Towards Secure User-space Provenance Capture

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OPUS

Observed Provenance in User Space

Data Scientists

Low Intrusion

User Space Provenance

Low Privilege Requirement

Easier Install Path

Semantically Closer

User Space Provenance Techniques

LD_PRELOAD

Binary Rewriting

ptrace

FUSE

How can we rely on user-space provenance?

Assumptions

Malicious User

Malicious Application

Trusted Kernel/Hardware

5 Attack Classes

Circumvention

Direct Library Call

Direct Syscall

Denial of Service

Falsification

Man in the Middle

Time of Check Time of Use

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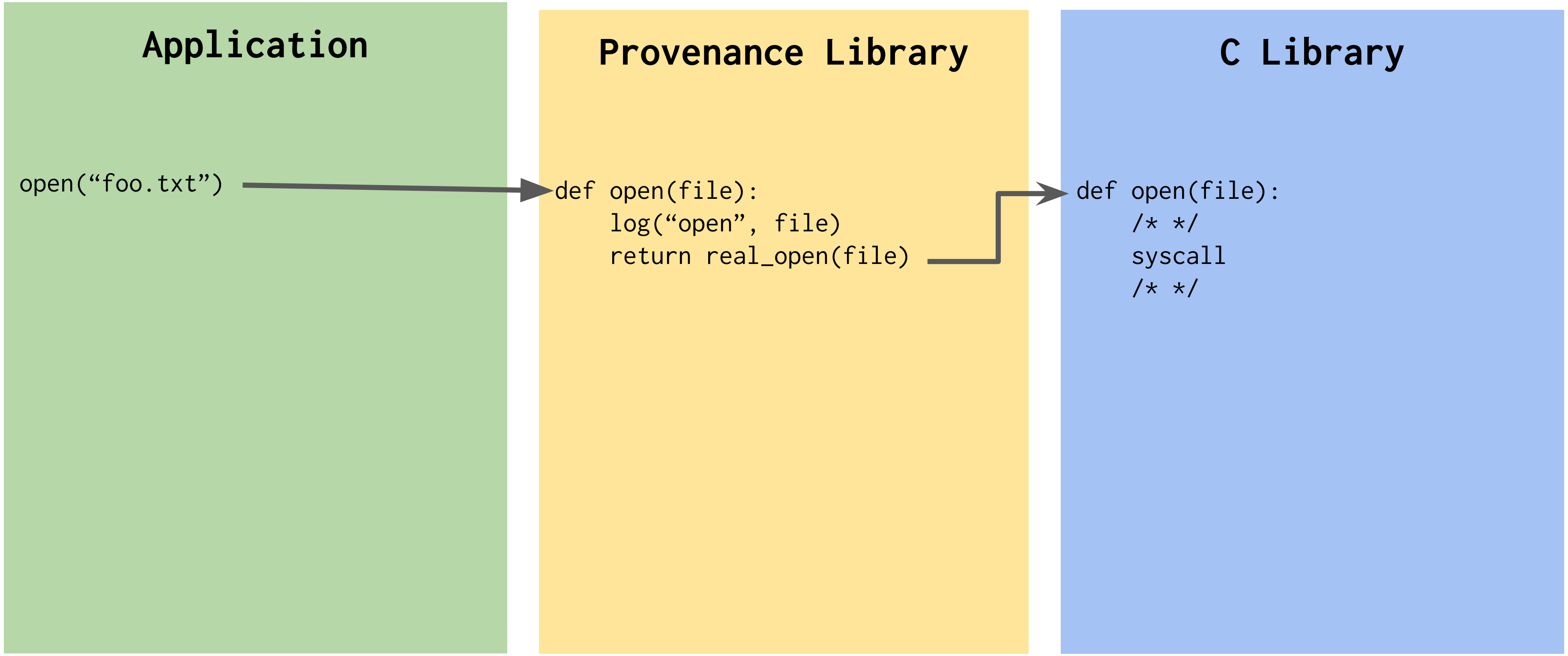
Time of Check Time of Use

