BarriCCAde:
Isolating Closed-Source Drivers with ARM CCA

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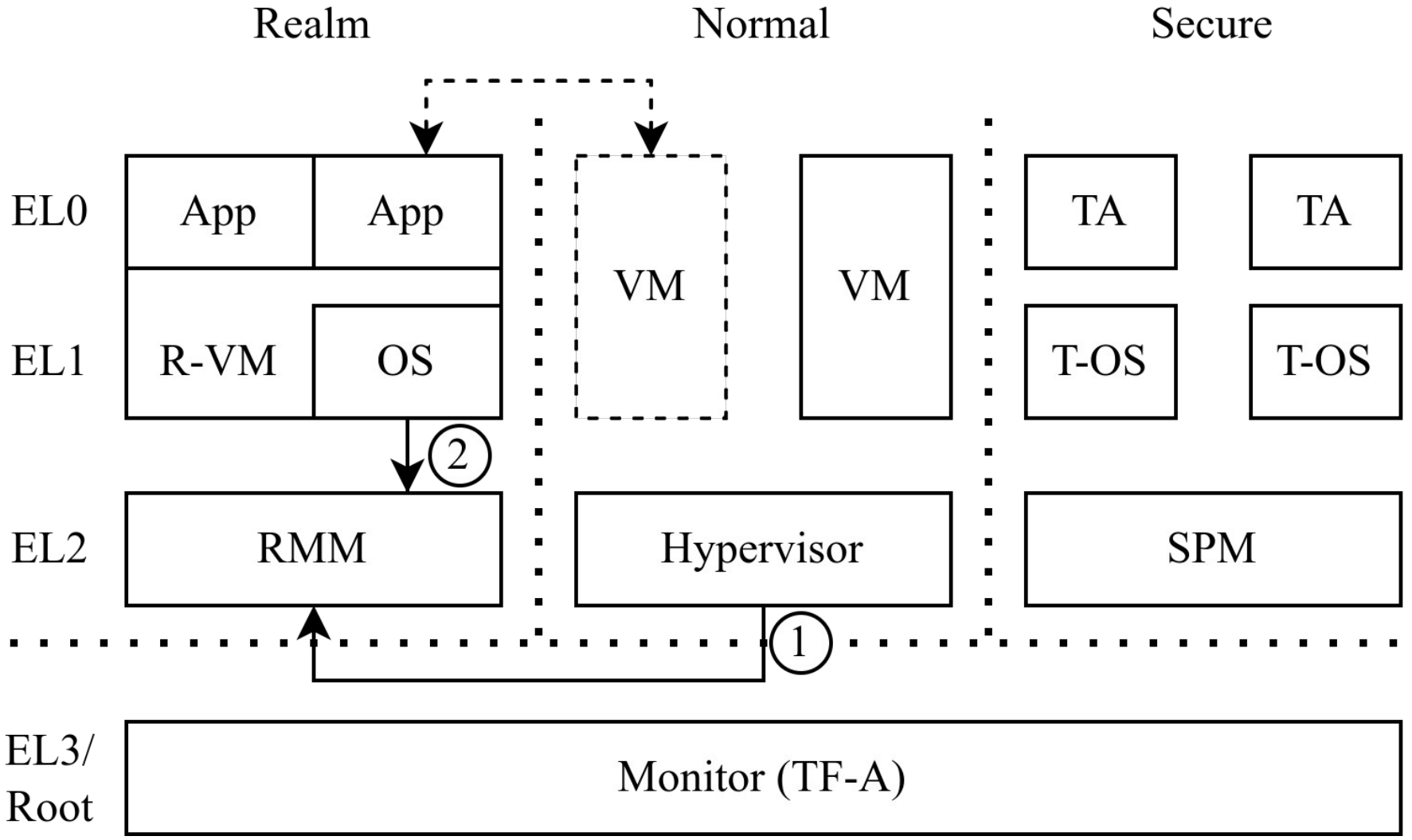
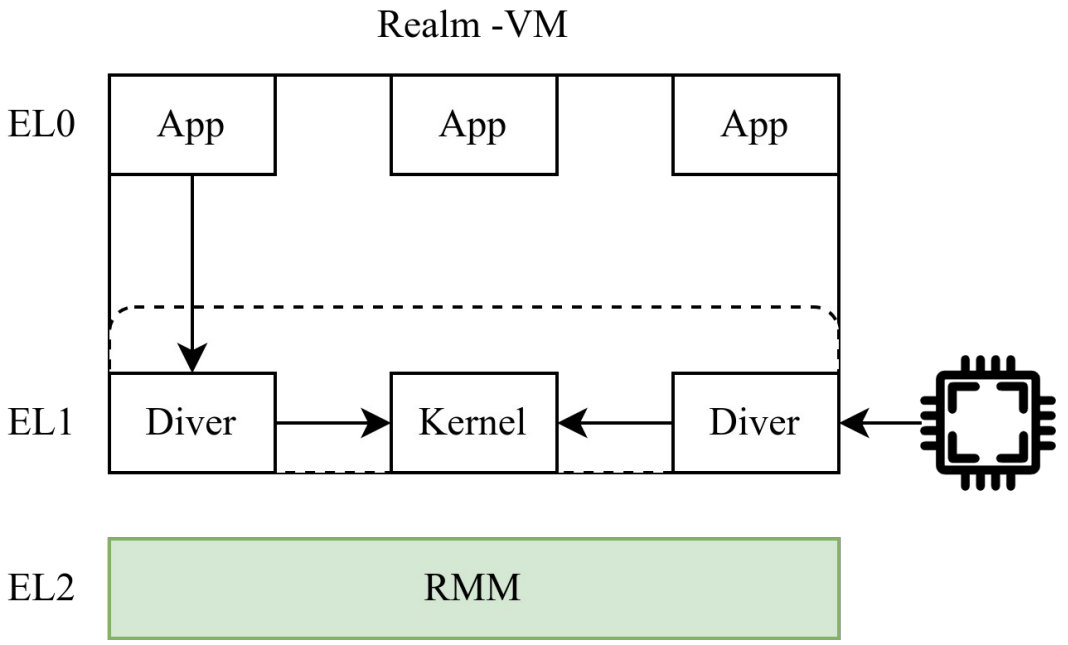
ARM CCA


Realm
Normal
Secure
EL0
App
App
VM
VM
TA
TA
EL1
R-VM
OS
T-OS
T-OS
2
EL2
RMM
Hypervisor
SPM
1
EL3/
Root
Monitor (TF-A)

Attacker Model

- CCA offers protection from untrusted software running „outside“ the R-VM
- Attacker „inside“ the R-VM still a siginificant danger



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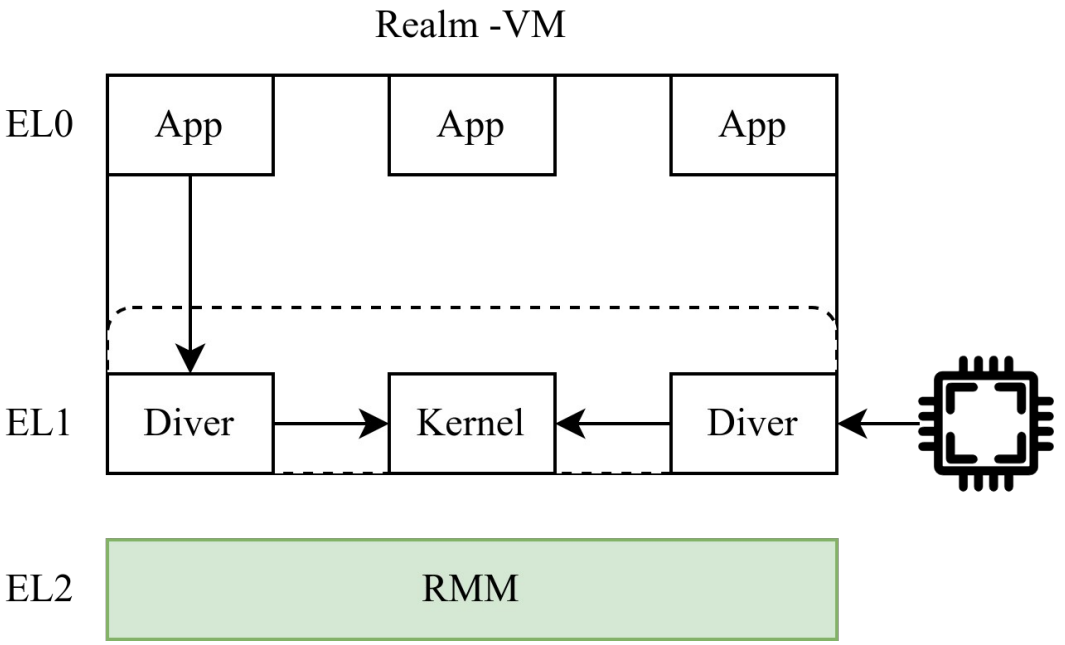

