it all started

It was a bug.
Not a feature.

First significant feedback to Nmap project.



http://seclists.org/nmap-dev/2008/q4/543

ip->ip_len != IP length

/usr/src/linux-2.6.26/net/ipv4/raw.c

```
iphlen = iph->ihl * 4;
if (iphlen >= sizeof(*iph)
   && iphlen <= length) {
     if (!iph->saddr)
       iph->saddr = rt->rt_src;
       iph->check   = 0;
       // iph->tot_len = htons(length);
       if (!iph->id)
         ip_select_ident(iph,
           &rt->u.dst, NULL);
  …
```

Linux being too strict. No problem: recompile kernel

No shady business there, sir.

/usr/src/sys/kern/raw_ip.c

```
if (((ip->ip_hl != (sizeof (*ip) >> 2))
       && inp->inp_options)
       || (ip->ip_len > m->m_pkthdr.len)
       || (ip->ip_len < (ip->ip_hl << 2))) {
         INP_UNLOCK(inp);
         m_freem(m);
         return EINVAL;
 }
```

150-175 Open Source Organizations

3-4 months

1000 students

~26k lines of code (Ncrack)

4,500k – 5000k $ stipends

The goal: Ncrack

Ncrack is designed to be a fast and flexible network authentication cracker. You can point it at a service (ssh, msrpc, http, imap, pop3, SNMP, telnet, ftp, etc.) and it will make repeated authentication attempts. The goal is, of course, to find working credentials by brute force. It is a very handy tool to have during pen-tests, as many/most users still choose weak passwords.

http://seclists.org/nmap-dev/2009/q2/238

RFC on Ncrack, A new network authentication cracker

Why?

- Weak passwords more common than exploits
- Brute force scripts most popular in NSE
- Competitors (*THC-Hydra, Medusa* etc)
  - not very actively maintained
  - some are way old and buggy (*Brutus, TSGrinder*)
  - portability problems (esp. Windows)
  - limitations (multiple hosts, timing fine-graining)
- Top 15 security tools (sectools.org) are cracking natured

