Logging to the Danger Zone: Race Condition Attacks and Defenses on System Audit Frameworks

Riccardo Paccagnella, Kevin Liao, Dave Tian, Adam Bates

ILLINOIS

Logs Are Useful

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CAPEC-268: Audit Log Manipulation

Attack Pattern ID: 268
Abstraction: Standard

Presentation Filter: Complete

Description

The attacker injects, manipulates, deletes, or forges malicious log entries into the log file, in an attempt to mislead an audit of the log file or cover tracks of an attack.

Hackers are increasingly destroying logs to hide attacks

According to a new report, 72 percent of incident response specialists have came across hacks where attackers have destroyed logs to hide their tracks.

By Catalin Cimpanu for Zero Day | November 2, 2018 -- 16:36 GMT (09:36 PDT) | Topic: Security

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Can We Protect the Logs?

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- Secure Logging!

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- Secure Logging!
- Logs recorded prior to full system compromise cannot be undetectably tampered with.

How Secure Logging Works

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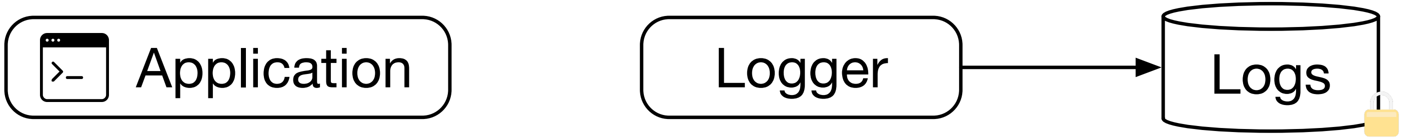

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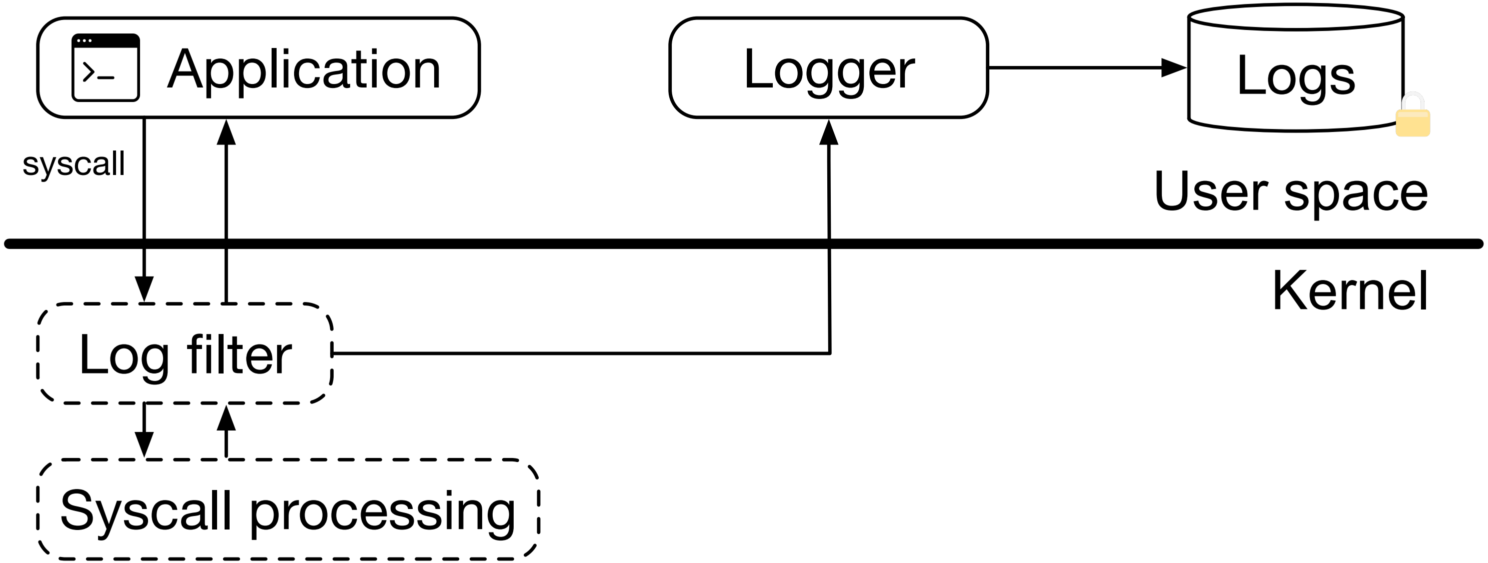

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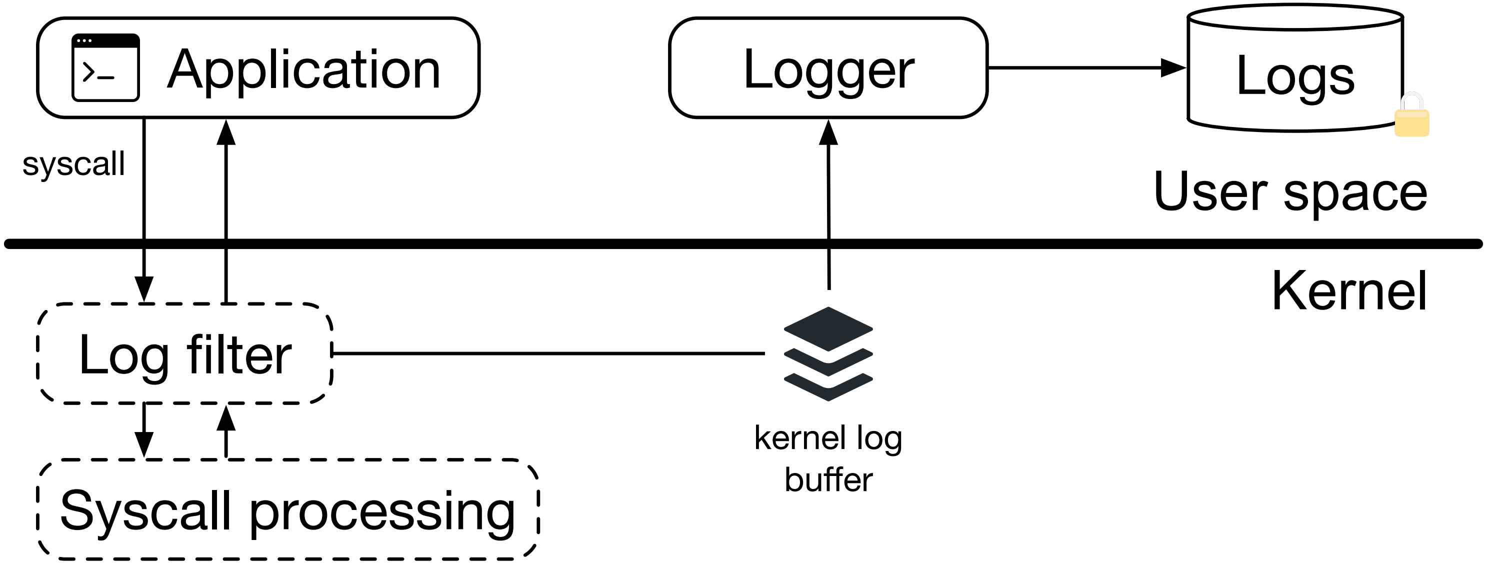

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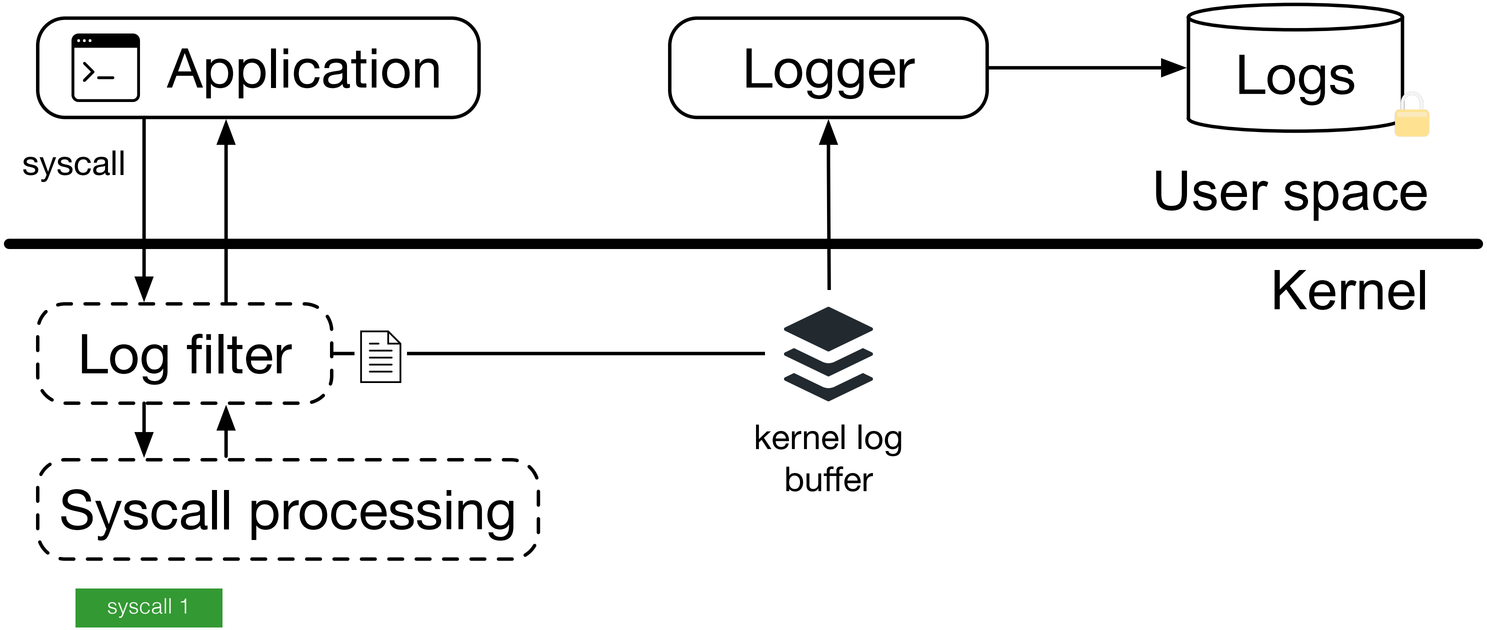