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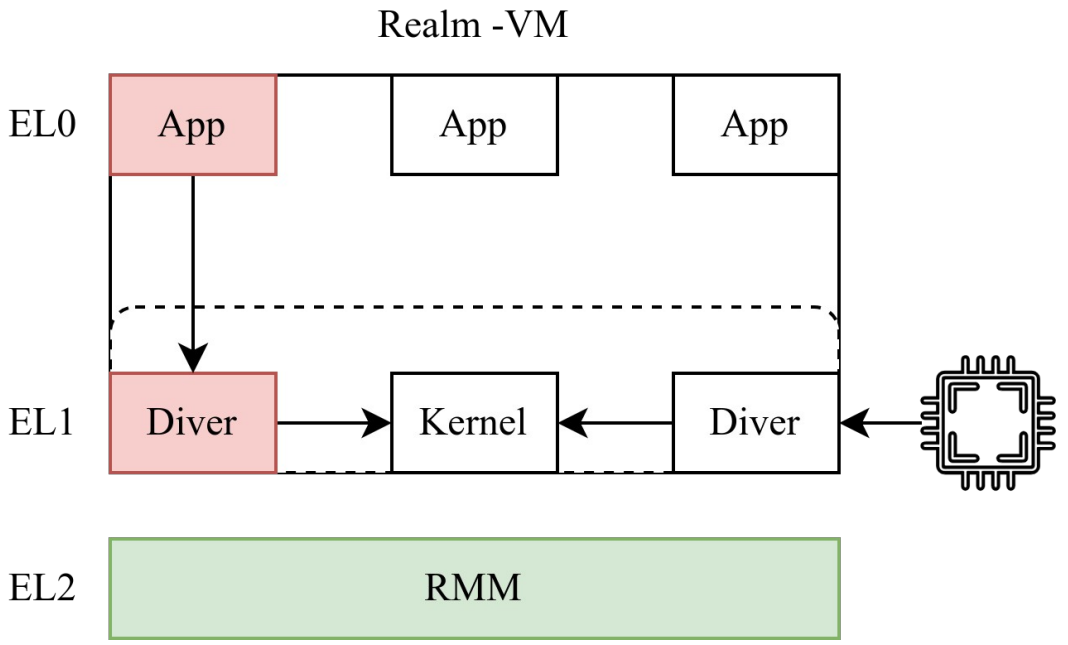

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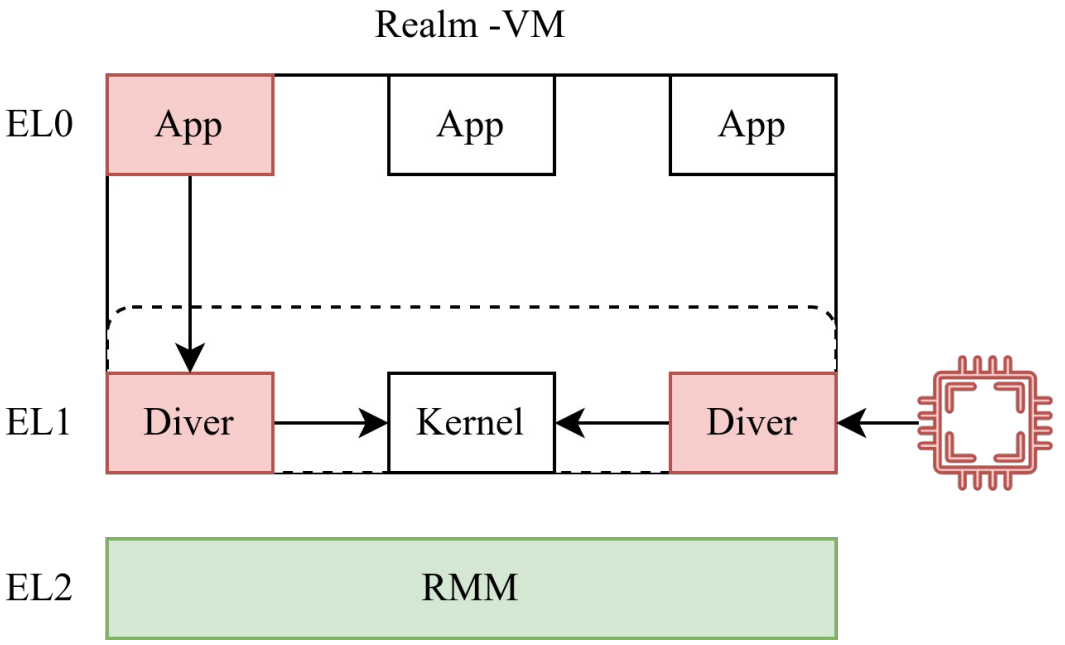

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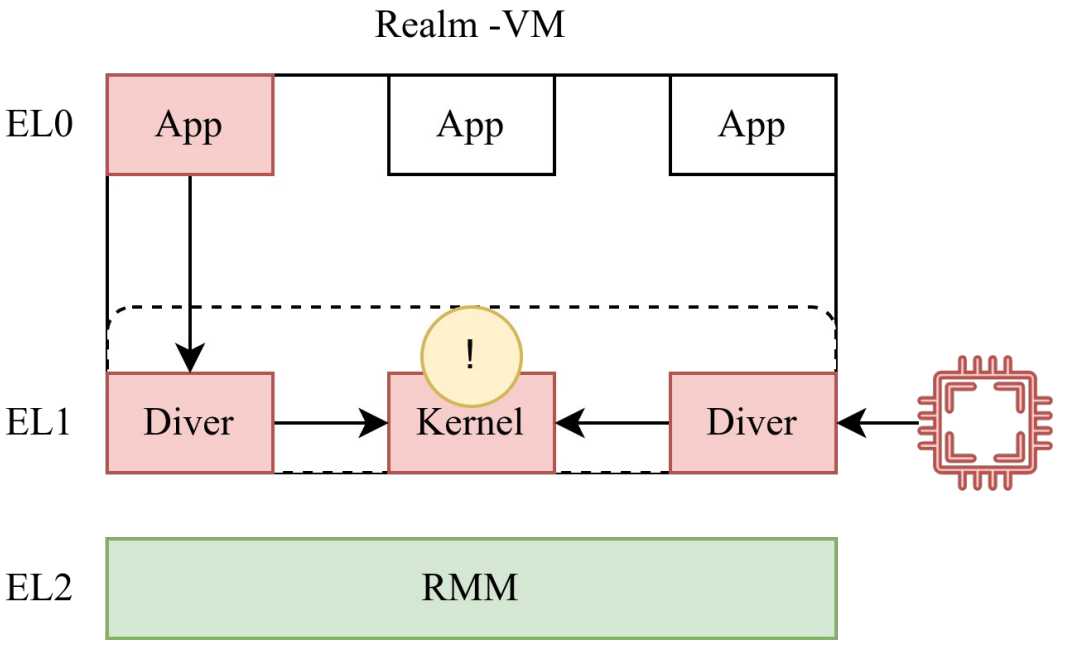
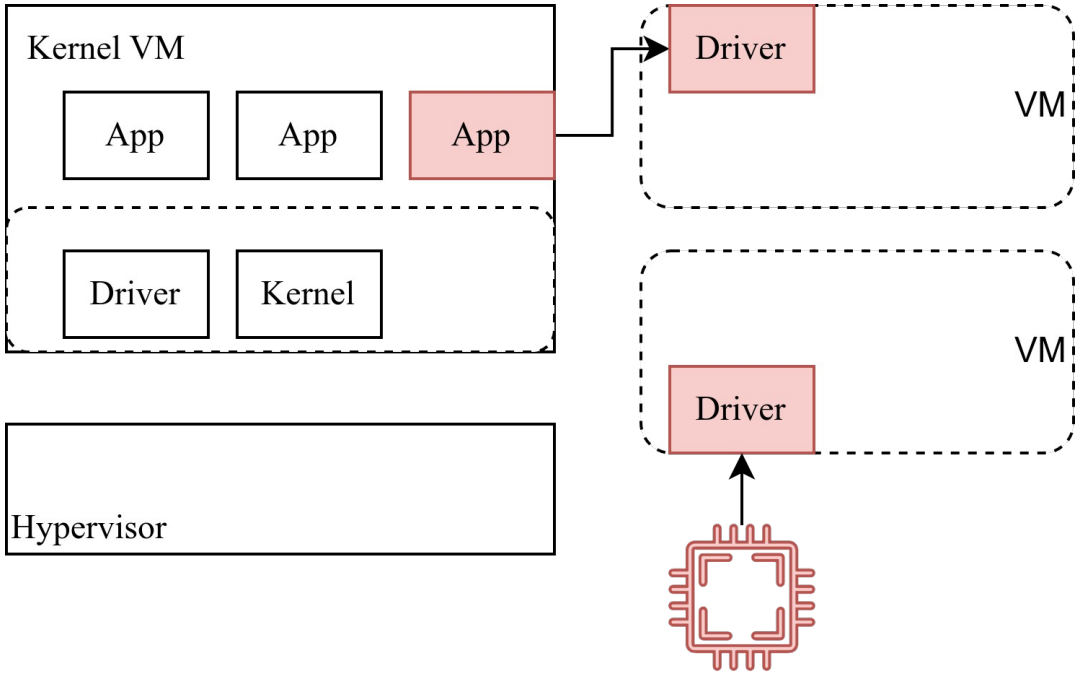