Architecture

< timing
& dynamic
adaptation >

< registers Nsock
callback handlers >

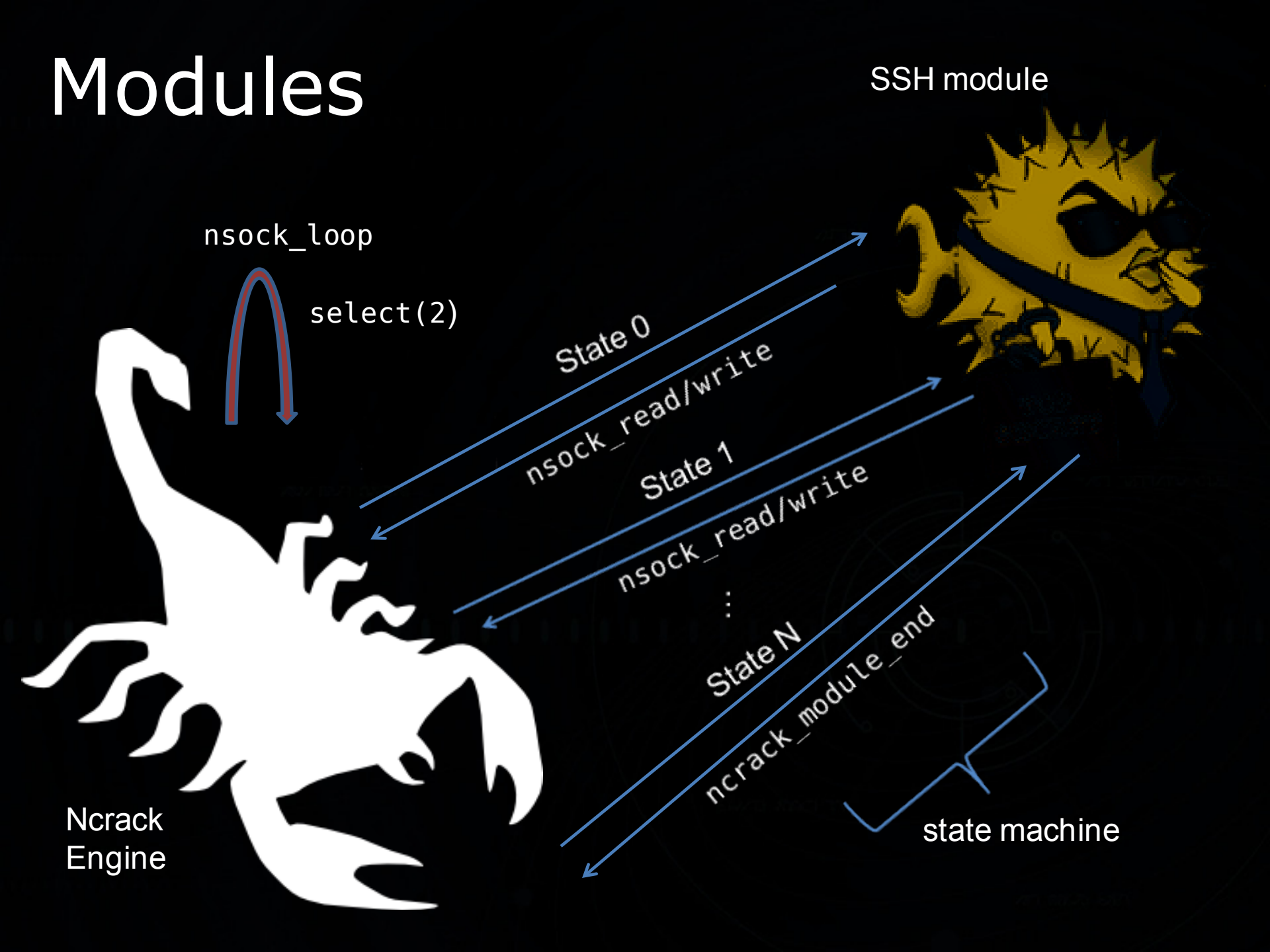
< checks
network
conditions >

< handles
connection &
authentication
endings >

Ncrack Core
Engine
0.4 alpha

< calls protocol
modules >

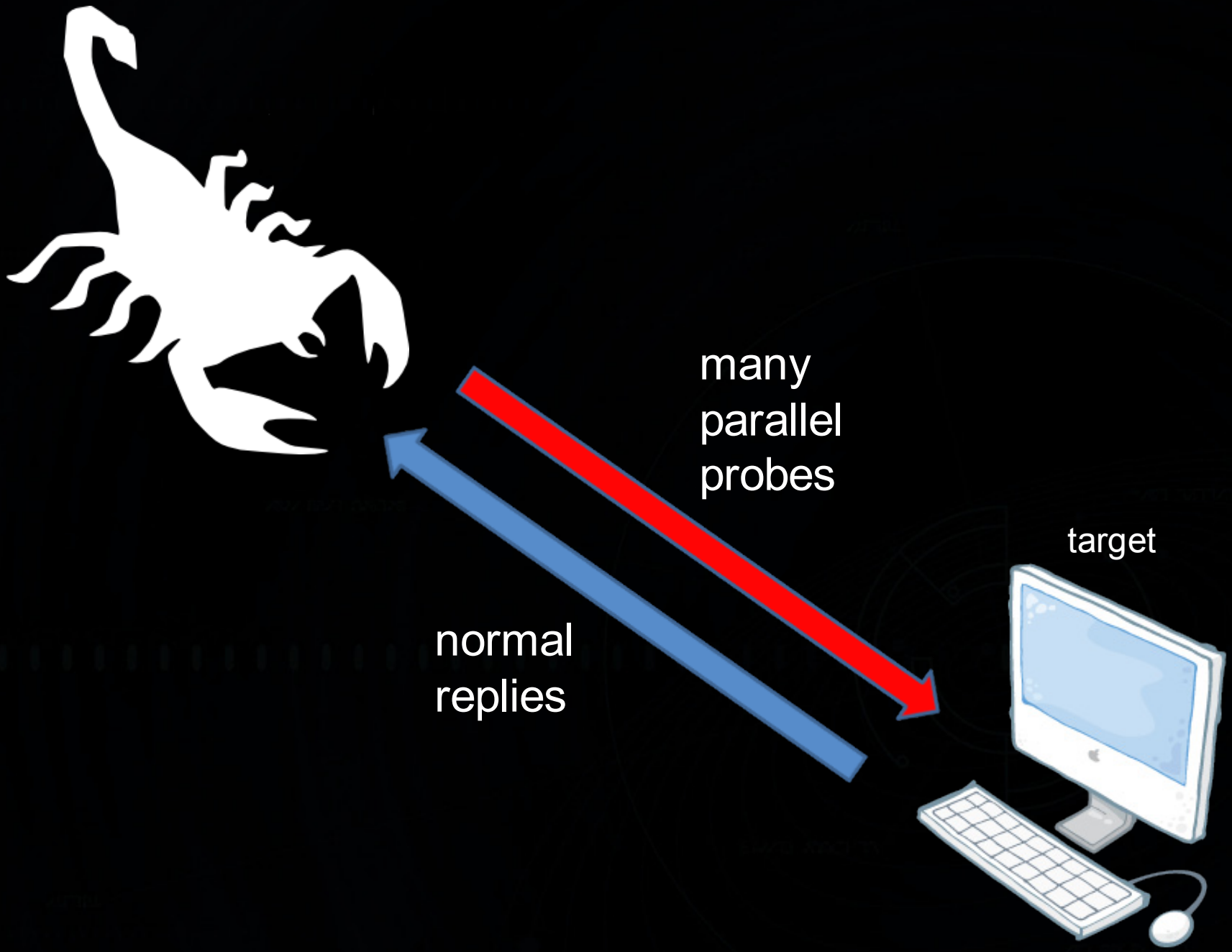
Modules

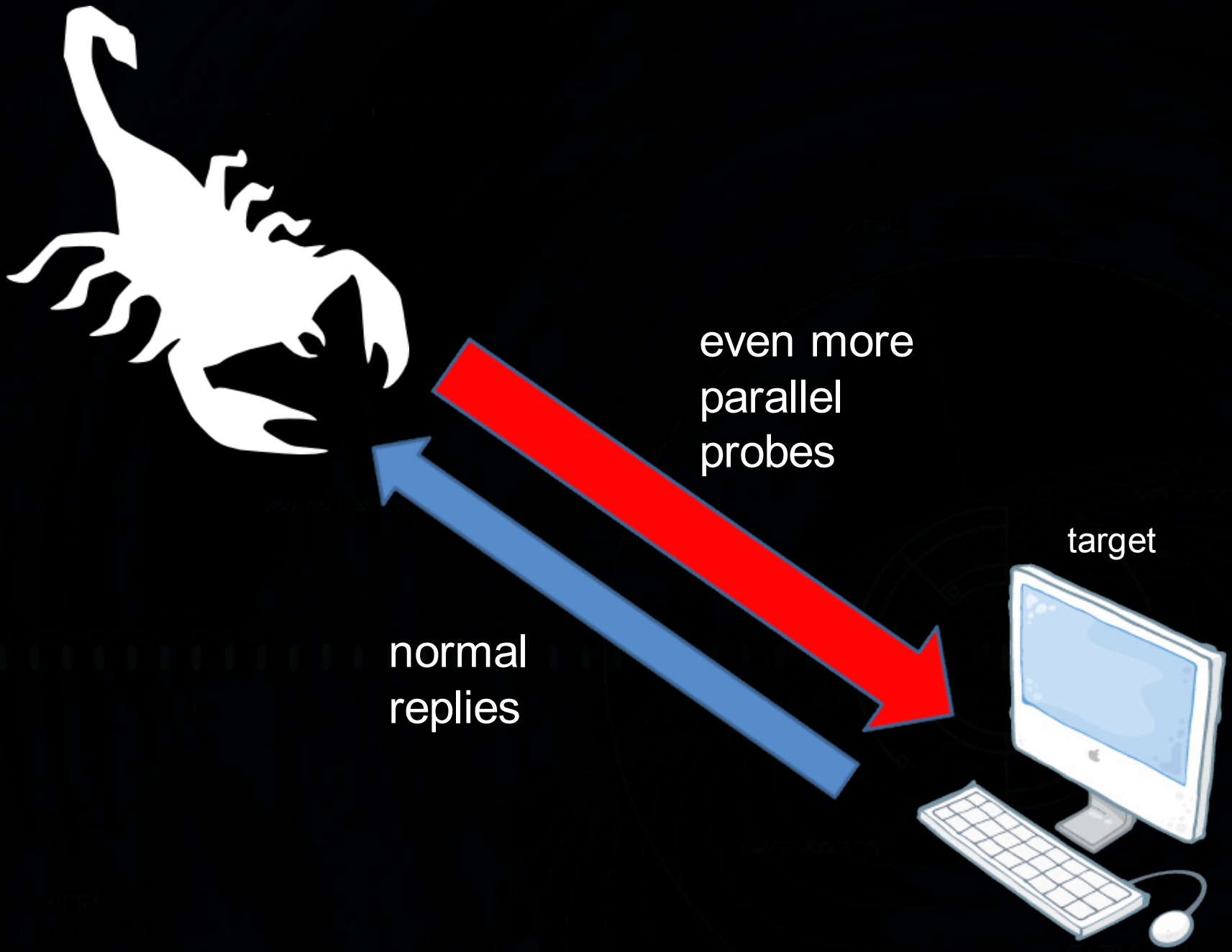

SSH module
nsock_loop
select(2)
State 0
nsock_read/write
State 1
nsock_read/write
State N
ncrack_module_end
Ncrack
Engine
state machine