Direct Call

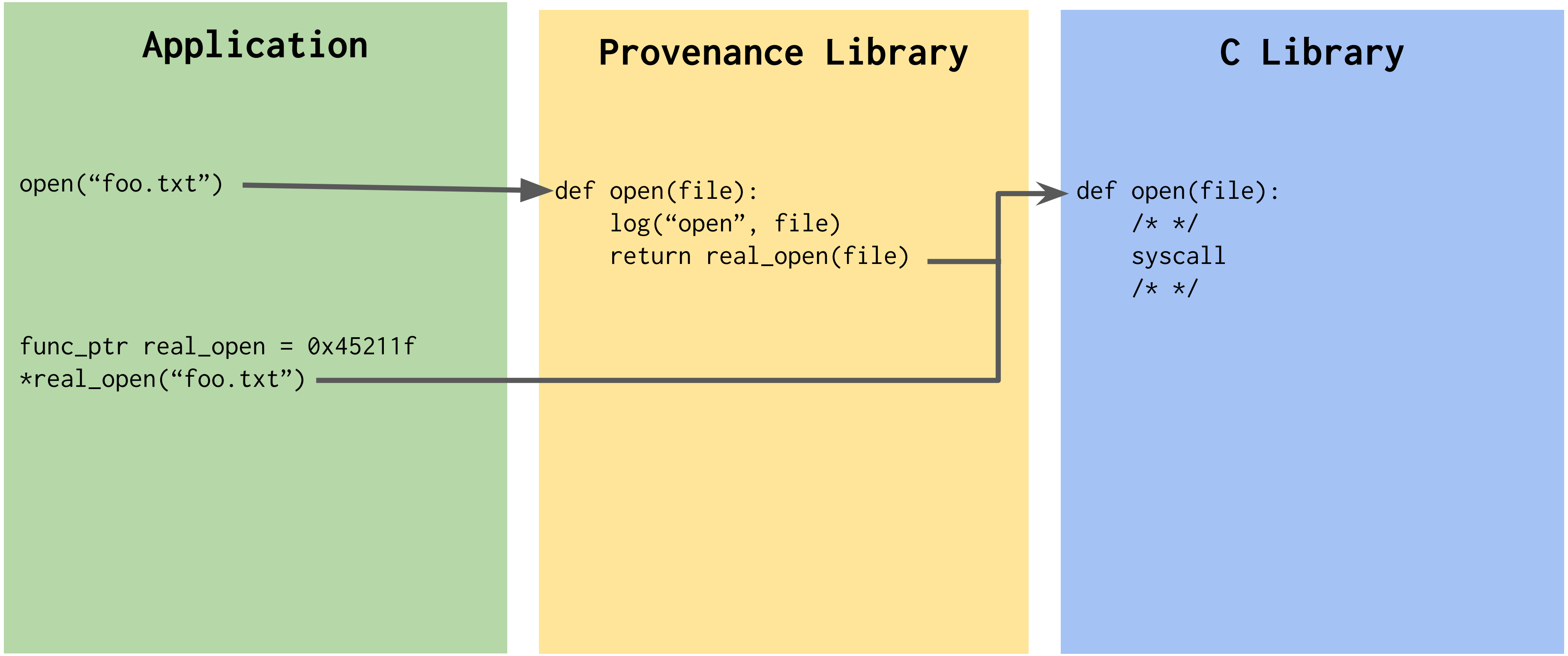


```
open(“foo.txt”)
```

```
def open(file):
    log(“open”, file)
    return real_open(file)
```

```
def open(file):
    /* */
    syscall
    /* */
```