Monolithic Kernel => System Compromise

Challenges

- State of the art solutions isolate Drivers into VMs



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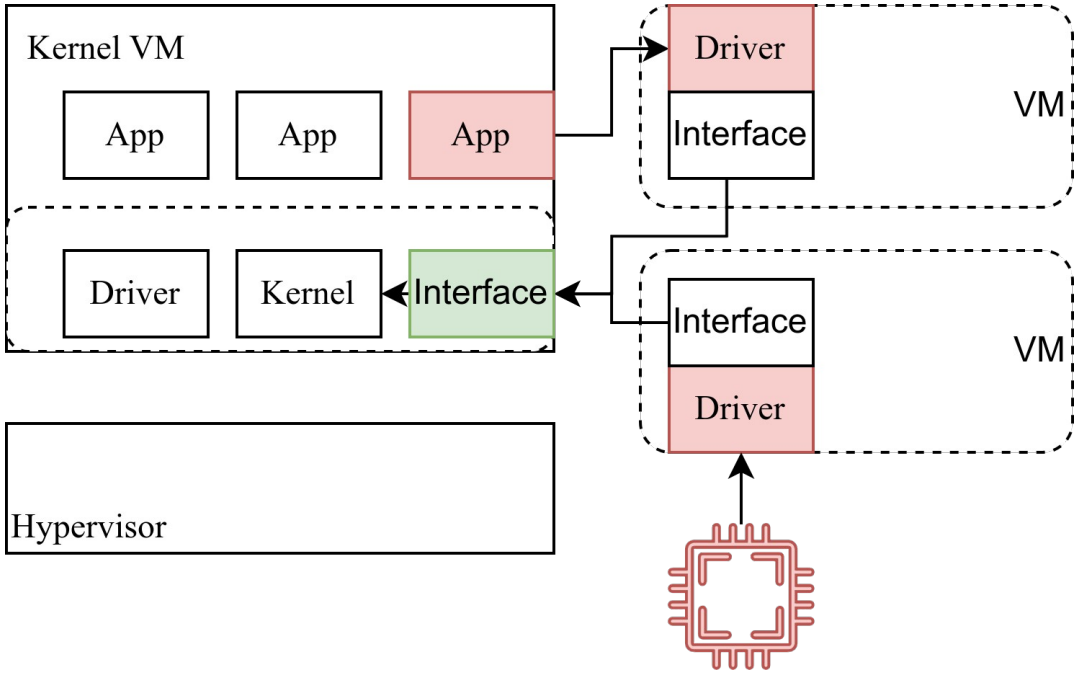

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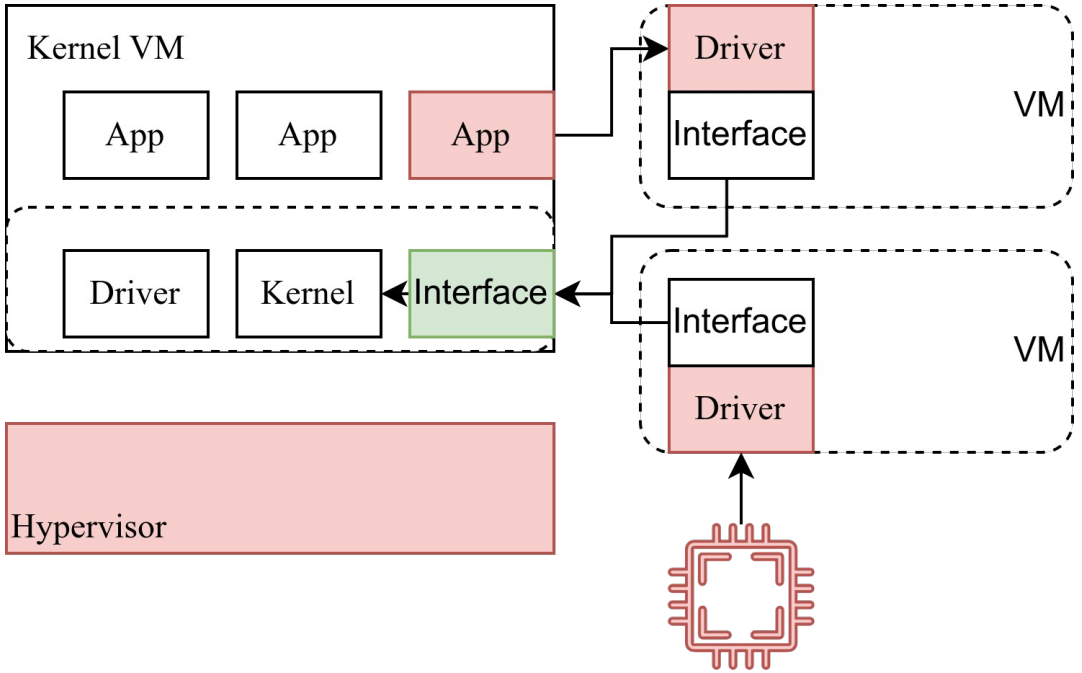

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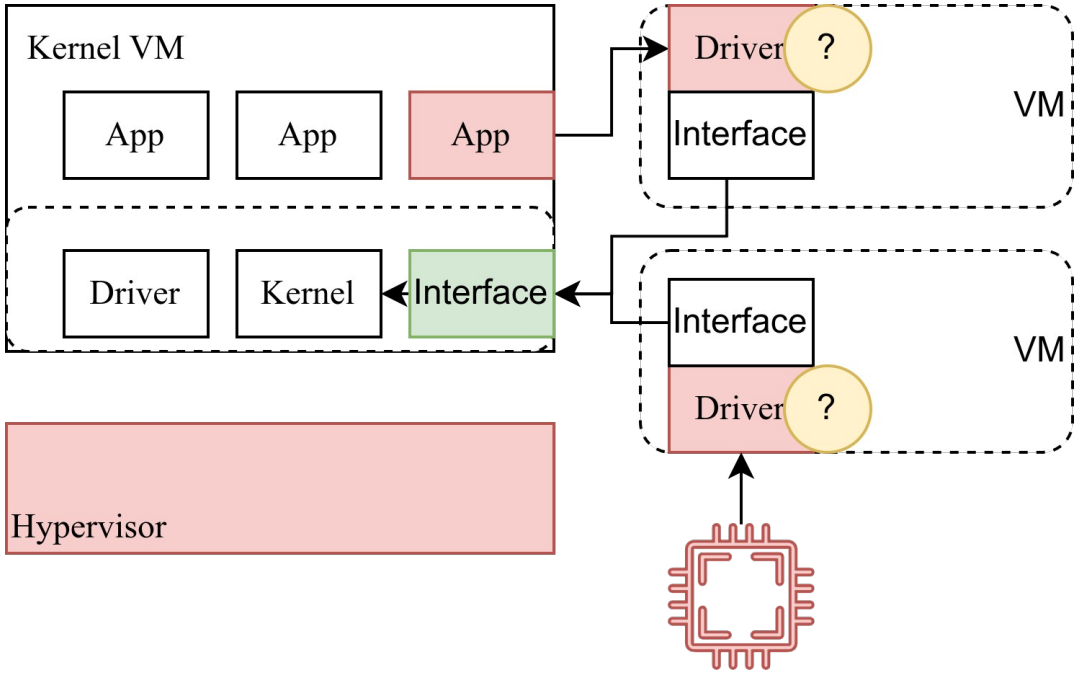

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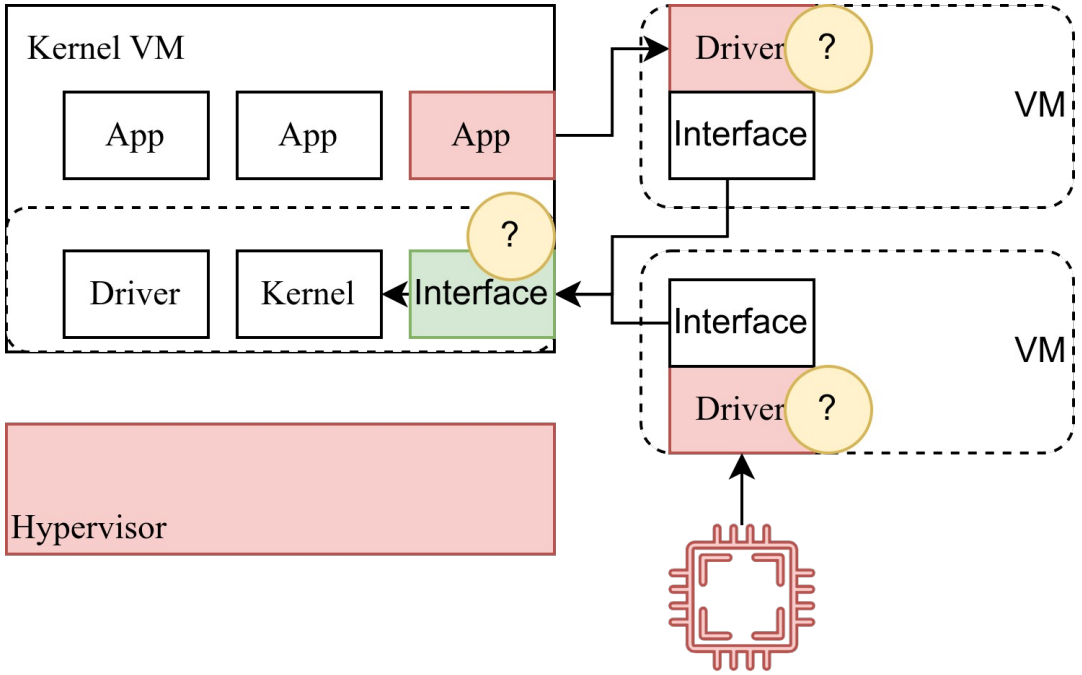
  - How to actually filter out „evil“ requests?



