Introduction to GNU/Linux hardening

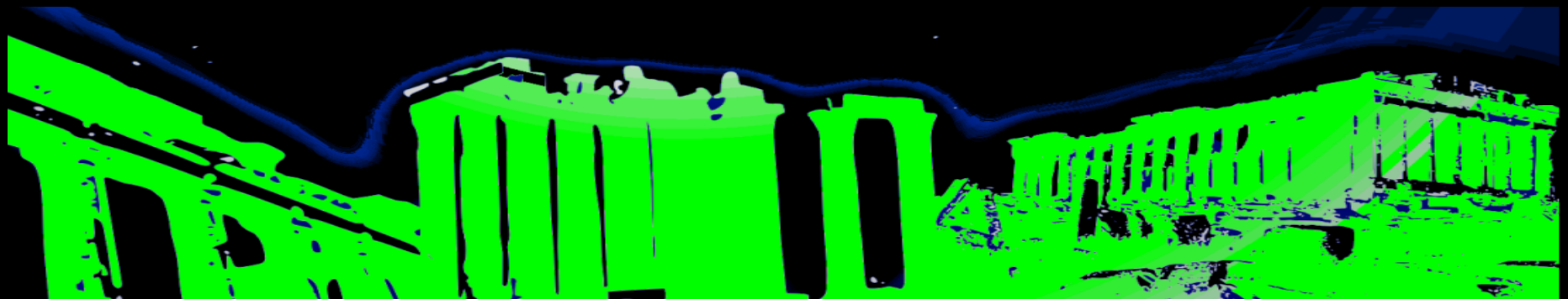
OpenSUSE conference 2013

Thessaloniki, Greece

Γεια σου, Θεσσαλονίκη!

Shawn the R0ck

July 21 2013



cat /proc/agenda

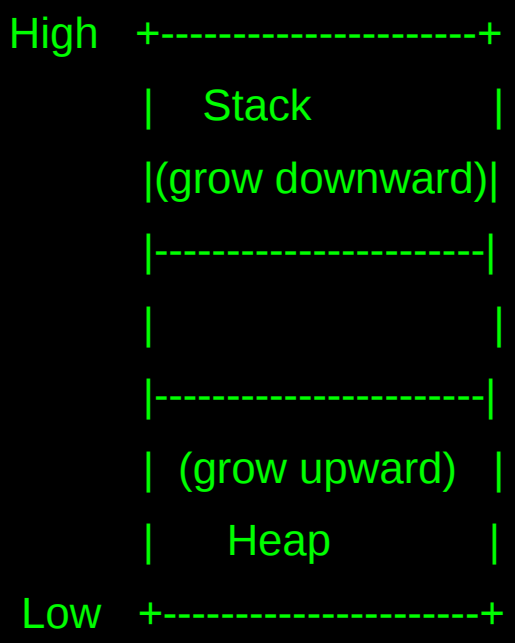
* Who am I?
* Smash the stack in old good hacking days
* Easy ways to Hardening
  * Mitigation tech via GCC/glibc
  * Network
  * Confinement
* What is security
* Why exploit
  * for Fun and... Profit
  * Hacker ethic

whois

* Chinese dude
* IT
  * Security guy
  * Monkey coder
* Day job at SUSE Linux

Smashing the stack

* Stack/Heap layout
* Stack grows down (x86, MIPS)
* ESP points to the current top of the stack
* EBP points to the current function frame



Example of overwrite ret

```
#include <stdio.h>
#include <string.h>

void fuck_me(const char *input)
{
  int x; /* integer variable need 4-bytes in memory */
  char buf[10];
  strcpy(buf, input);
  printf("%s \n", buf);
}


int main(int argc, char *argv[])
{
  printf("The address of func fuck_me(): %p\n", fuck_me);
  fuck_me(argv[1]);//    -----> It's a vunerable func without bound checks!
  return 0;
}
```

Further reading/hacking

* Smashing the Stack for Fun and Profit, by Aleph One,

* Smashing the stack in 2010:

http://www.mgraziano.info/docs/stsi2010.pdf

* Smashing the Stack in 2011:

https://paulmakowski.wordpress.com/2011/01/25/smashing-the-stac

* Open Security Training:

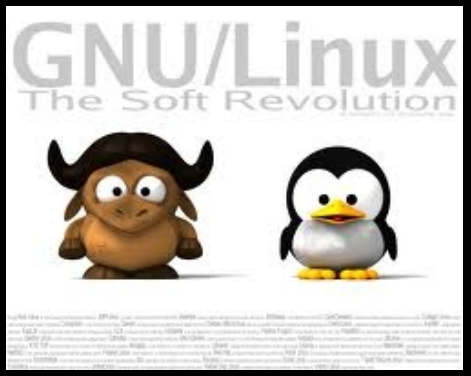
http://www.opensecuritytraining.info/Welcome.html

* Join the io-wargame:

http://smashthestack.org/index.php

SMASH THE STACK
WARGAMING NETWORK

Mitigation tech via GCC/glibc



* Stack canary

--> A “canary” value is placed

between frame pointer and data

on the stack

* Position-Independent-Executable

--> PIE enforces every process's code segment is mmap()'d, it begins at a different base address at each execution of the application.

Note: mmap()' is always used no matter what the type of the executable is (PIE vs. non-PIE).For non-PIE binaries the kernel uses an internal flag equivalent to MMAP_FIXED when mapping program headers.

