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What If You Could Actually *Trust* Your Kernel?

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We've Got a New Toy!

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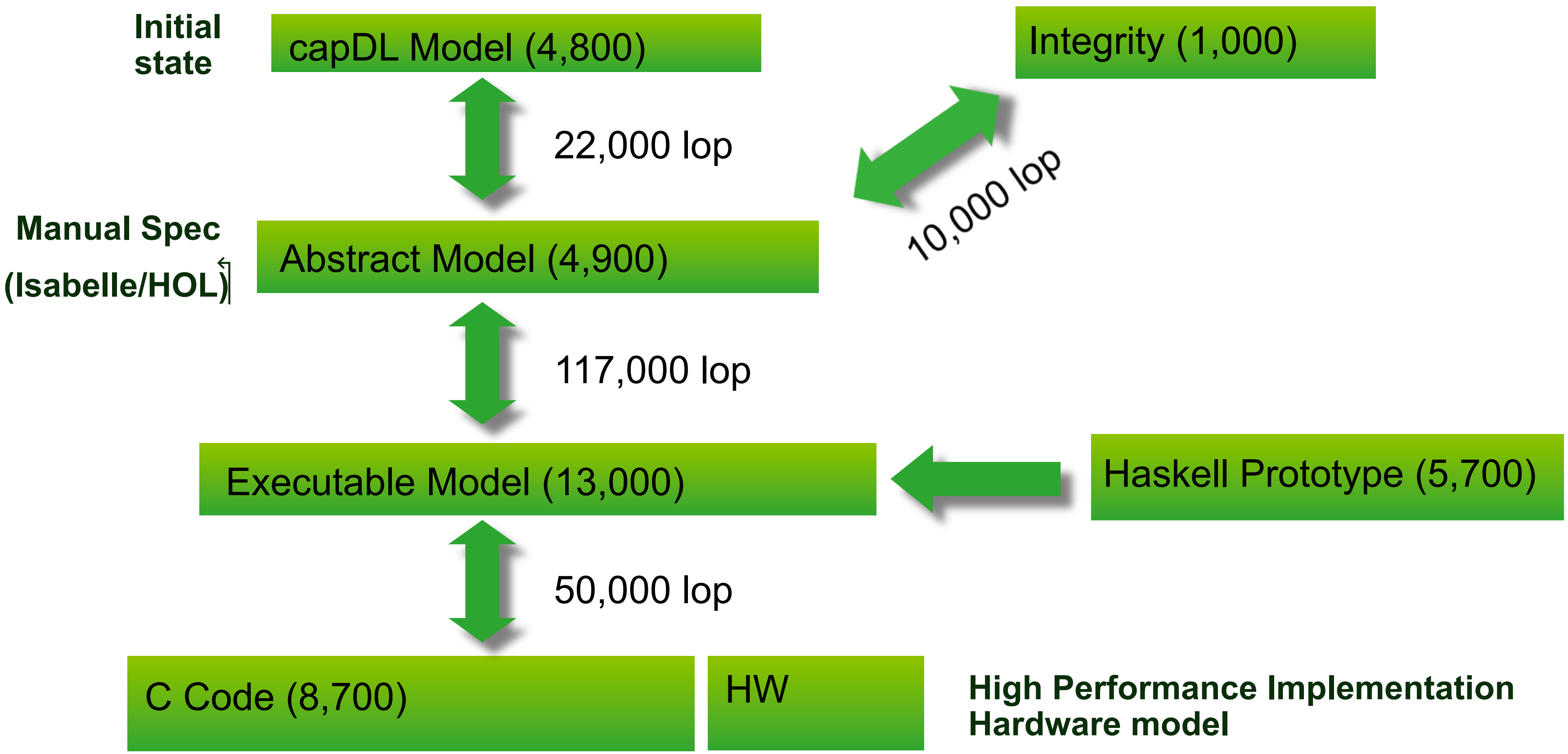
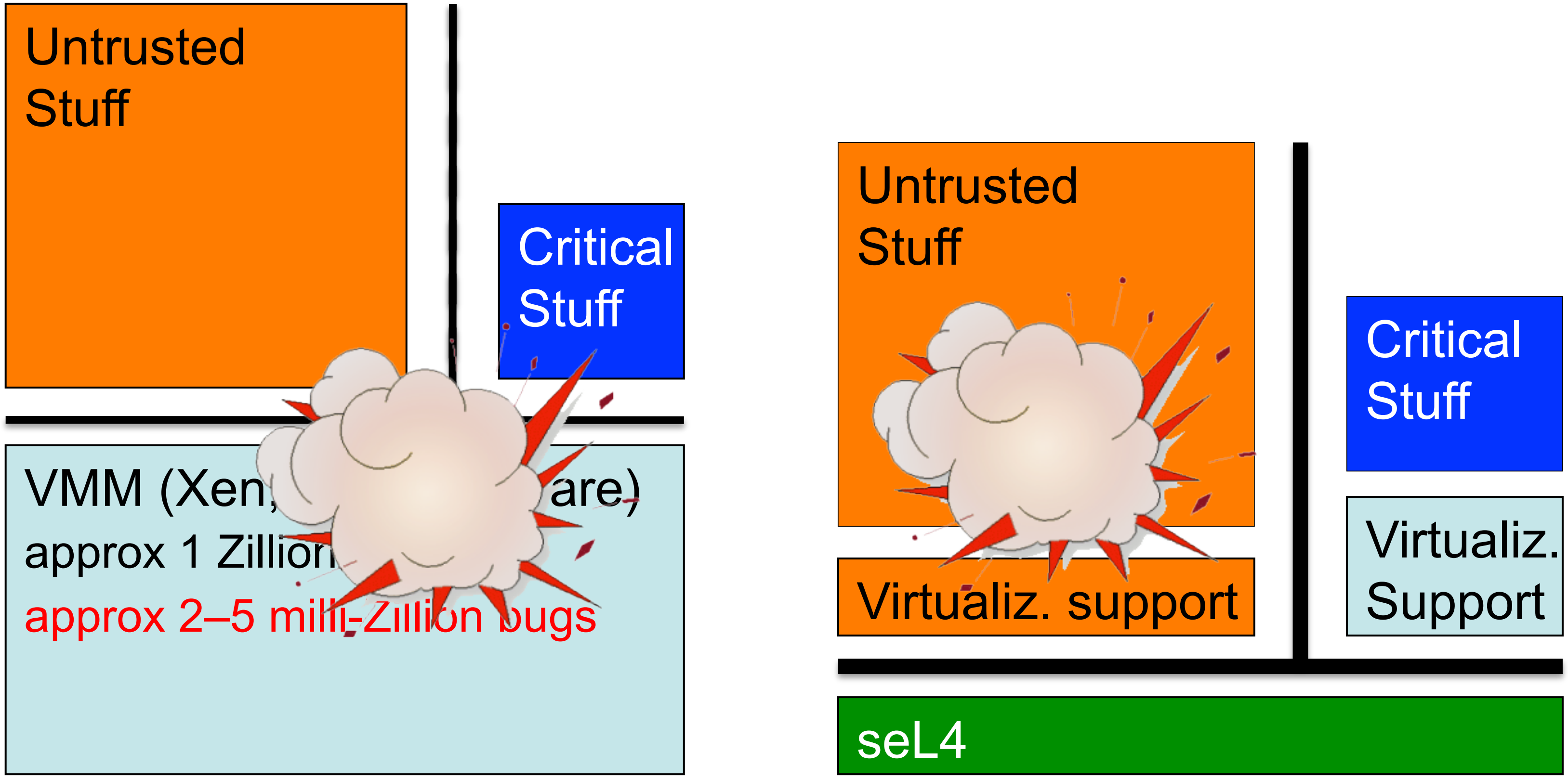