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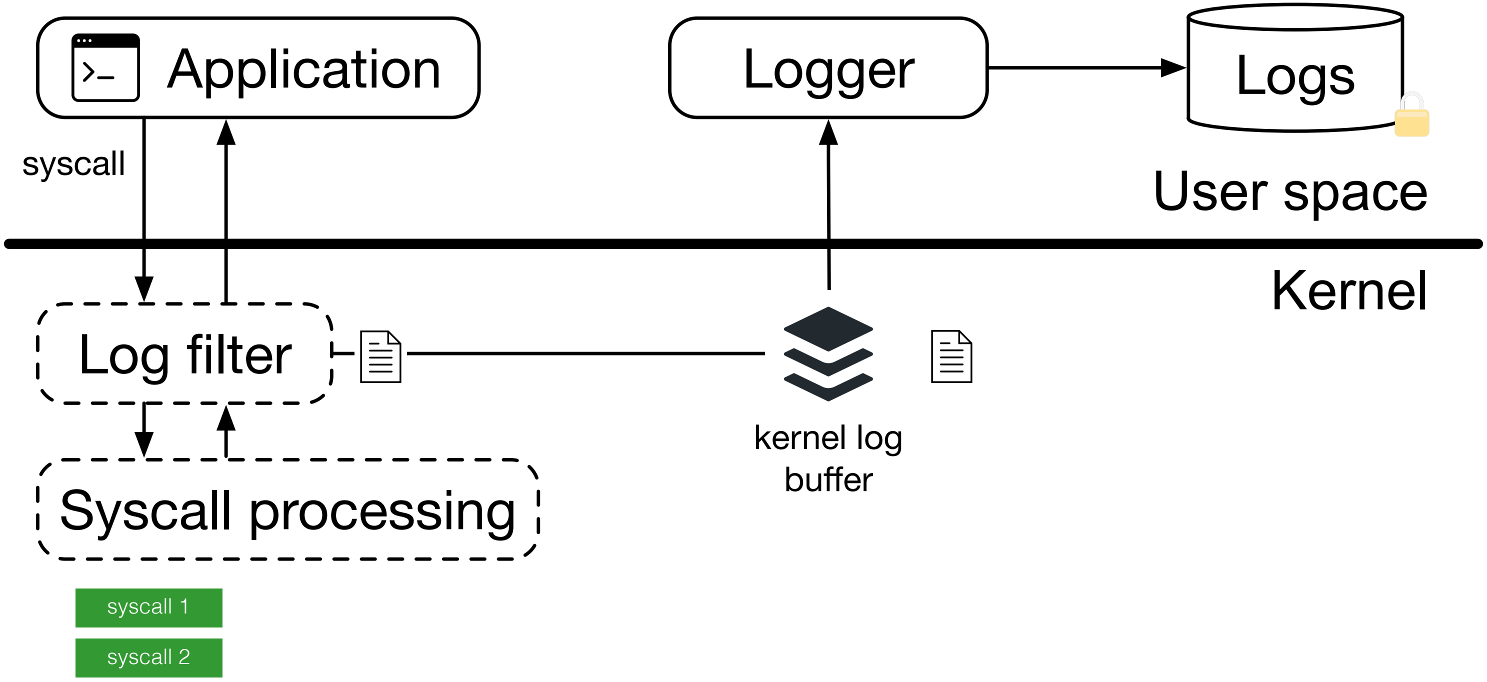

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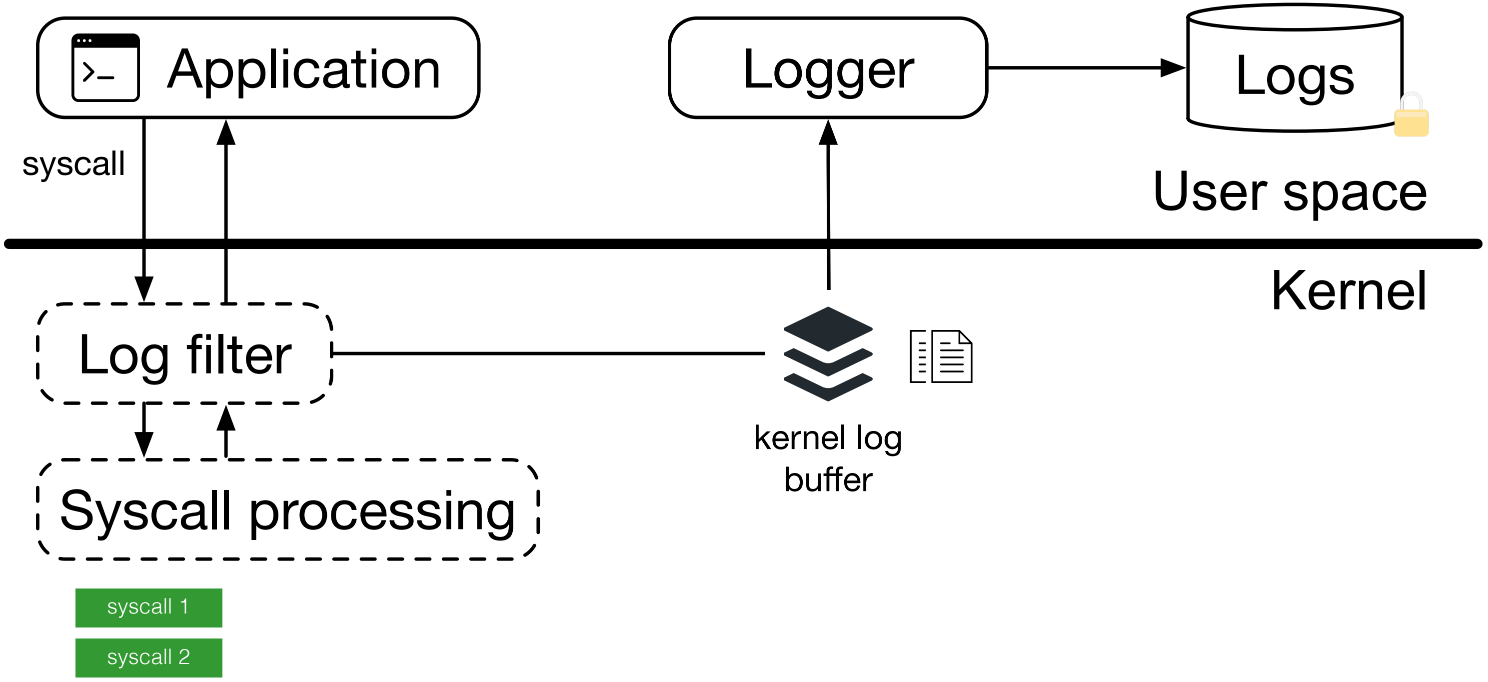

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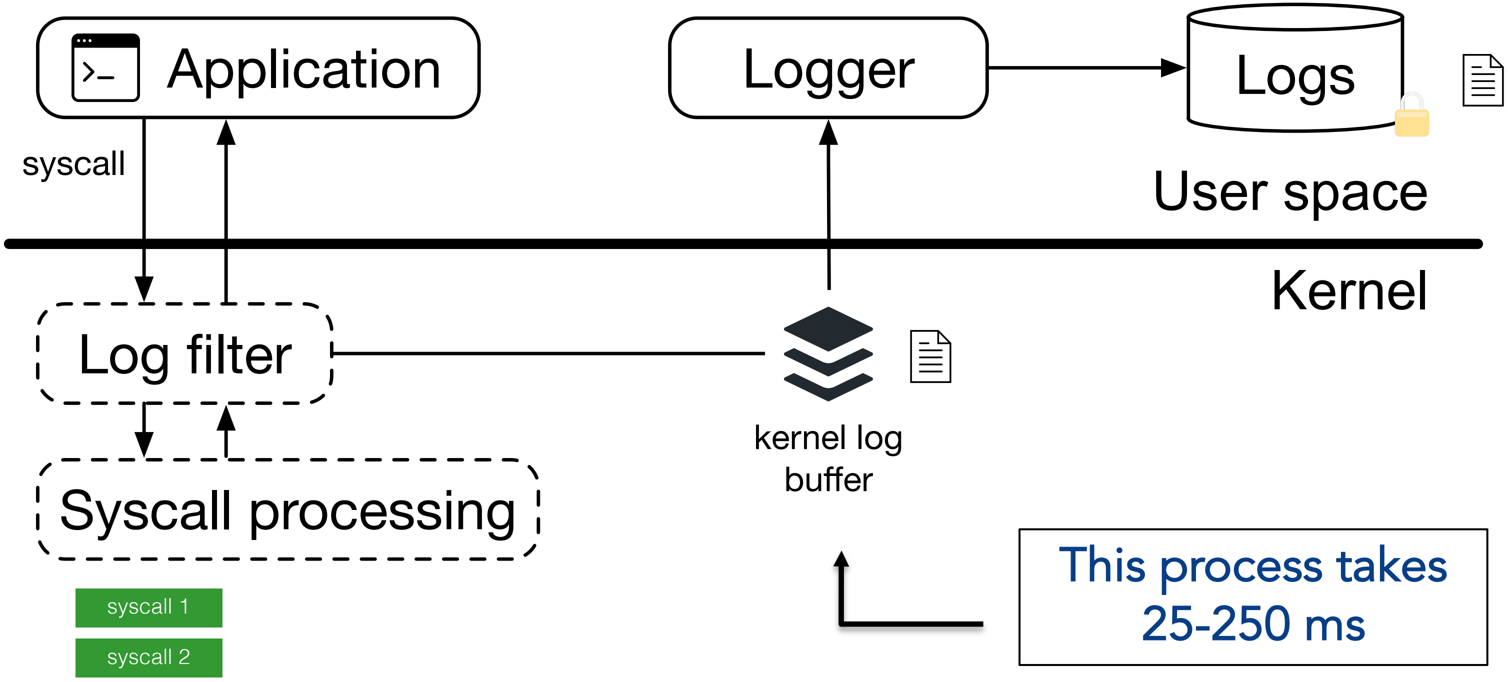

This process takes
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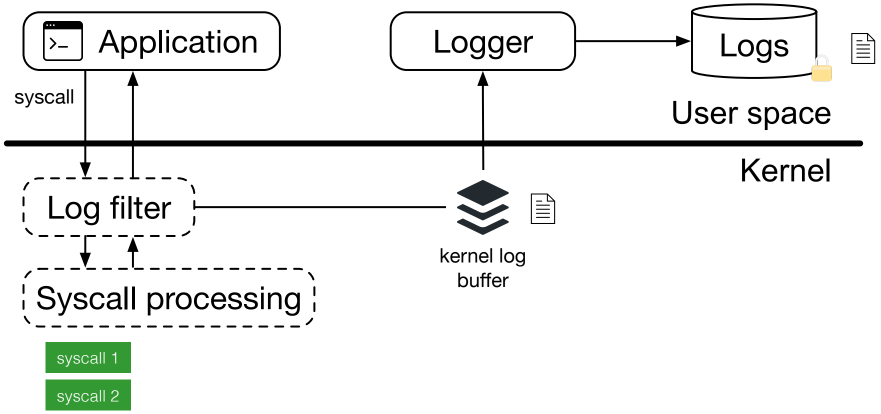
How Secure Logging Works



