Library version checking - QuarksLab REDOCS'16

Adel Benamara **Thomas Gougeon** **Ludovic Robin**
Fred Raynal

October 28, 2016

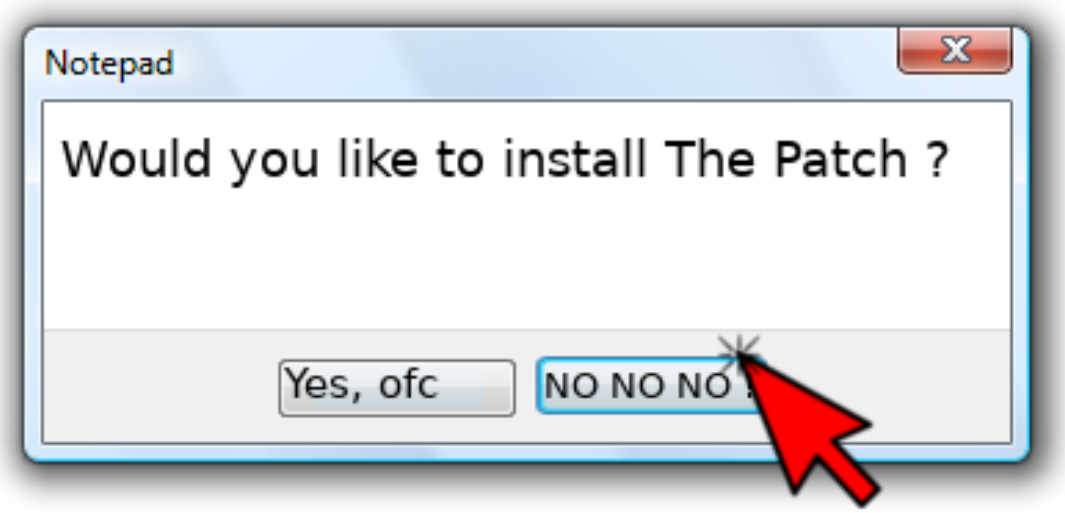
Section 1

Introduction

Introduction

- **Hackers** look for vulnerabilities in programs ;
- Sometimes, finding one allow them to make an exploit ;
- **Developers** try to fix vulnerabilities, publishing a patch ;
- **Users** install the patch to hopefully fix the vulnerability on their version of the program.

What could go wrong ?



- The vulnerability is not necessarily patched and the old version may remain ;
- Very dangerous !

Which libraries are used by a program ?

```
thomas@thomas-HP-ZBook-15:~/Cours/Doctorat/Autres/Conferences/REDOCS16/Materials/redocs/tp1/ROM/UnzipAudible/lib/x86$ ls -1a
.
..
libAAX_SDK.so
libiniaudio_i.so
libiniaudio_j2.so
libiniaudio_j.so
libiniaudio_k.so
libiniaudio_l.so
libprhlpr.so
```

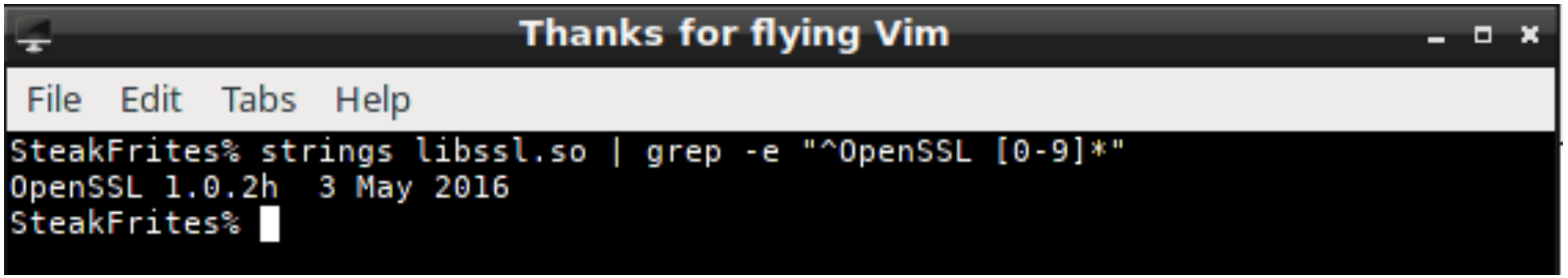
```
thomas@thomas-HP-ZBook-15:~/Cours/Doctorat/Autres/Conferences/REDOCS16/Materials/redocs/tp1/ROM/UnzipAudible/lib/x86$ ldd libiniaudio_k.so
        linux-gate.so.1 =>  (0xf77ee000)
        libprhlpr.so => not found
        libdl.so => /usr/lib32/libdl.so (0xf76c6000)
        liblog.so => not found
        libz.so => not found
        libmedia.so => not found
        libutils.so => not found
        libandroid_runtime.so => not found
        libbinder.so => not found
        libnativehelper.so => not found
        libcutils.so => not found
        libstagefright.so => not found
        libssl.so => not found
        libcrypto.so => not found
        libexpat.so => not found
        libOpenSLES.so => not found
        libstdc++.so => not found
        libc.so => not found
        libm.so => /usr/lib32/libm.so (0xf766d000)
        libc.so.6 => /lib/i386-linux-gnu/libc.so.6 (0xf74b7000)
        /lib/ld-linux.so.2 (0x56589000)
```