BarriCCAde

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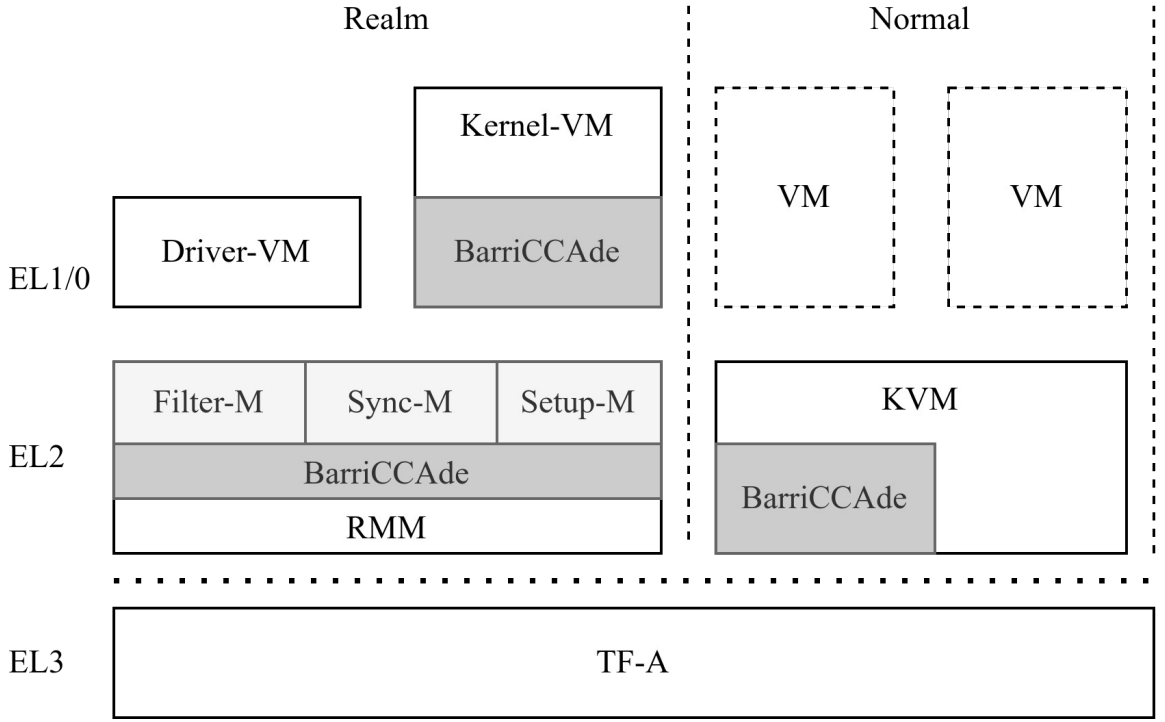

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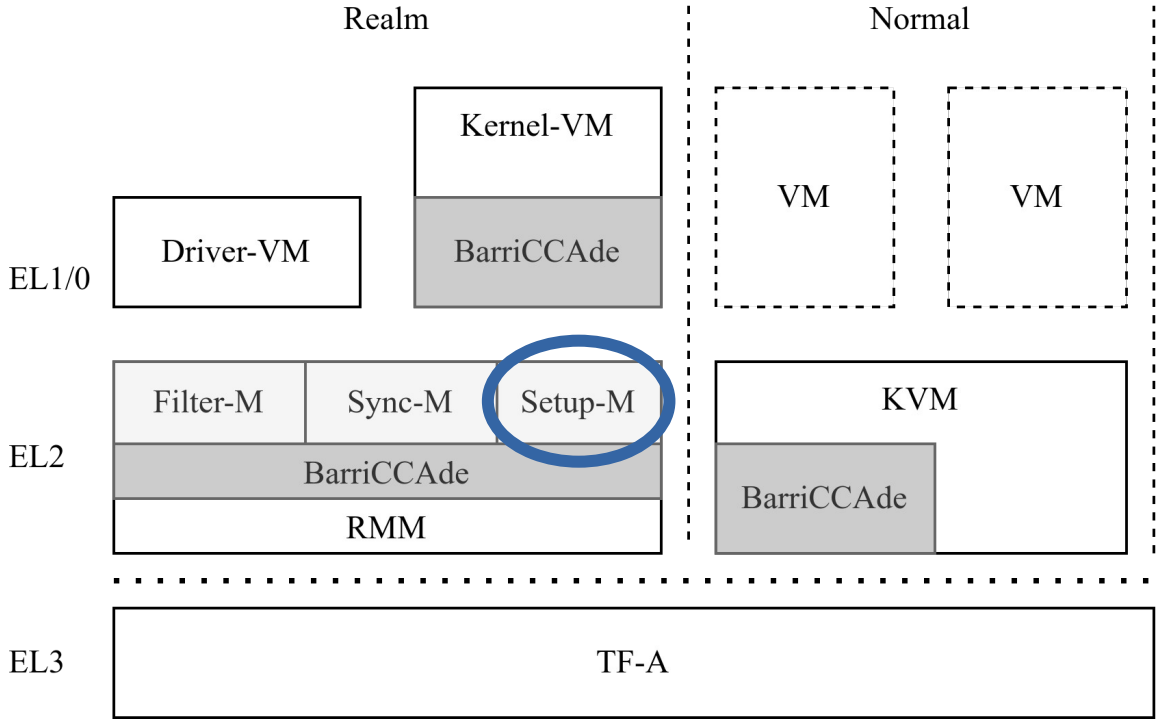

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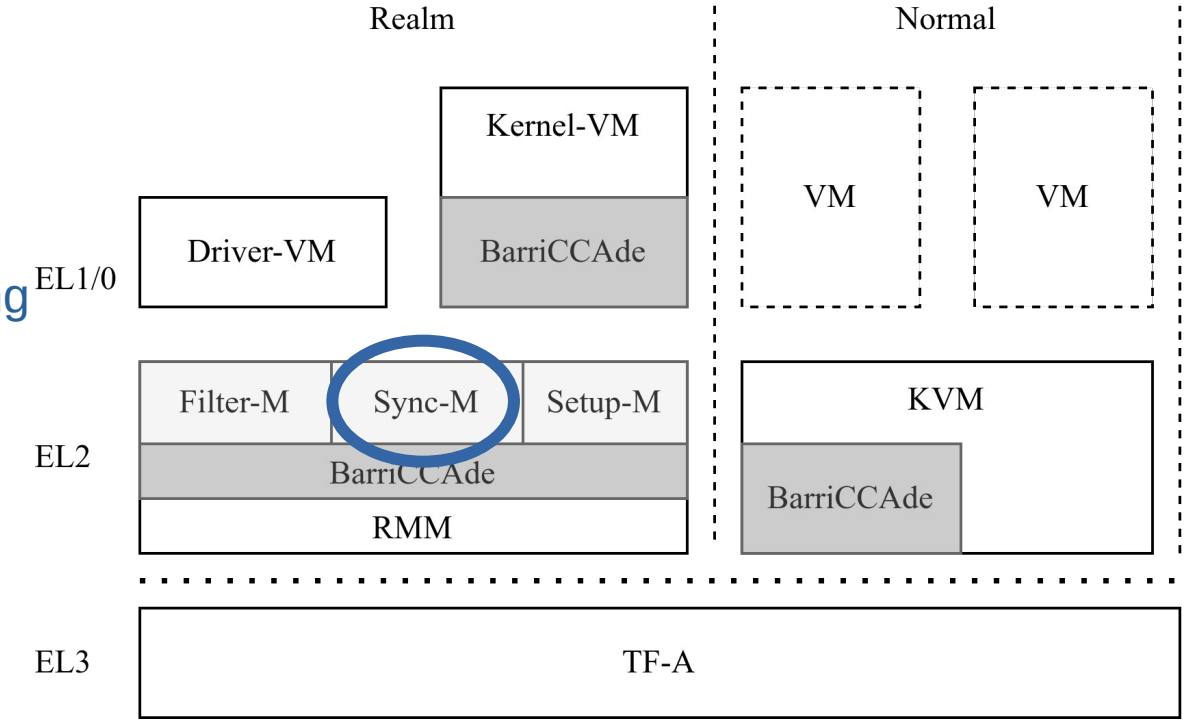

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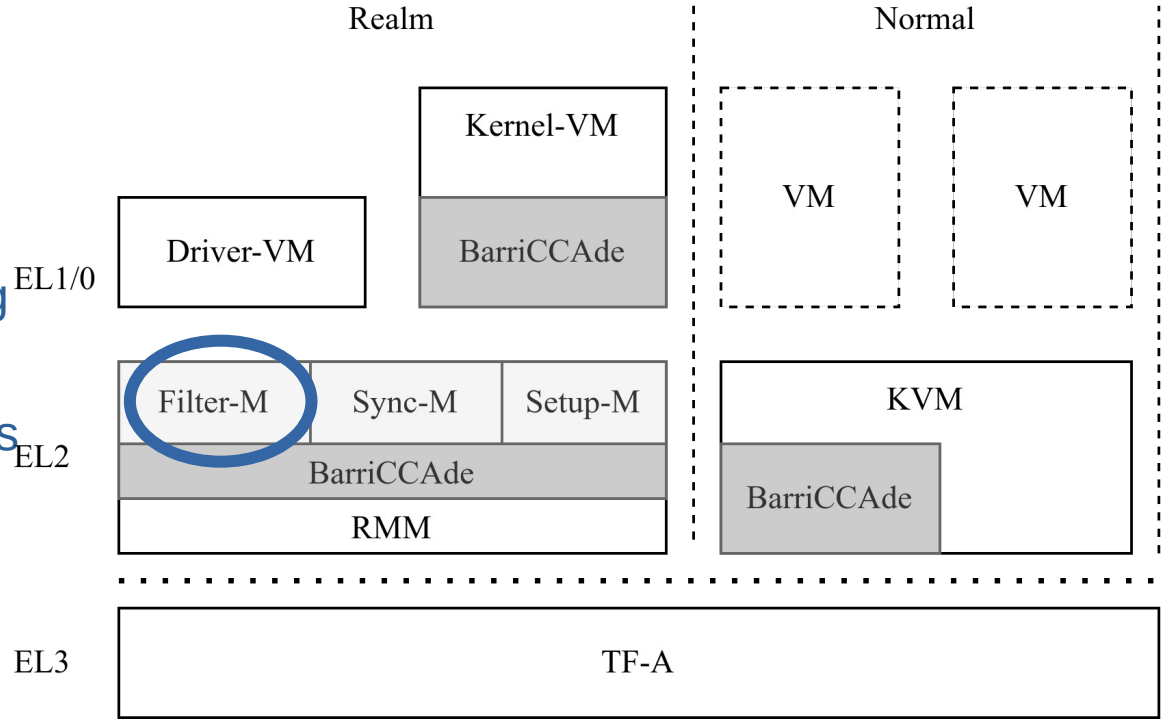

