Rethinking System Audit Architectures for High Event Coverage and Synchronous Log Availability

Varun Gandhi, Sarbartha Banerjee, Aniket Agarwal,
Adil Ahmed, Sangho Lee, and Marcus Peinado

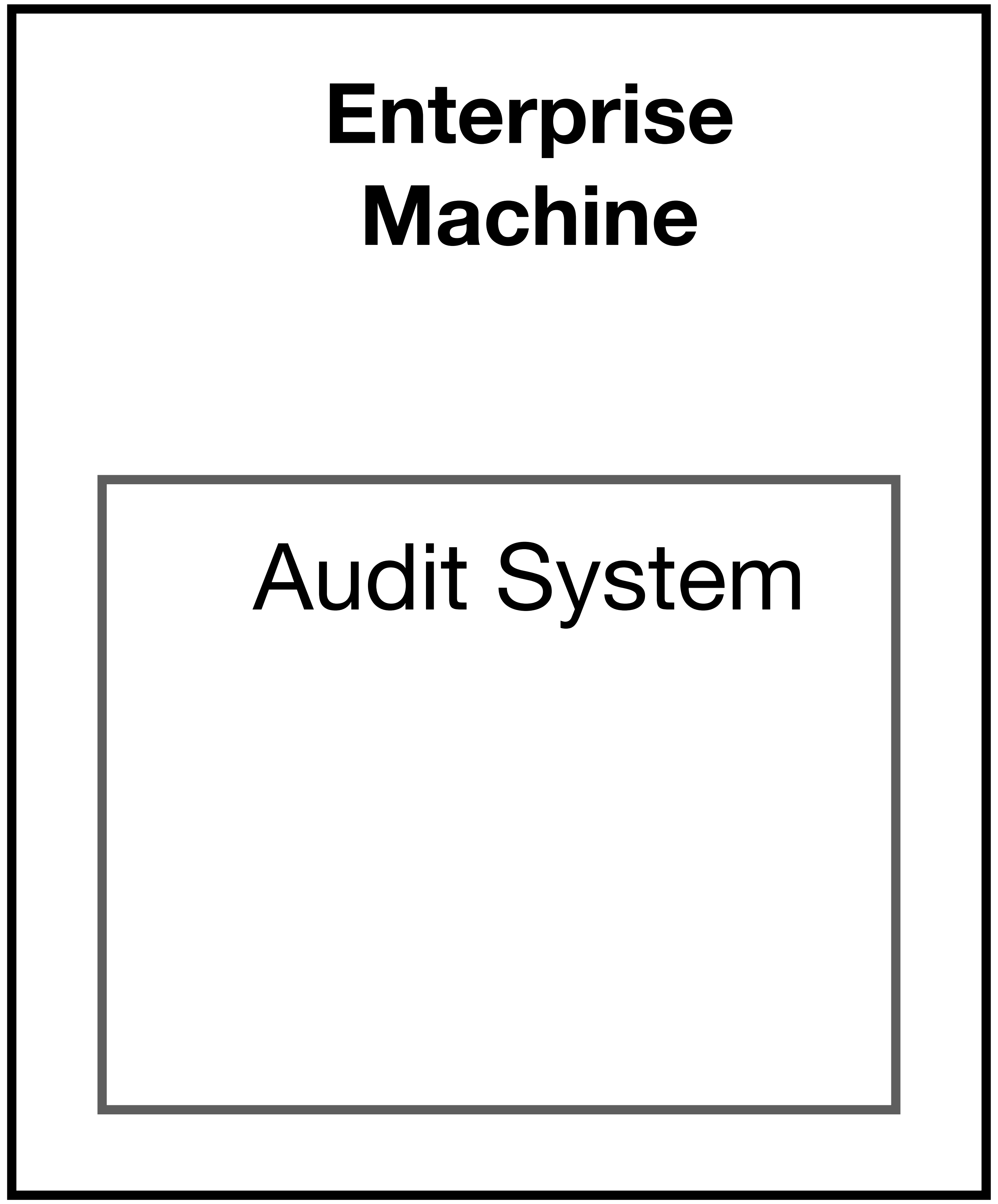
HARVARD UNIVERSITY

THE UNIVERSITY OF TEXAS AT AUSTIN

Arizona State University

Microsoft Research

System auditing is critical for forensic analysis



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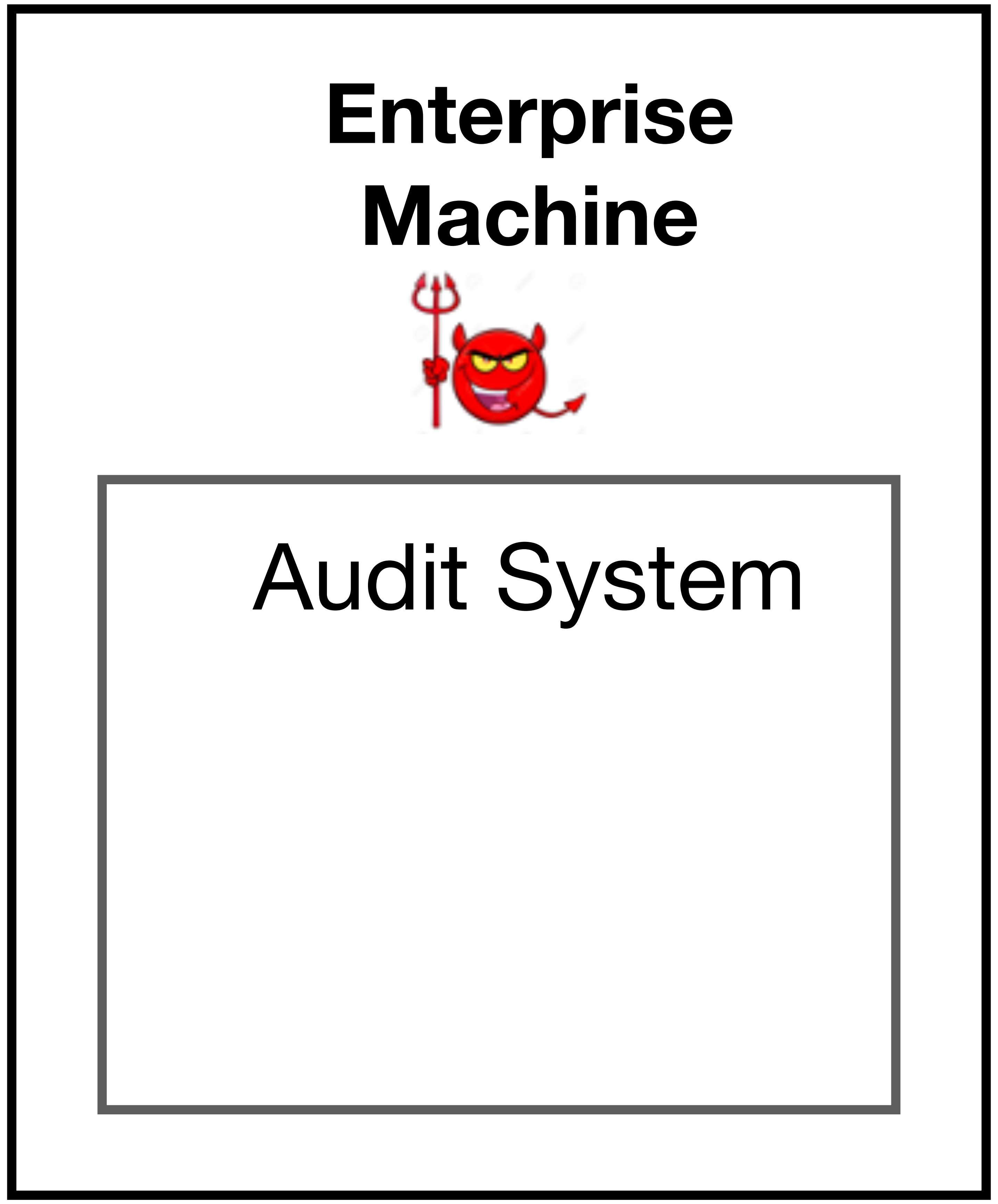

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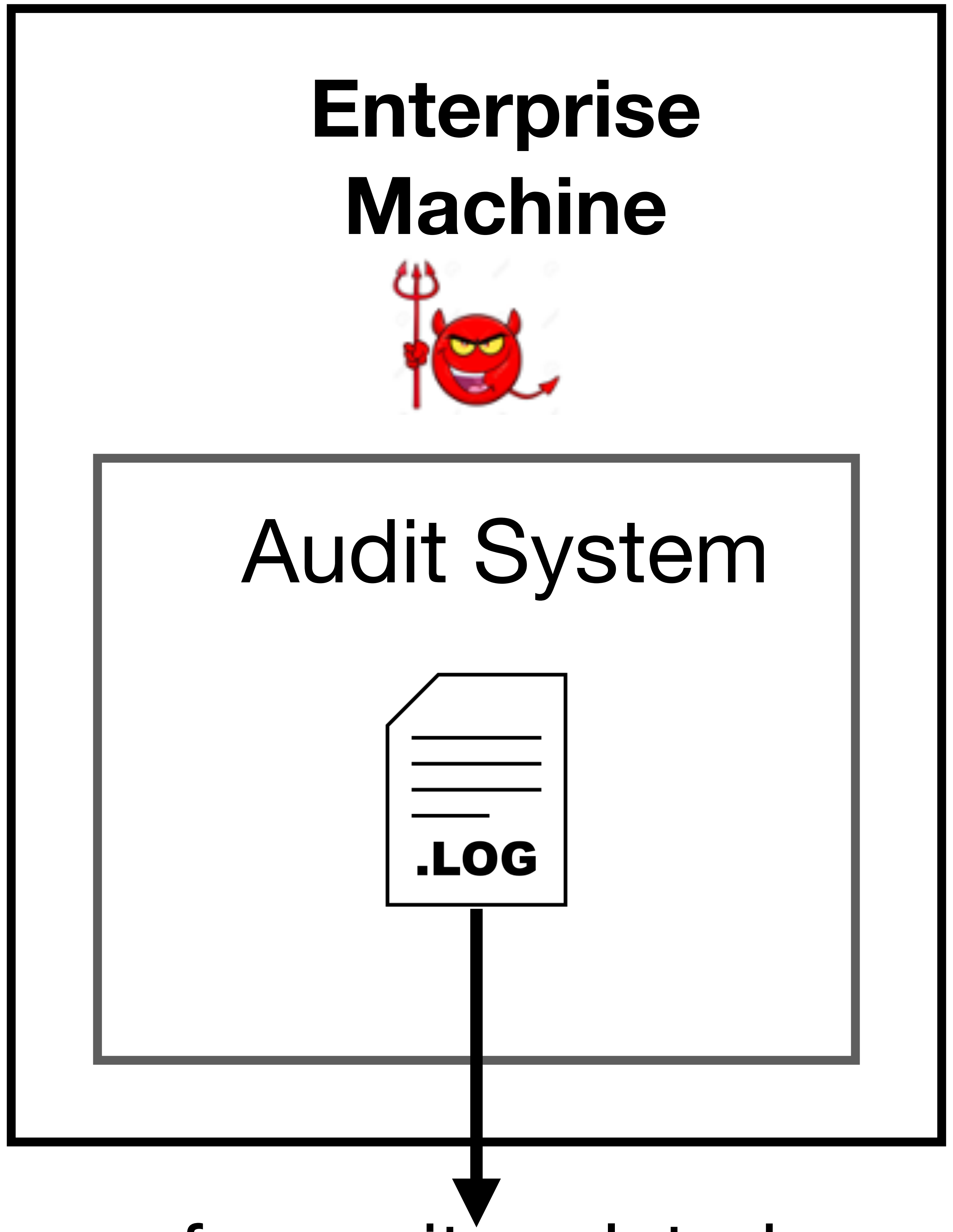

Trace of security-related events
E.g., system calls

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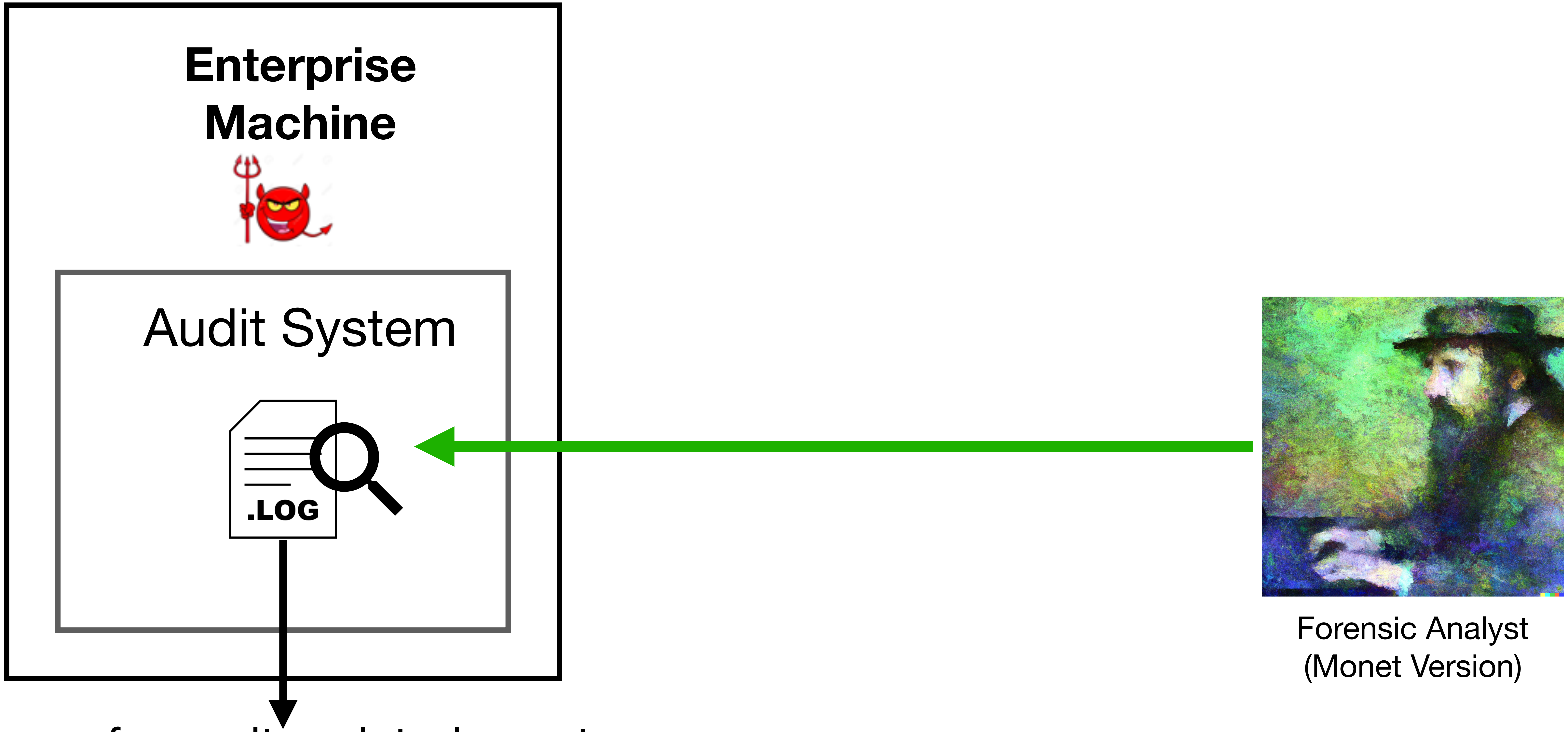

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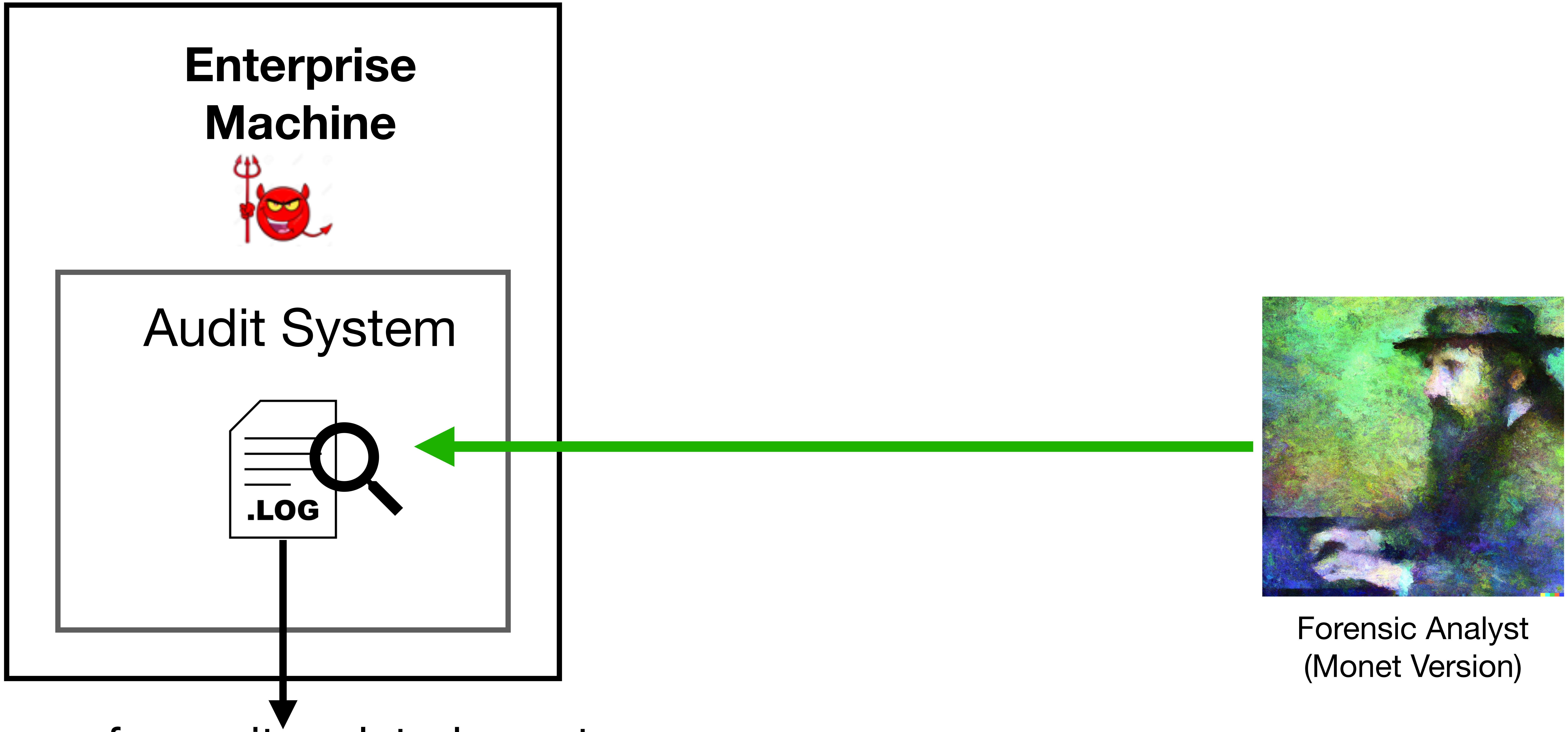
What makes a log effective for forensic analysis?