What is the version of OpenSSL ?

Use your hands

Strings

- Strings command gives binary infos.



It does not work for zlib

- We do not know any other methods. But pros do.
- Is there any pro here ?

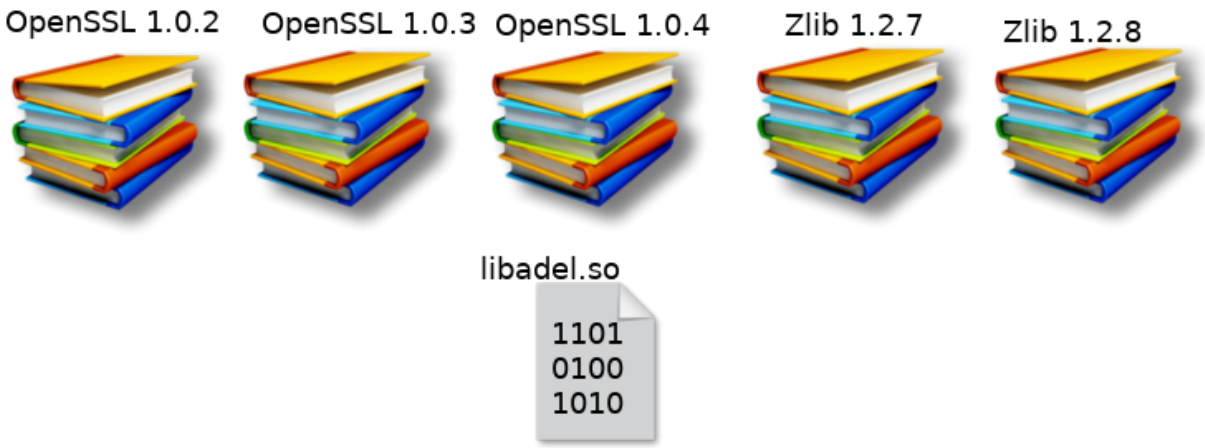
Section 2

Determine library version

Overview - How to check if we applied a patch ?

What do we have ?

- An unknown .so library, L ;
- A set of known libraries sources, S.

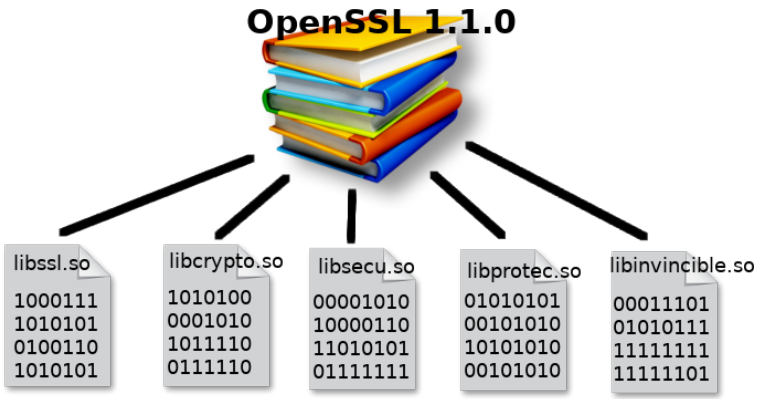


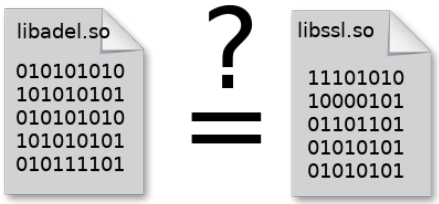
What are we doing ?