* Other

Stack canary

GCC options:

-fstack-protector, -fstack-protector-all

Example?


```
Int fuc_me(int x, int y) /* x? WTH */
{
    Int v; /* v? */
    char buf[256];
    int h;
.....
}
```

Original layout:

[High addr...[y].[x].[ret].[frame pointer].[v].[buf].[h]...Low addr]

Simple Canary layout:

[High addr...[y].[x].[ret].[frame pointer].[canary].[v].[buf].[h]...Low addr]

But, it might looks like this:

[High addr...[y].[x].[ret].[frame pointer].[carnary].[buf].[h].[v]...Low addr]

Position-Independent-Executable

GCC options:

-pie, it would randomize the .text segment

Example:

```
void* getEIP () {
    return __builtin_return_address(0);
};

int main(int argc, char** argv){
    printf("retaddr: %p\n",getEIP());
    return 0;
}
```

---

retaddr: 0xb78d950a

retaddr: 0xb77a450a

retaddr: 0xb776350a

Turn off ASLR

Turn on ASLR

```
root@sl13:/tmp# echo 0 > /proc/sys/kernel/randomize_va_space
root@sl13:/tmp# ./a.out
retaddr: 0xb7fff50a
root@sl13:/tmp# ./a.out
retaddr: 0xb7fff50a
root@sl13:/tmp# ./a.out
retaddr: 0xb7fff50a
root@sl13:/tmp# echo 2 > /proc/sys/kernel/randomize_va_space
root@sl13:/tmp# ./a.out
retaddr: 0xb77d450a
root@sl13:/tmp# ./a.out
retaddr: 0xb780c50a
root@sl13:/tmp# ./a.out
retaddr: 0xb786850a
root@sl13:/tmp#
```

Other mitigation in GCC

GCC options:

-FORTIFY_SOURCE, prevent string format vulnerability

-z nostack, non-executable stack

-z relro, -z relro -z now, read-only relocation – it's a hardening option for GOT

Bypass these mitigations

Reference:

Scraps of notes on remote stack overflow exploitation, Phrack Issue 67

http://www.phrack.org/issues.html?issue=67&id=13&mode=txt

Bypassing PaX ASLR protection, Phrack Issue 59

http://phrack.org/issues.html?issue=59&id=9&mode=txt

The Art Of ELF: Analysis and Exploitations

http://fluxius.handgrep.se/2011/10/20/the-art-of-elf-analysises-and-exp

A Eulogy for Format Strings

http://www.phrack.org/issues.html?issue=67&id=9&mode=txt

Network

Network policy:

Tcp wrapper, it's userspace implementation of host-based networking ACL. It's easy to use:

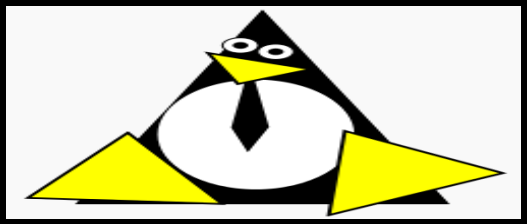
/etc/hosts.allow, /etc/hosts.deny

iptables/netfilter, SuSEFirewall or your own policies? It's only 5-tuple matters.

Do you really need IDS(Snort, BRO) or layer-7 classifier(l7, opendpi)?

grsecurity

Confinement



Why do we need grsecurity/SELinux/Smack/Apparmor? 0Day attack mitigation?

Apparmor, whitelist-based policy. Example:

```
/home/shawn/a.out {
  #include <abstractions/base>

  /home/shawn/a.out mr,
  /home/shawn/hello r,
  /home/shawn/world w,
   network stream,
}
```

AppArmor

cat /proc/security

Security is NOT:

* Security is NOT installing a firewall
* Security is NOT a Product or Service
* Security is Not a Product; It's a Process

Security is:

* Security is a Process, Methodology, Costs, Policies and People
* Security is only as good as your "weakest link"
* Security is 24x7x365 ... constantly ongoing .. never ending

Conclusion:

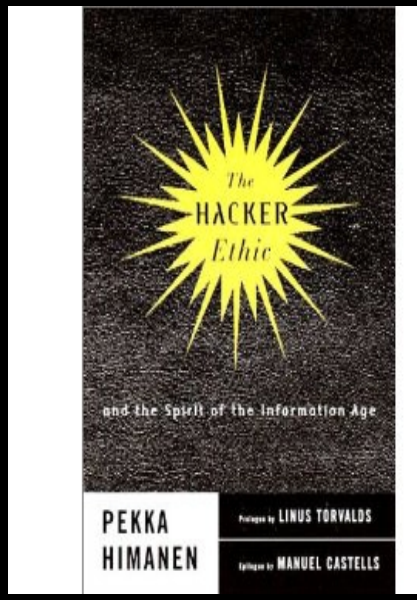
* Hardening should be part of your security process

Why exploit

* Motivation
  * Fun? To some hackers, hacking is part of their life. They can't live without hacking. They are happy with joy while writing exploit...
  * Profit? Money, of course. White hat working for commercial company. Black hat?
  * Both White and Black are possible to sale exploit in underground.

Hacker ethic?

* For further reading/hacking.
* Book
  * The HACKER Ethic and the Spirit of Information Age
*Documentary film
  * Revolution OS
* The best security ezine
  * Phrack



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- Check out our careers page www.suse.com/careers
- Contact our recruiting team at jobs@suse.com

Questions?

Download examples:

https://github.com/citypw/citypw-SCFE/tree/master/security

Thanks!

Drop me a line if you want:

<Shawn the R0ck, citypw@gmail.com>

Reference

SUSE Linux Enterprise Server 11 SP3
Security and Hardening:

https://www.suse.com/documentation/sles11/single

Phrack:

http://phrack.org/