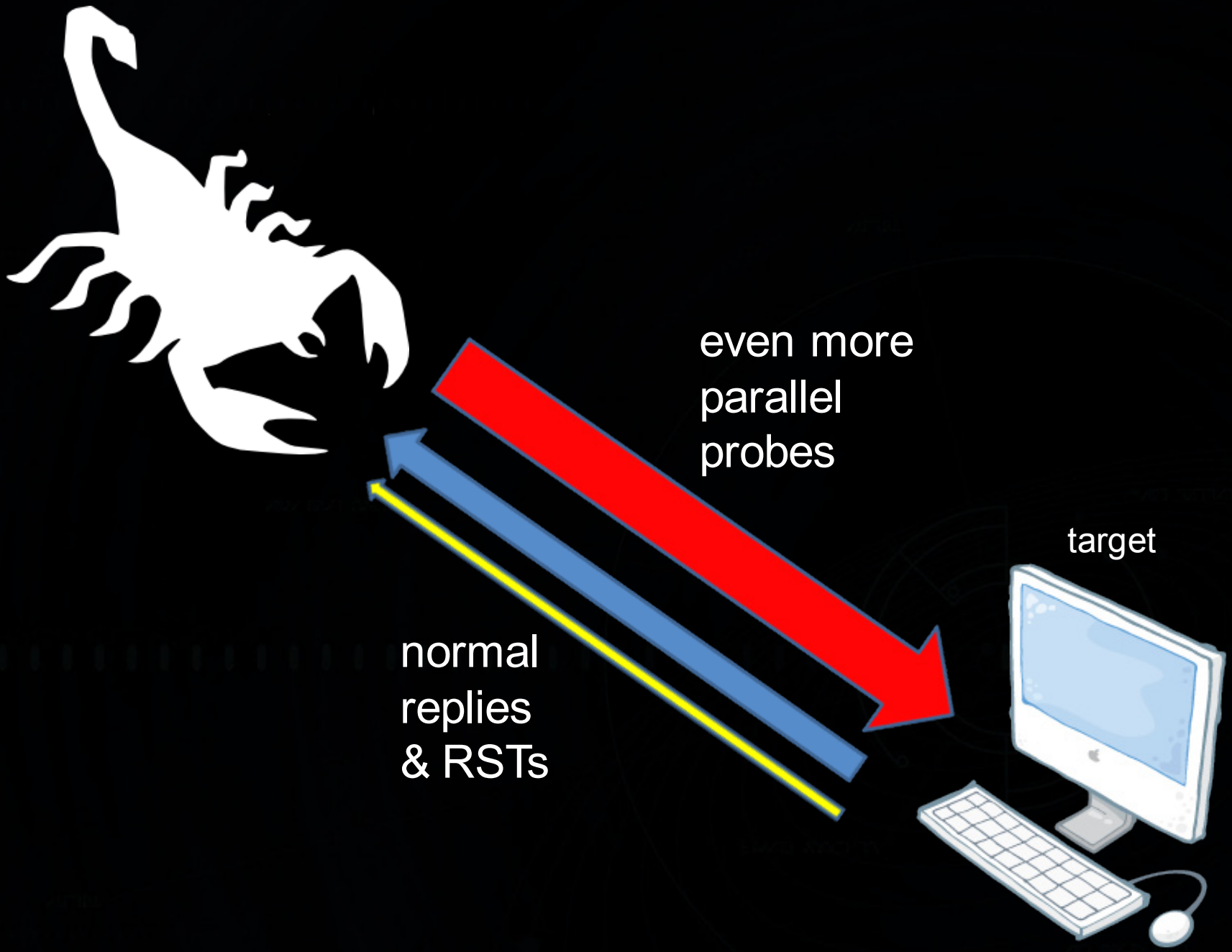
Nsock above TCP => no SOCK_RAW

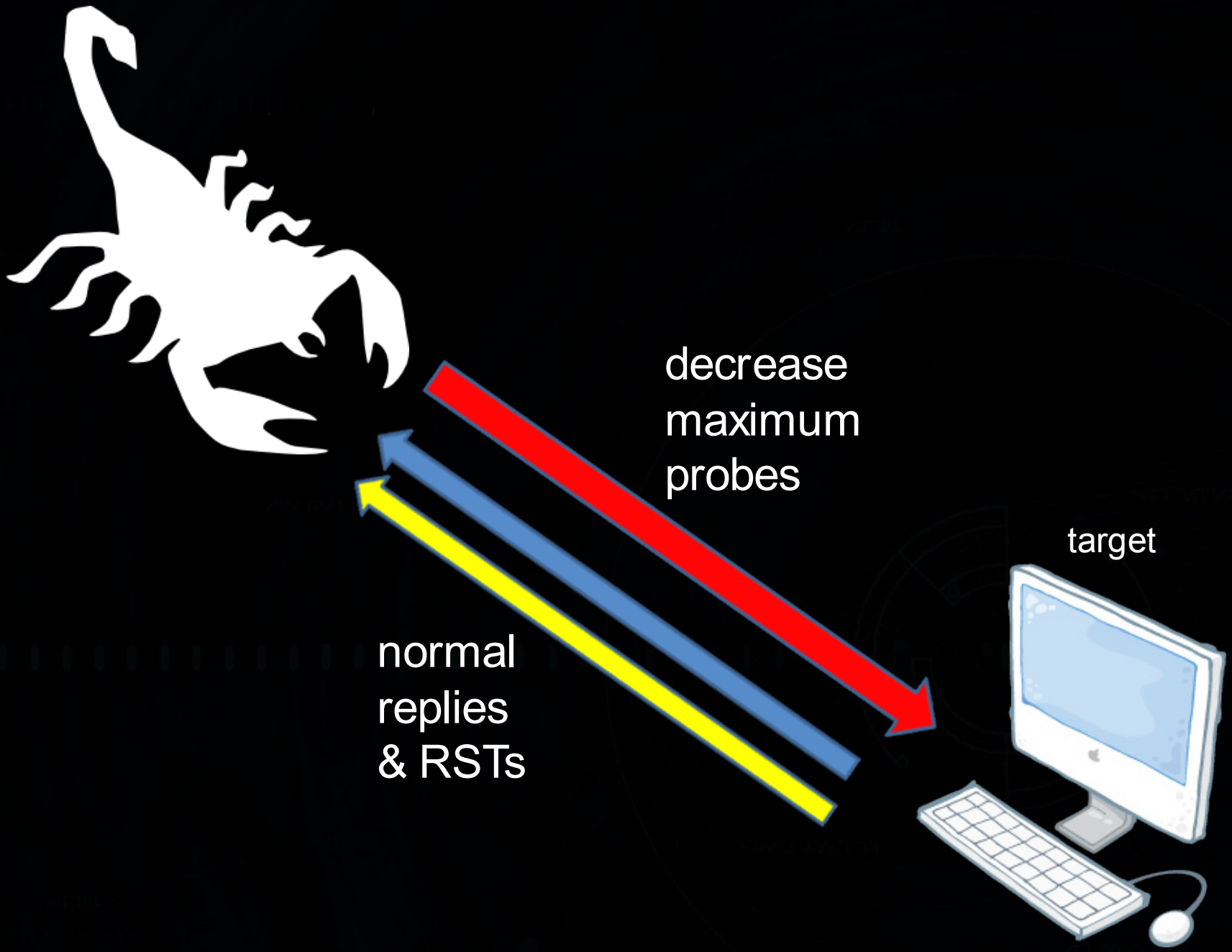
Problem: timing algo without power over packets