seL4: microkernel with formal proof of functional correctness

What Games Can We Play?

Obvious ones: Security

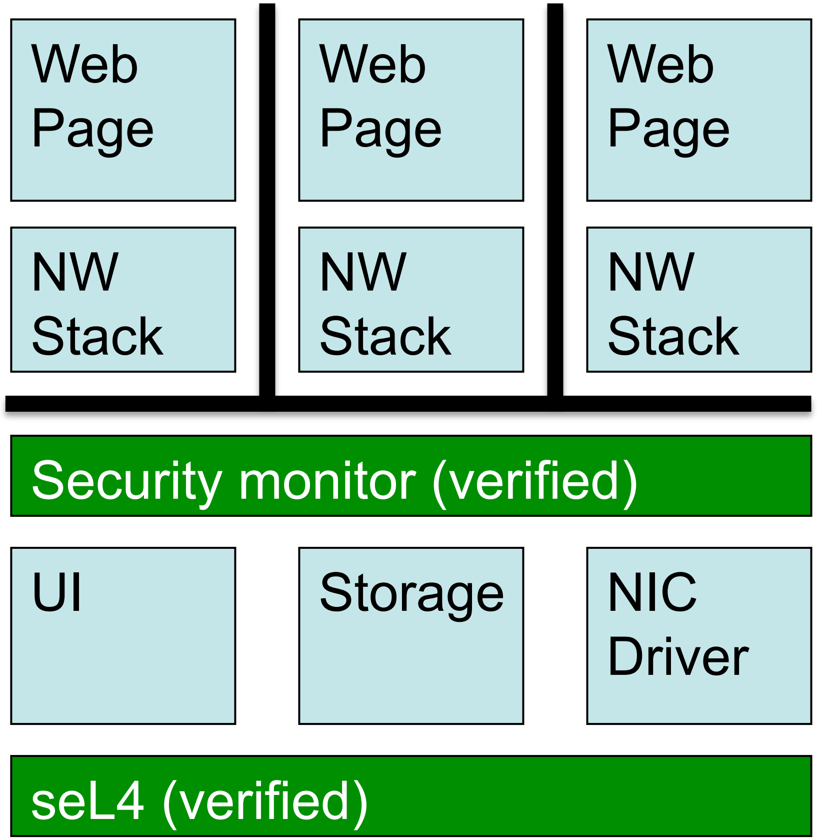
- Eg. virtualization:



What Games Can We Play?

Obvious ones: Security

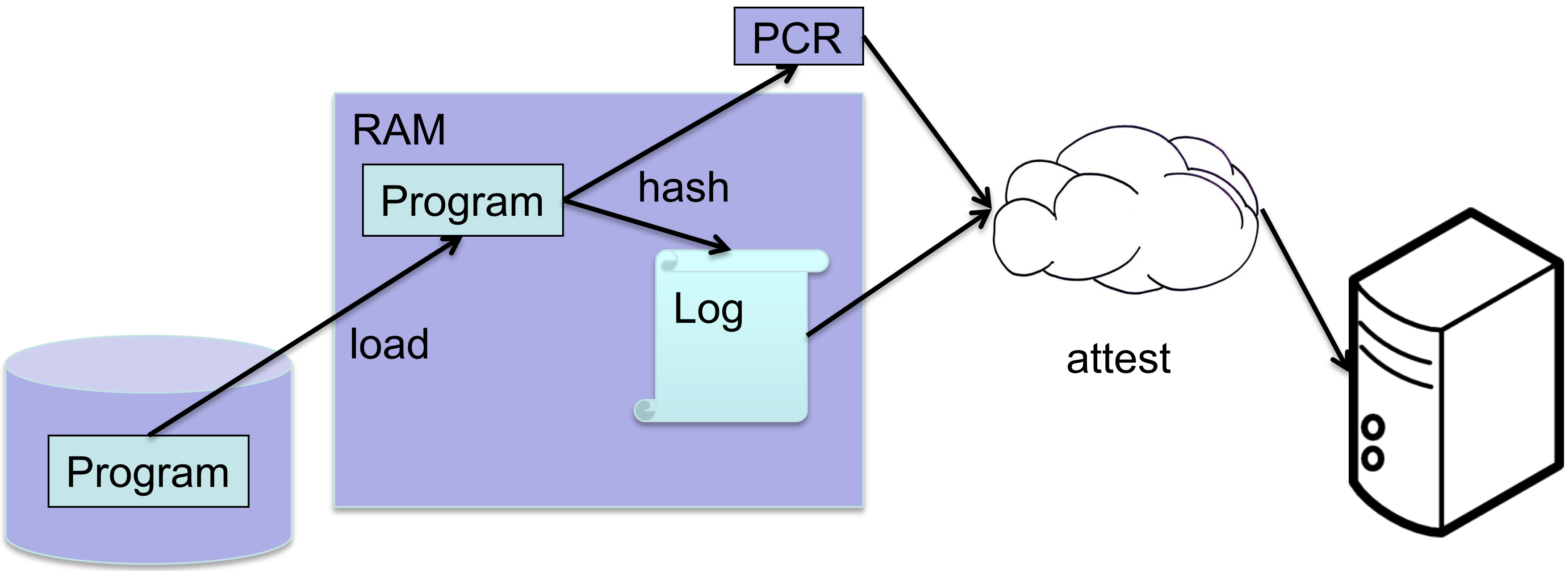
- Eg. web browsing:
- Strong isolation (like IBOS):
  - SOP enforcement
  - Minmal TCB
- … but actual guarantees!
- More on this kind of stuff in next talk (Toby)