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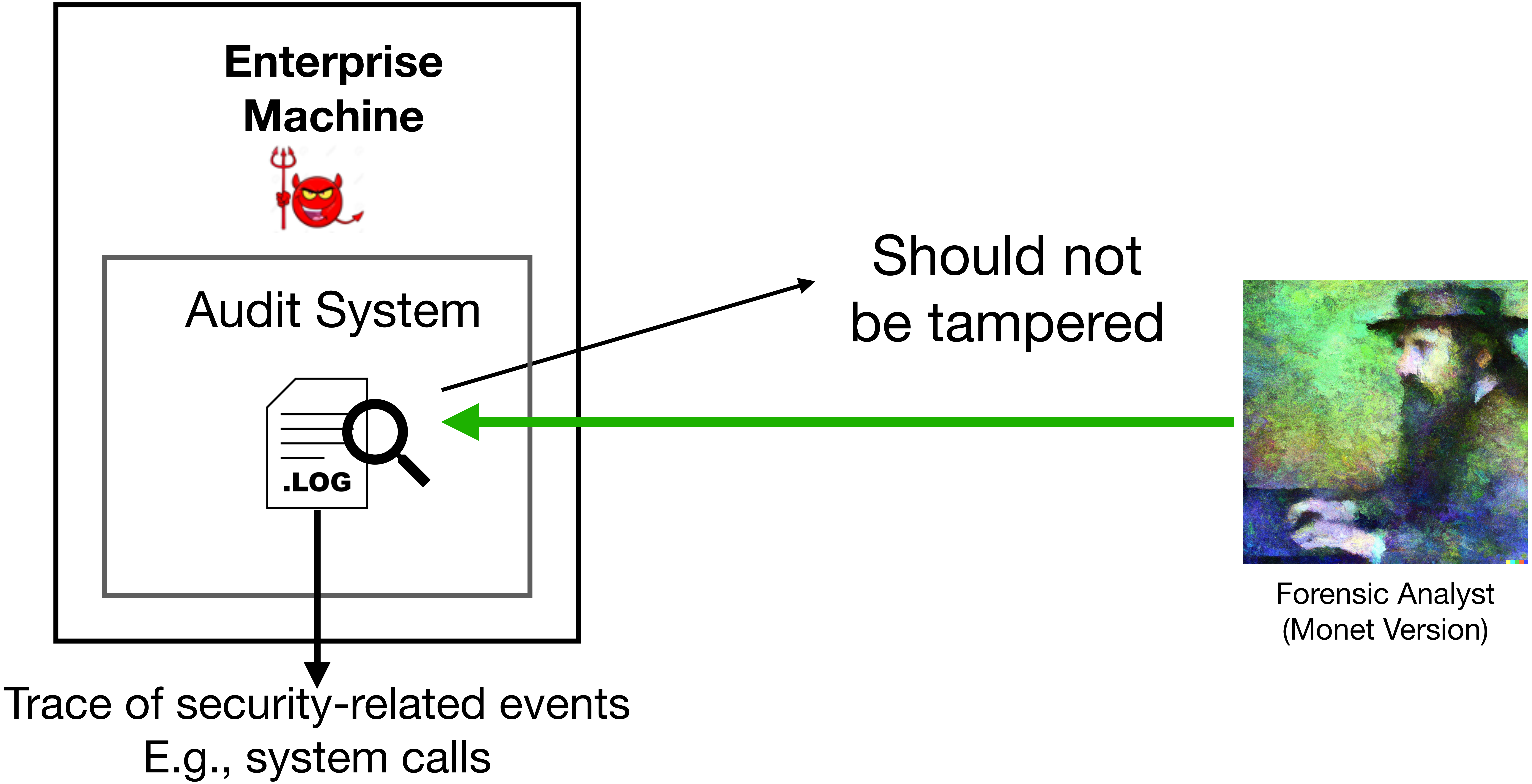

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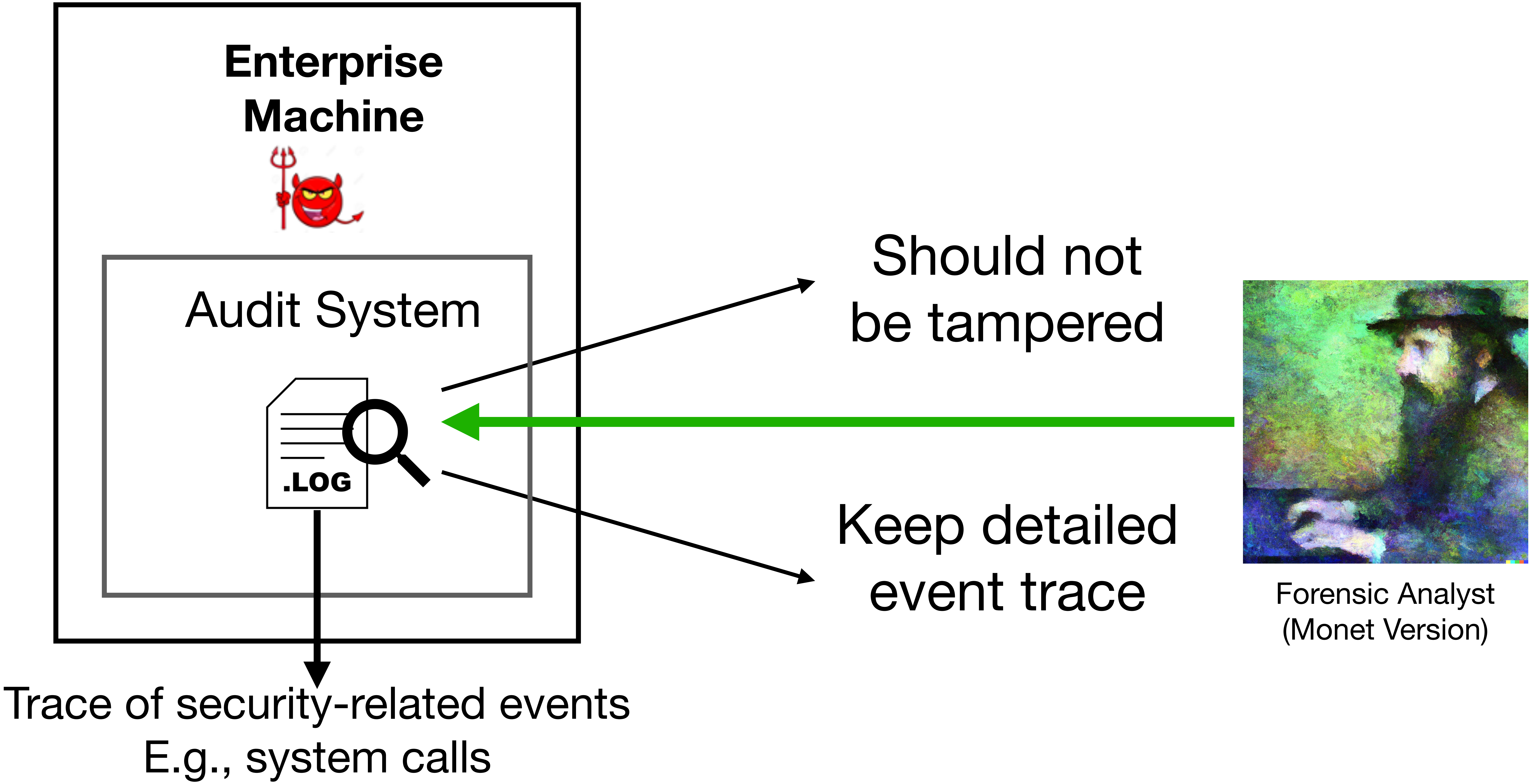

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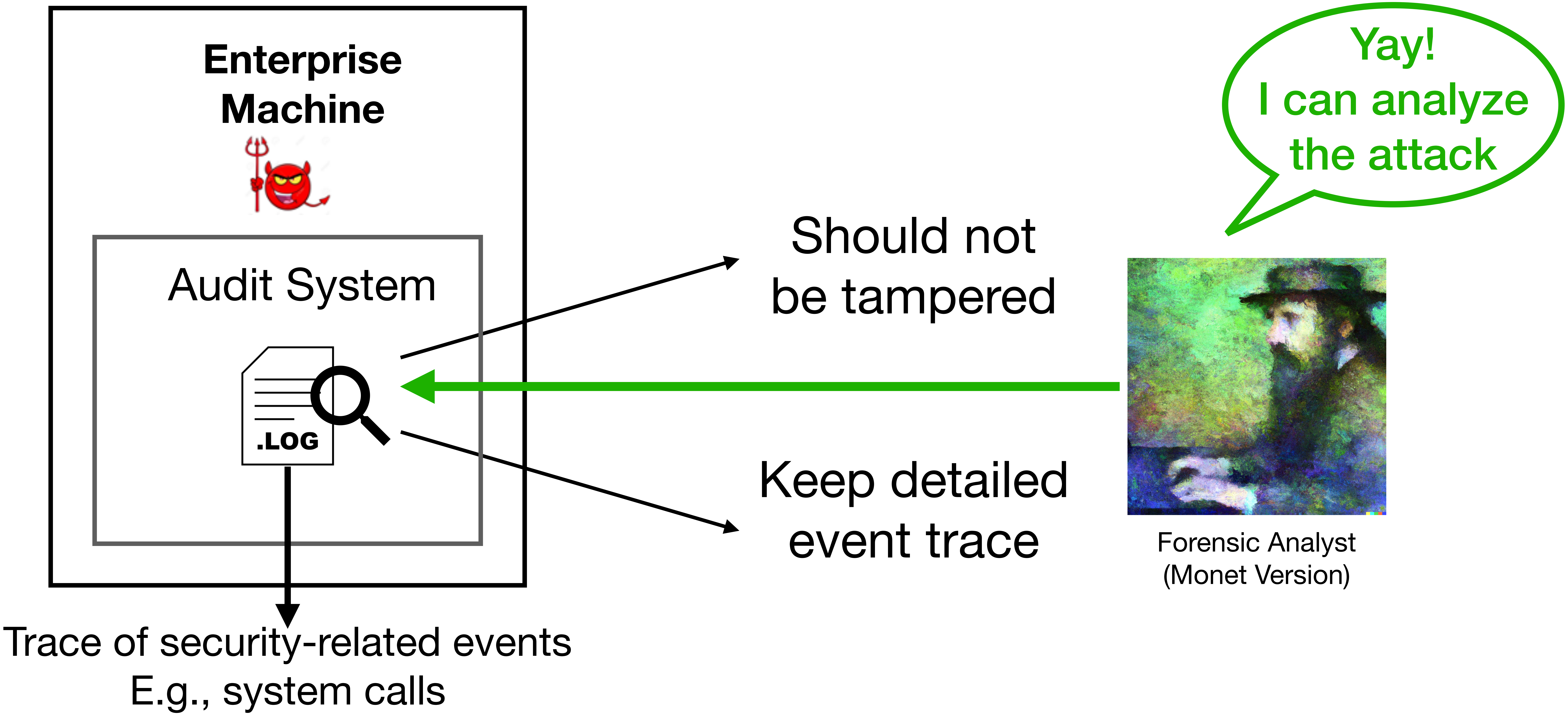

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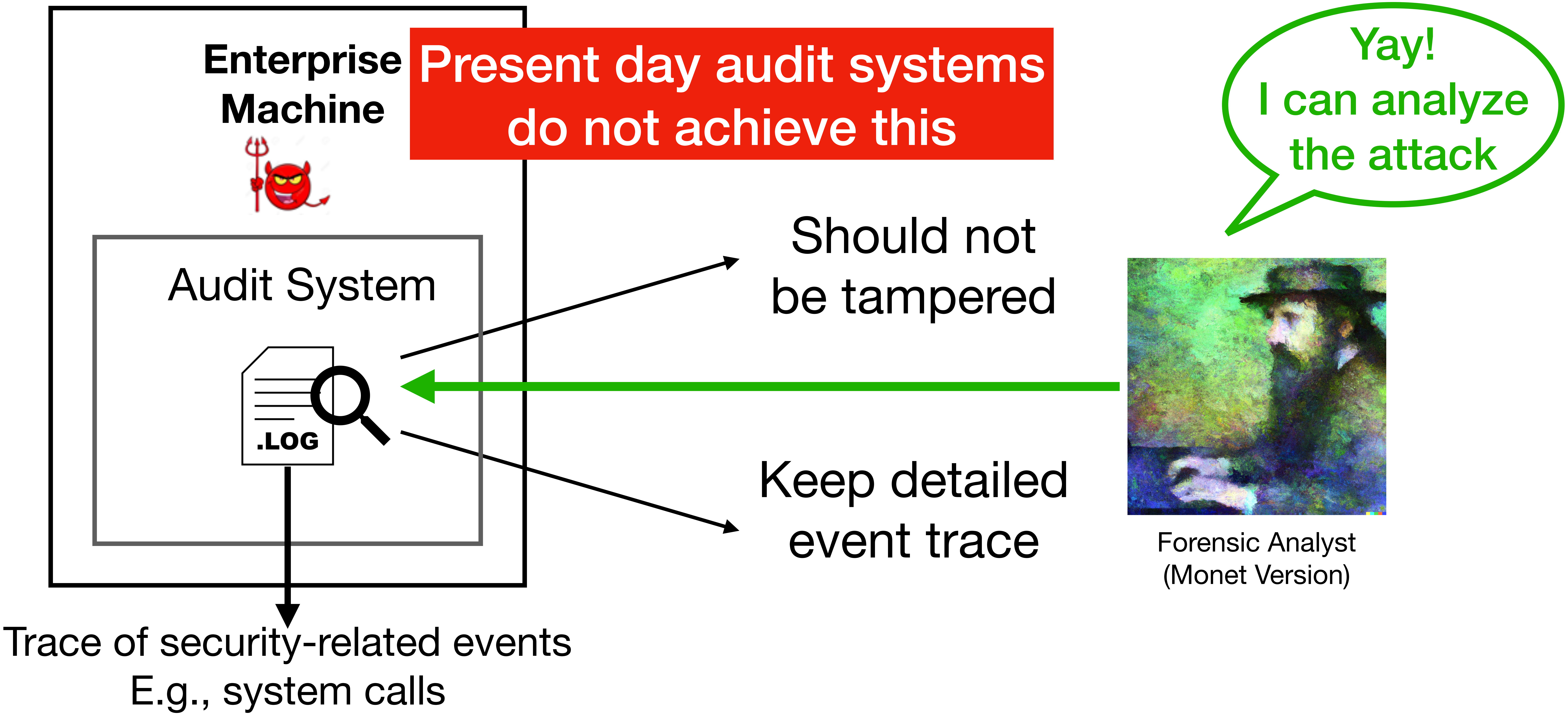
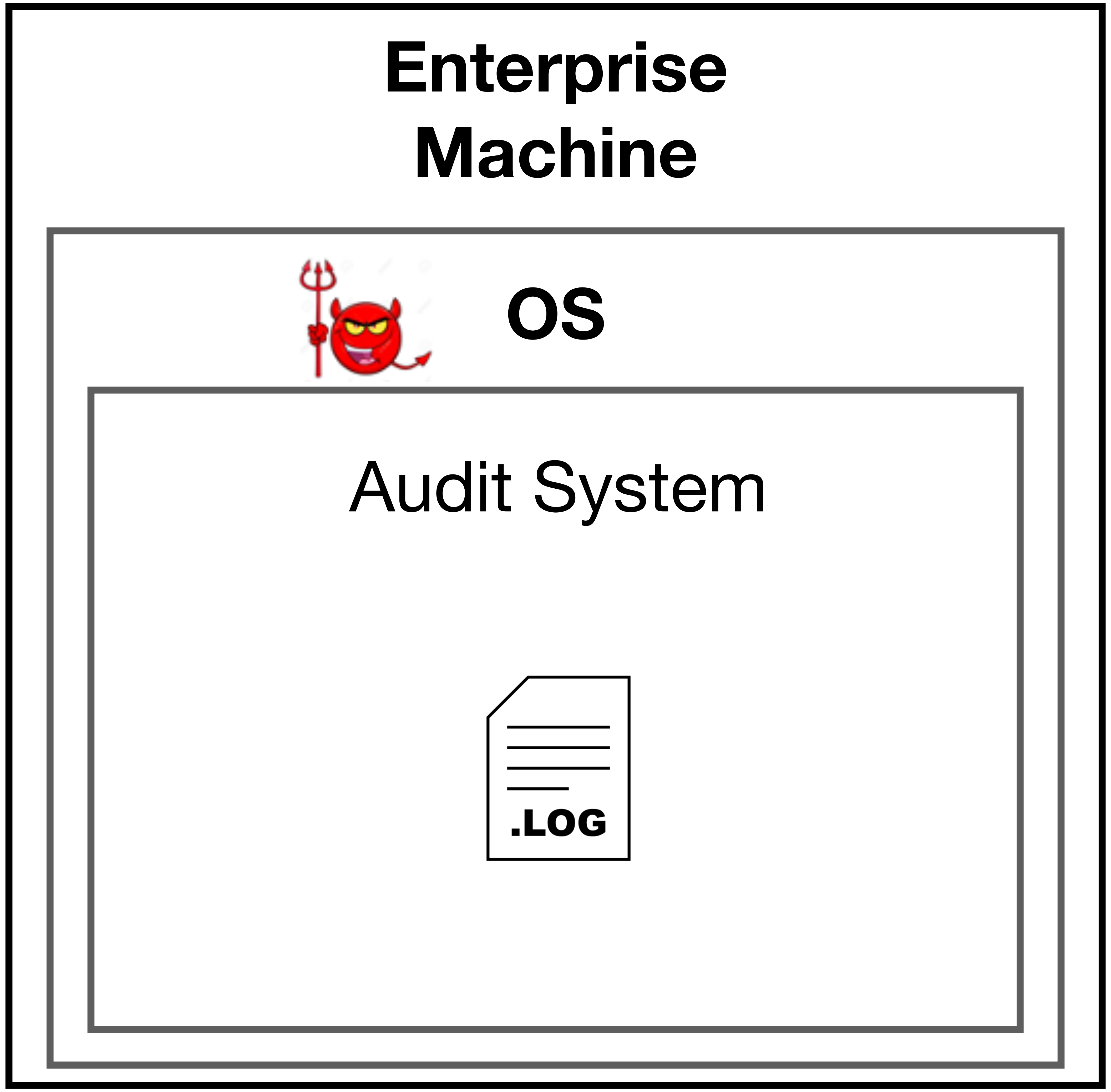