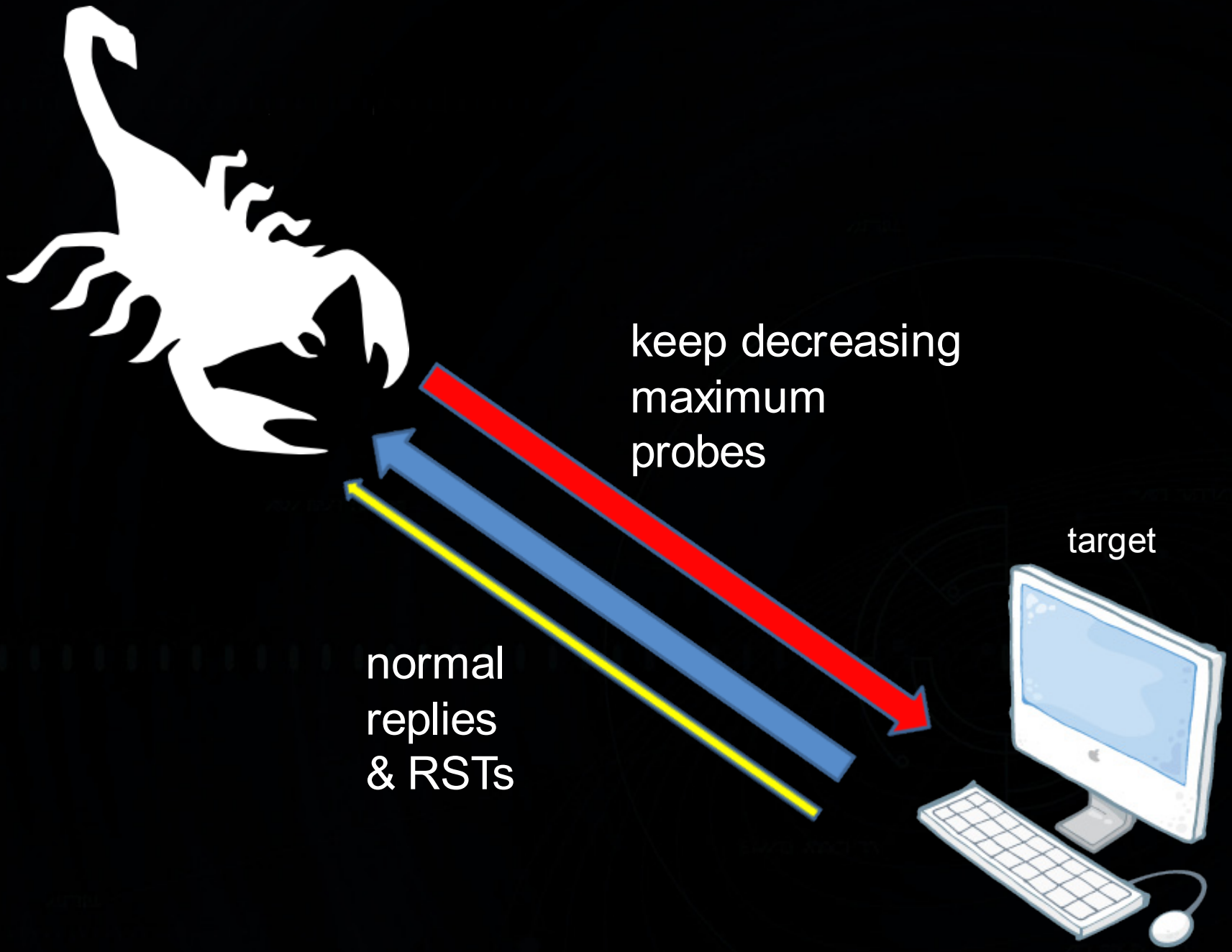
Solution: rely on **RST**, **timeouts** **and statistics**