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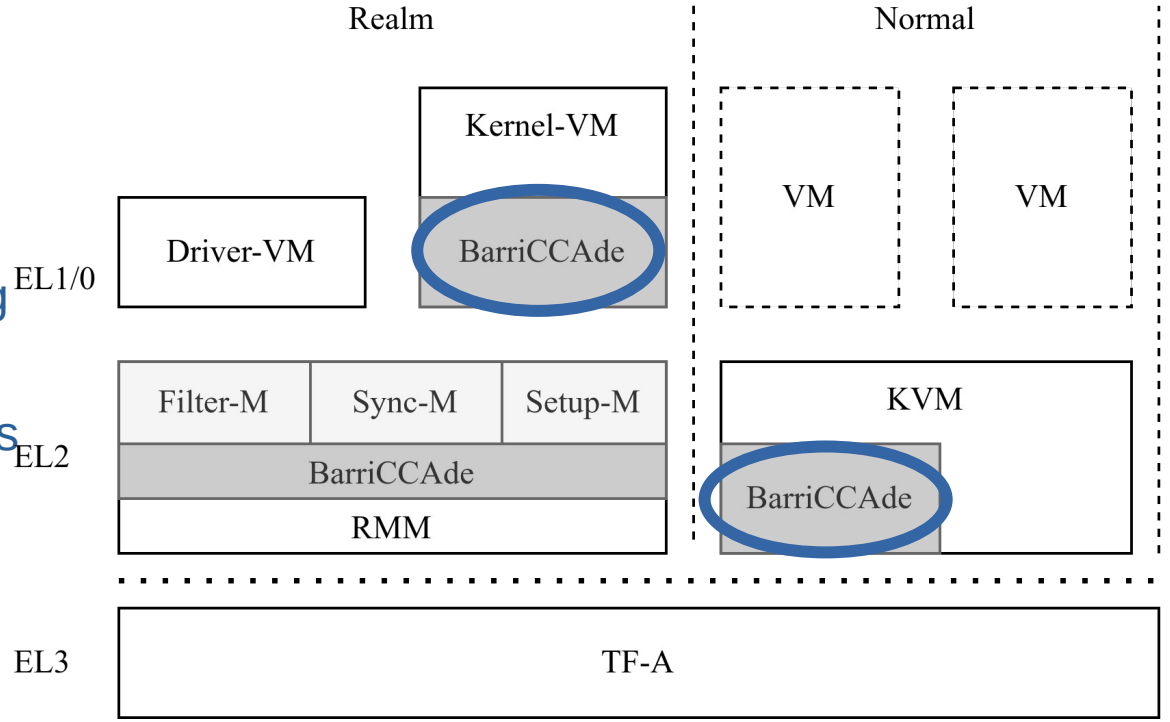
- Expand other untrusted components as needed



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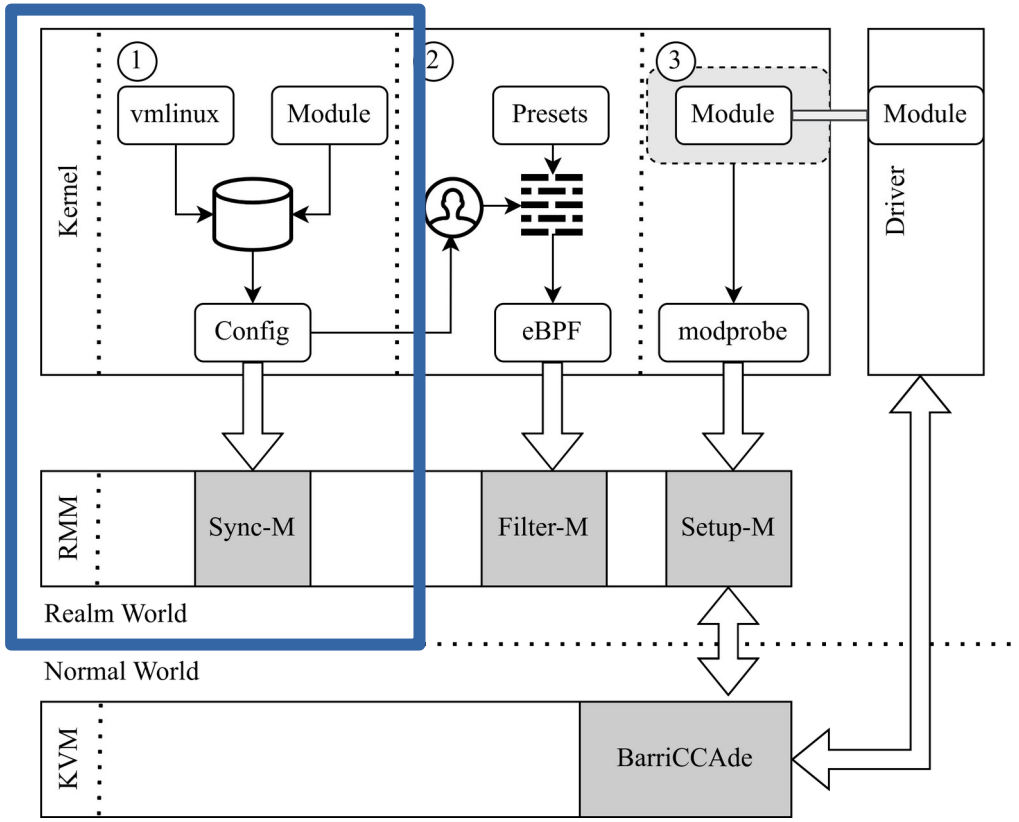

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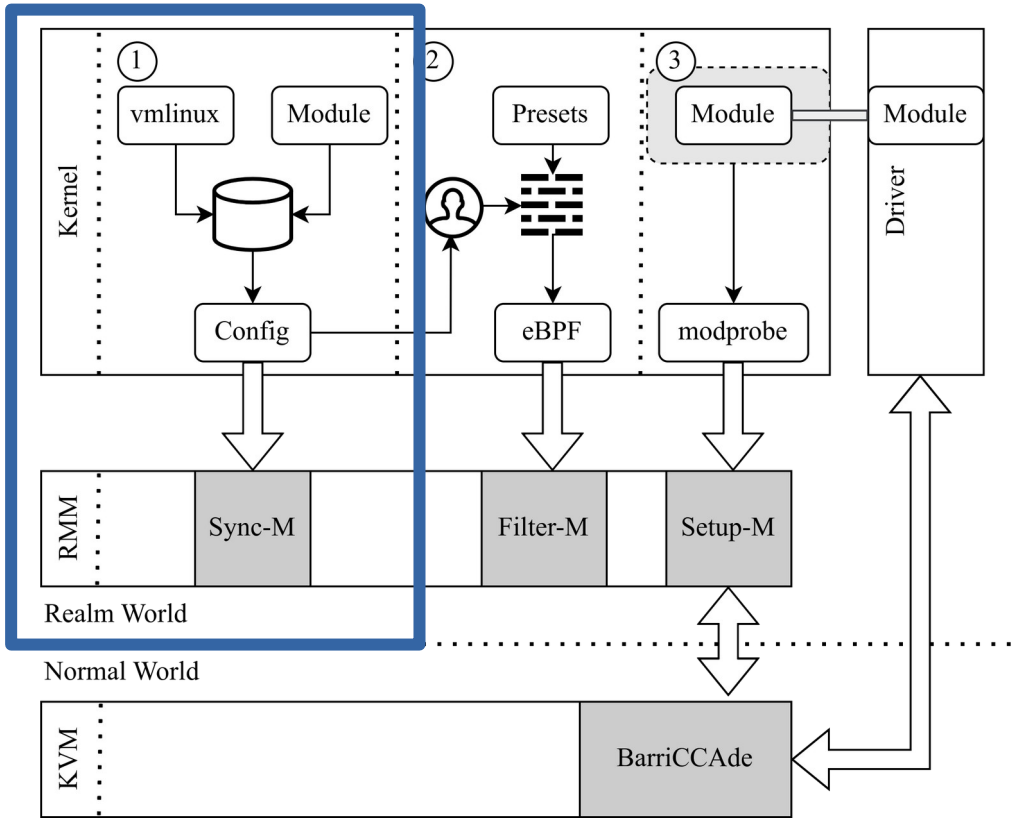