Direct Call



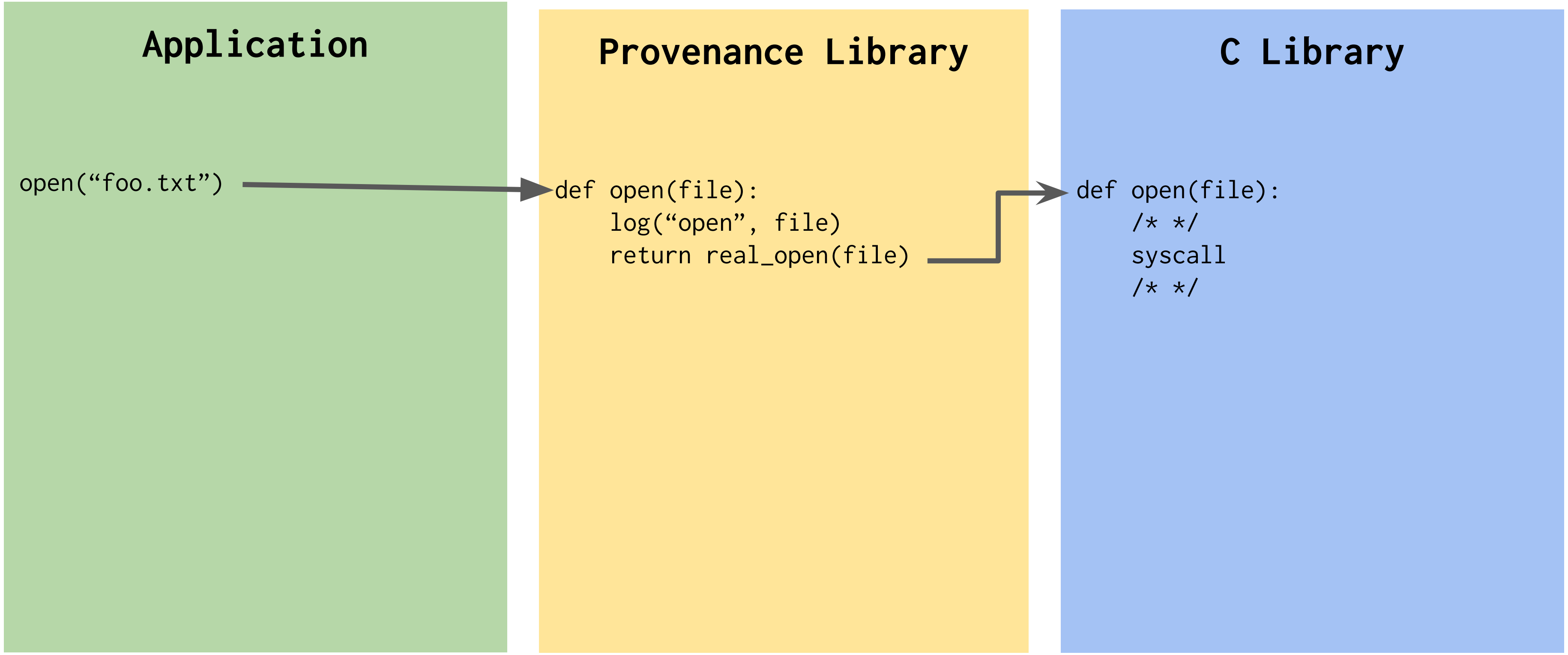
```
open("foo.txt")
```

```
func_ptr real_open = 0x45211f
*real_open("foo.txt")
```

```
def open(file):
    log("open", file)
    return real_open(file)
```

```
def open(file):
    /* */
    syscall
    /* */
```