For all library s in S, we check if L is of the same version as s.

Lazy start

- Compile libraries in S, $c_1, \ldots, c_n$;
- Compare bit by bit L and $c_1, \ldots, c_n$.





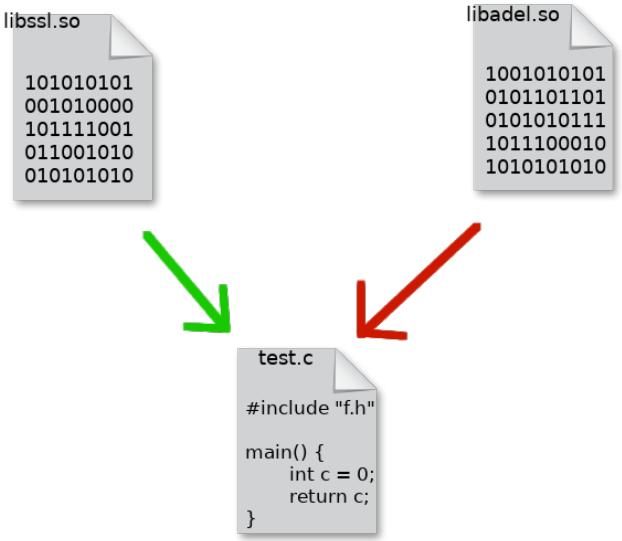
Issues

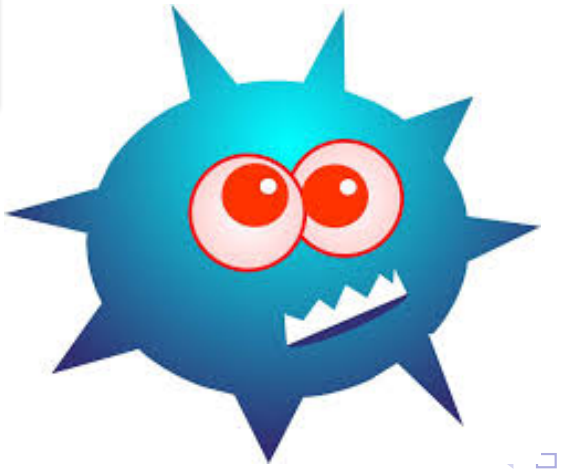
L is compiled with a different **compiler** and different **compiling options**.