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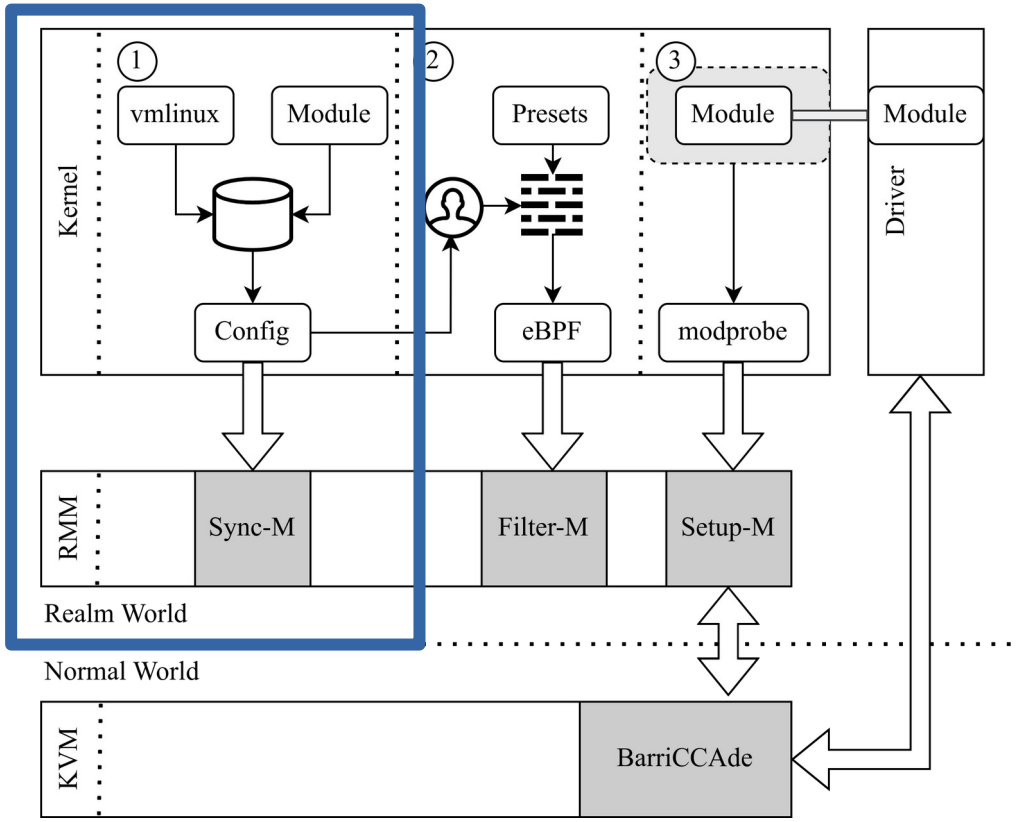

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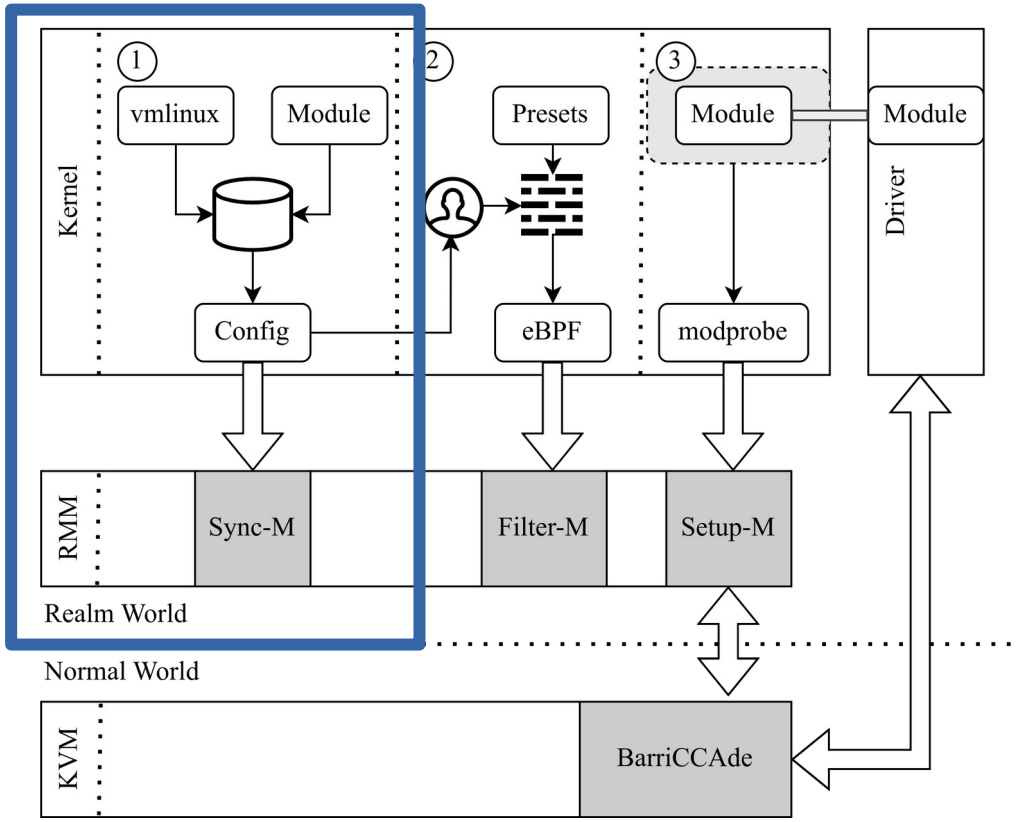
- Evaluate recursively, load into **Sync-M**



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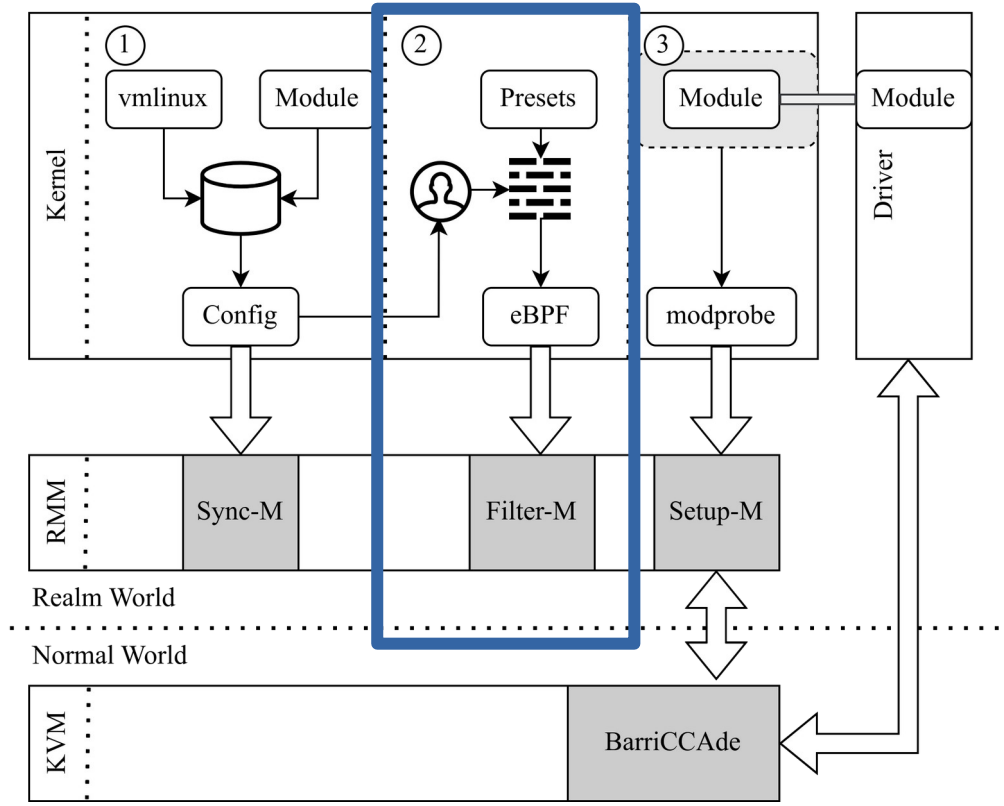

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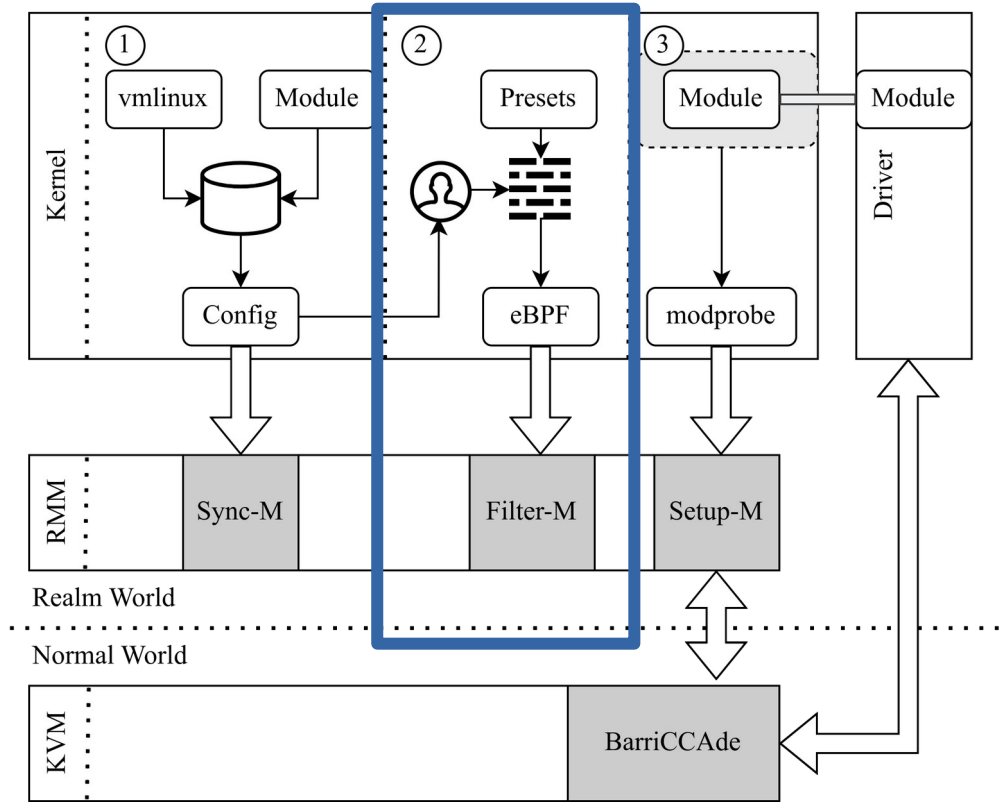

