Fast Object Naming for Kernel Data Anomaly Detection

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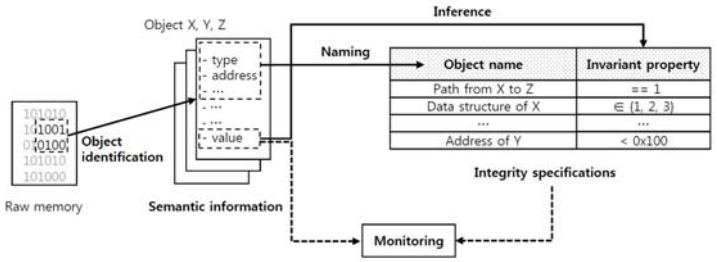
Memory Introspection



Motivation

- Deployed security systems usually rely on integrity specifications, which are typically set by a security administrator
- Non-control data attacks in kernel

➔Need for kernel data integrity

- Unfortunately, it is nontrivial to manually set specifications for all kernel data

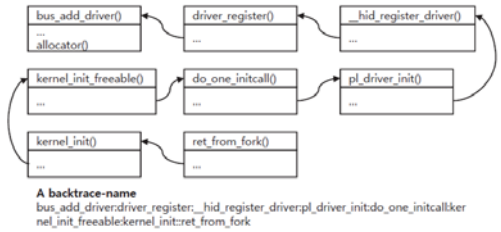
➔ Automated specification generation with machine learning

- Prior work was done in this area
  - A.Baliga, V.Ganapathy, and L.Iftode. Automatic inference and enforcement of kernel data structure invariants. ACSAC 2008
- Has an issue that a large portion of generated specifications not being applicable after a system reboot

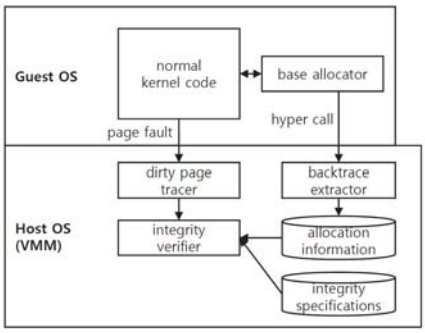
➔Needs to re-generate specifications after each reboot, which takes 20~50minutes even on an up-to-date machine

Backtrace Naming

Backtrace: a backward list of active function calls that starts with the last function call
Naming: Giving an identity to a data object to distinguish it from other objects with different names



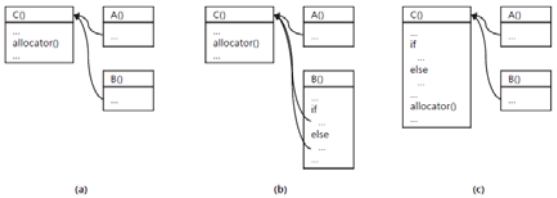
Prototype Overview



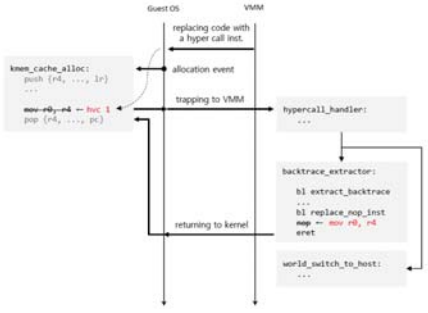
Naming Granularity

How would different naming schemes effect the granularity of which data objects would be distinguishable

- Path-name
- Type-name
- Backtrace-name



Backtrace extraction at an allocation event



Key Observations

1. Kernel objects are allocated through only a couple of fundamental object allocators.
2.The kernel context when a kernel object is created reflects the object's characteristic during runtime.

Preliminary Experiments

The number of allocations	186,132
The number of deallocations	156,367
The number of live objects	29,765
Avr. CPU cycles per trap	321
Avr. CPU cycles per backtrace-naming	140
Total spent CPU cycles of traps	116,440,503
Total spent time (ms) of traps at 1.7GHz	68.49

Acknowledgements

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