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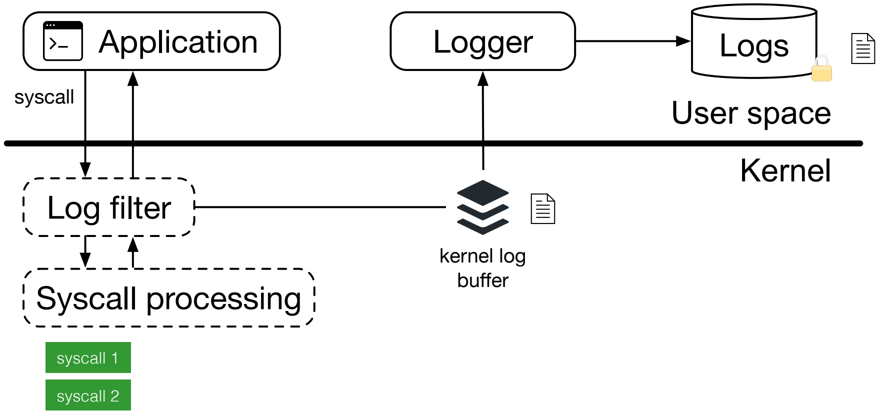
How Secure Logging Works



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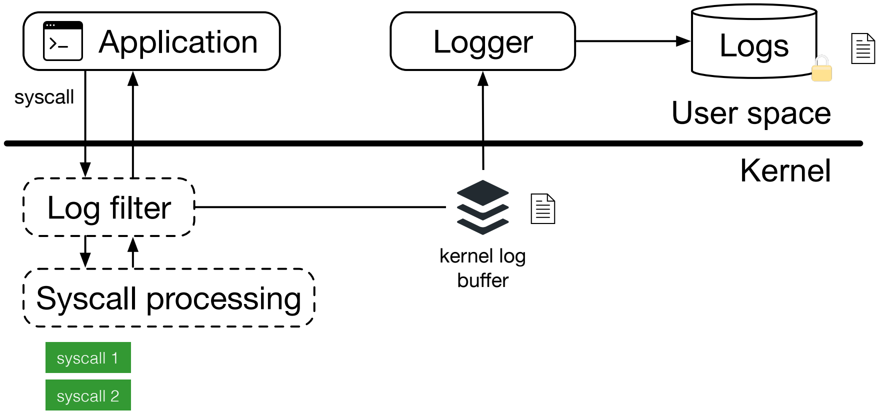

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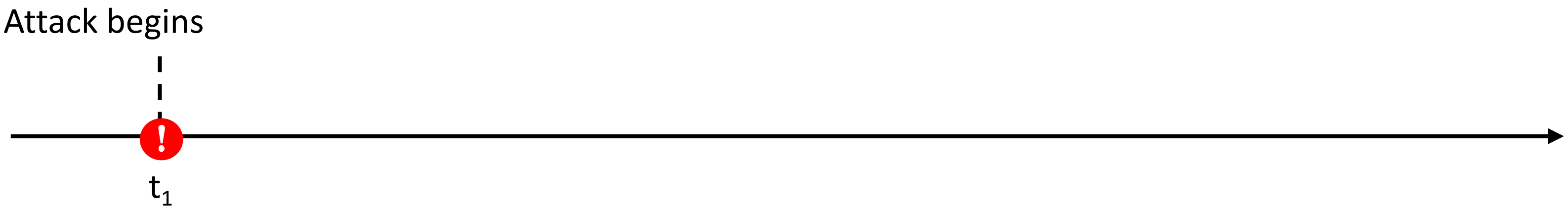
Logs are vulnerable when in the kernel log buffer!

Attack Timeline



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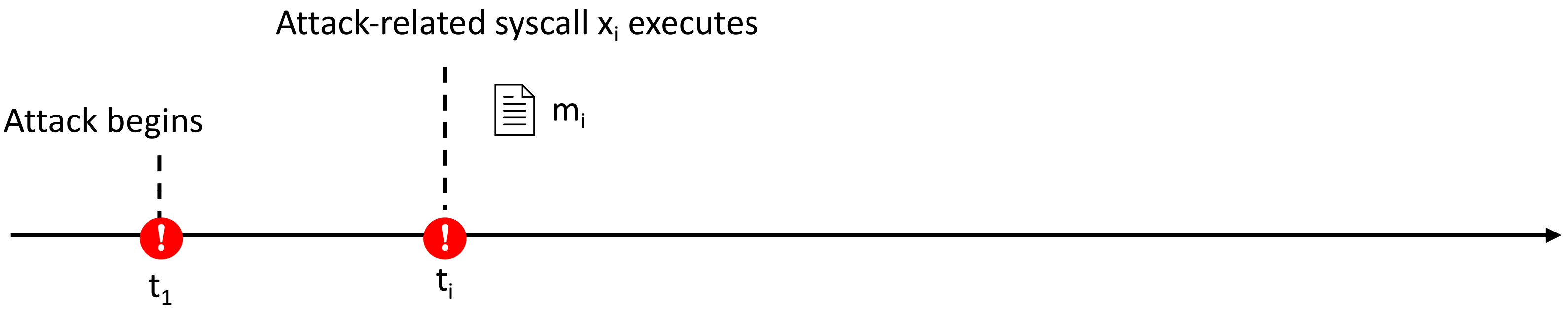

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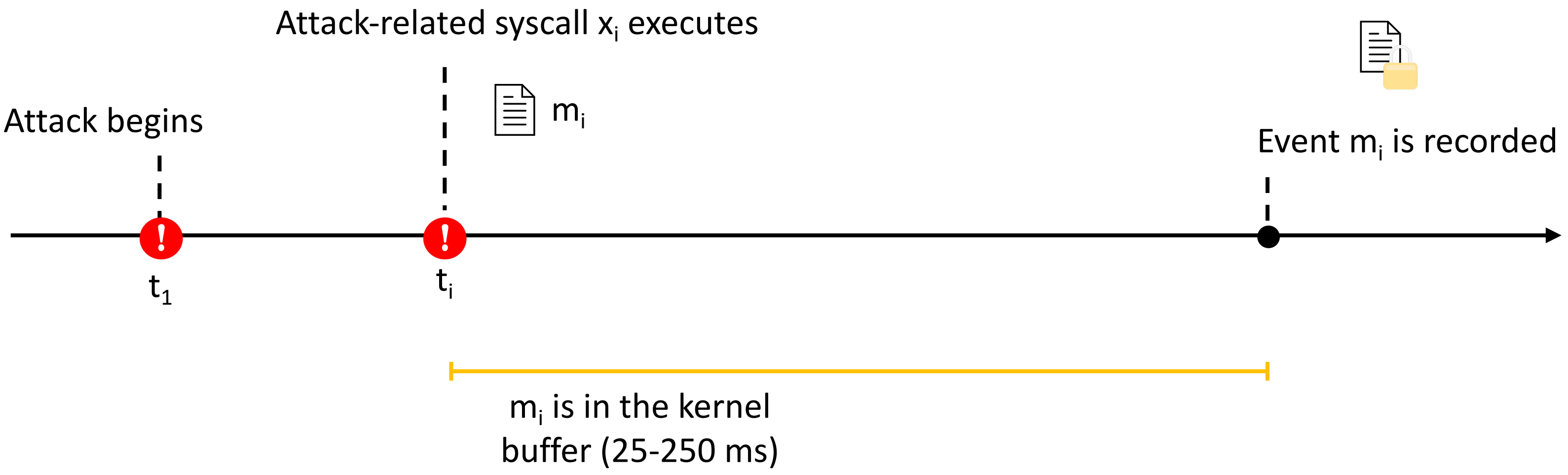

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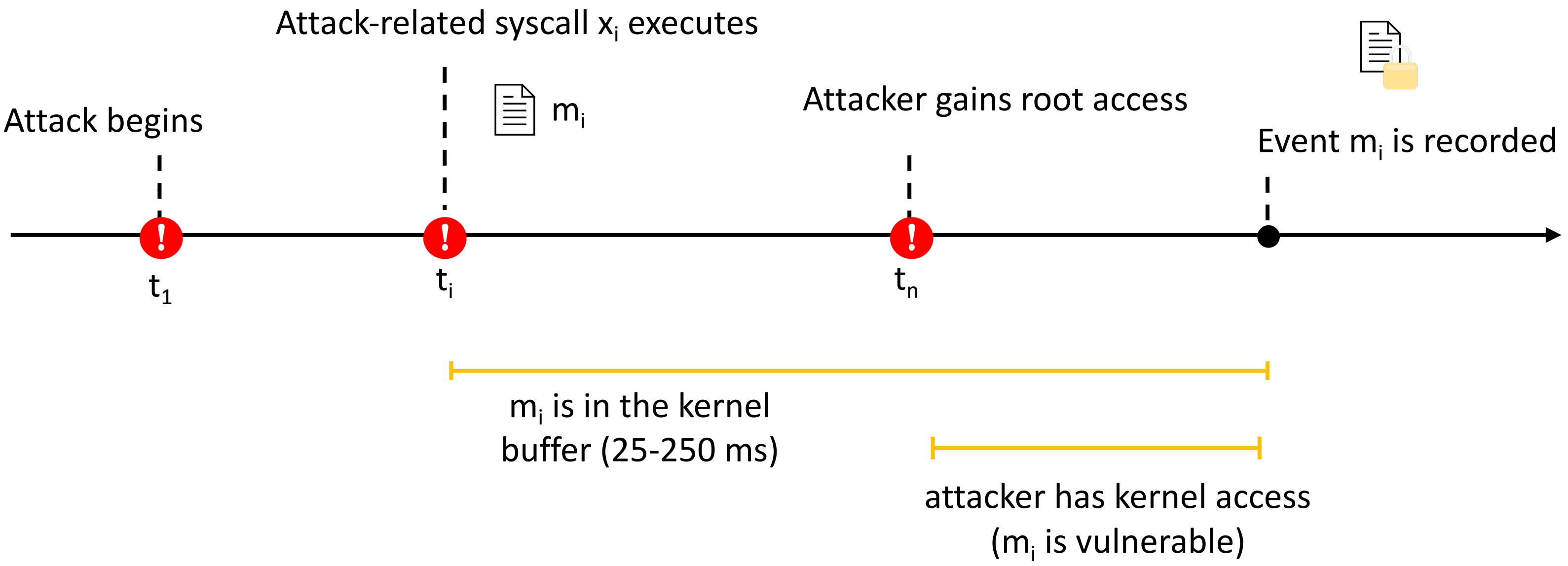
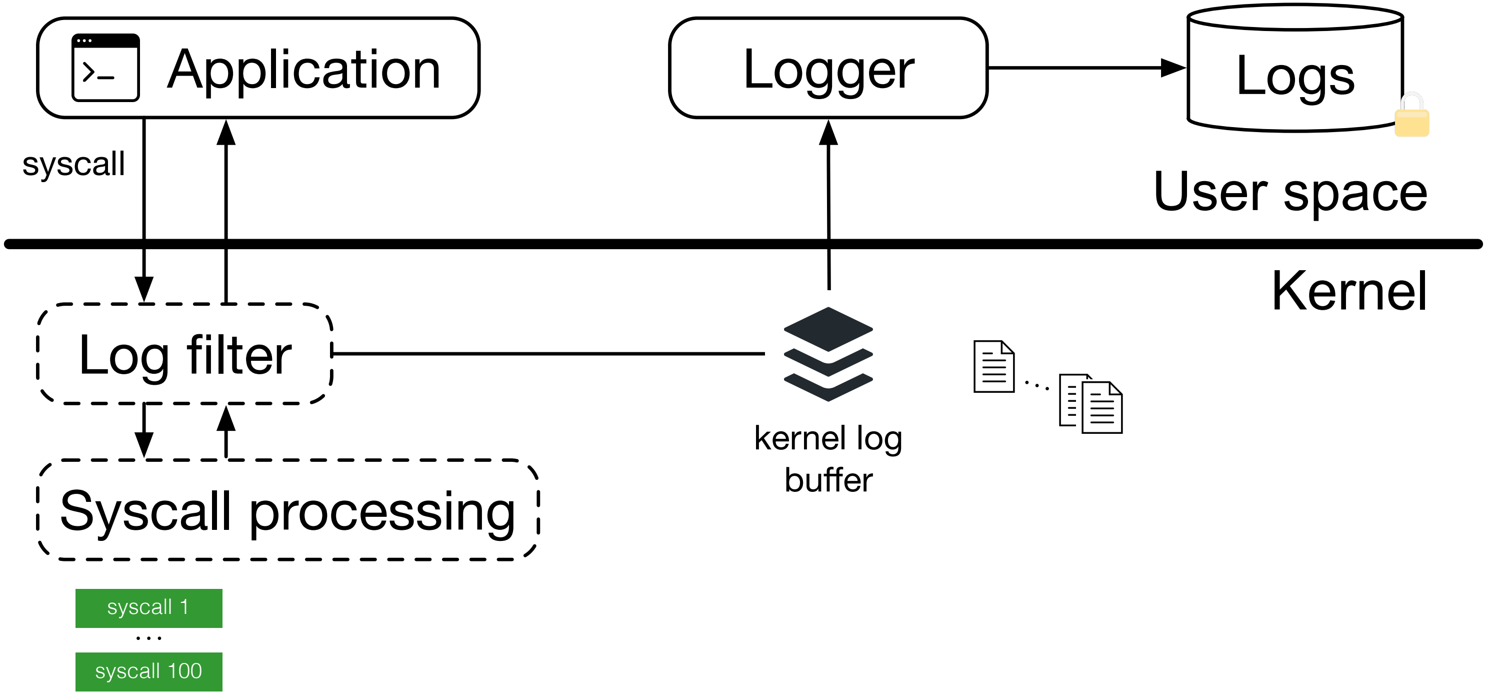