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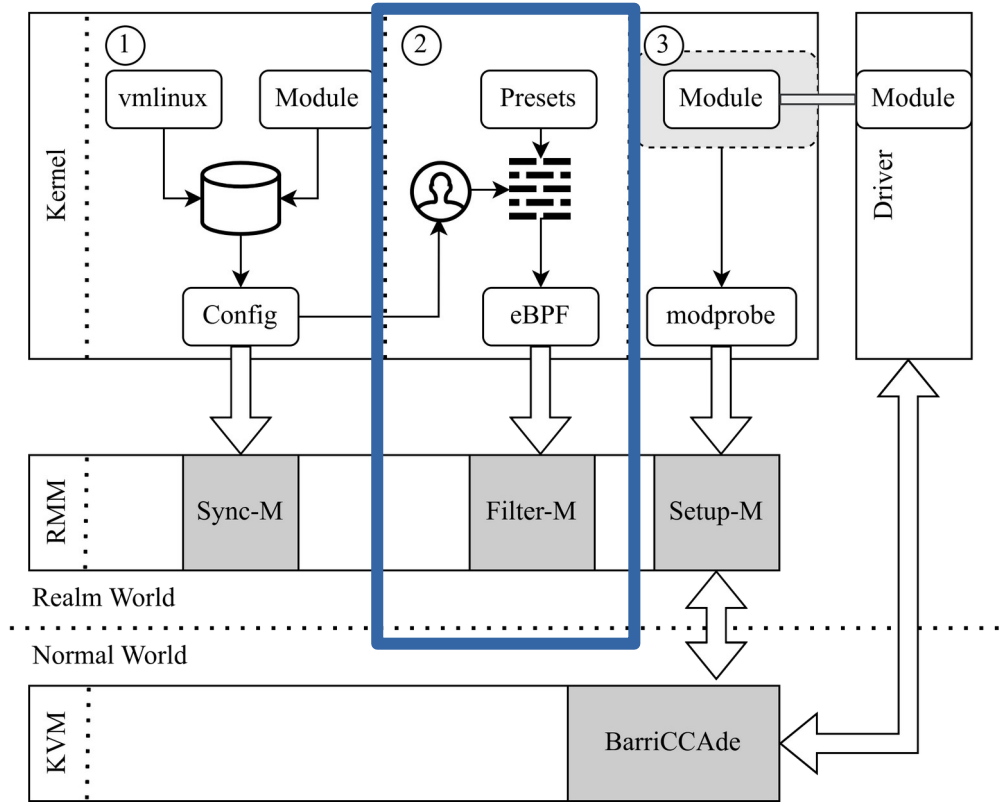

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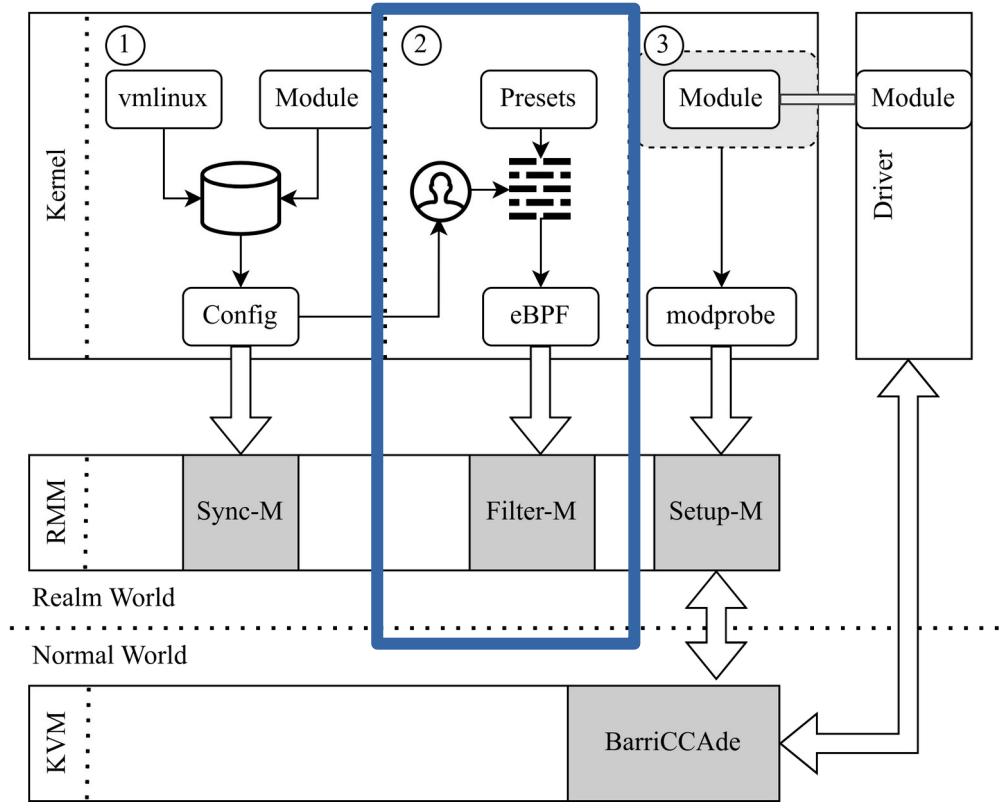
- Compile into eBPF Program and load into **Filter-M**



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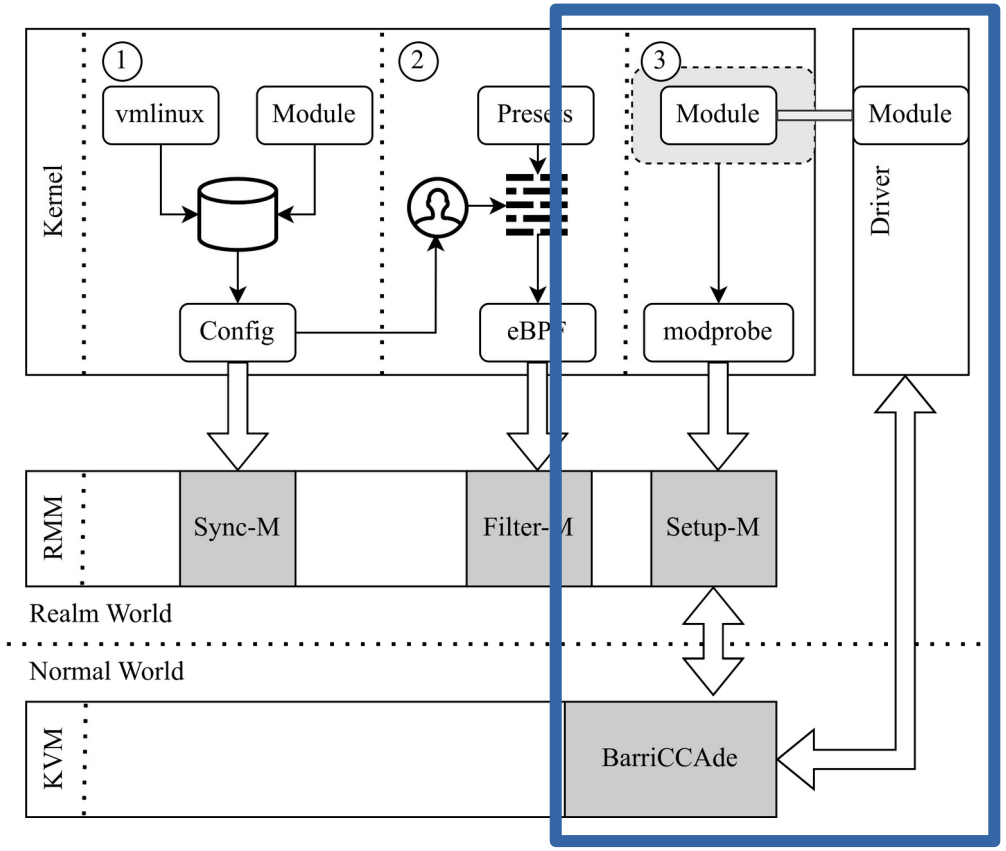
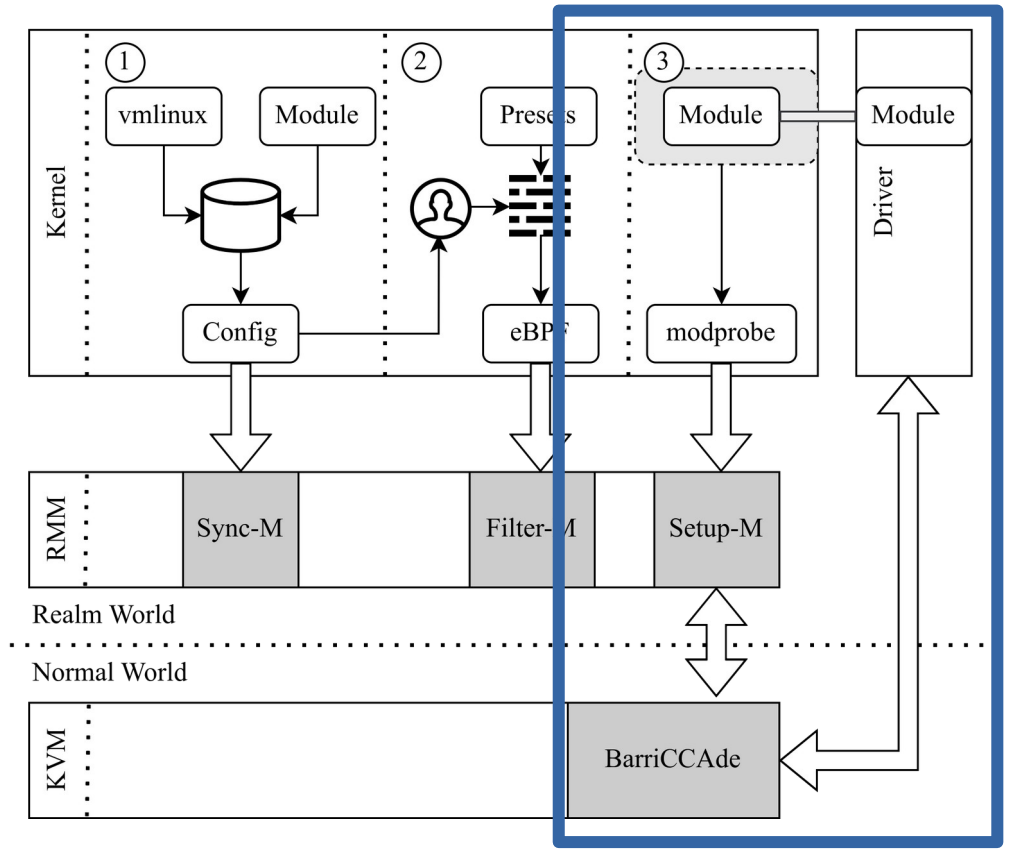
- Load module via modprobe