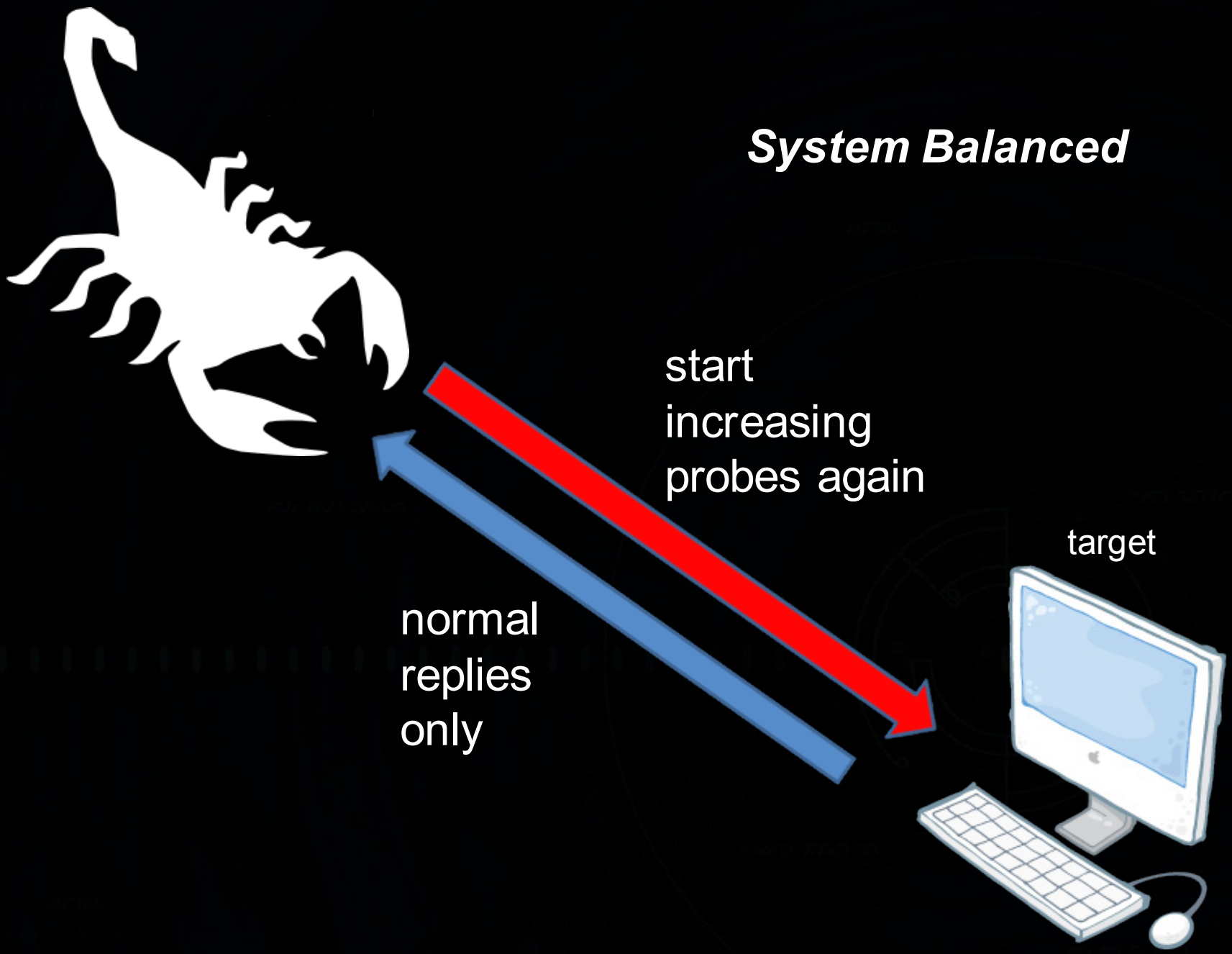

many
parallel
probes
target
normal
replies


even more
parallel
probes
target
normal
replies


even more
parallel
probes
target
normal
replies
& RSTs


decrease
maximum
probes
target
normal
replies
& RSTs


keep decreasing
maximum
probes
target
normal
replies
& RSTs


System Balanced
start
increasing
probes again
target
normal
replies
only


mean = ideal
parallelism?
ncrack
probes
RSTs
0
t

What about timeouts?

Much more difficult to handle:

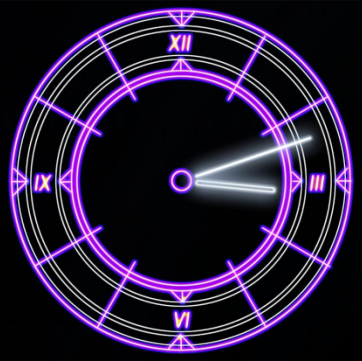
- might be due to network failure
- may stem from firewall rulesets
- could be combined with RSTs

or

- may result from accidentally DoS-ing the scanned service

In reality, our metric is not the amount of RSTs or timeouts but the **authentication rate**.

Ideally: use a trial-and-error approach and save a history of different performances



Timing algorithm

Experimentation phase:

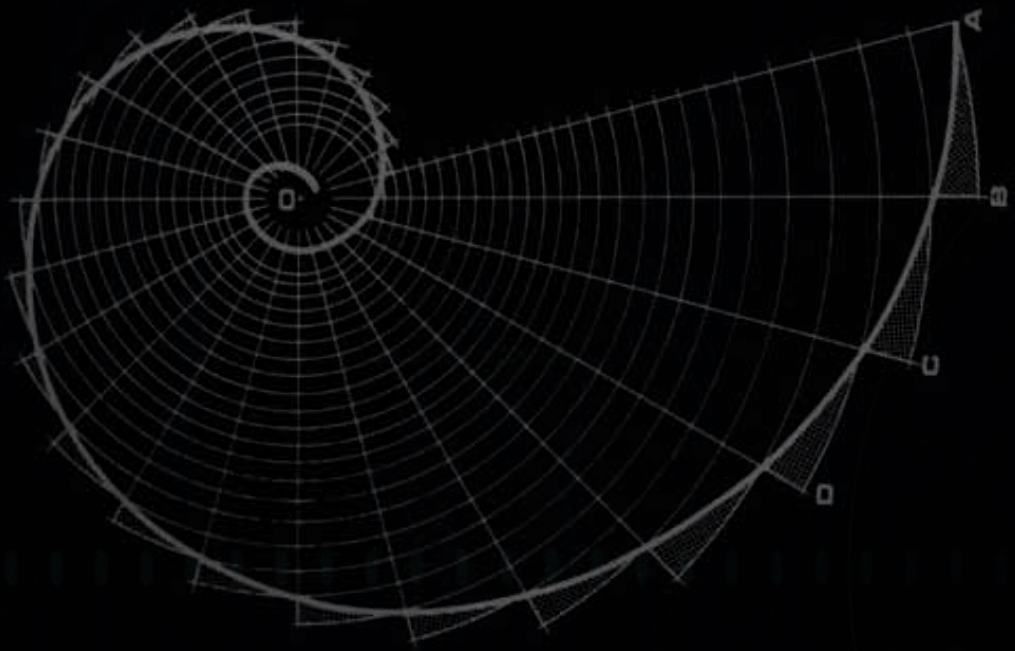
1. keep increasing parallel probes until:
   a. authentication rate drops OR
   b. authentication rate stays the same OR
   c. any error occurs (RST, timeout)
2. drop limit of probes if one of the above happens
3. Goto 1 until you have an adequate sample

Chicken and egg problem

How do we know we reached the ideal parallelism?

Answer: We don't. We always have to rely on past samples, which have been gathered through trial-and-error.