Race Condition Attack



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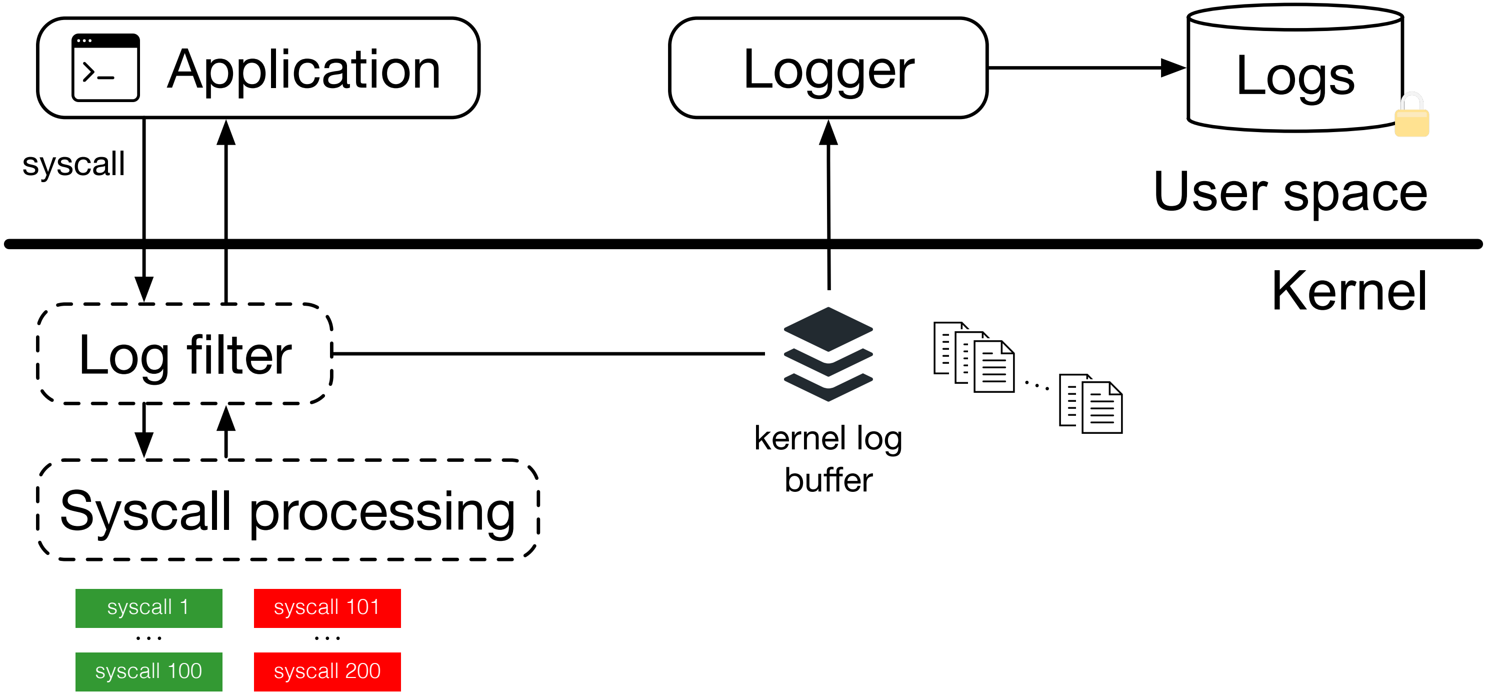

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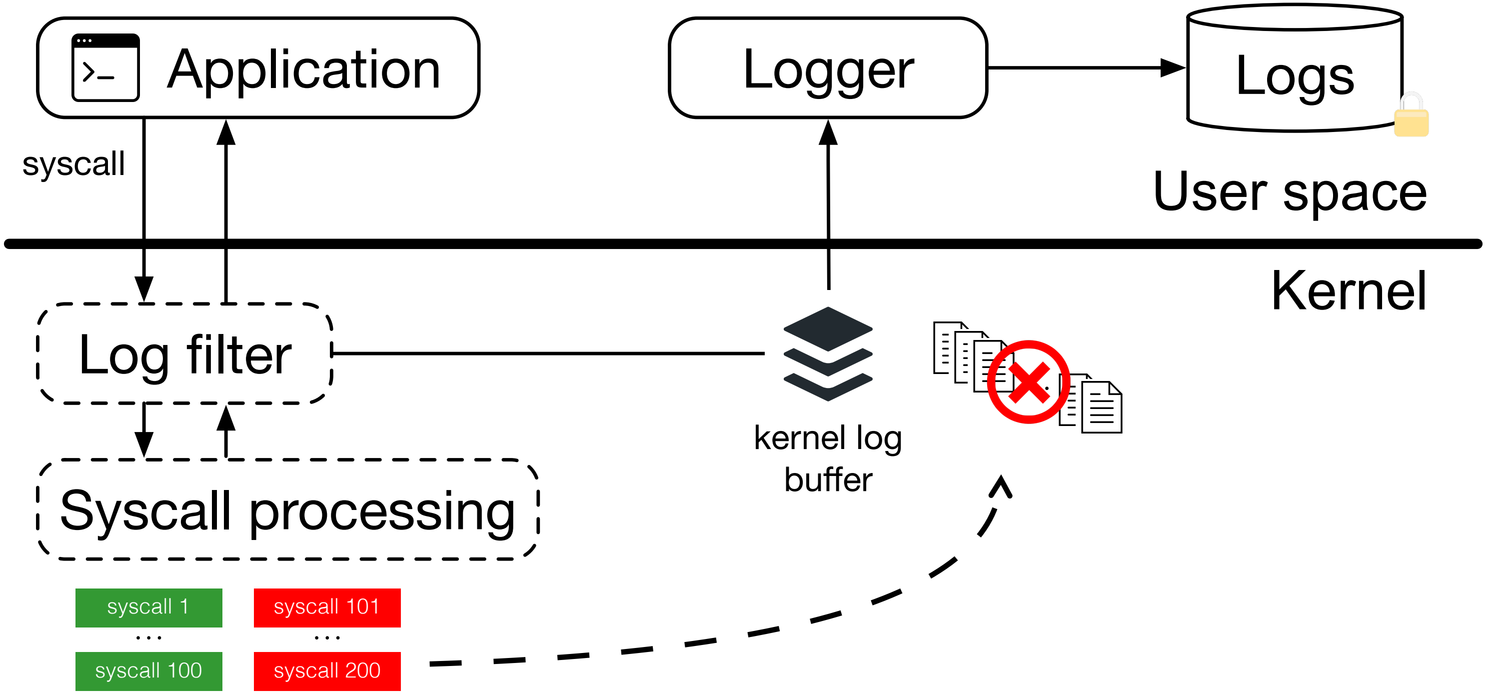
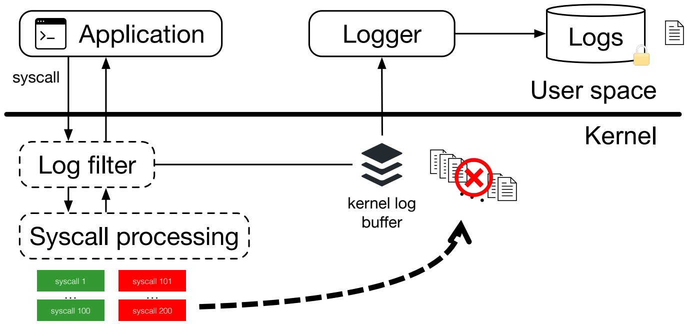
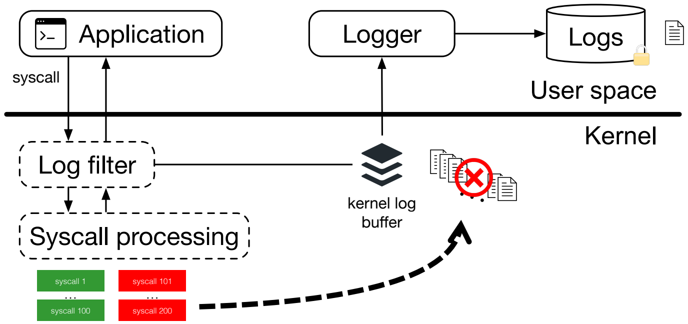


Realistic Attack Scenario



Realistic Attack Scenario

1. Remote code execution: CVE-2014-6271 (Shellshock)
2. Privilege escalation: CVE-2017-16995
3. Log tampering: log-interceptor (details in the paper)