Kernel exploits can tamper audit logs



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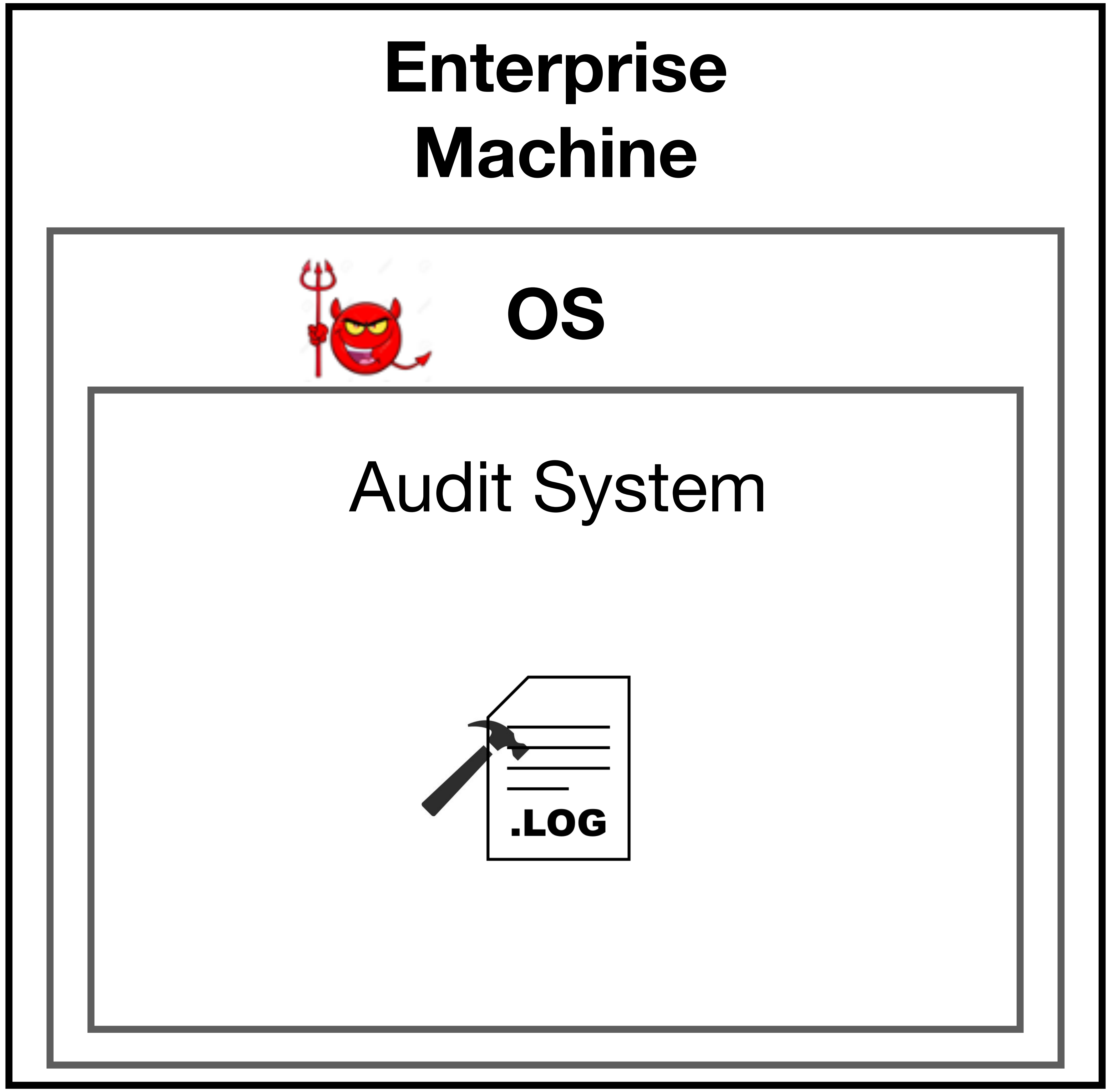

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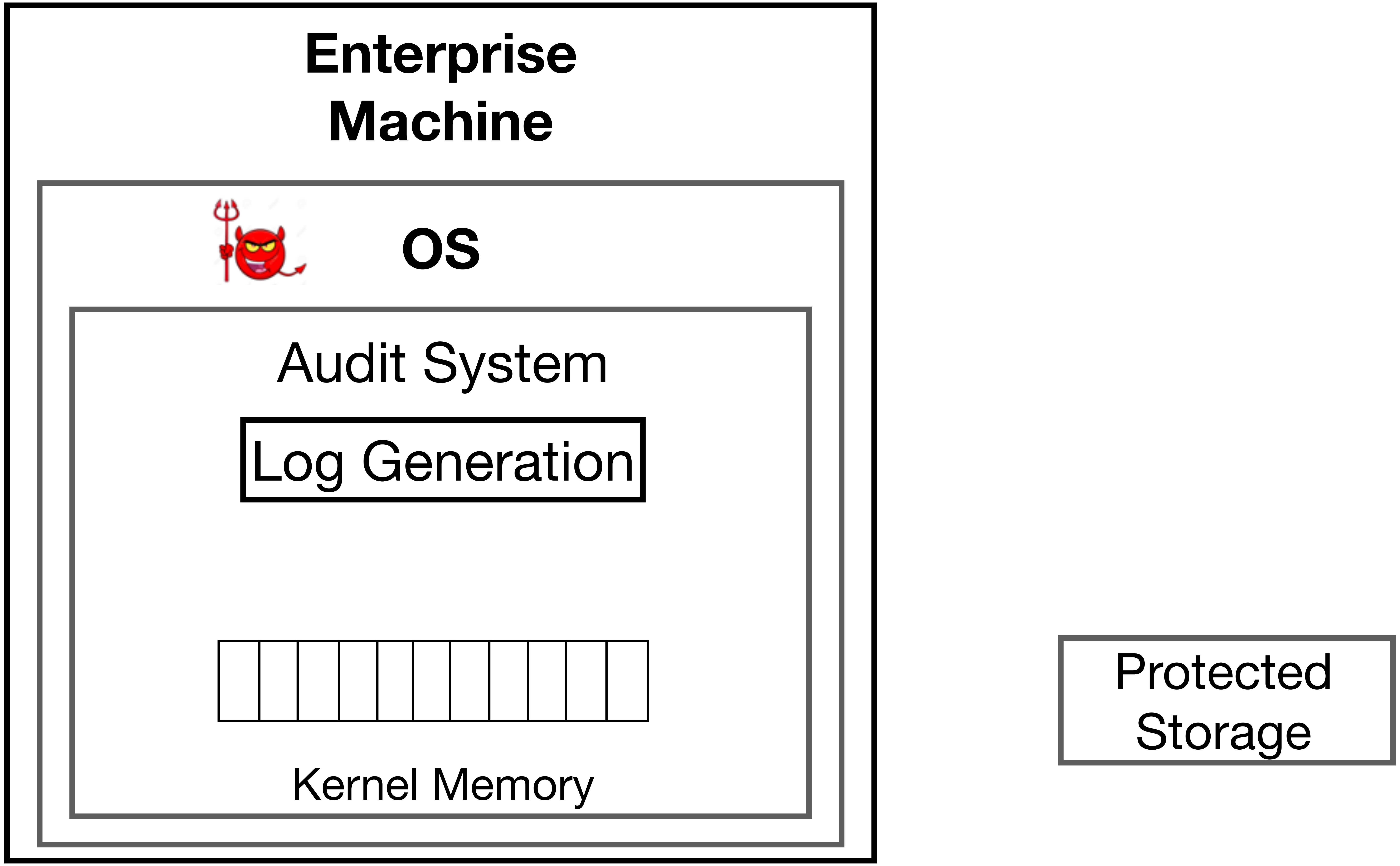

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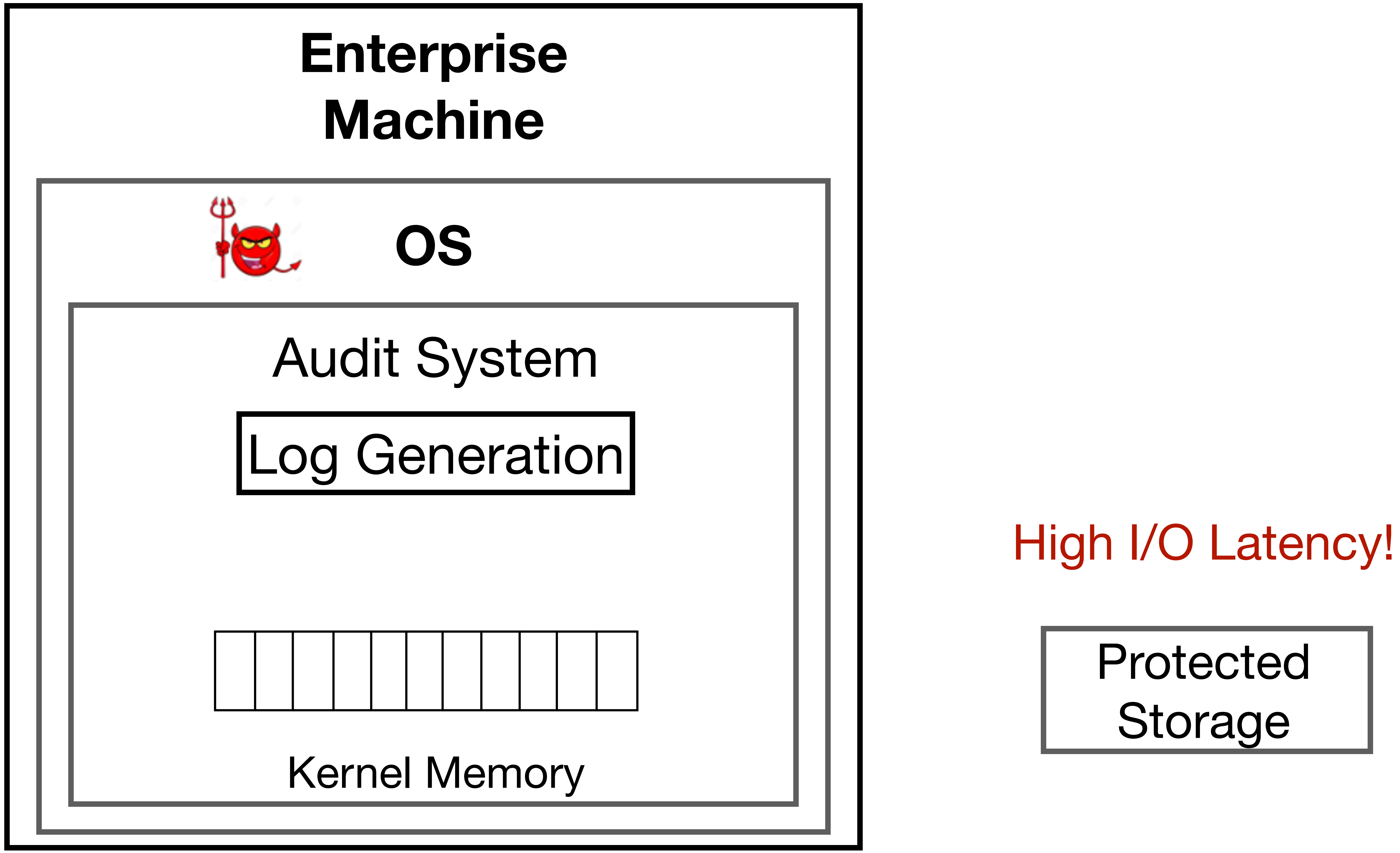

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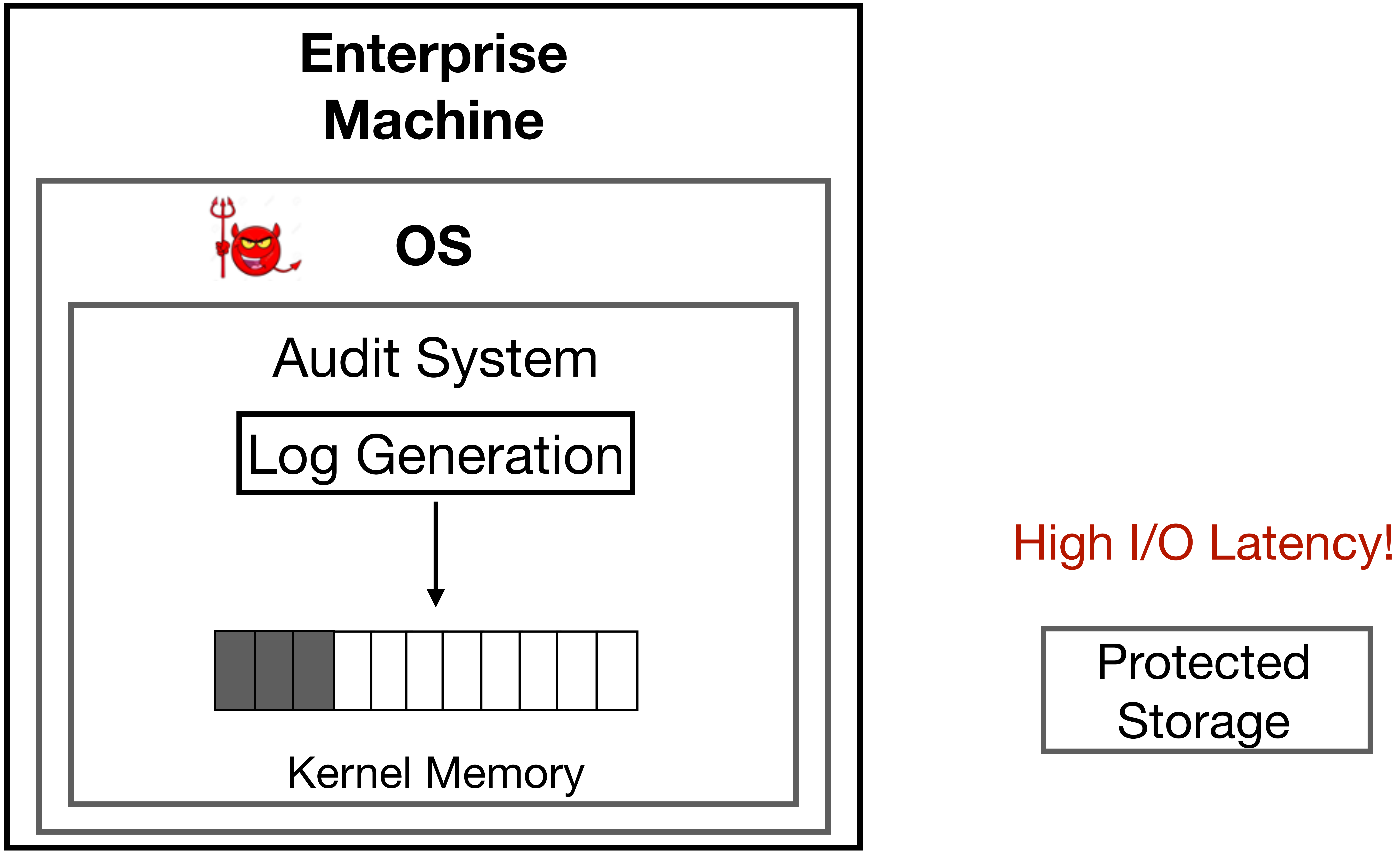