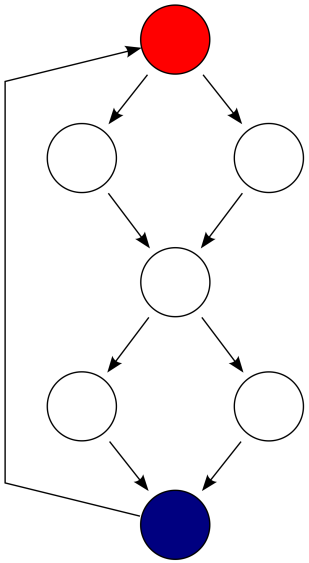
Be smarter

Ideas

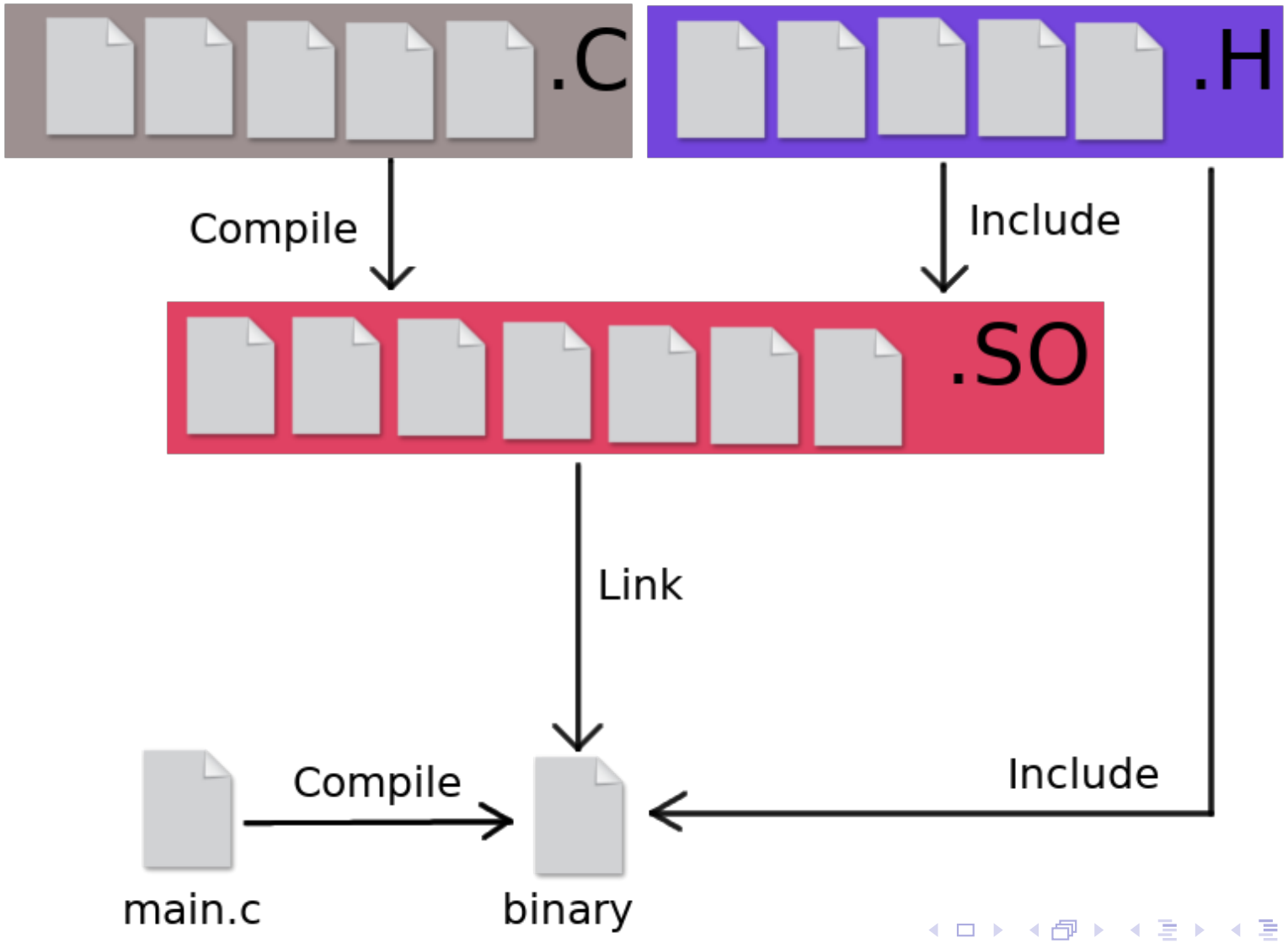
- Link compatibility ;
- Malware signature ;
- Traces.