More Interesting: Make TPMs Useful

Trusted Platform Module (TPM)

- Provides (among others) *remote attestation*
  - Evidence of the software configuration of the machine
  - PCR register holds cumulative hashes (“measurements”) of software



Problems with TPM

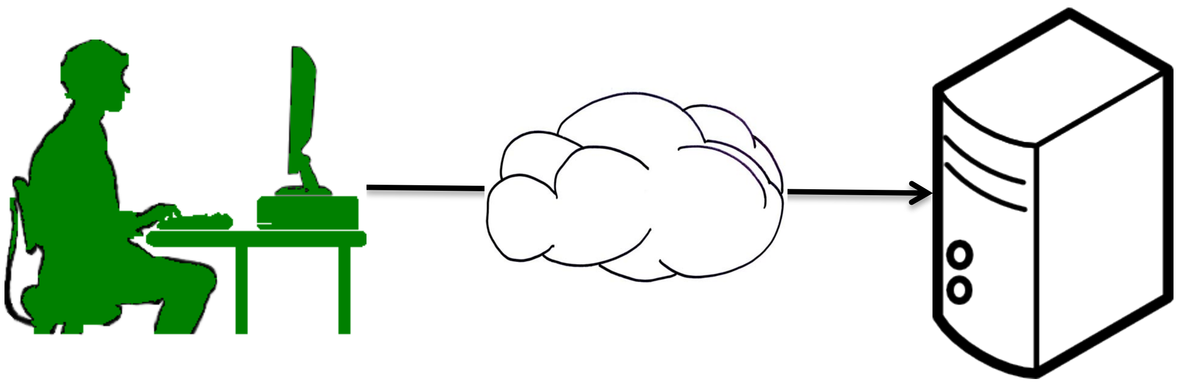
TPM asserts what has been loaded

- No protection against buggy software
  - Know what has been loaded, not that it is operating correctly!
  - Software could even be modified post-load
- Every piece of software loaded changes PCR
  - Server would need to keep hashes for *every* app user might load
    - Actually every distributed version of every app
  - Write your own app ⇒ attestation fails!
- Assumes no forgotten measurements
  - Eg buggy software loads code without measuring

Example: Home Banking

- Bank provides secure banking app
  - Uses remote attestation to confirm that this app is running
- But:
  - Unfeasible (and unhelpful) to allow for user's arbitrary apps
  - Force user to boot into special banking configuration
  - User loses concurrent access to other machine features
    - Spreadsheets, address book, printer, …

⇒ Practically useless!