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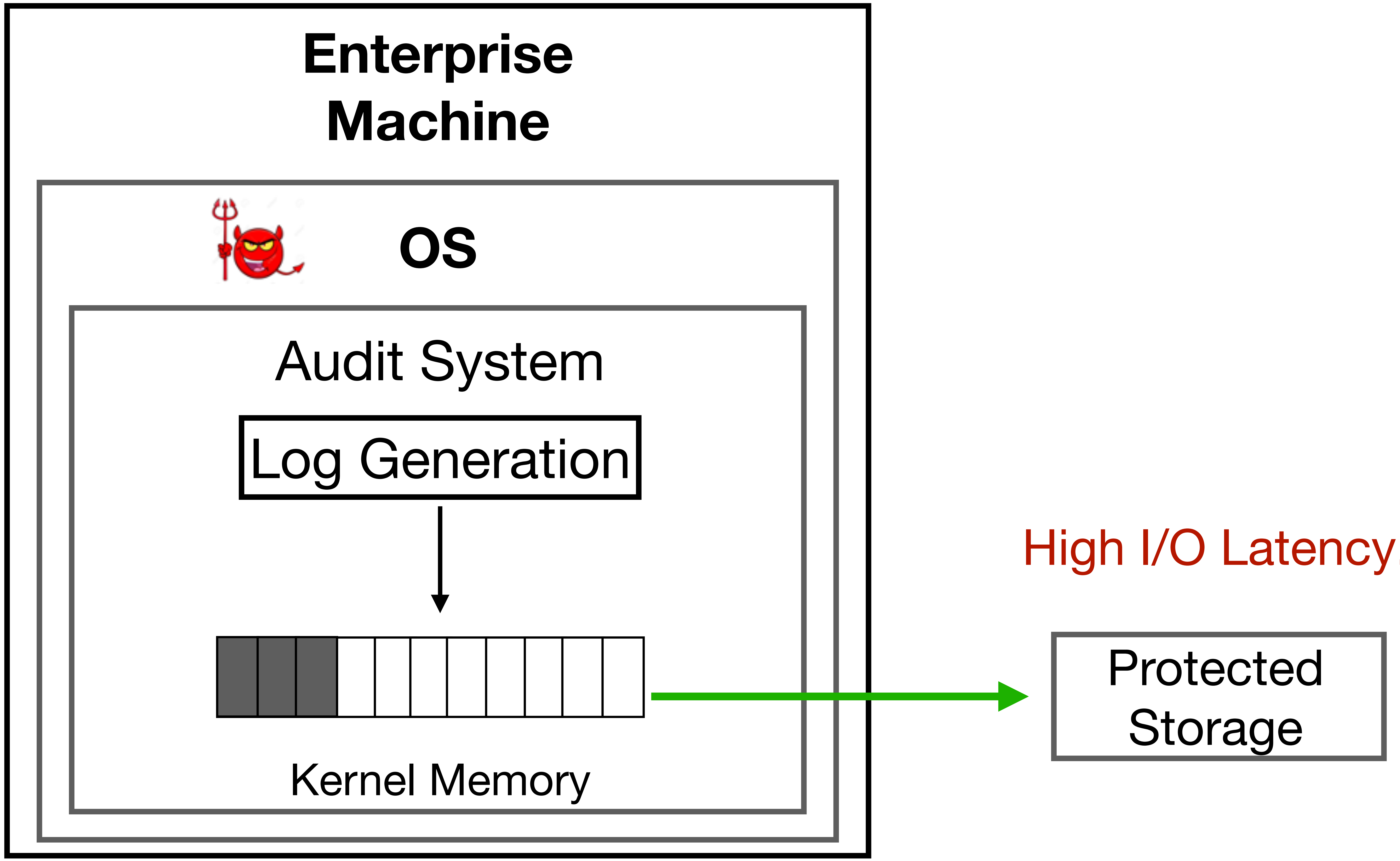

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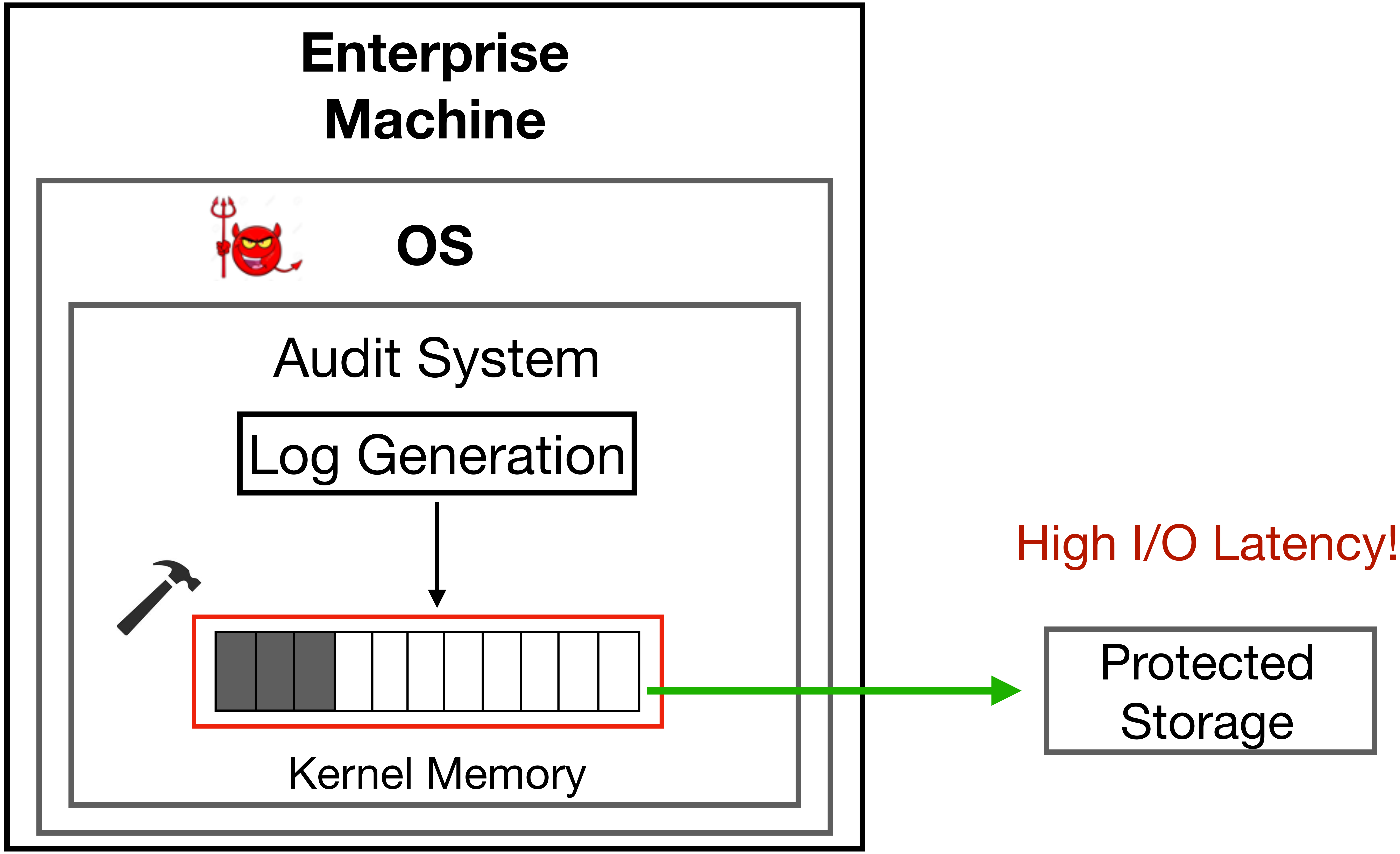

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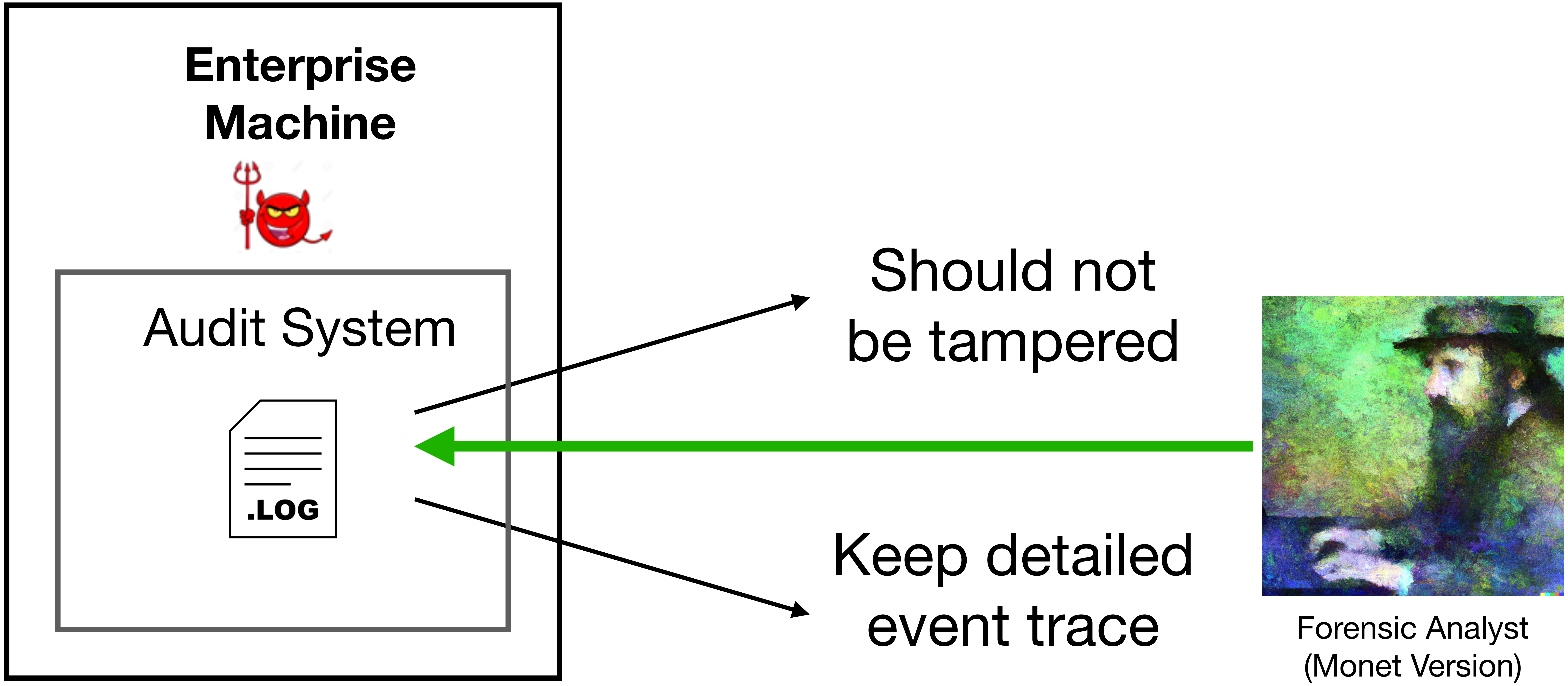
How do we build an audit system with these guarantees?



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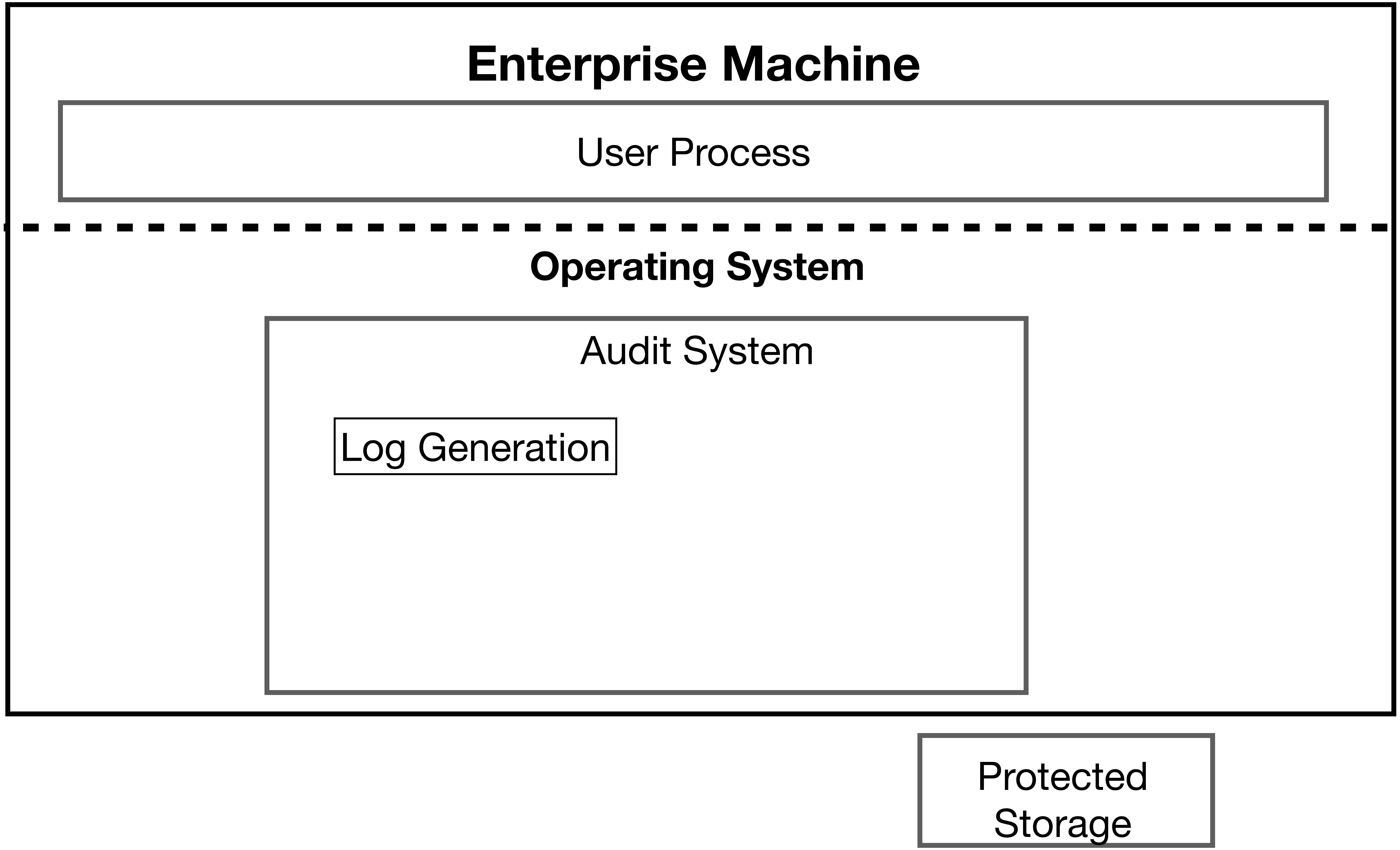