In search of the Golden Ratio



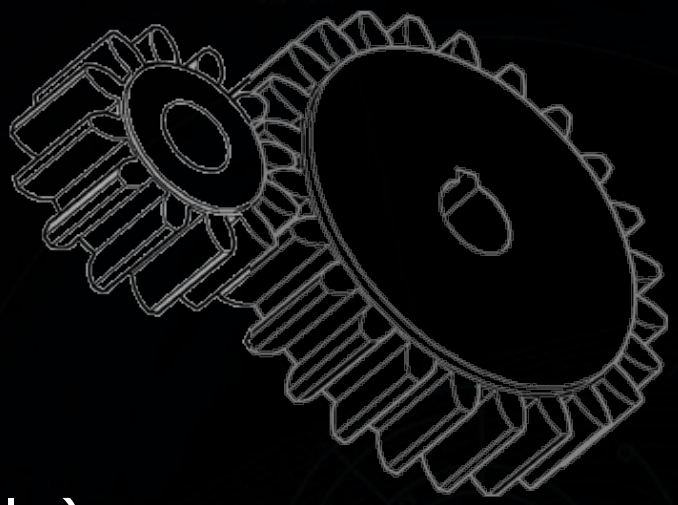
- **Accuracy**
- **Speed**
- **Resource saving**

Problem: Network conditions are dynamic and often random.

Temporarily use the mean of the samples and rerun sample-gathering algorithm at intervals.

Time fine-graining

User defined options which override Ncrack's dynamically found values.



Timing Template (Nmap style)

```
-T paranoid|sneaky|polite|normal|aggressive|insane
```

OR

T0-T5

possible DoS

Imposing limits

-cl (min connection limit): minimum number of concurrent parallel connections

VS

-CL (max connection limit): maximum number

-cd (connection delay): adjust delay time between each new connection

esp. useful for resource saving

-at: authentication attempts per connection

Punching the firewall hole

Assumption: Blocks IP if connections > 2 per minute

Scenario: Crack at least one SSH account of host "*diogenis.ceid.upatras.gr*" listening on *port 45120* without alerting/triggering any firewall/IDS.

sshd_config defaults

```
MaxAuthTries: 6
MaxStartups: 10
```

maximum attempts per connection (use -at)

maximum concurrent connections per IP (use –CL)

Our attack will take place during the nights only (use -to and cron)

Ncrack initially sends a *reconnaissance probe* to figure out maximum authentication attempts per connection

1 connection only

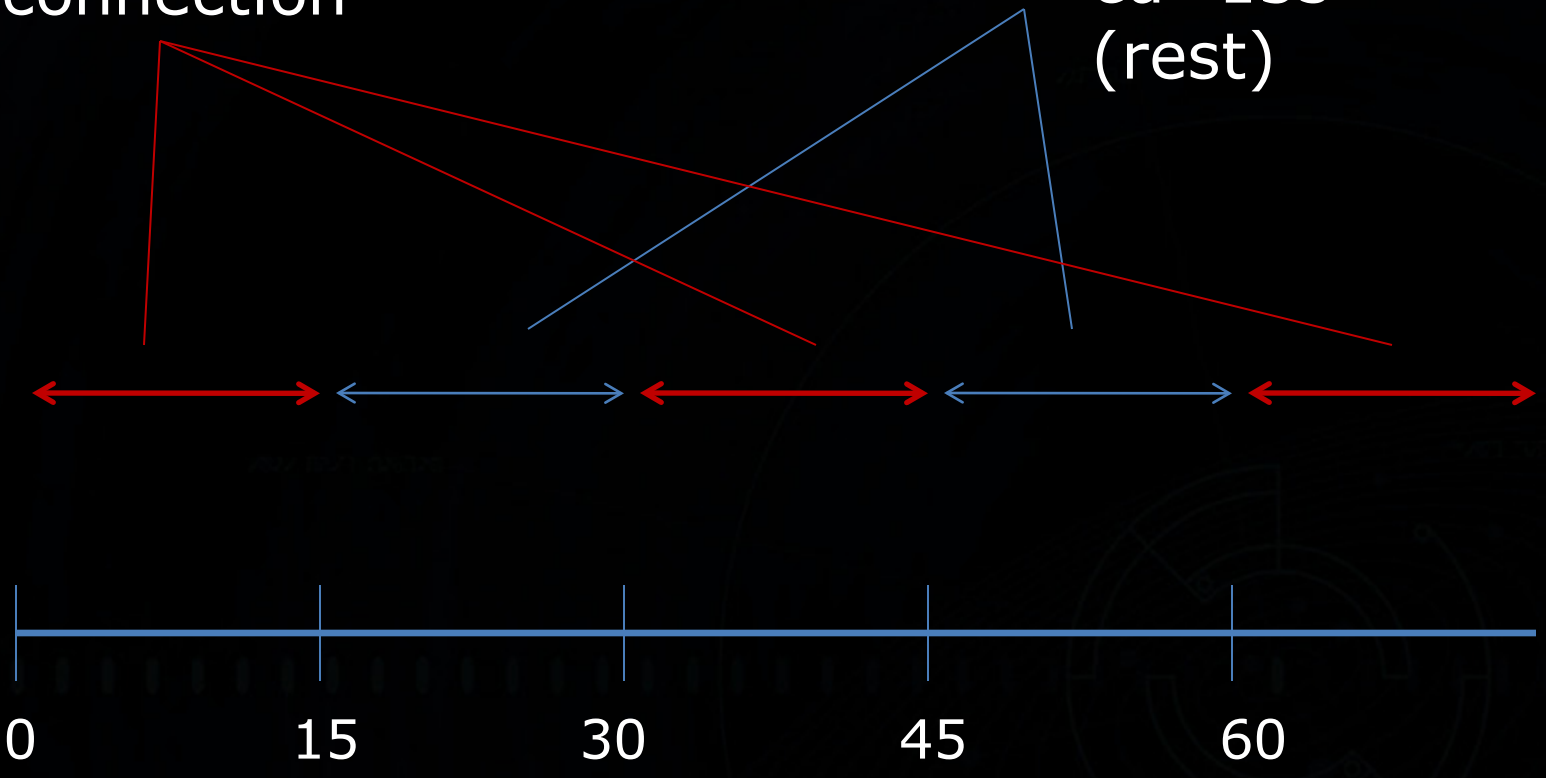
```
$ time ncrack \
> ssh://diogenis.ceid.upatras.gr:45120,CL=1,at=10,cd=1m \
> --passwords-first -d6

Starting Ncrack 0.4ALPHA ( http://ncrack.org ) at 2011-05-06
   02:27 EEST
ssh://150.140.141.181:22 (EID 1) Connection closed by peer
ssh://150.140.141.181:22 (EID 1) Attempts: total 6 completed 6
   supported 6 --- rate 0.43
caught SIGINT signal, cleaning up
Saved current session state at:
   /home/ithilgore/.ncrack/restore.2011-05-06_02-28

real    0m16.049s
user    0m0.010s
sys     0m0.010s
```

time for one connection

maximum attempts per connection

cracking time
1 connection

cd=15s
(rest)