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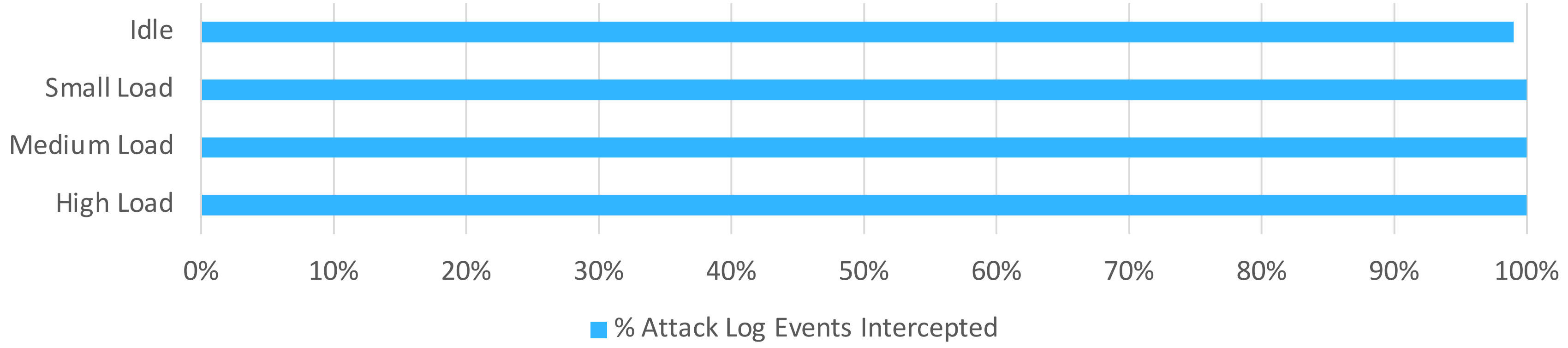
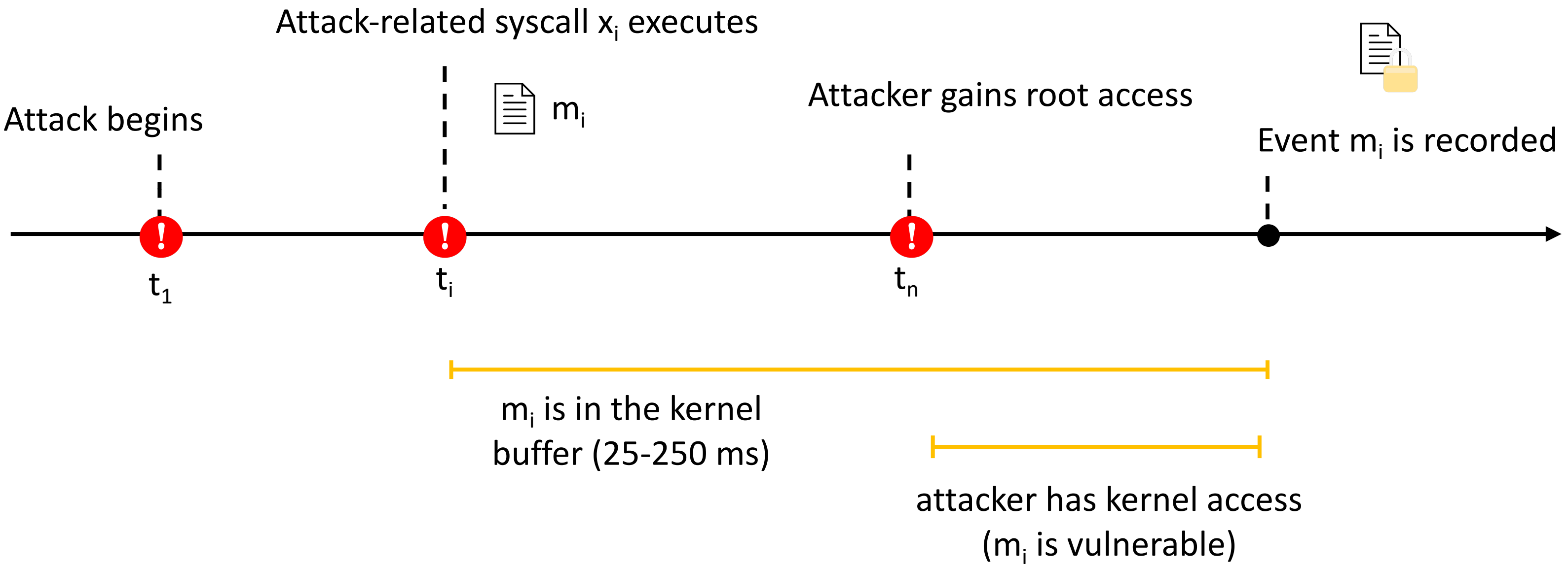


How do we defend against this attack?

Defense Goals

- **Synchronous integrity**: securing logs synchronously with their creation.

Ways to achieve synchronous integrity



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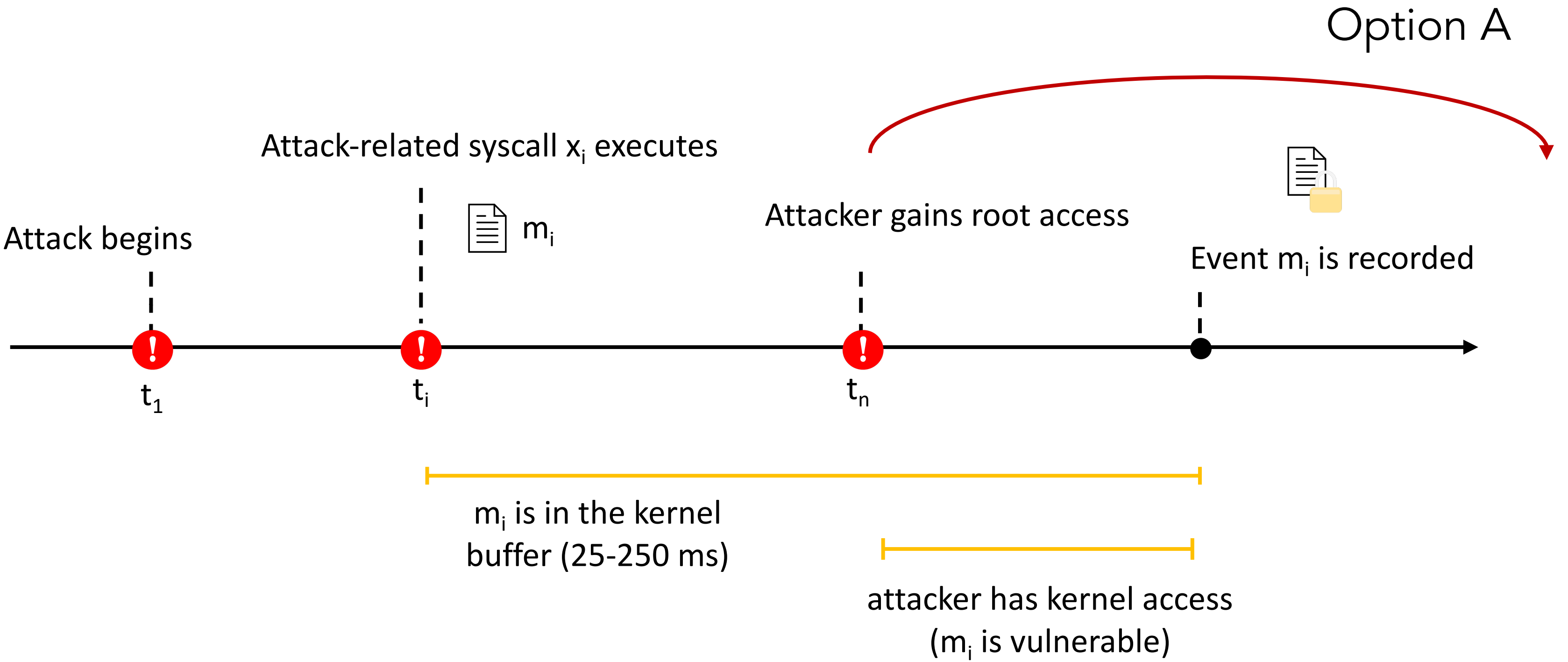