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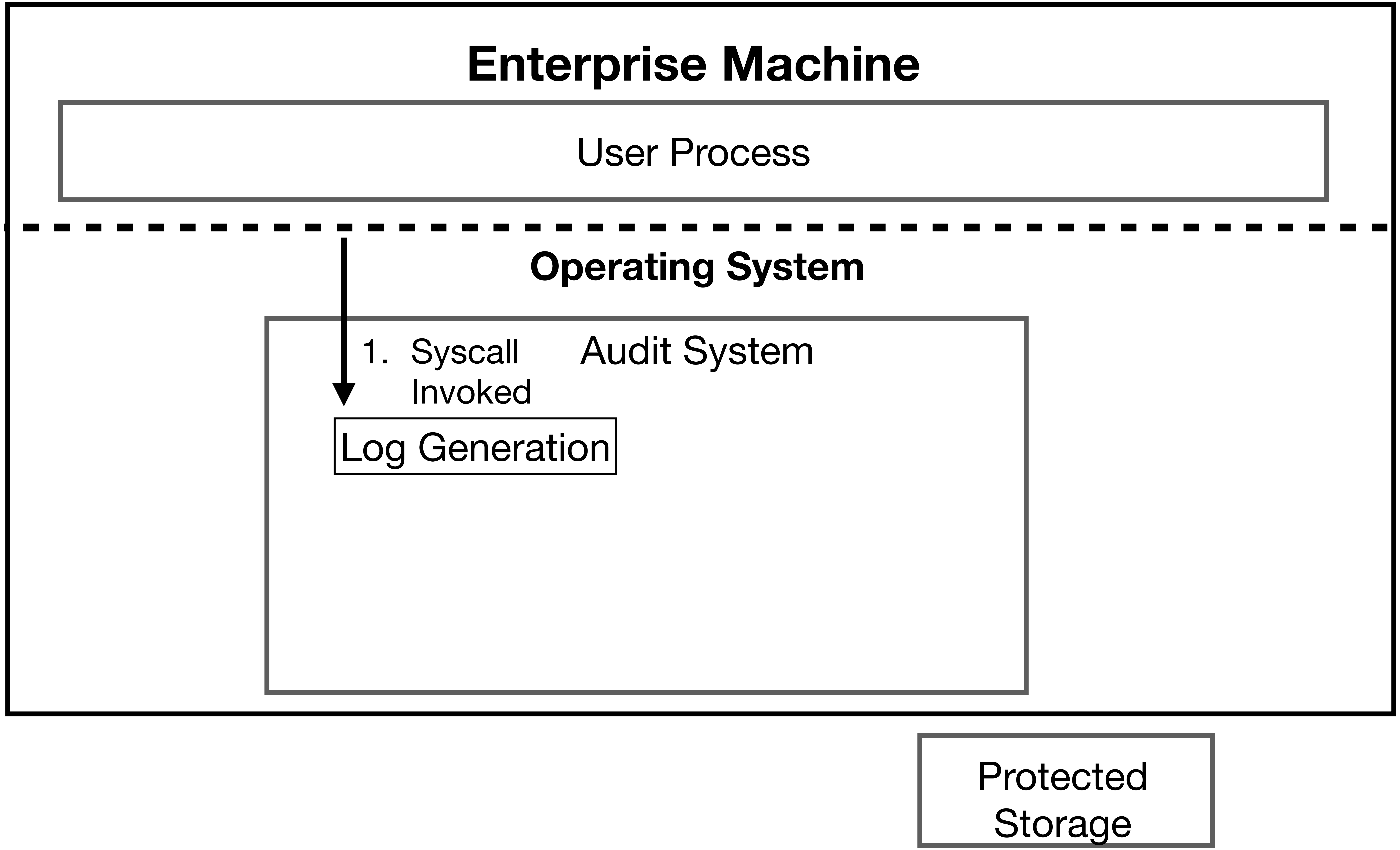

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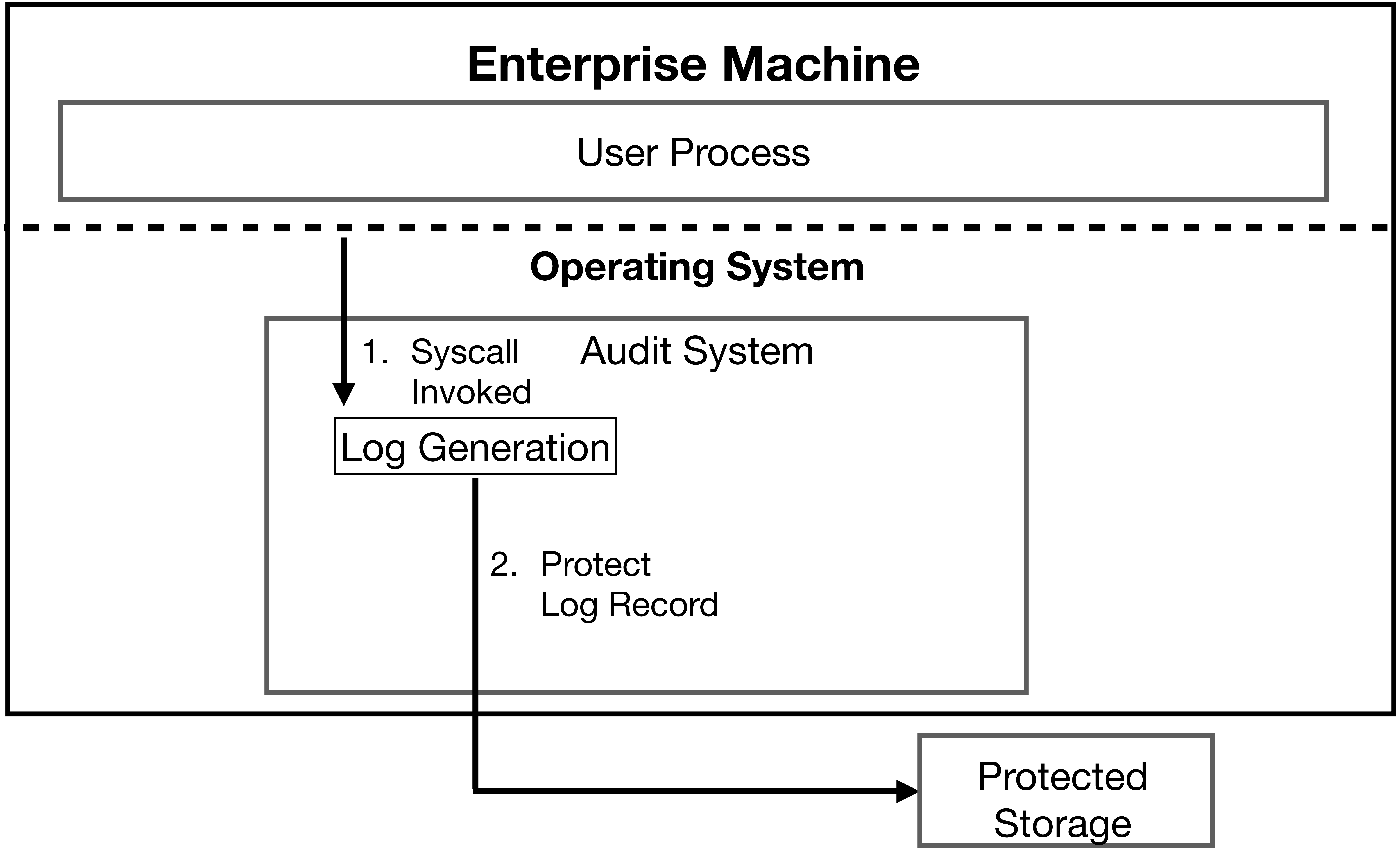

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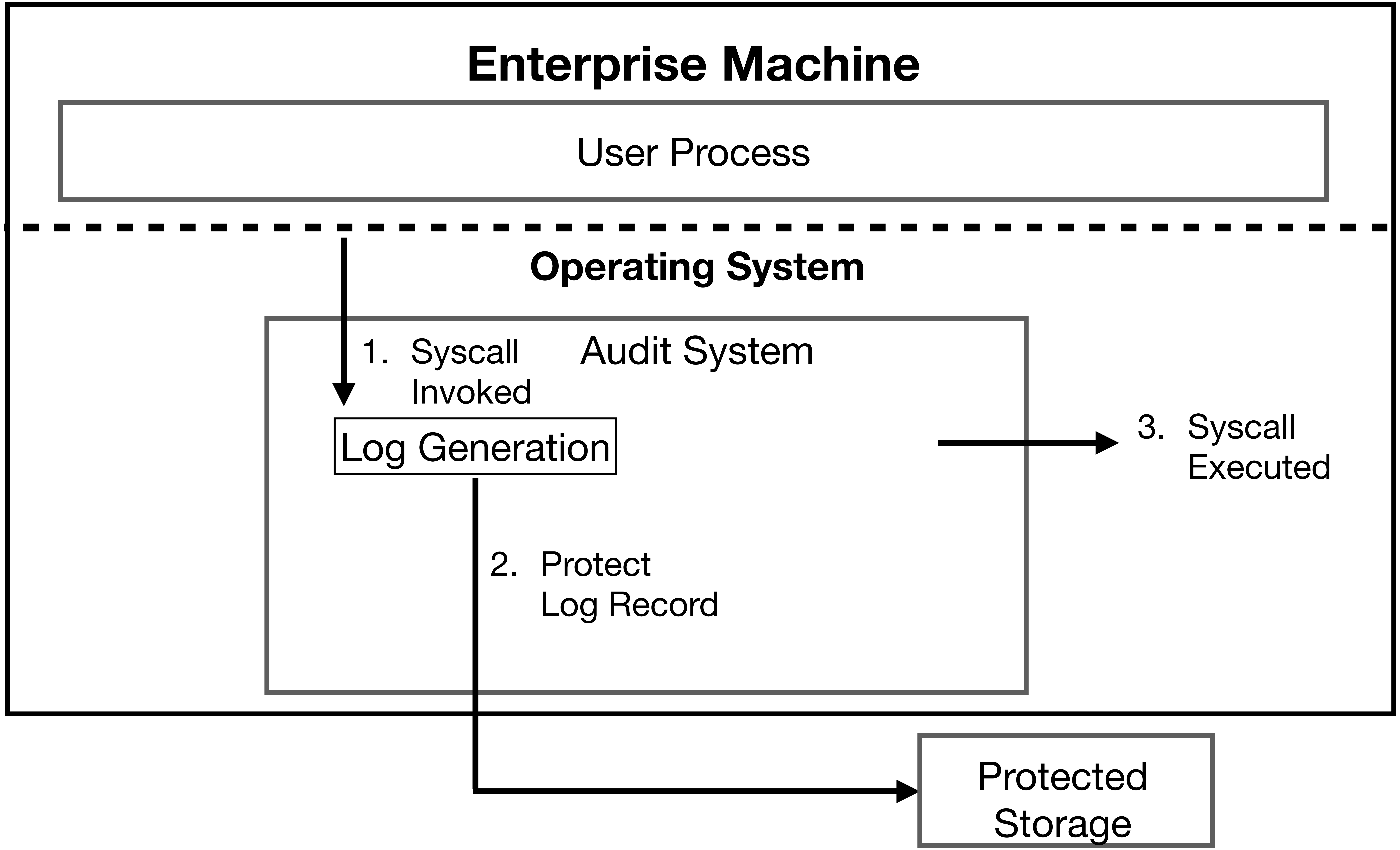

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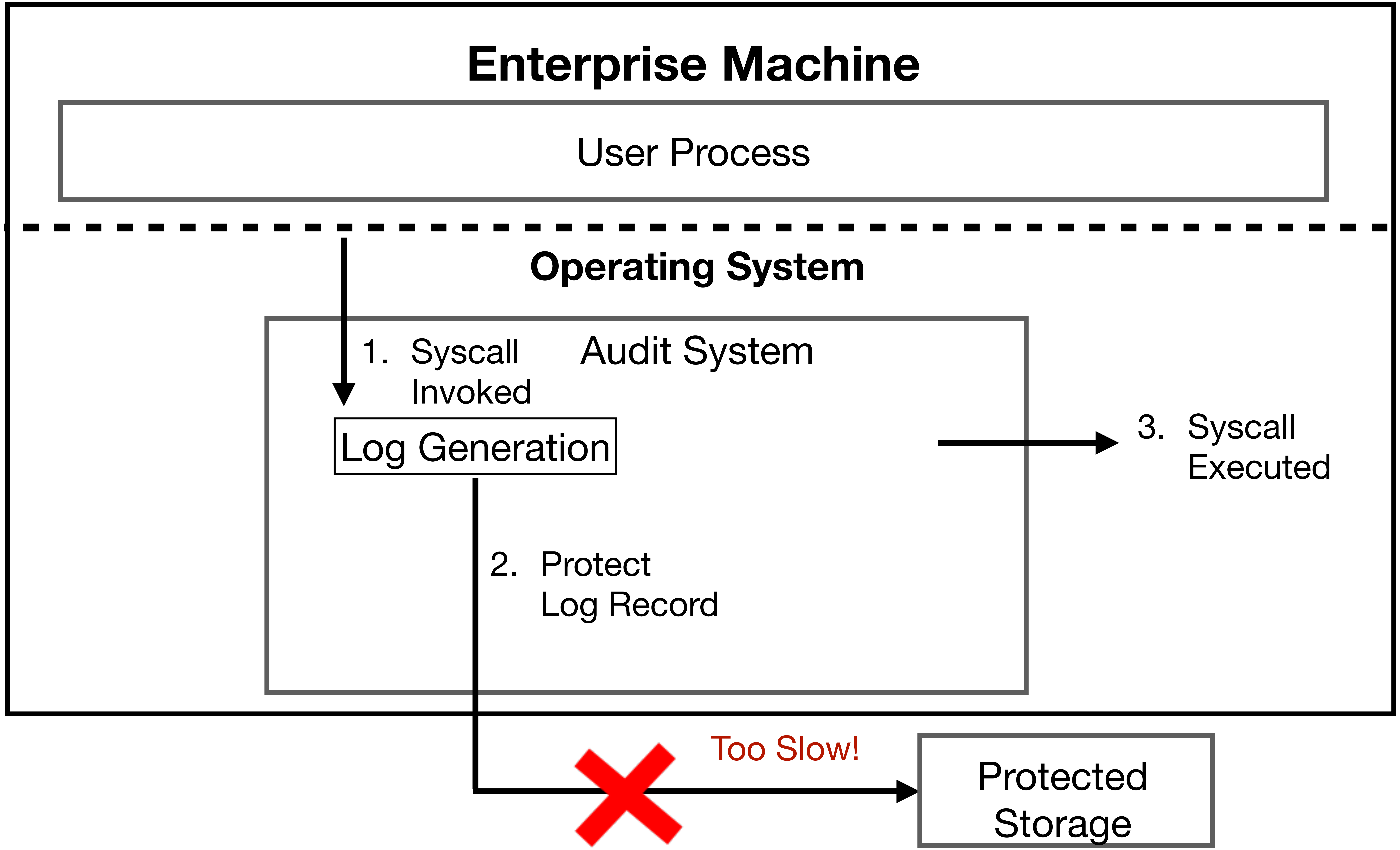

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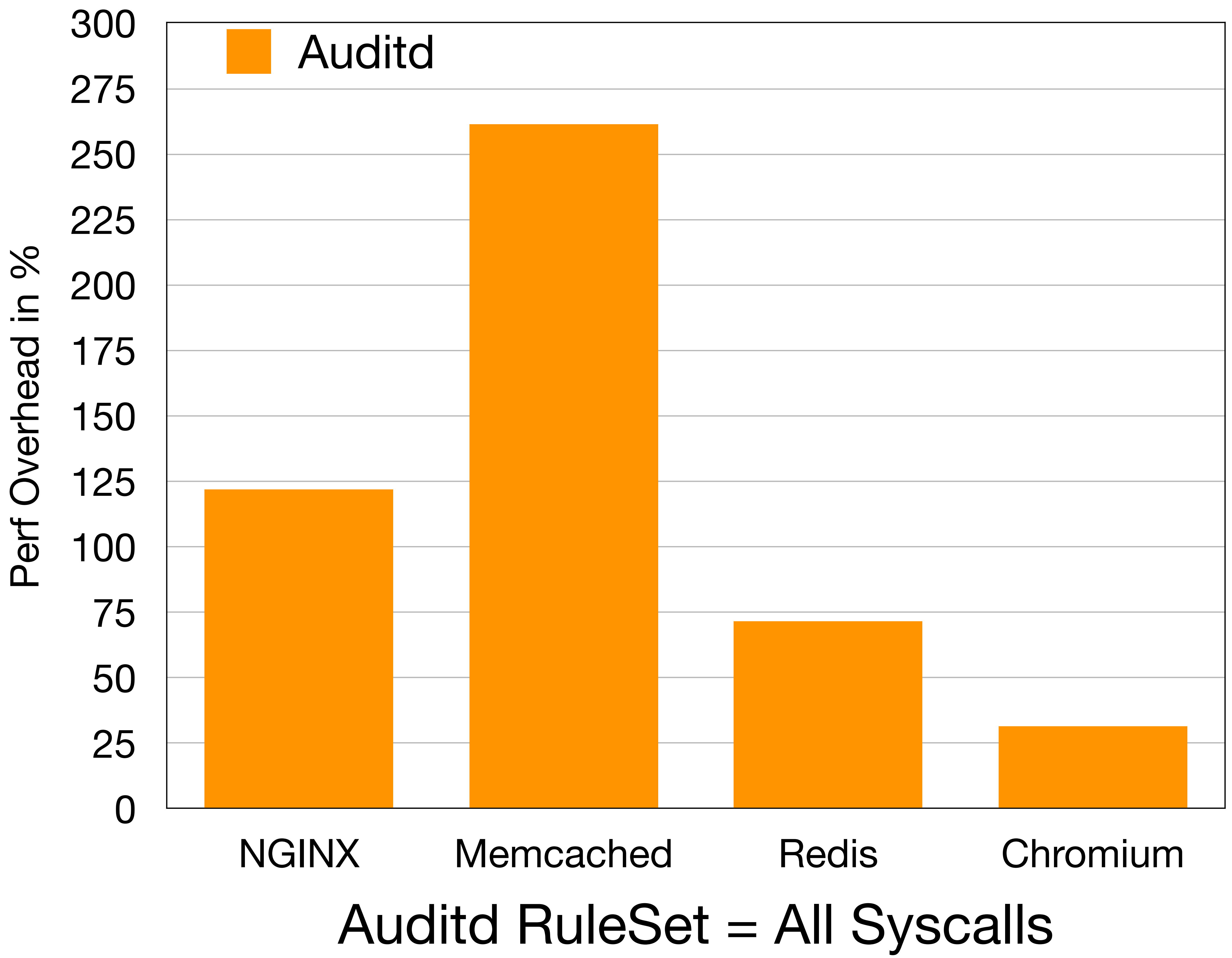