Goal: <= 2 connections per minute

We assumed ~15 secs per connection

delay between each new connection

```
$ ncrack \
> ssh://diogenis.ceid.upatras.gr:45120,CL=1,at=6,\
> cd=15s,to=6h -v -f --user ‘xantzis’ \
> -P ~/lists/greeklish_pass.txt --save ~/ssh_session
```

quit cracking after 1 found credential

keep cracking for 6 hours

save current session to be resumed later

```
$ crontab –l
00 21 * * * /usr/local/bin/ncrack --resume
/home/ithilgore/ssh_session
```

Ncrack SSH library:

- based on OpenSSH code
- hacked socket code and substituted with Ncrack callbacks
- backwards compatibility with obscure ssh servers
- extensible for many types of authentication

Effective SSH cracking

Username list: `guest, root`
Password list: `12345, test, foo, bar`

Default order: `guest/12345, root/12345, guest/test, root/test, guest/foo, root/foo, guest/bar, root/bar`
(`--passwords-first` to reverse order)

Problem: SSH doesn't allow changing a username in the same connection

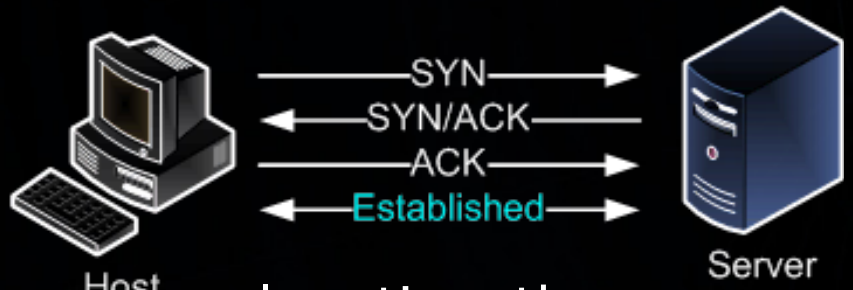
Use reconnaissance probe to learn the maximum authentication attempts per connection (suppose 3).

Username list: guest, root
Password list: 12345, test, foo, bar, changeme, lala, keke, 000

Suppose 4 parallel connections:
#1 -> guest/12345 and ‘test’ and ‘foo’
#2 -> root/12345 and ‘test’ and ‘foo’
#3 -> guest/bar and ‘changme’ and ‘lala’
#4 -> root/bar and ‘changme’ and ‘lala’

Remember: sometimes services purposefully insert delay (2-3 sec or more) between each auth attempt

In that case: may be better to open many connections with 1 auth attempt each and immediately close