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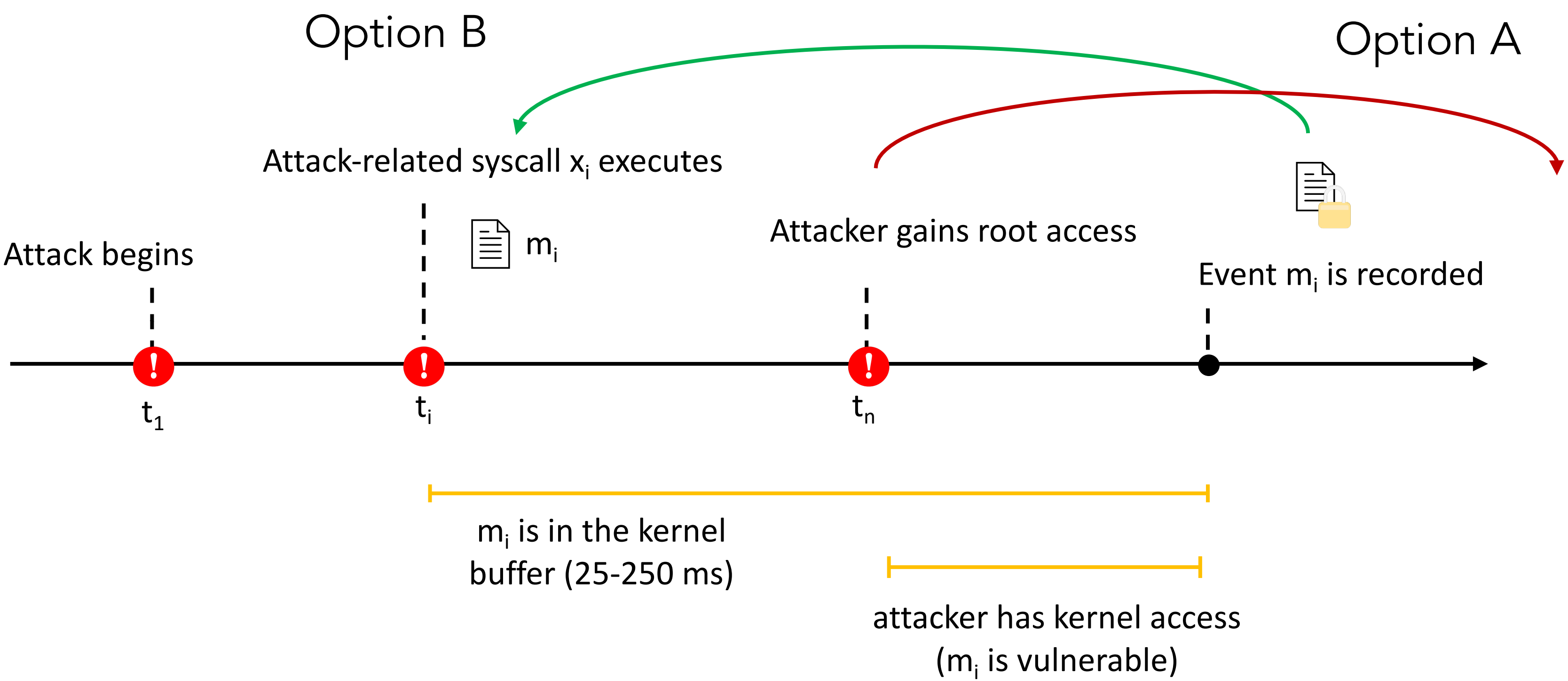
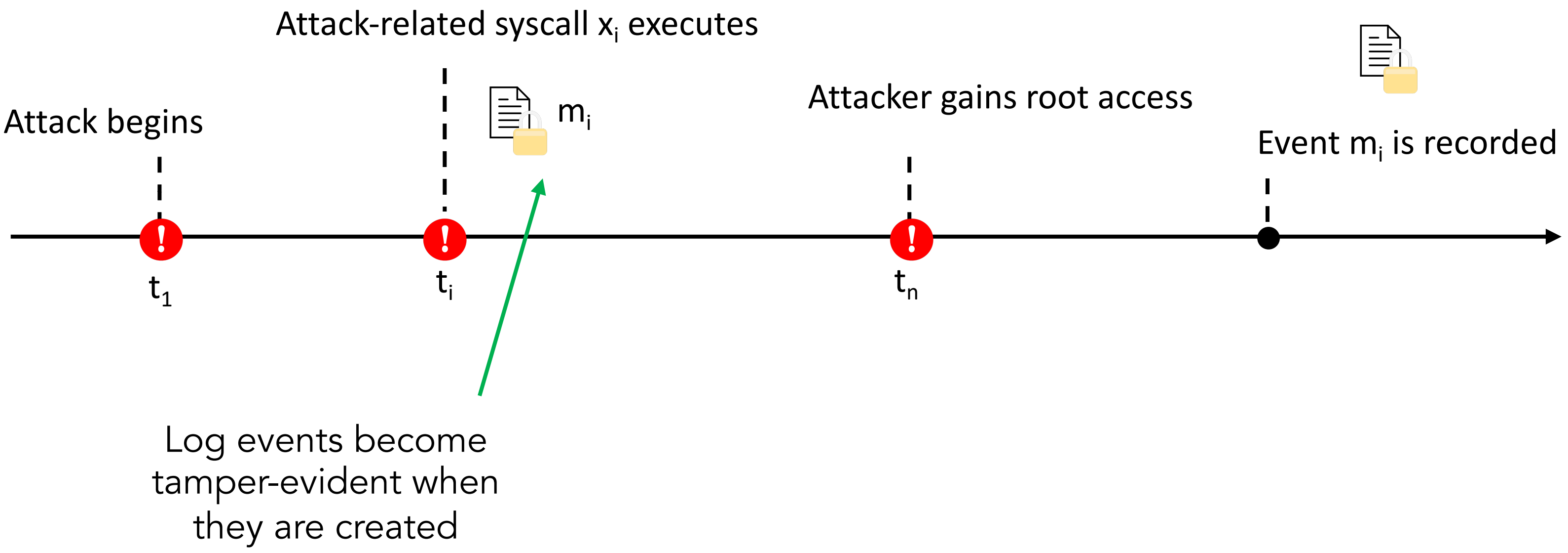


KennyLoggings



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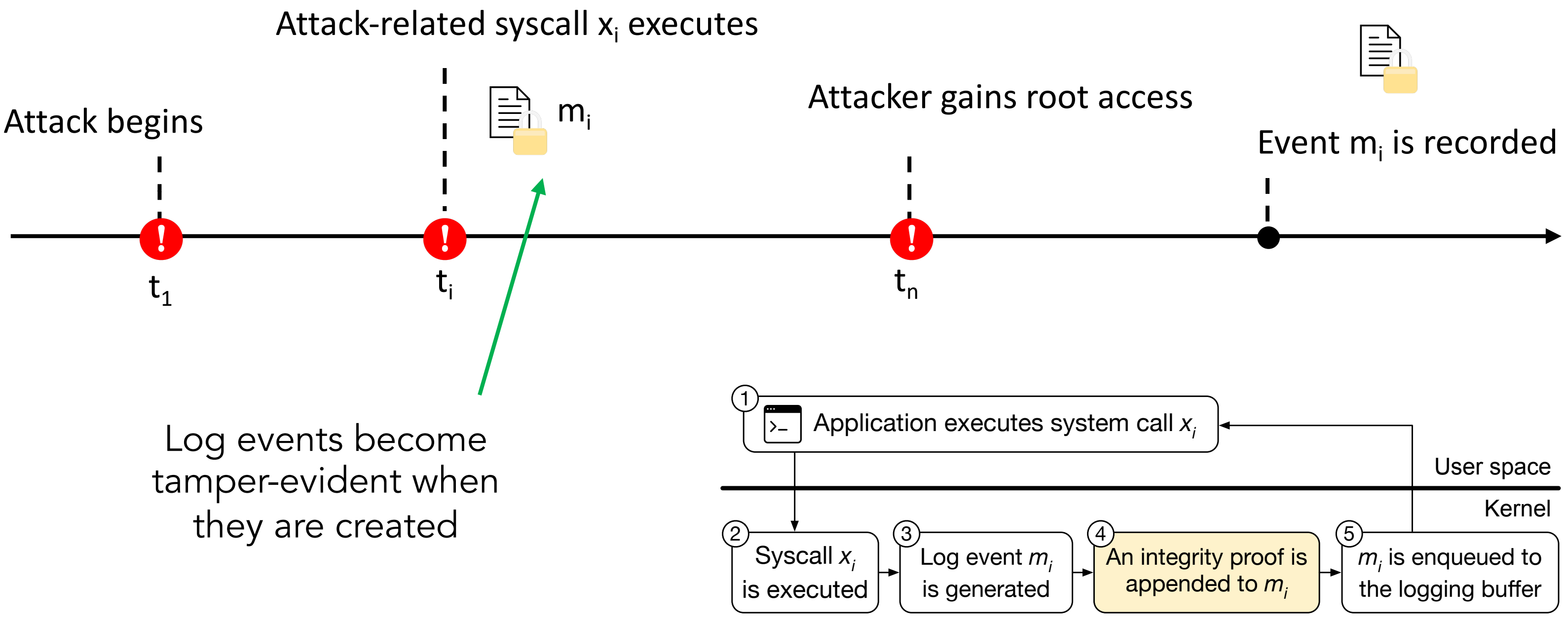
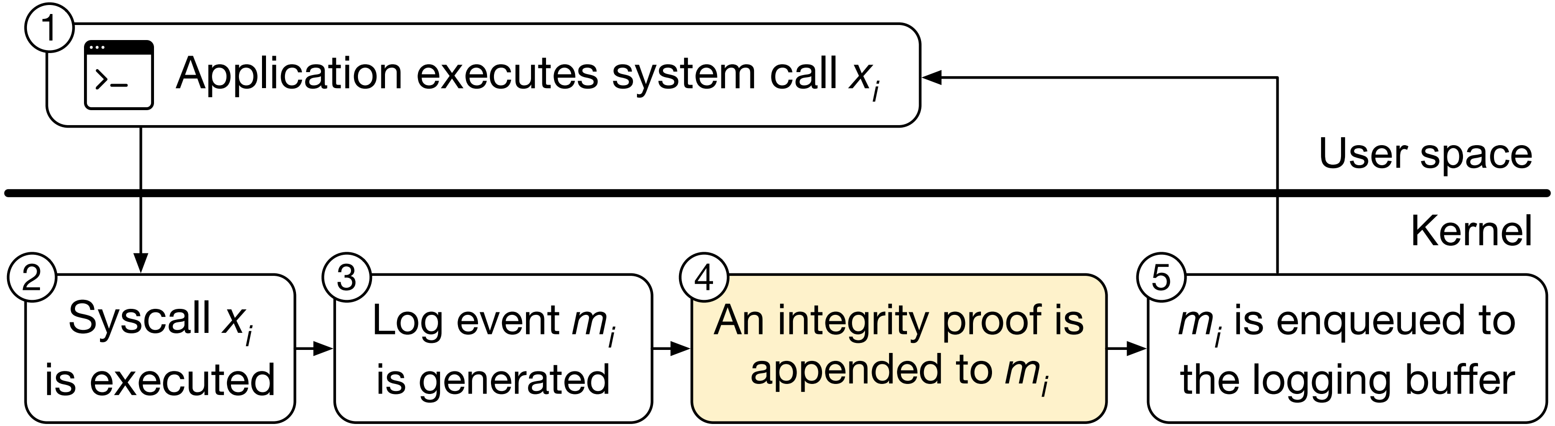


Log events become tamper-evident when they are created



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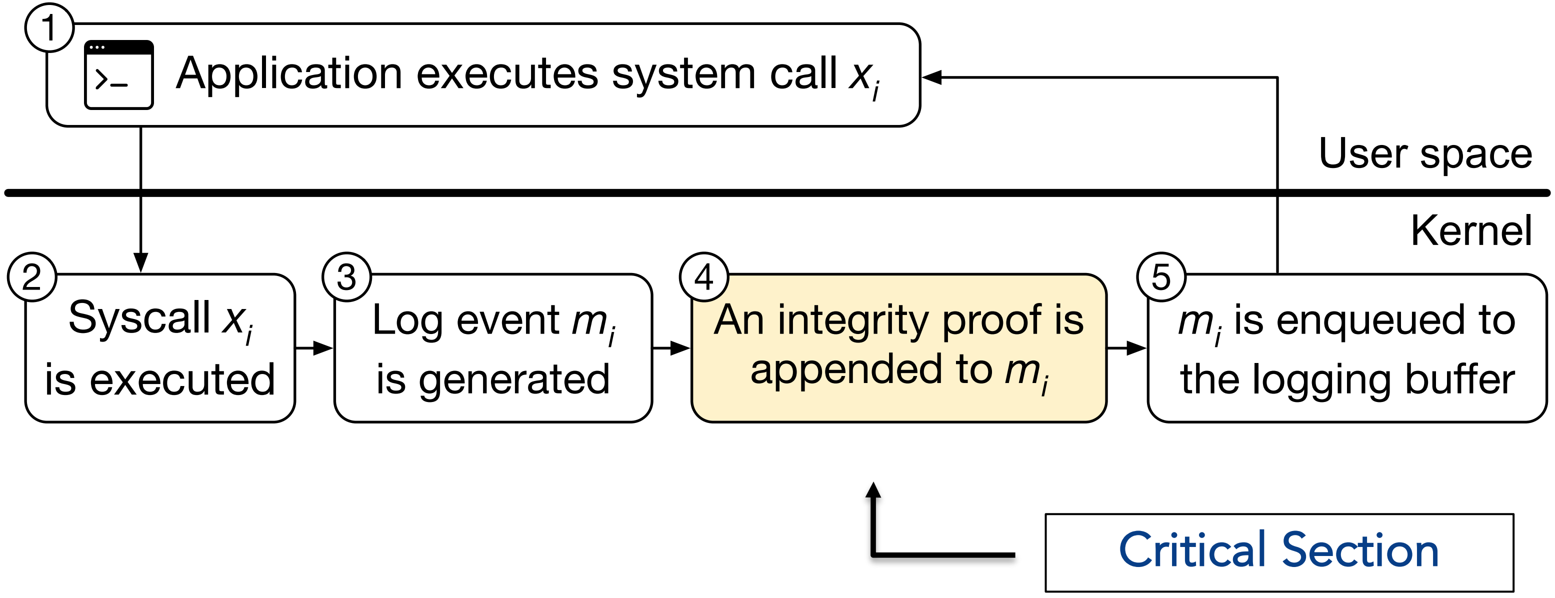