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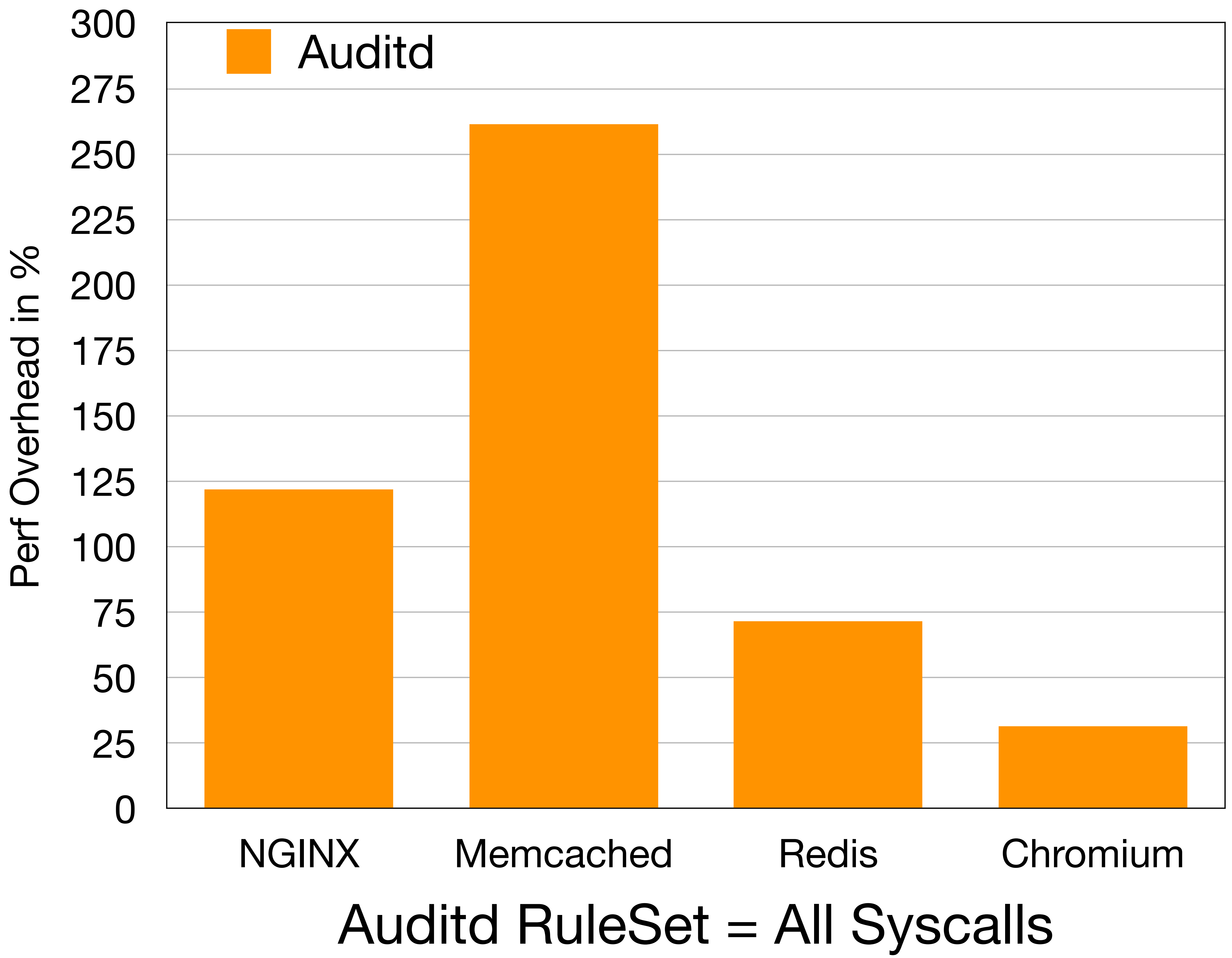
- Even for asynchronous logging, the slowdown is prohibitive



OMNILog addresses these efficiency challenges

Challenge 1: High I/O latency for synchronous logging

Challenge 2: Inefficient logging pipeline

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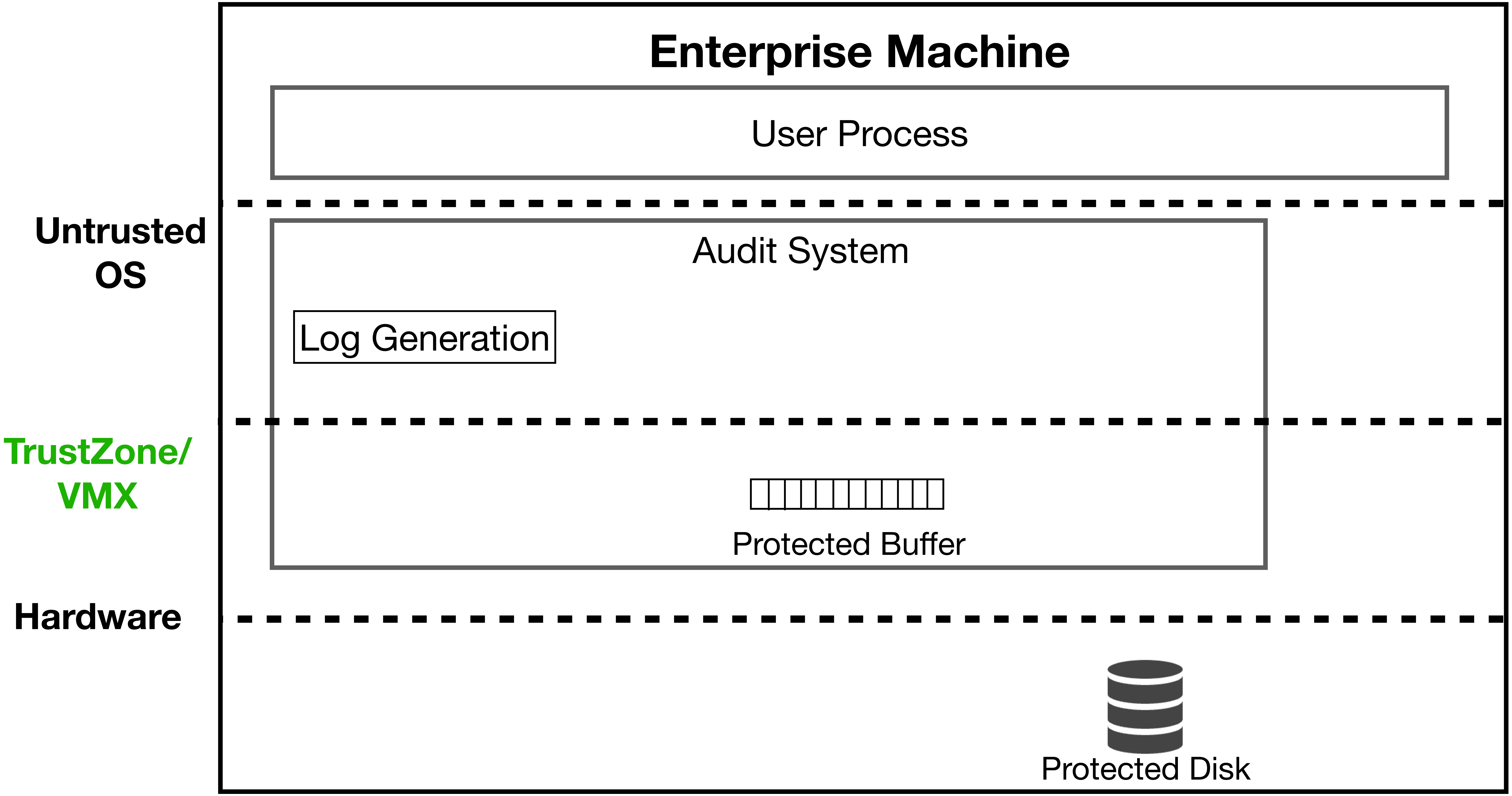
Challenge 2: Inefficient logging pipeline

- Optimizing the end-to-end pipeline from log generation to persistence

How does OMNILog build a protected environment?



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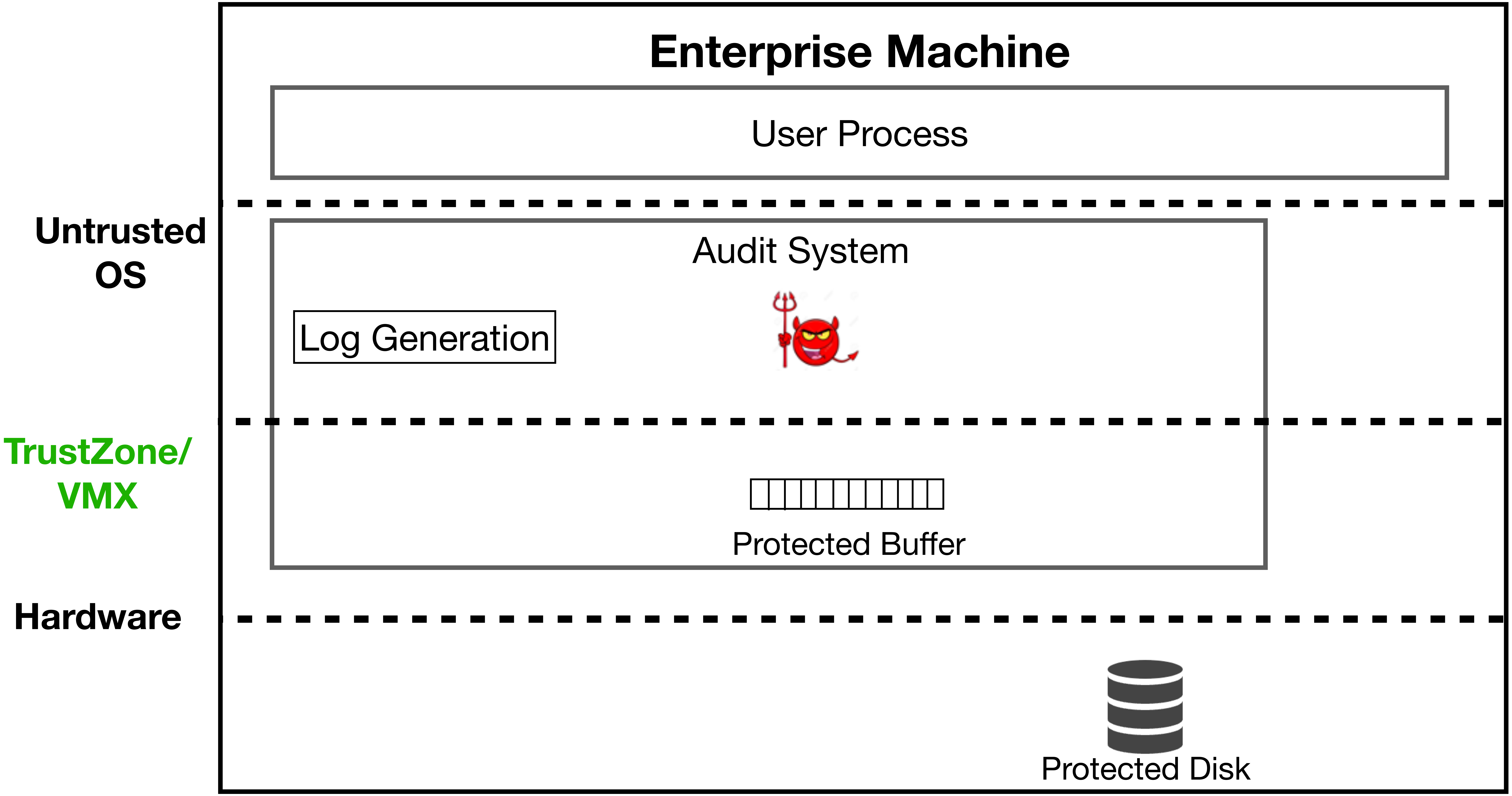

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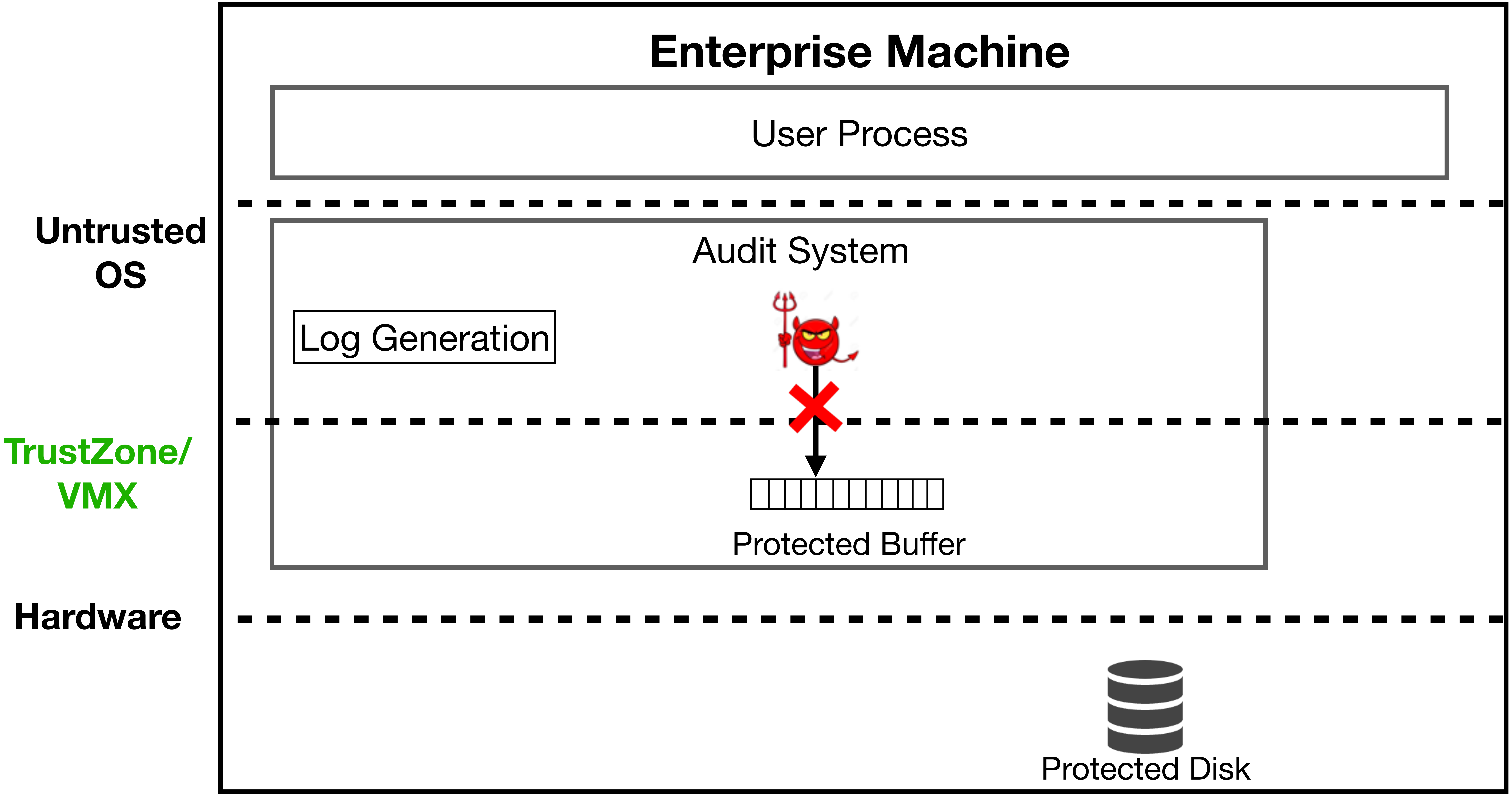