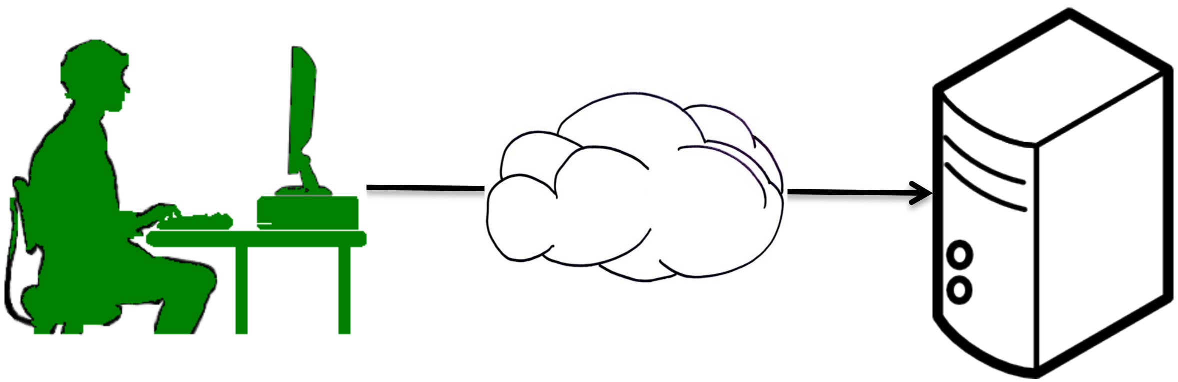


Late Launch / DRTM?

Dynamic root of trust, e.g. Intel TXT, AMD SVM:

- Suspends normal machine operation
- Loads specific kernel in clean environment
  - Untainted by previously loaded software
- Can remotely attest this state
- But:
  - No interrupts, DMA, multiprocessing!

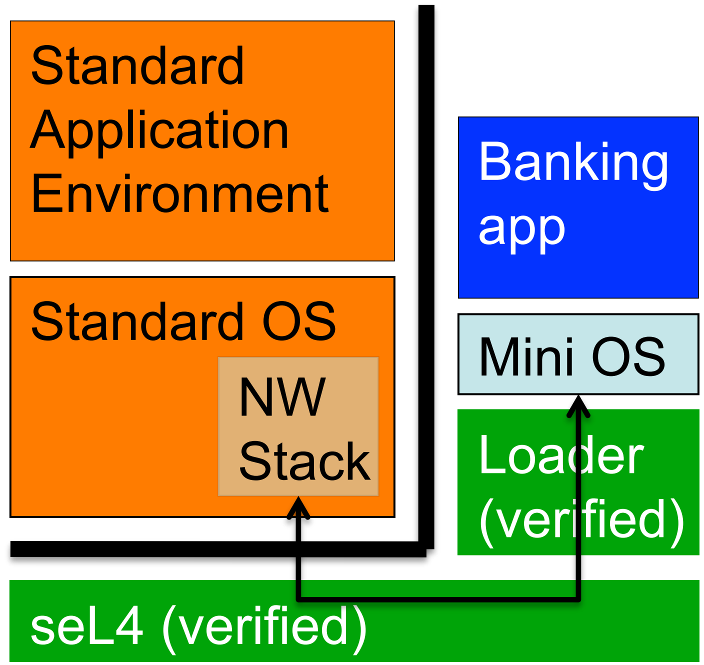
⇒ Practically useless!



Practical TPM-based Solution

seL4 provides secure VM for banking app

- Runs verified loader
- Loads mini OS
  - Keyboard, mouse, display driver
  - Crypto, SSL endpoint management
  - Secure screen sharing
- Banking app runs concurrently with standard app environment
- Chain of trust for banking app:
  - seL4 (verified, changes rarely)
  - Loader (verified, no changes)
  - Mini OS (trusted)
  - Banking app (trusted)



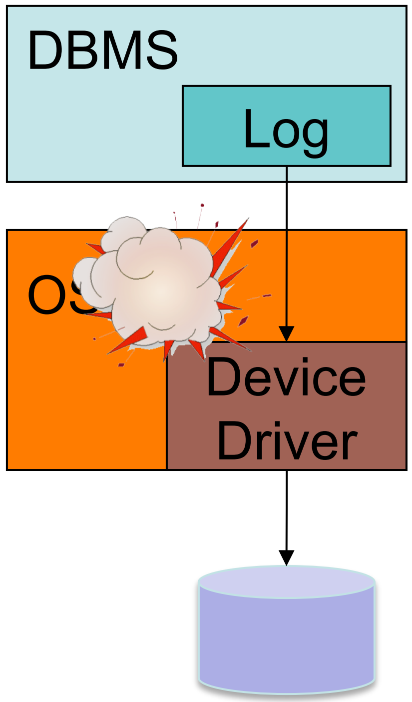
Supports practicable and meaningful remote attestation