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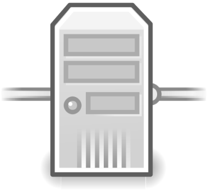
🔑$_0$ ⇒ 🔑$_1$ ⇒ 🔑$_2$



Logger

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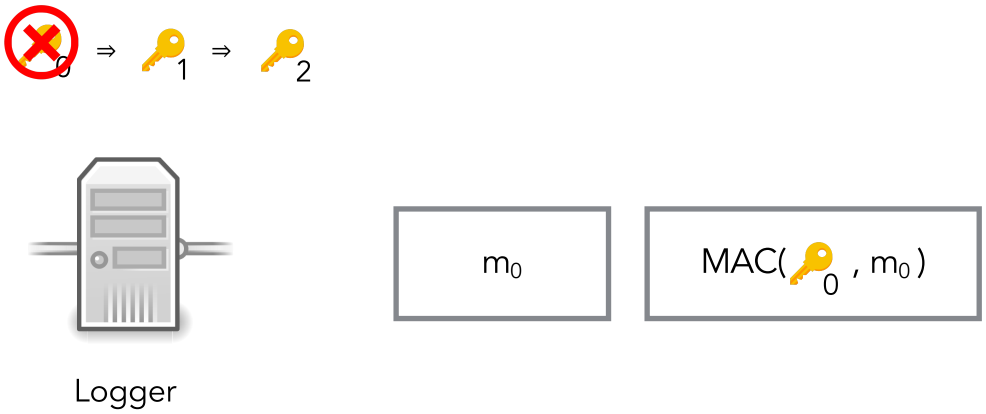

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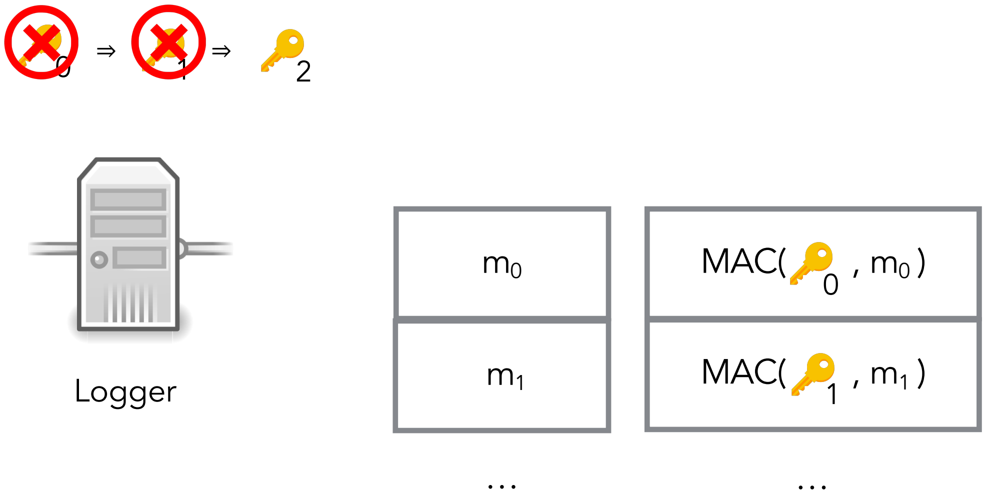

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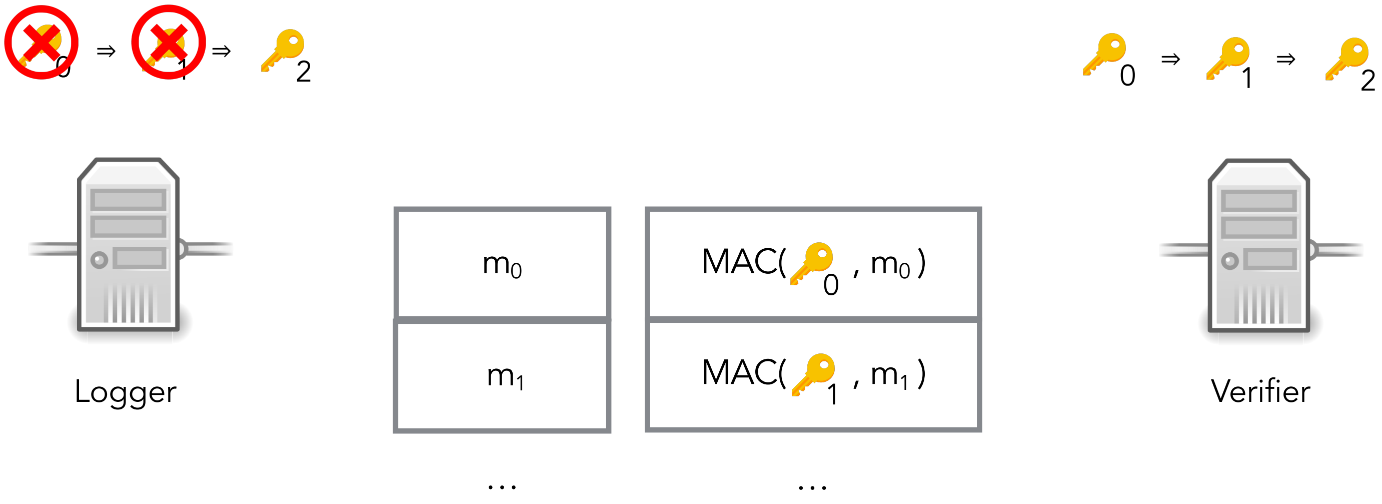

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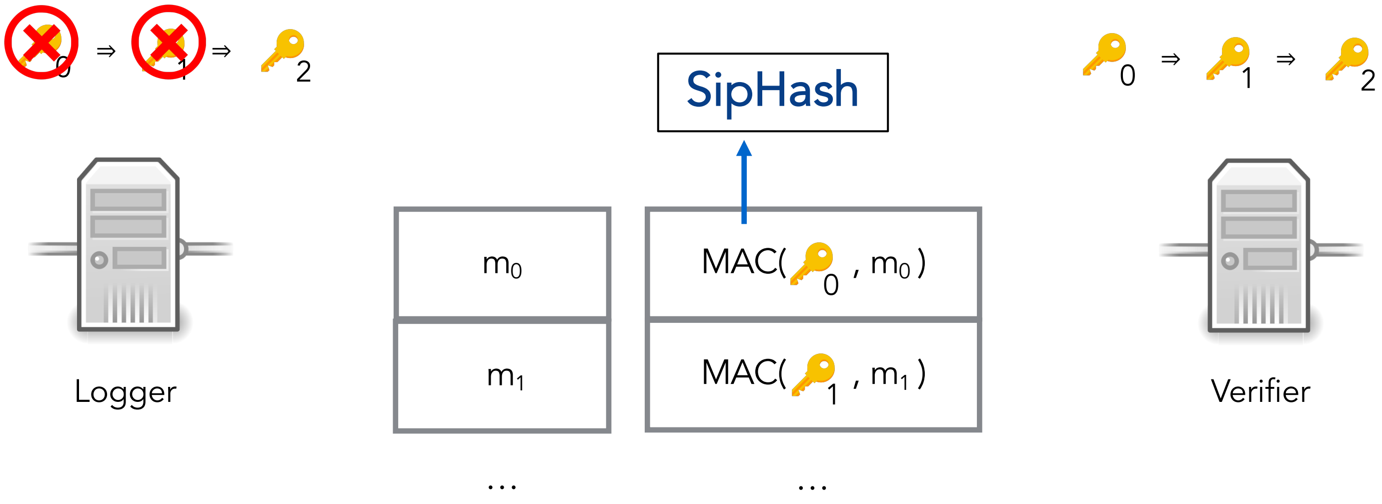

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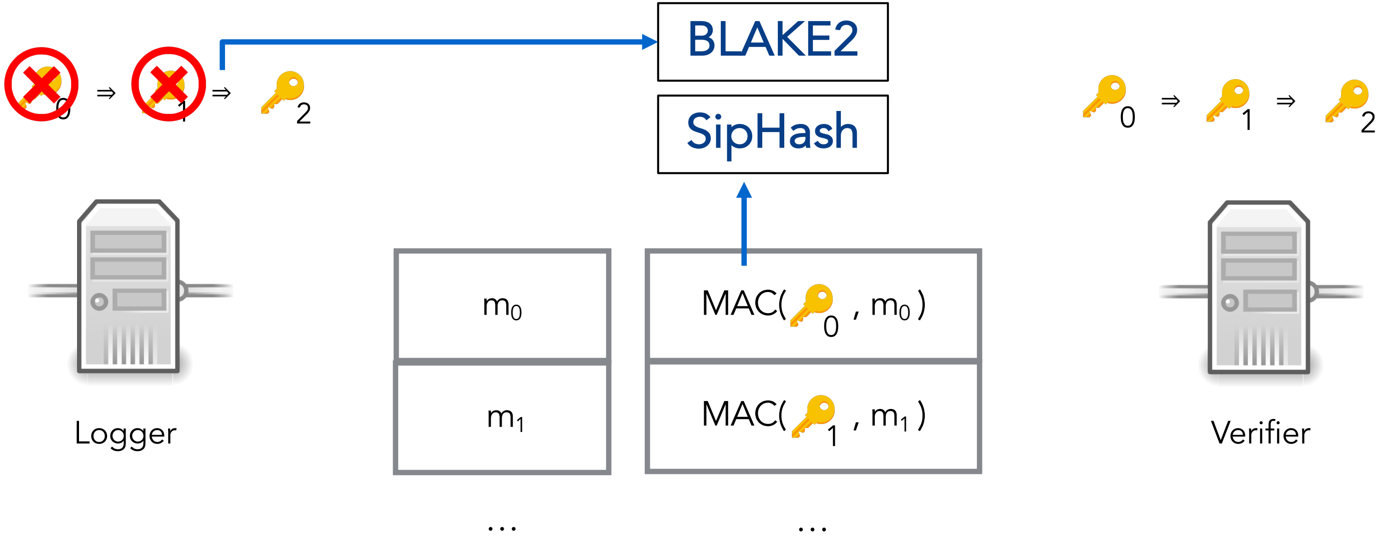