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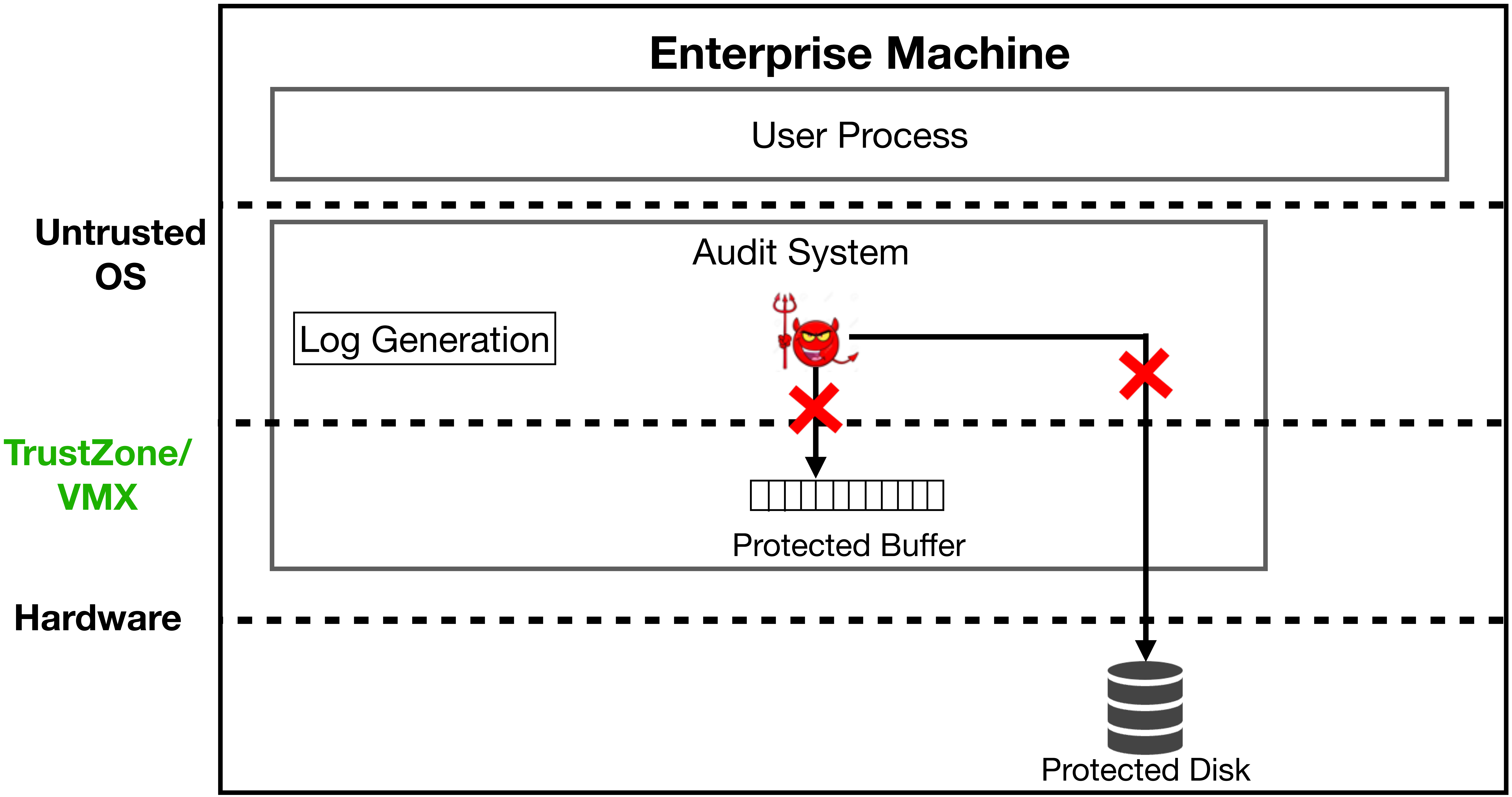

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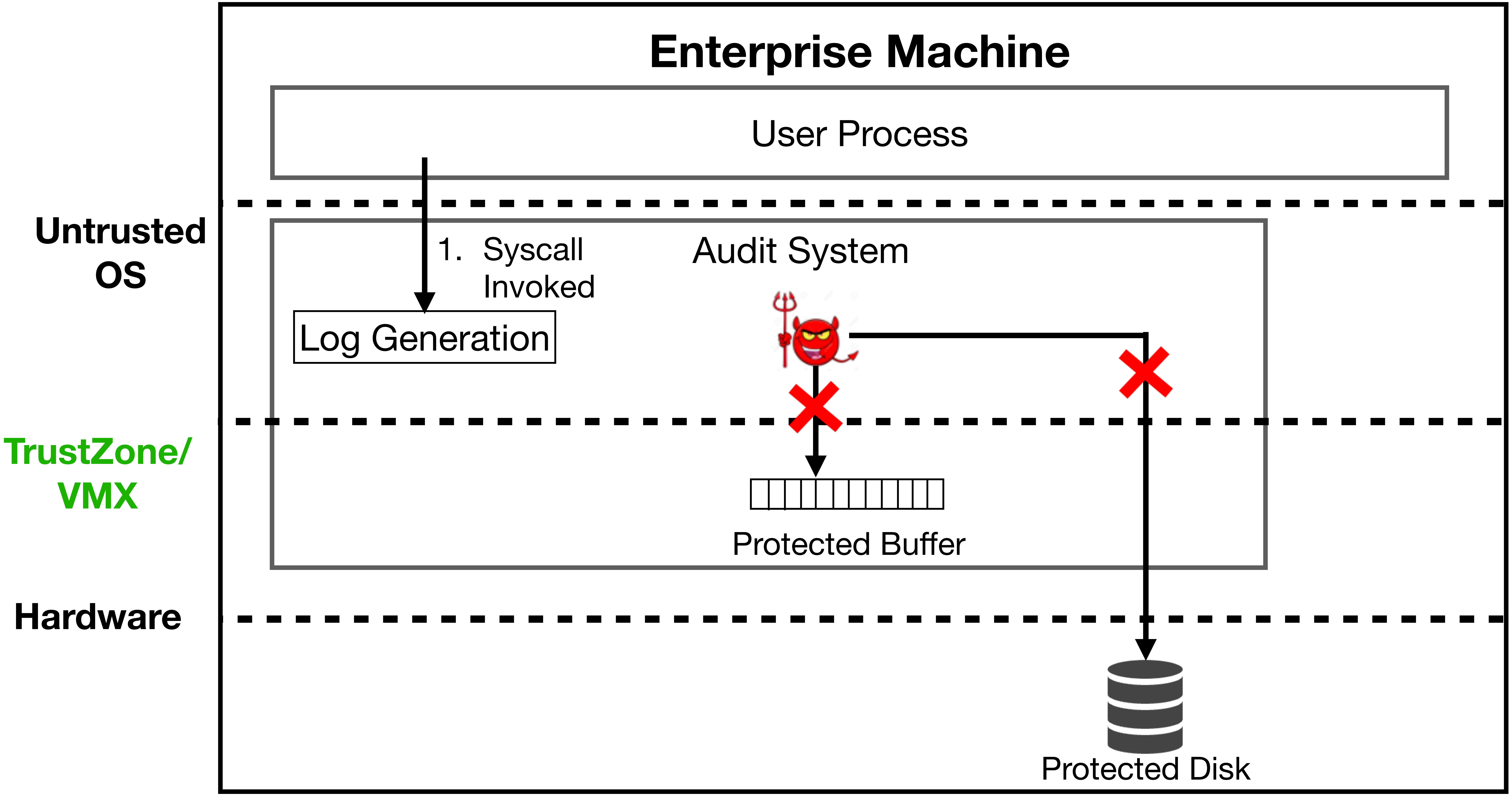

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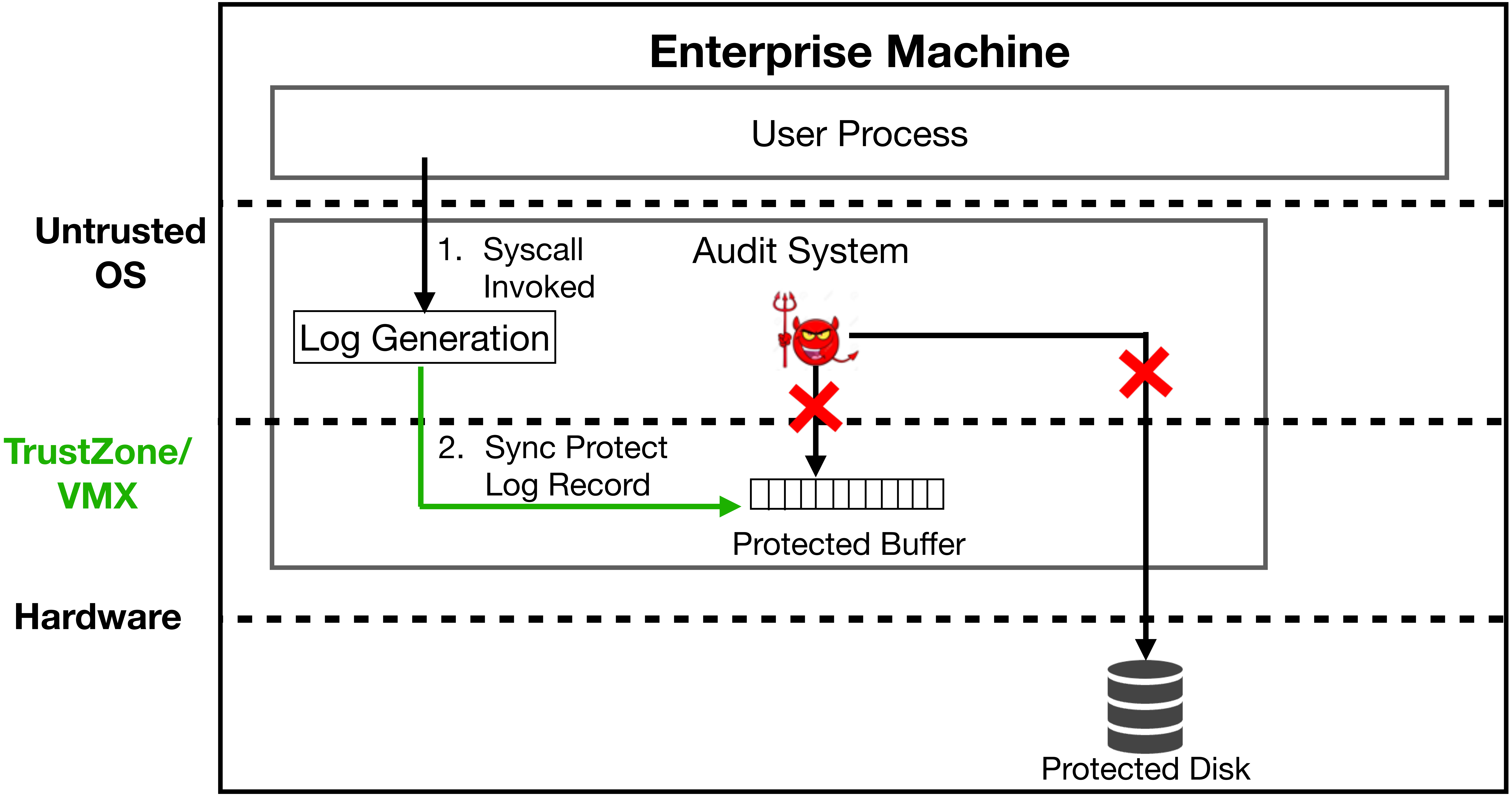

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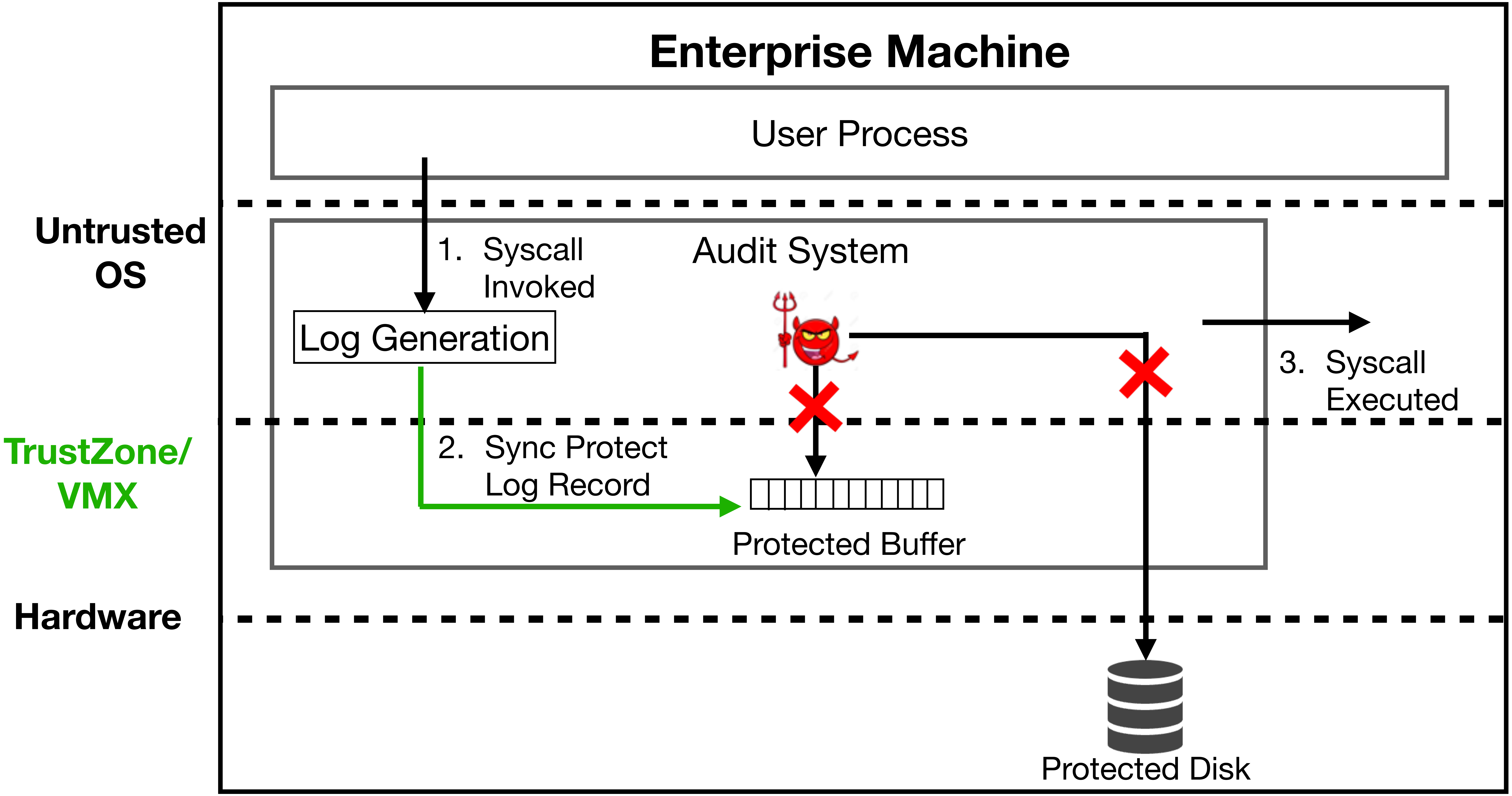

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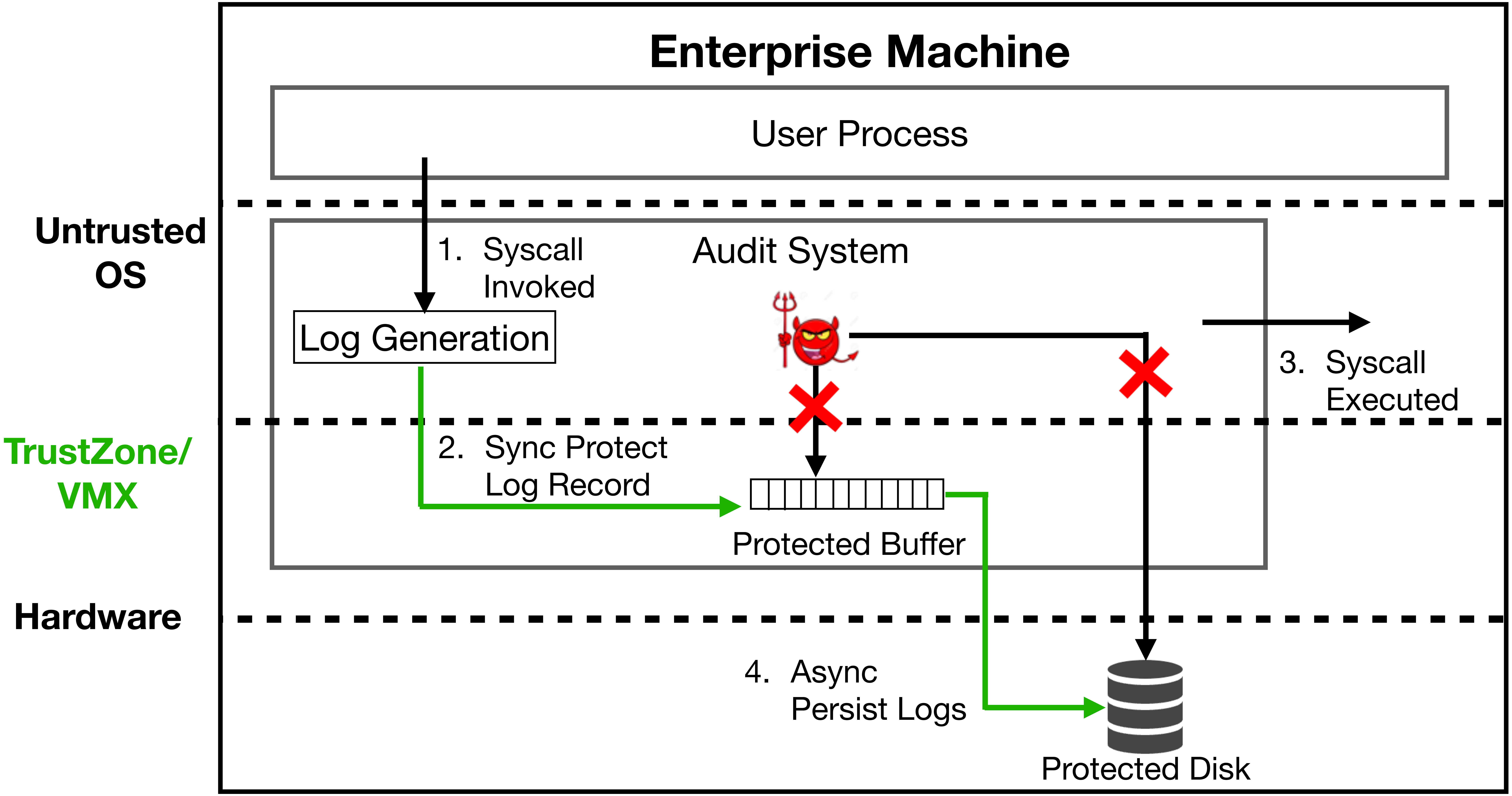

