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To cite this version:

HAL Id: hal-01311032
https://hal-centralesupelec.archives-ouvertes.fr/hal-01311032
Submitted on 23 Jun 2016

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Introduction

HardBlare proposes a software/hardware codesign methodology to ensure that security properties are preserved all along the execution of the system but also during files storage. The general context is to address Dynamic Information Flow Tracking (DIFT) that generally consists in attaching marks (also known as tags) to denote the type of information that are saved or generated within the system.

Let’s suppose that “print” function is public and the tag of a variable x is underlined value

<table>
<thead>
<tr>
<th>Example code</th>
<th>Tag initialization</th>
<th>Tag propagation</th>
<th>Tag check</th>
</tr>
</thead>
<tbody>
<tr>
<td>p = 3;</td>
<td>a ← public</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s = 42;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x = p + s;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>print(x);</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During the compilation phase, a static analysis is done on the LLVM intermediate representation produced from the source code, and propagated to the ARM backend for the machine code generation.

The result of static analysis gives a list of dependencies between information containers (e.g., registers, memory spaces...) for every basic blocks which are stored on a dedicated section in a ELF File.

During run-time, the Program Trace Macrocell (PTM) generates a trace containing the address for each committed instruction modifying the PC value.

Annotations related to the basic block identified by its address, given by the trace, are processed by the coprocessor to propagate tags.

Static Analysis

Annotations

DIFT step-by-step

- ARM CoreSight Components export trace (for both CPUs) towards PL in PFT (Program Flow Trace) protocol
- PFT Decoder decodes trace in usable format
- Using decoded trace, DIFT Coprocessor reads tags dependencies block
- DIFT Coprocessor looks for the tags either in memory or tag register file
- DIFT Coprocessor computes tags depending on propagation rules
- DIFT Coprocessor updates corresponding tags
- DIFT Coprocessor checks for security policy violation and raise an interruption

Main Contributions at a Glance

- Hardware-assisted DIFT system with limited time overheads.
- Approach based on a non-modified CPU with a standard Linux and generic binaries => Could be implemented by industrial partners in medium-term.
- Hardened with hardware security mechanisms: trusted coprocessor storage and bus protection in terms of confidentiality/integrity.
- Contributions on software-related issues as well (static/dynamic IFC analysis, i.e. hybrid analysis).
- Perspectives on runtime reconfiguration and multicore/manycore systems.

Some References