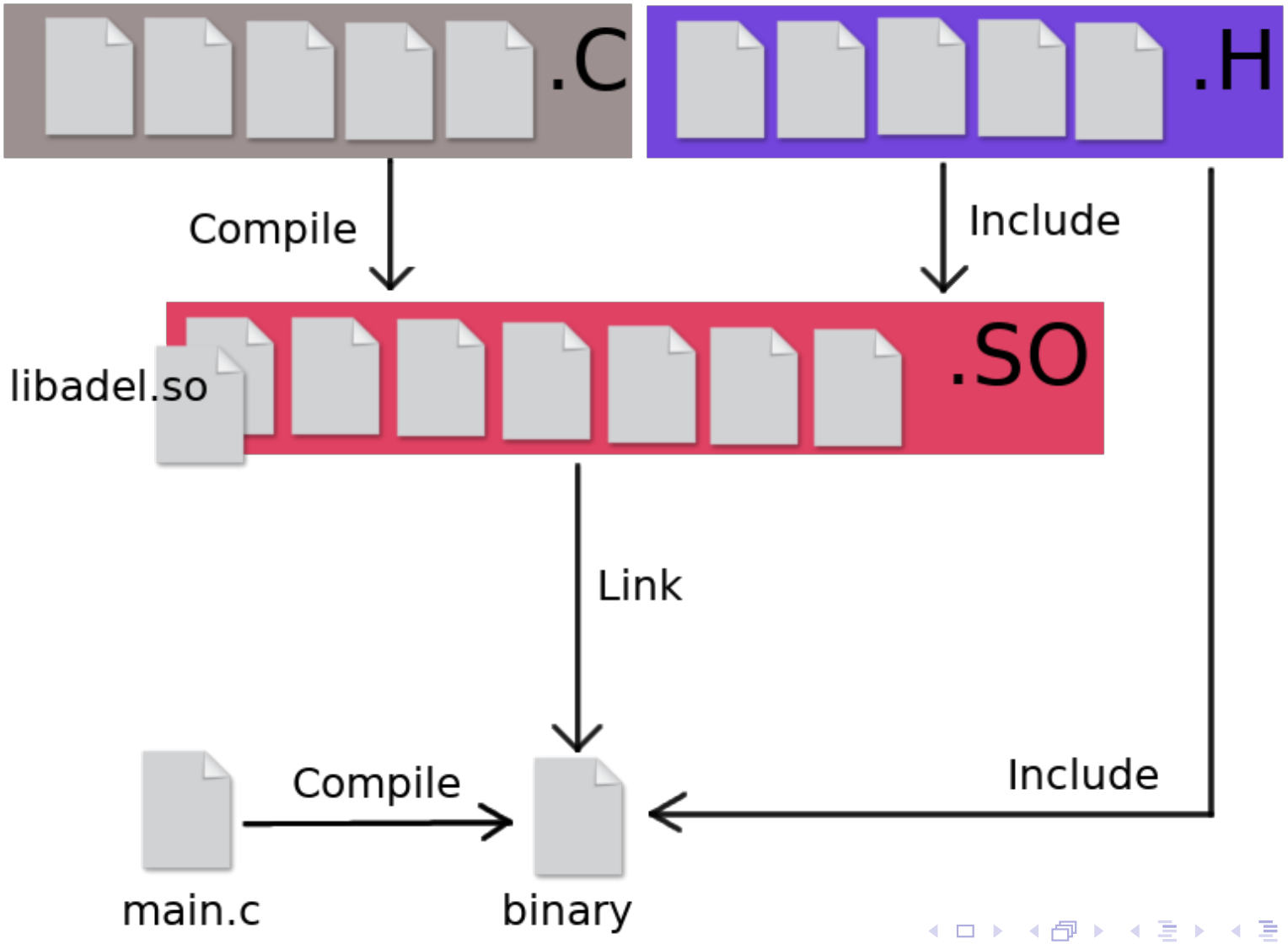




Link dynamically the library



Link dynamically the library



What do we need ?

Scripts

- Generate .so from libraries: OpenSSL, Zlib, libXml, ...
- Generate different versions for each library;
- Generate test program calling library functions;
- Link program with unknown library.

Turnkey programs

Build the program

- Checking major version of a library with link-testing;
  - Semi-auto-compiling libraries ;
  - Semi-auto-extracting headers ;
  - Auto-generation of a c program to link-test libraries.

Tested with OpenSSL 1.0.2h

- OpenSSL 1.0.2j - cannot distinguish;
- OpenSSL 1.0.1e - can distinguish.

Tested with Zlib 1.2.8

- Zlib 1.2.7 - cannot distinguish;
- Zlib 1.1.3- can distinguish.

Malware signature

Control flow graph

- Representing binary with a CFG;
- Using reduced CFG (Gorille);
- Should work for major versions;
- Not adapted to distinguish minor versions.

Open questions

- Distinguish minor patch from optimisation ?
- How security patch more impacts binaries ?

Analyse traces

- Analyse program behaviour;
- Analyse functions.

Fuzzing

- Does not work with references;
- Smart fuzzing would be to use library tests.

DSE

Should work to distinguish functions

Section 3

Conclusion

Conclusion

Issues

- Tools are too specific to some cases, not our cases.

Results

- Distinguish major versions ;
- Some ideas to improve results.

It brought us..

Feelings

- Inner peace;
- Intimacy;
- We lost faith in formal methods, for binary analysis at least.

Technical

- We got back our Perl, that is priceless;
- Binaries are complex but fun.