Man In The Middle



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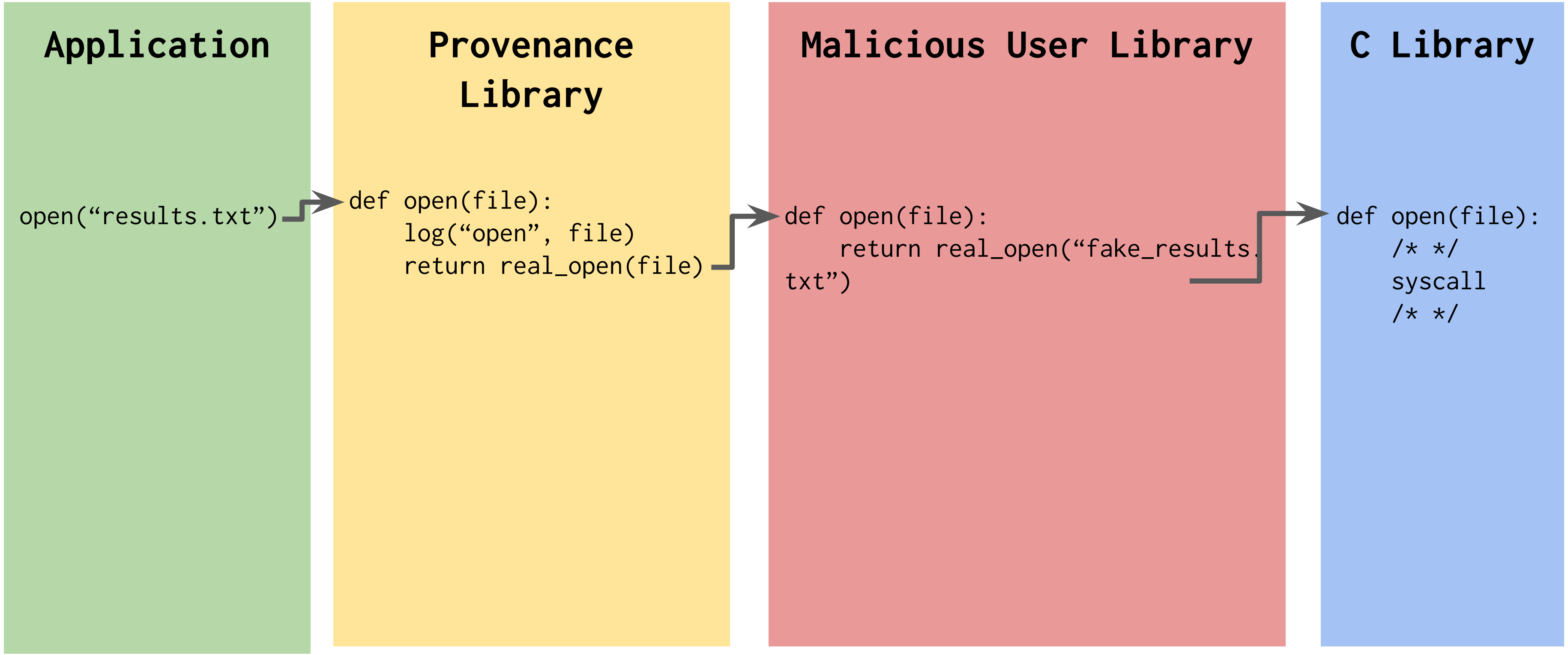
Man In The Middle



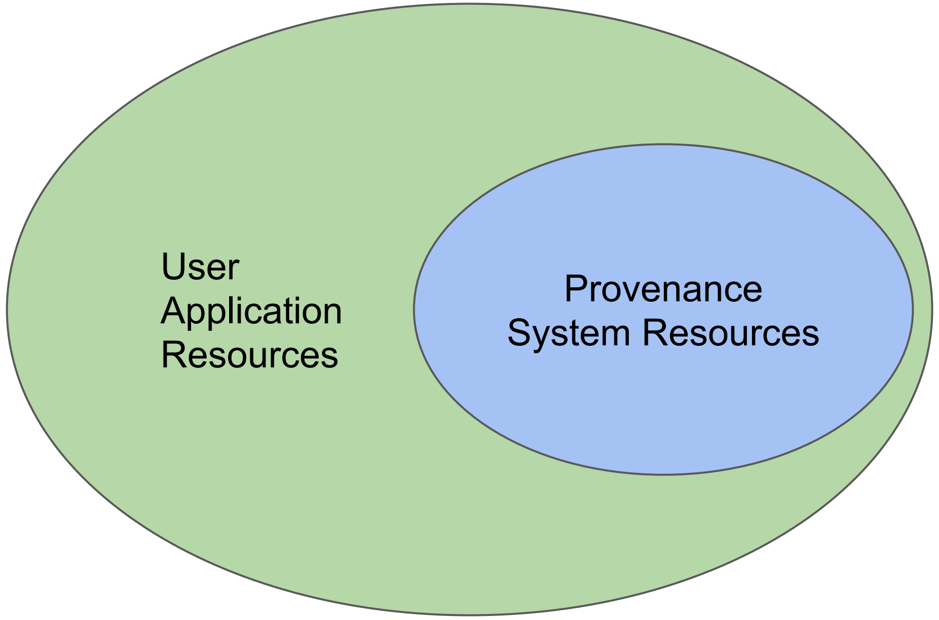
```
open("results.txt")
```

```
def open(file):
    log("open", file)
    return real_open(file)
```

```
def open(file):
    return real_open("fake_results.
txt")
```

```
def open(file):
    /* */
    syscall
    /* */
```

Denial of Service



File Descriptors

Memory

Our Approach

Intel Secure Guard Extensions (SGX)

Existing Sandboxing Techniques

Dynamic Binary Rewriting

Conclusions

System-level provenance is not always preferable to user-space provenance

User-space provenance suffers from some threats

It can still be made secure

Thank you

Any Questions?

For more Info:

http://www.cl.cam.ac.uk/research/dtg/fresco/