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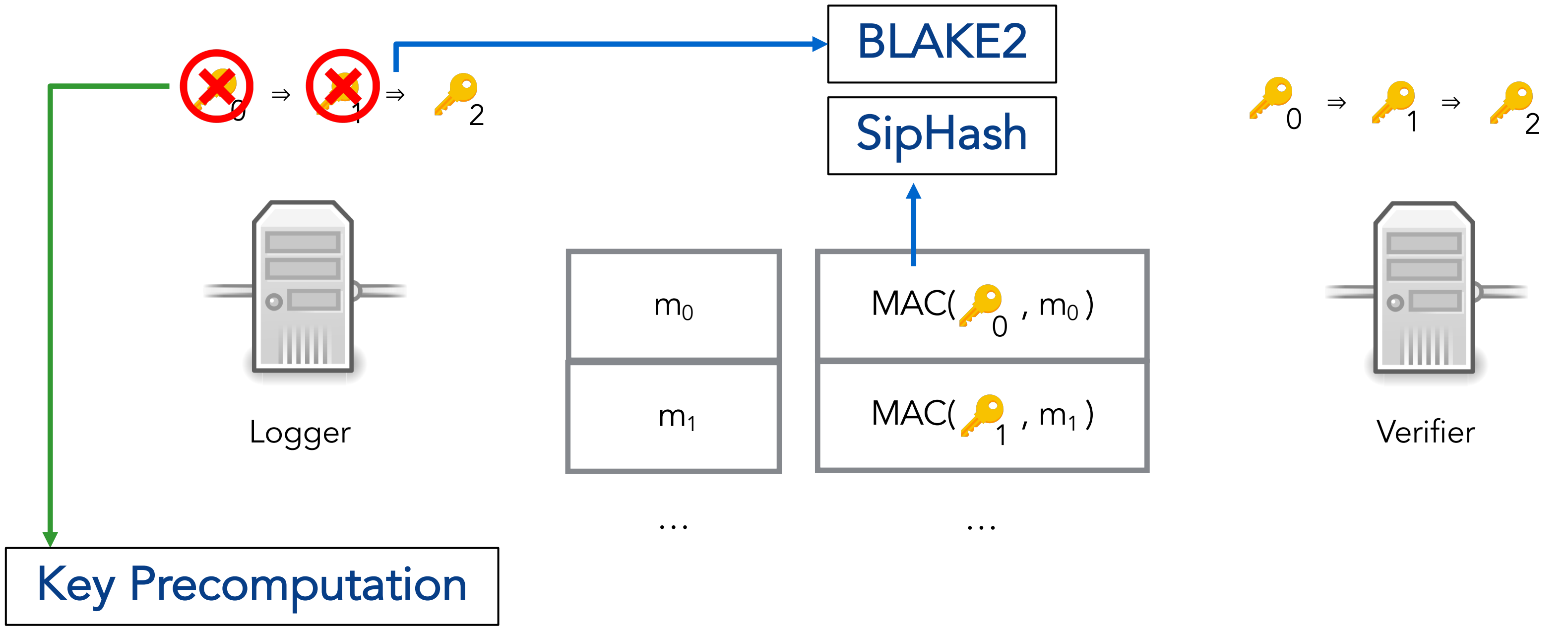

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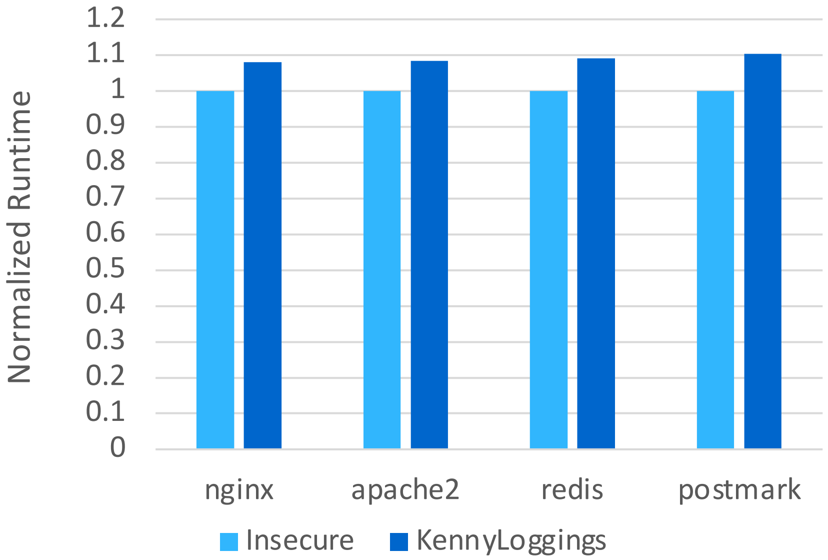

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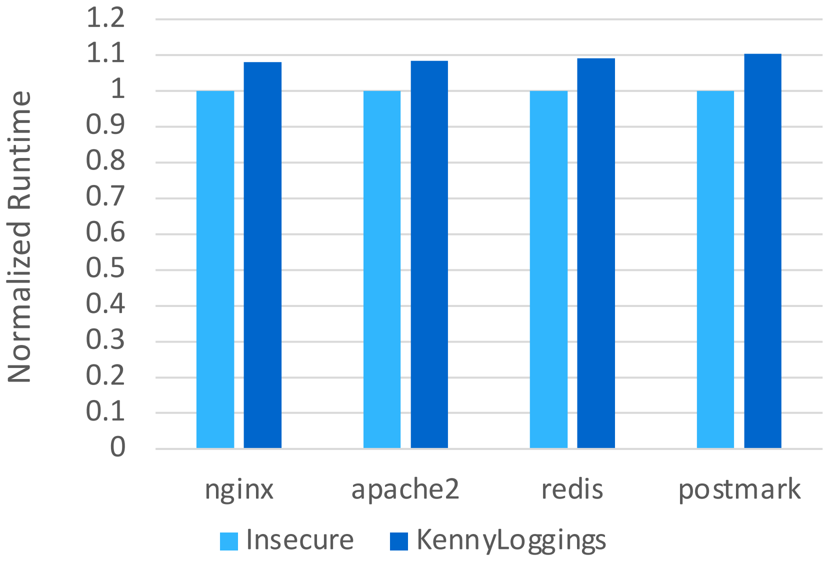

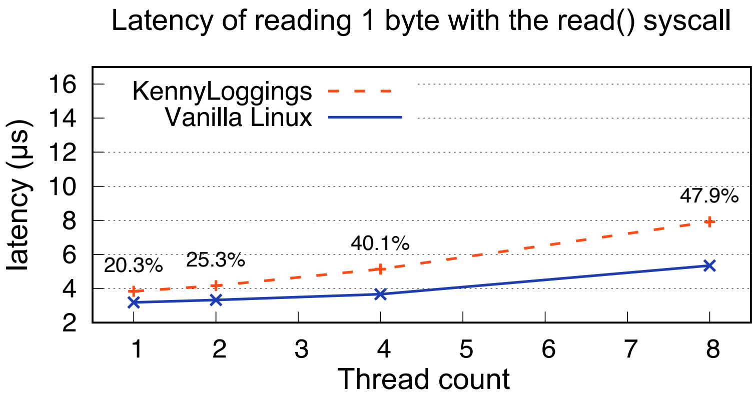

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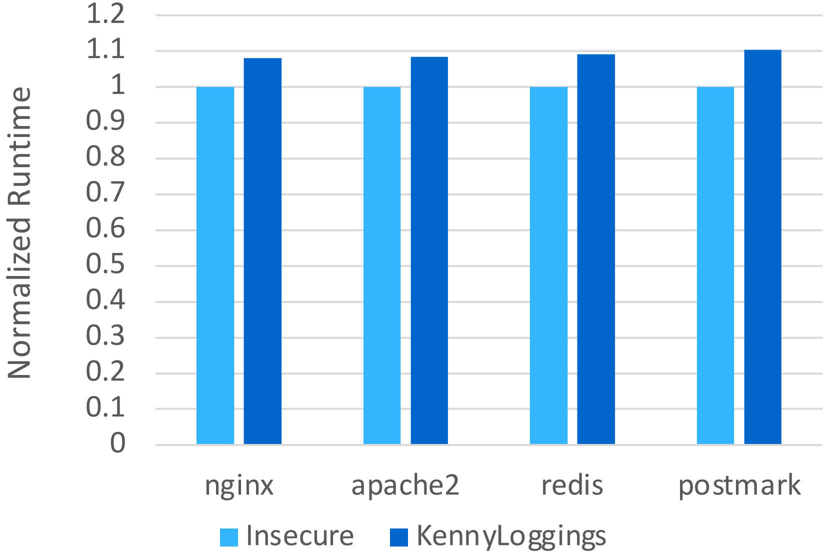

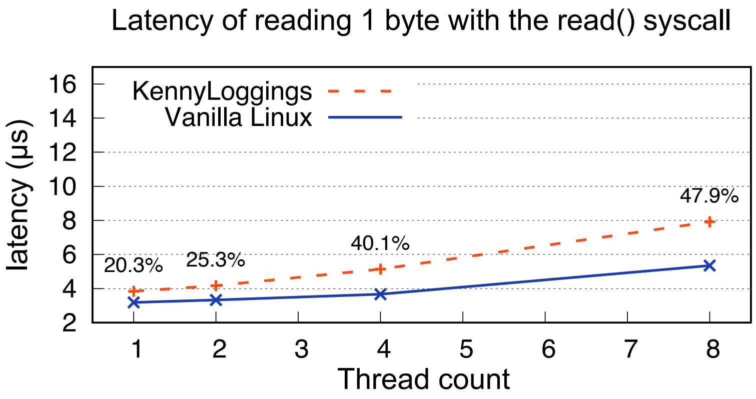

Ultimately, overhead is dictated by contention on the critical section

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Hackers are increasingly destroying logs to hide attacks

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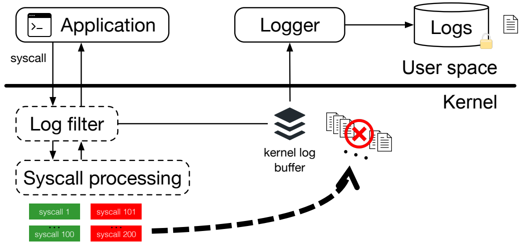

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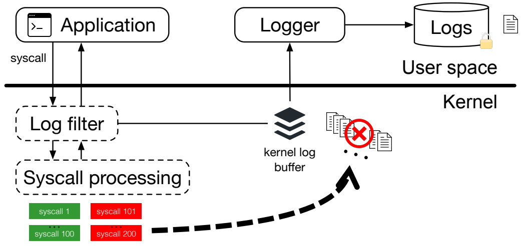

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- https://bitbucket.org/sts-lab/kennyloggings

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