Control Flow Based Security

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Chair for IT Security / I20
Prof. Dr. Claudia Eckert
Technical University of Munich

29.06.2016
Outline

1. Organization and Requirements
2. Grading
3. Time Table
4. Seminar Topics
5. Literature Research
6. Next Steps
7. Q&A
The seminar will be organized as a scientific conference:

1. Familiarization phase (approx. 2 Week)
2. Manufacturing phase (approx. 6 Week)
3. Review phase (approx. 2 Week)
4. Improvement phase (approx. 2 Week)
5. Talk preparation (approx. 1 Week)
6. Talk and Discussion
Requirements

Report Elaboration
- Delivery of a scientific paper with about $\geq 10$ pages in length
- Usage of LaTeX is mandatory for all
- Formatting with the LaTeX-Style of Springer (LNCS)

Reviews
- Each one of you creates two anonymous reviews about other two reports
- Size of the one review: approximately one page in LaTeX
- Additionally each of you will get an review from us

Presentation
- Preparing of the presentation (Tool free choice)
- 30 minutes presentation
- Afterwards 15 minutes discussion
The Grading is comprised of all personal contributions of this seminar and is composed of:

- Report (50%)
- Presentation (25%)
- Delivered review (15%)
- Participation and discussion (10%)
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<tr>
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<td>Regular meetings (presence mandatory)</td>
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# Time Table

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Organization

Before we go to the topics...

Questions, comments, need for discussion?
Seminar Topics

Overview

1. What is the control flow integrity (CFI)?
2. How CFI protects the software security?
3. Only CFI based defense is enough?
4. Several advanced attacks, such as ROP, JIT-ROP as well as COOP
5. CFI is introduced to defend the ROP and its variants
6. One advanced attack which based on the vTable hijacking
7. Source code recompiling based defense for the vTable hijacking
8. Binary rewriting based defense for the vTable hijacking
Control flow integrity - new version

Nathan Burow et. al., Control-Flow Integrity: Precision, Security, and Performance, ACM CSUR, 2016

Coarse-grained CFI can be diverted

Seminar Topics (2) - Attacks

ROP attack
Hovav Shacham et. al., The Geometry of Innocent Flesh on the Bone: Return-into-libc without Function Calls (on the x86), *In the Proc. of the ACM Conference on Computer and Communications Security, (CCS)*, 2007

JIT-ROP attack

Blind-ROP attack
Andrea Bittau et. al., Hacking Blind, *S&P*, 2014

COOP attack
Seminar Topics (3)- CFI-based defenses

CFI for ROP
Nicholas Carlini et. al., ROP is Still Dangerous: Breaking Modern Defenses, *USENIX*, 2014

CFI for JIT-ROP
Ben Niu et. al., Modular Control-Flow Integrity, *In the Conference on Programming Language Design and Implementation*, PLDI14

hash-based CFI
B. Niu et. al., Cryptographically Enforced Control Flow Integrity, *CCS*, 2015

hardware-based CFI
Seminar Topics (4) - vTable Hijacking and defenses

**Source-code recompiling based defense**
Dongseok Jang et. al., SAFEDISPATCH: Securing C++ Virtual Calls from Memory Corruption Attacks, *NDSS*, 2014

**Source-code recompiling based defense**
Caroline Tice et. al., Enforcing Forward-Edge Control-Flow Integrity in GCC LLVM, *USENIX*, 2014

**Binary rewriting based defense**
Robert Gawlik et. al., Towards Automated Integrity Protection of C++ Virtual Function Tables in Binary Programs, *ACSAC*, 2014

**Binary rewriting based defense**
Topic assignment

- Who wants which topic?
Literature Research

Goal:

- To find relevant literature
- Main arguments, Techniques or Approaches...
  1. find,
  2. understand,
  3. explain,
  4. prove them

Structure Topics
  - Report structure
Literature Research & Sources

**Good**

- Books, Library
- [http://portal.acm.org/](http://portal.acm.org/)
- [http://www.springerlink.com/](http://www.springerlink.com/)
- [http://www.computer.org/](http://www.computer.org/)
- [http://citeseer.ist.psu.edu/](http://citeseer.ist.psu.edu/)
- [http://scholar.google.com/](http://scholar.google.com/)

**Wrong**

- Heise-Newsticker
- Wikipedia
- e.g., *Website XYZ*
Access to Literature

Through the Authors Website

- Authors publish the papers mostly on their websites
- Other resources can be found through Google Scholar

Through Springer, ACM, IEEE

- Download of papers costs
- TUM has full rights to download papers
- Usage on an Proxy-Server required: www.lrz.de
- Access through the proxy in the TUM web is restricted
Next Steps

\textbf{\LaTeX{}-Introduction}

- Is there the need?
- Schedule a date?

\textbf{ToDos in the Familiarization phase}

1. Literature research
2. Create report structure
Q&A?