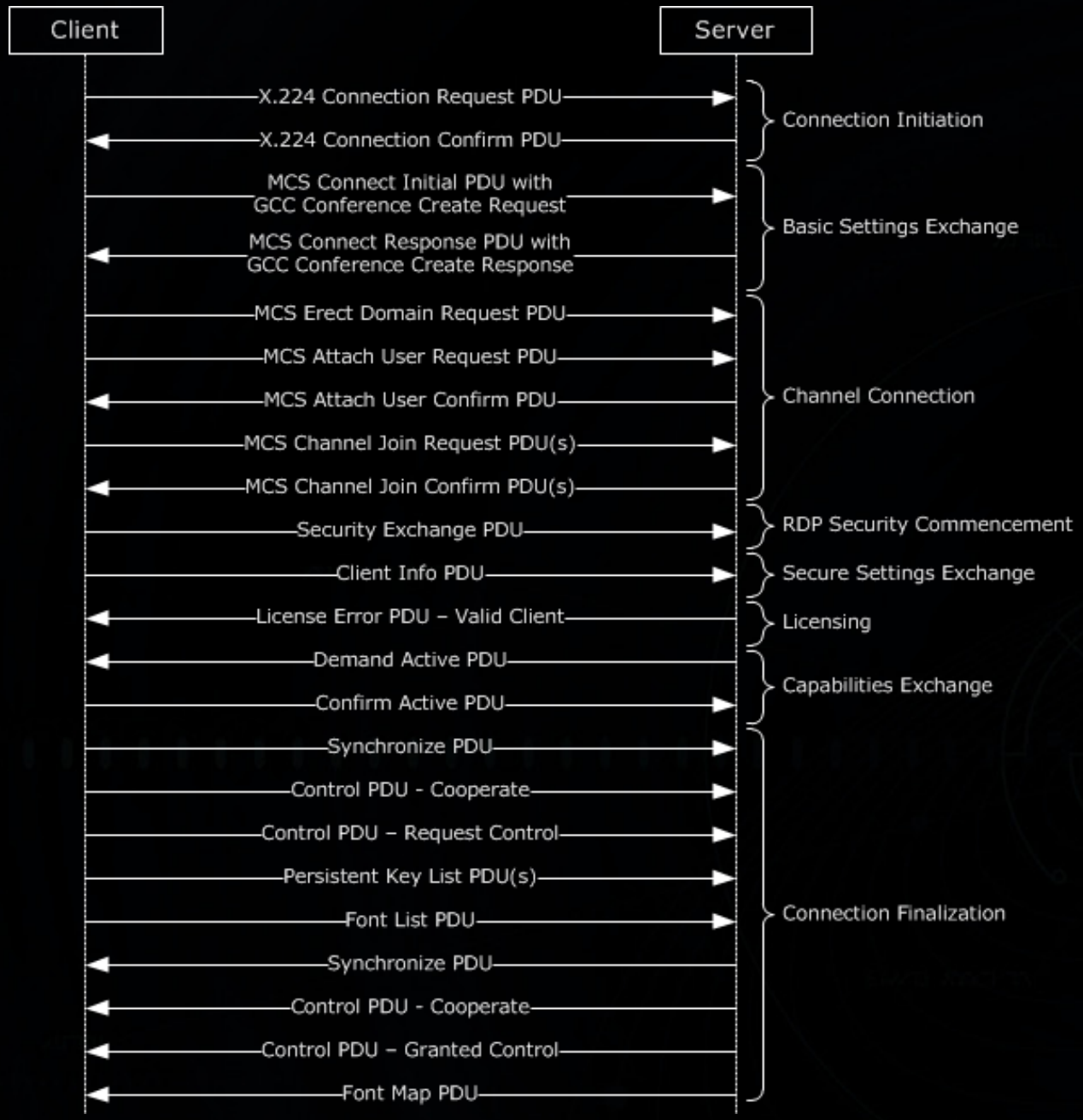
less time than imposed delay

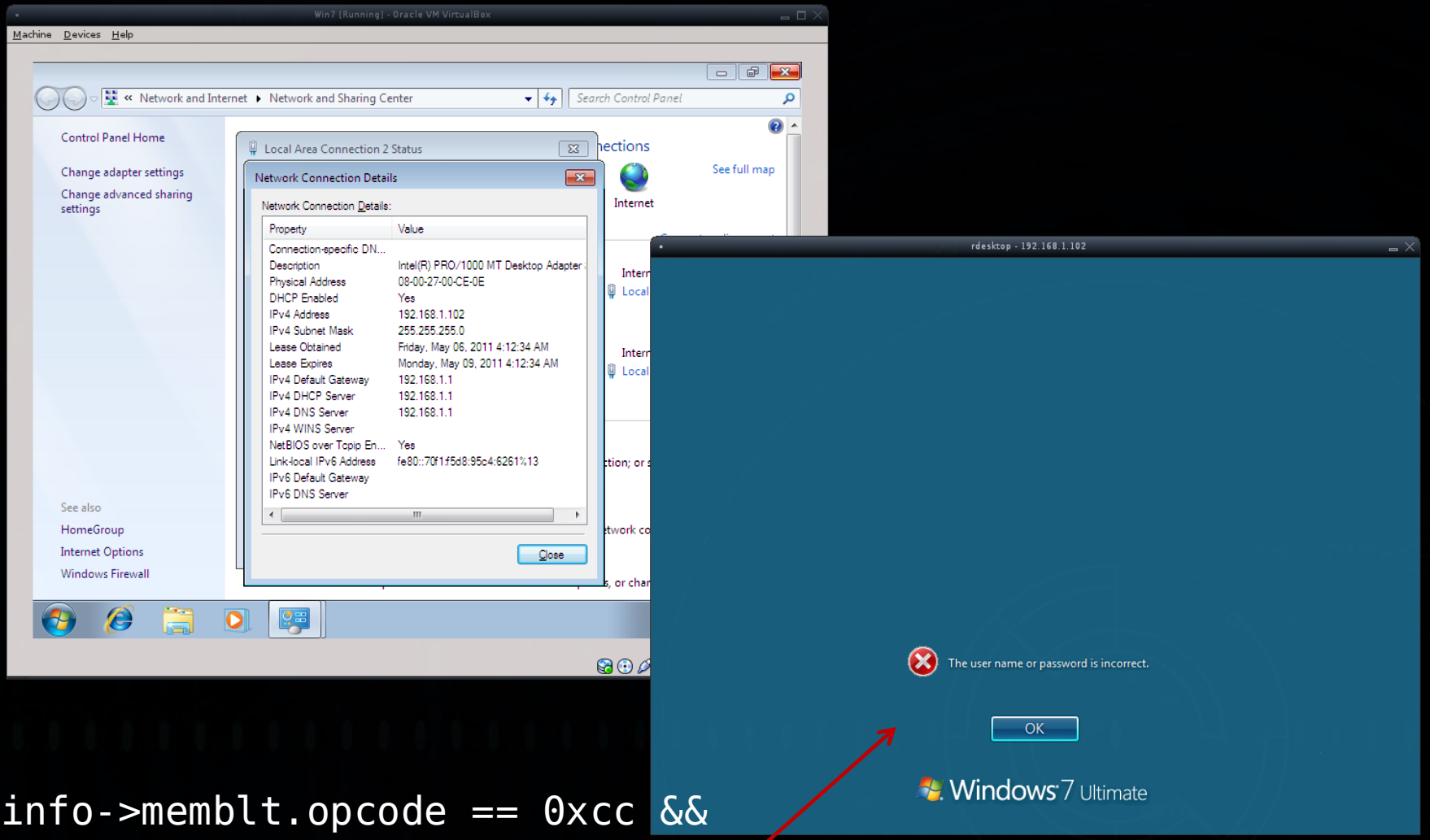
Remote Desktop: the 1+ man-month task

Unique in cracking:
- tsgrinder broken
- rdesktop patches don’t really do any real work

bitmap compression =>
don’t flip that bit!

RDP Hell


Client
Server
X.224 Connection Request PDU
X.224 Connection Confirm PDU
Connection Initiation
MCS Connect Initial PDU with GCC Conference Create Request
MCS Connect Response PDU with GCC Conference Create Response
Basic Settings Exchange
MCS Erect Domain Request PDU
MCS Attach User Request PDU
MCS Attach User Confirm PDU
MCS Channel Join Request PDU(s)
MCS Channel Join Confirm PDU(s)
Channel Connection
Security Exchange PDU
RDP Security Commencement
Client Info PDU
Secure Settings Exchange
License Error PDU – Valid Client
Licensing
Demand Active PDU
Confirm Active PDU
Capabilities Exchange
Synchronize PDU
Control PDU - Cooperate
Control PDU – Request Control
Persistent Key List PDU(s)
Font List PDU
Synchronize PDU
Control PDU - Cooperate
Control PDU – Granted Control
Font Map PDU
Connection Finalization




```
info->memblt.opcode == 0xcc &&
info->memblt.x == 740 &&
info->memblt.y == 448 &&
info->memblt.cx == 60 &&
info->memblt.cy == 56 &&
info->memblt.cache_id == 2
```

magic RDP fingerprint for Windows Vista/7/Server 2003/2008

Ncrack features pentesters will adore

- Target input straight from Nmap's output (`-iX -oX`) (`-iN -oN`)
- Nmap notation in target/service specification e.g `10.0.0-255.1-254, microsoft.com/24, 150.140.*.*`
- High quality username/password lists (jtr, leaked phpbb/myspace etc)
- Platform portability: Windows, *BSD, Linux, Mac OS X
- --resume, --save
- IPv6 support, interactive output (Nmap style)

Resources

i. http://nmap.org/ncrack
ii. http://nmap.org/ncrack/man.html
iii. http://nmap.org/ncrack/devguide.html
iv. http://sock-raw.org/nmap-ncrack.html
v. http://sock-raw.org/papers/openssh_library

```
$ svn co --username guest --password “” \
> svn://svn.insecure.org/ncrack
```