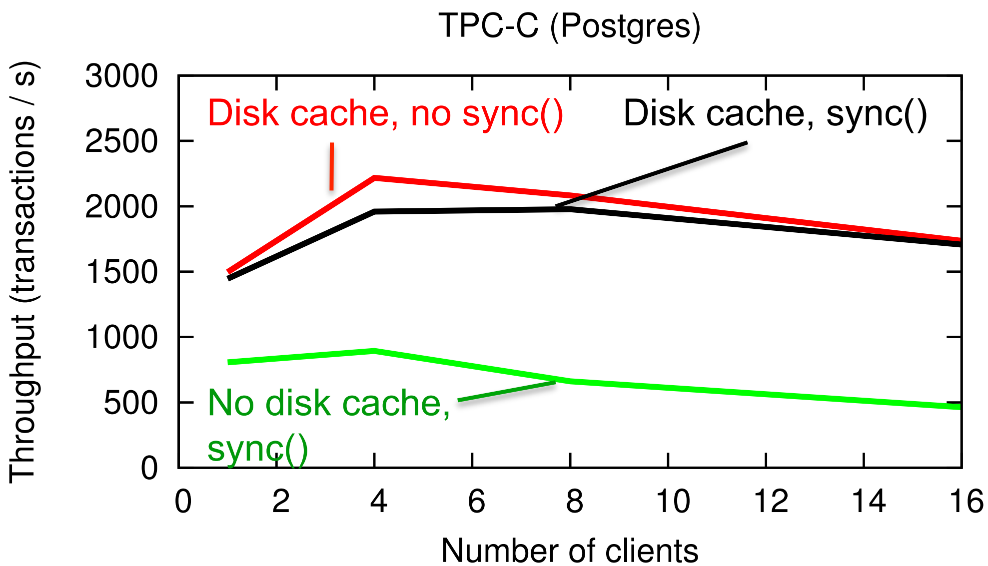
- Minimal and stable TCB $\Rightarrow$ manageable set of measurements

Buying Performance with Reliability

Databases require durability guarantees

- In the presence of failures (OS crash, power)
- Ensured typically by write-ahead logging
  - Flush log before continuing processing
  - Disk writes on critical path
- What if you knew that your OS doesn't crash?





DBMS with Crash-Proof OS?