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Native Auditd

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Human-Readable
~12k cycles | 1KB

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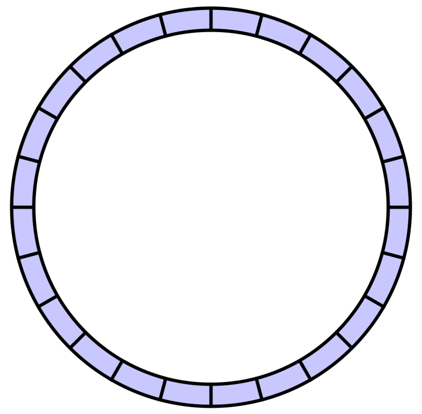

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Global Buffer

OMNILog

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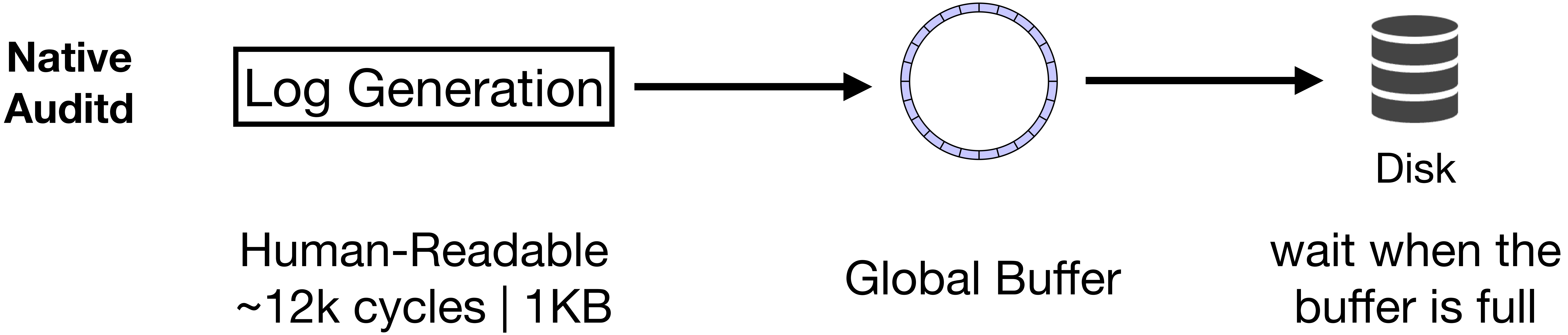

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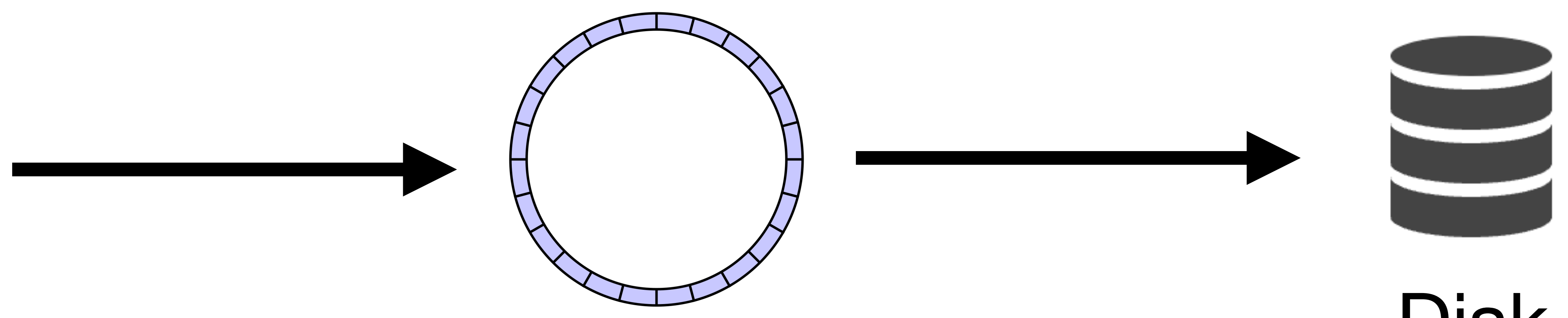

Disk

Human-Readable
~12k cycles | 1KB

Global Buffer

wait when the buffer is full

OMNILog

Fast
Log Generation

Raw and compressed
~3k cycles | 64B

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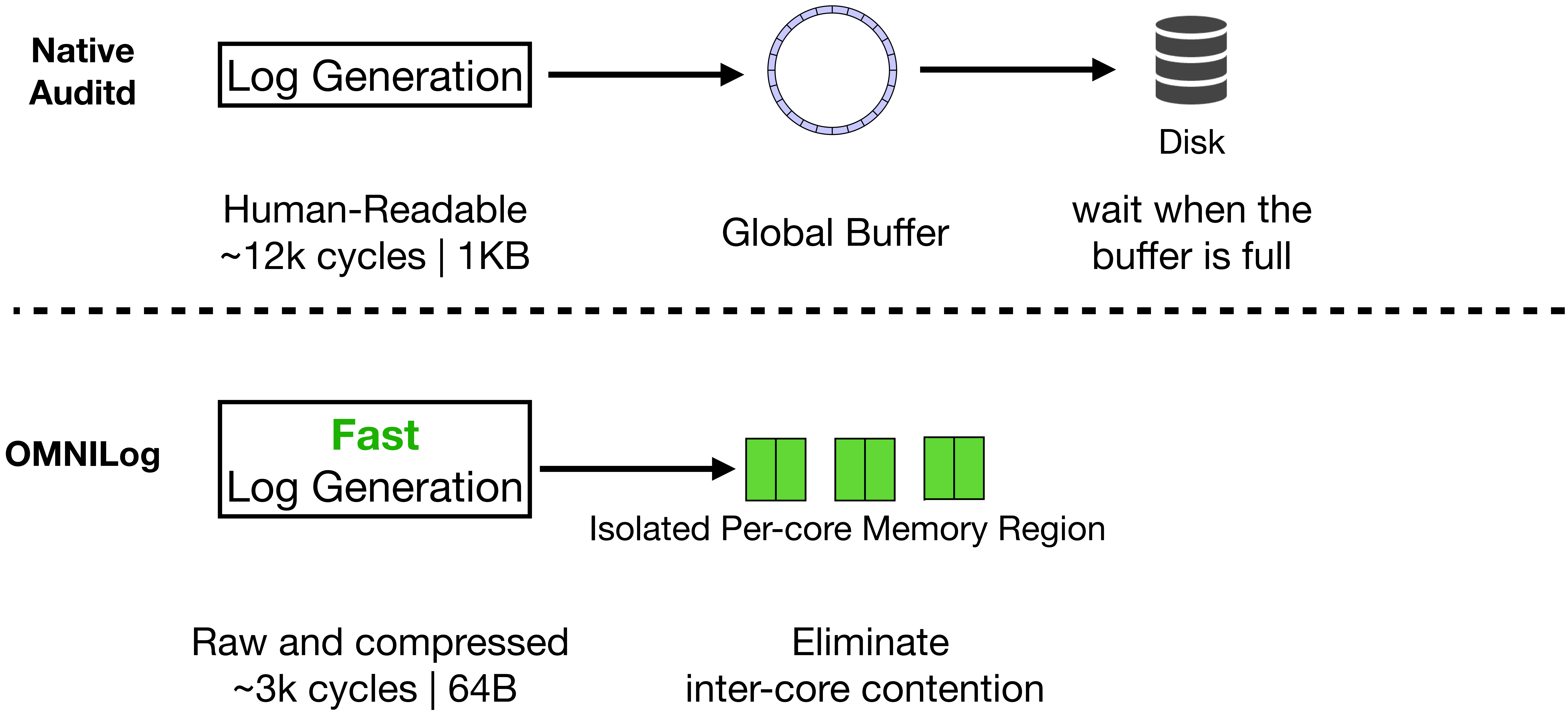

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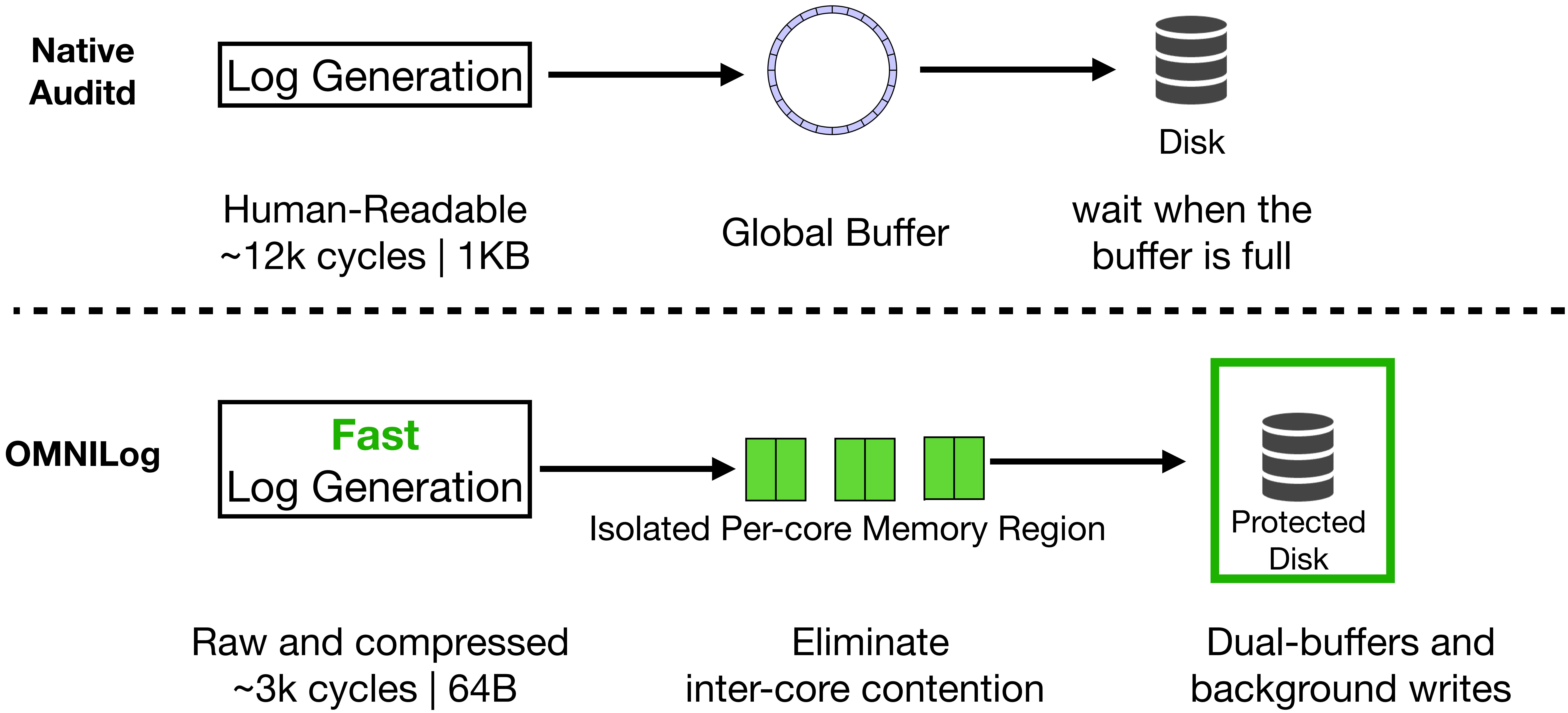
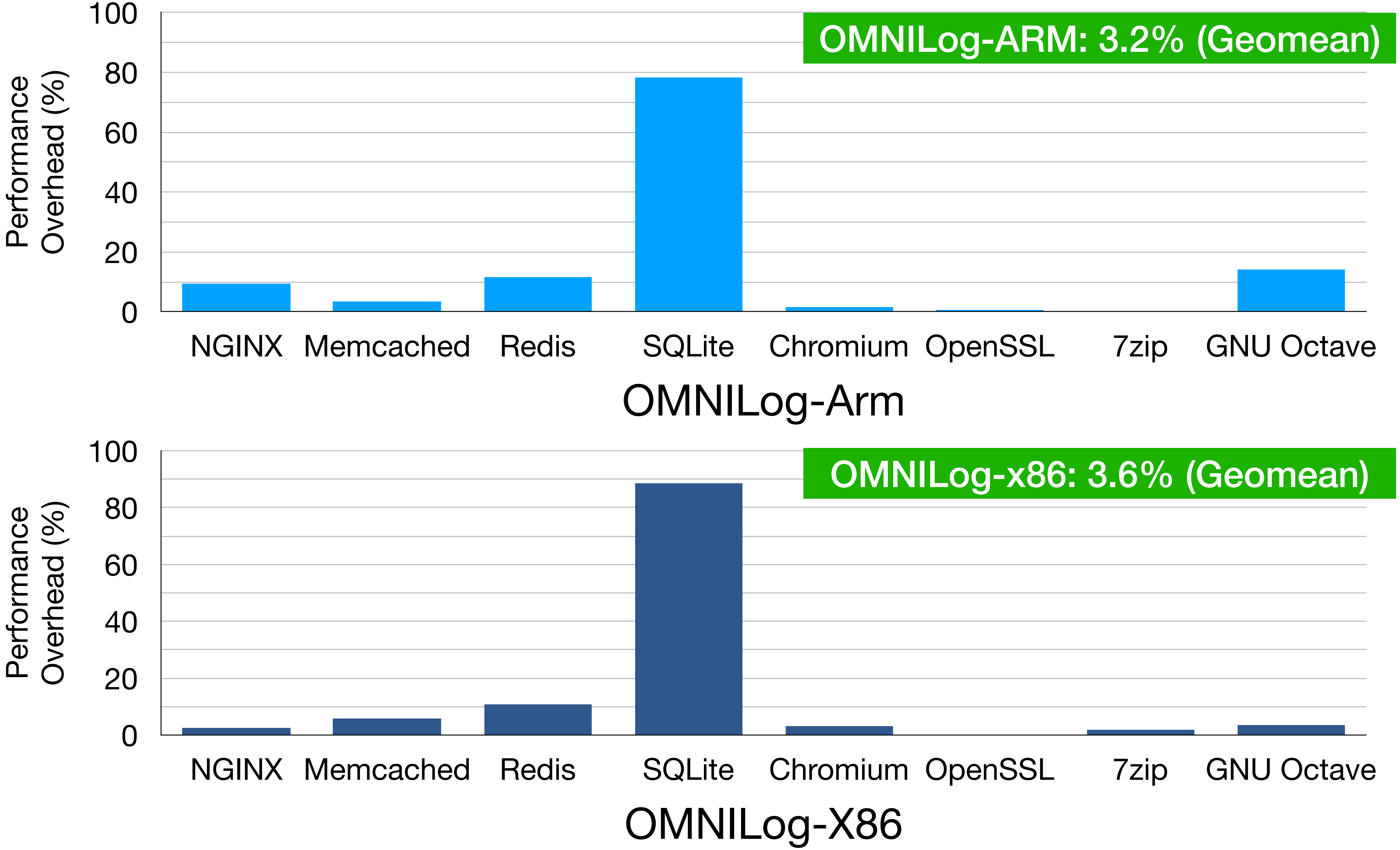


OMNILog incurs low overhead over native execution



Conclusion

- Current audit systems architectures:
  - Can't prevent tampering of all logs under kernel exploits
  - Can't keep a detailed trace of security-related events
- OmniLog redesigns audit architecture to:
  - Prevent all log tampering for all events
  - Keep a full trace of all syscalls executed during kernel exploits
- OMNILog's overhead compared to native execution is **~3.5%** (geomean)

Thanks!

vgandhi@g.harvard.edu