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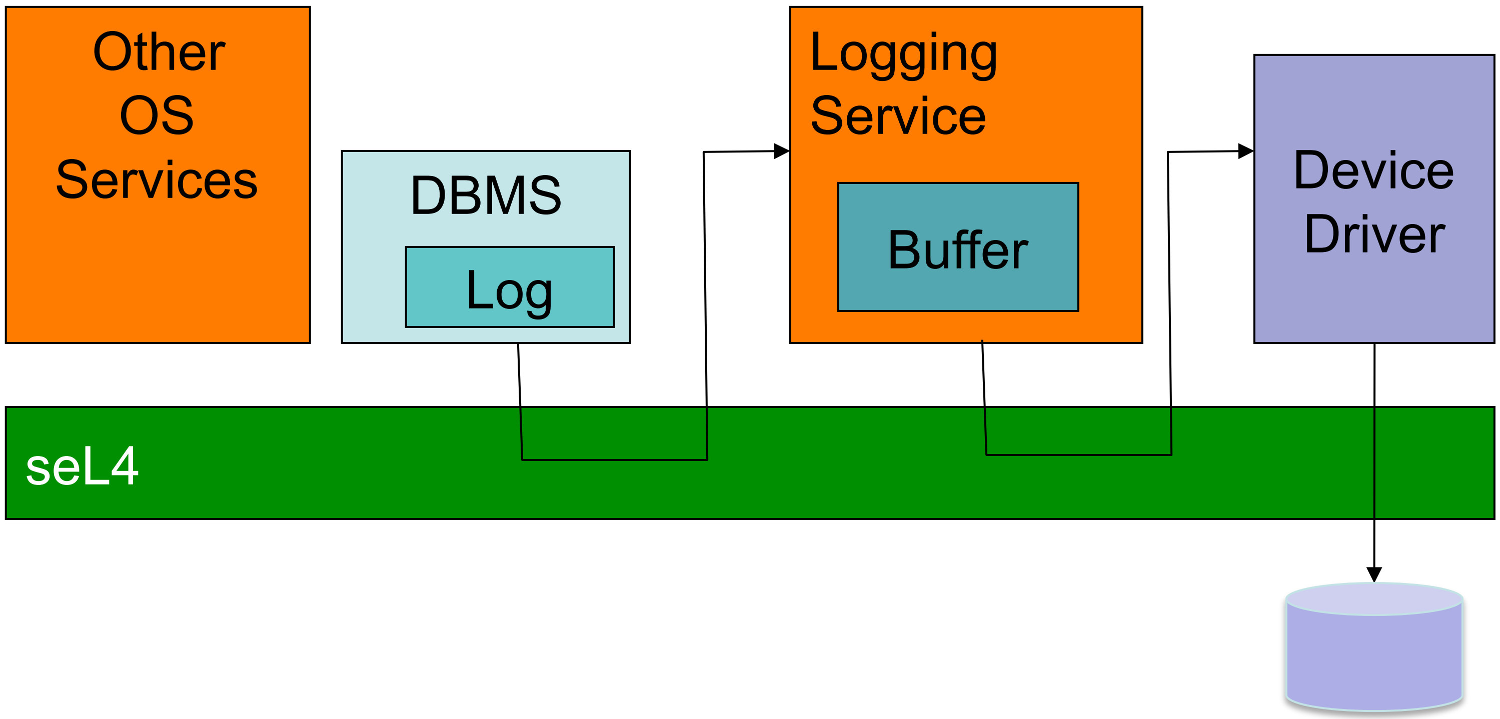
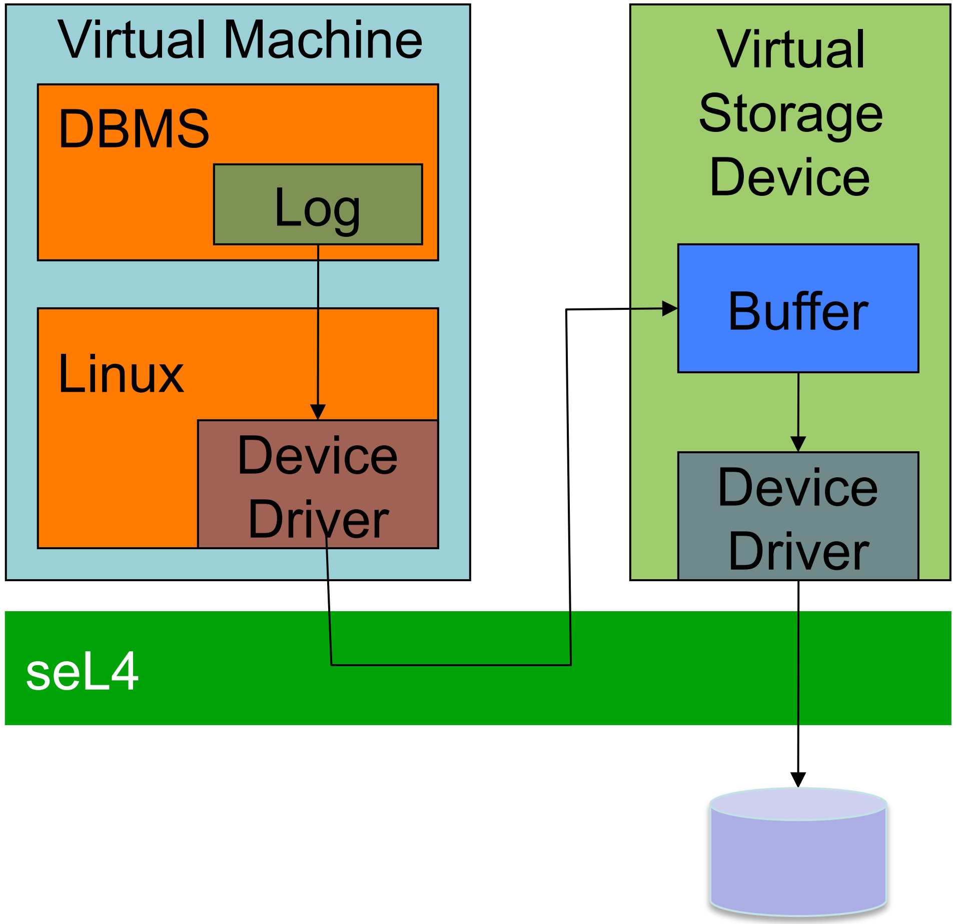
Could port DBMS to run directly on seL4



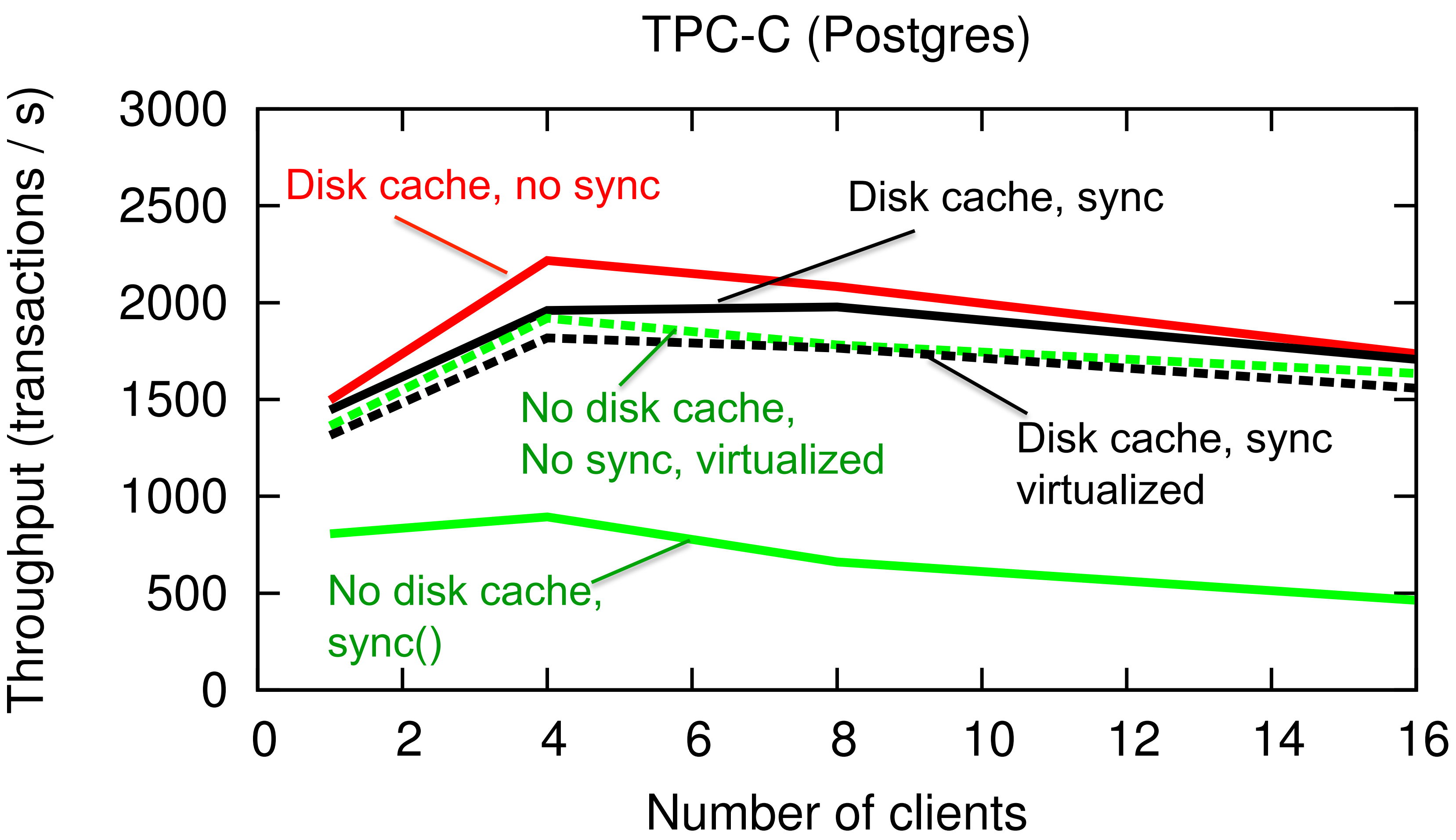
Problem: costly, legacy issues, etc ⇒ not very attractive

Alternative: Use Virtualization



- No changes to DBMS or OS!

Performance



Thank You

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