BarriCCAde – Setup

- Load module via modprobe
- Forward bounds to **Setup-M**
  - Creates Driver-VM



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- Trap context contains address accessed and state of the VM (e.g., params in registers)

  => Implicitly contains all information needed for access forwarding

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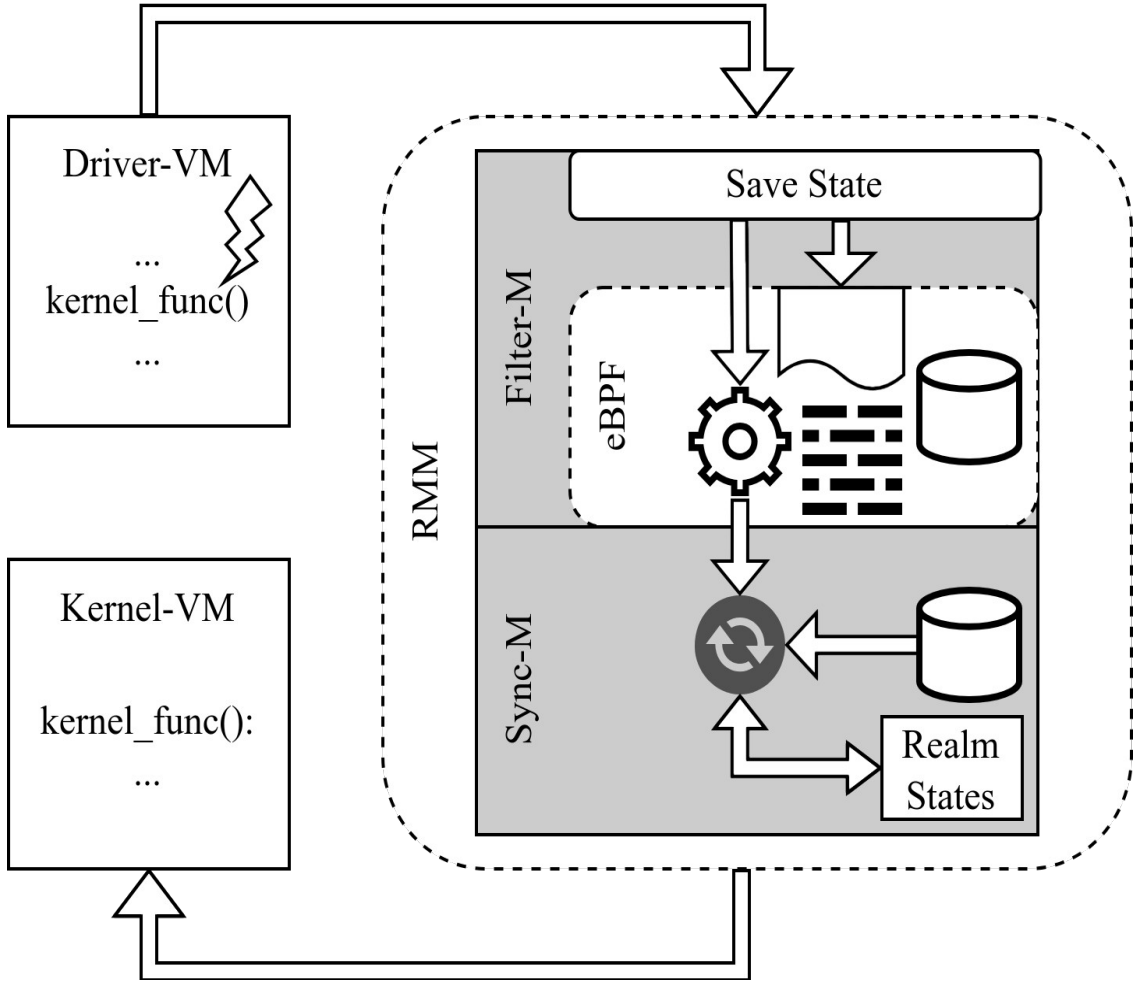
- Driver VM init function is called



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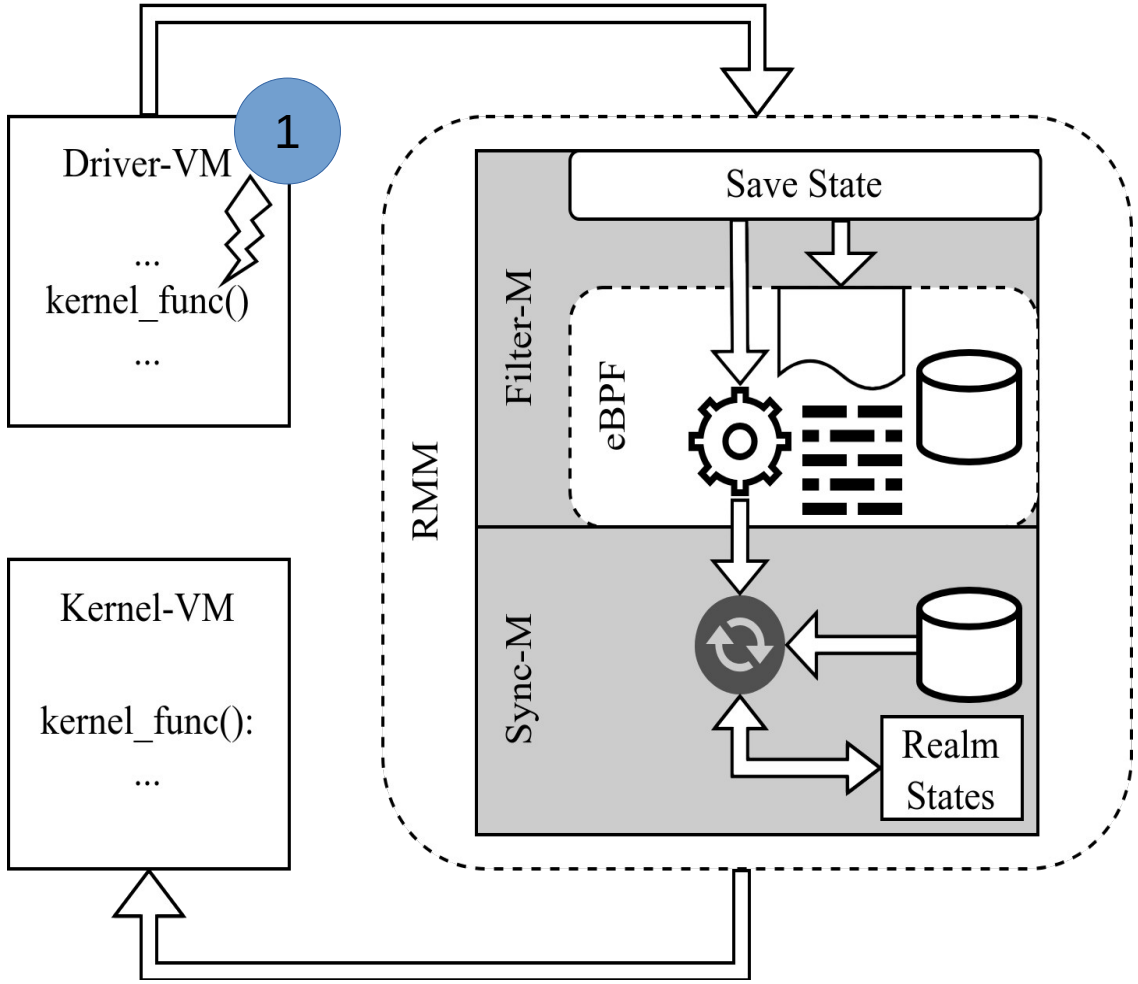

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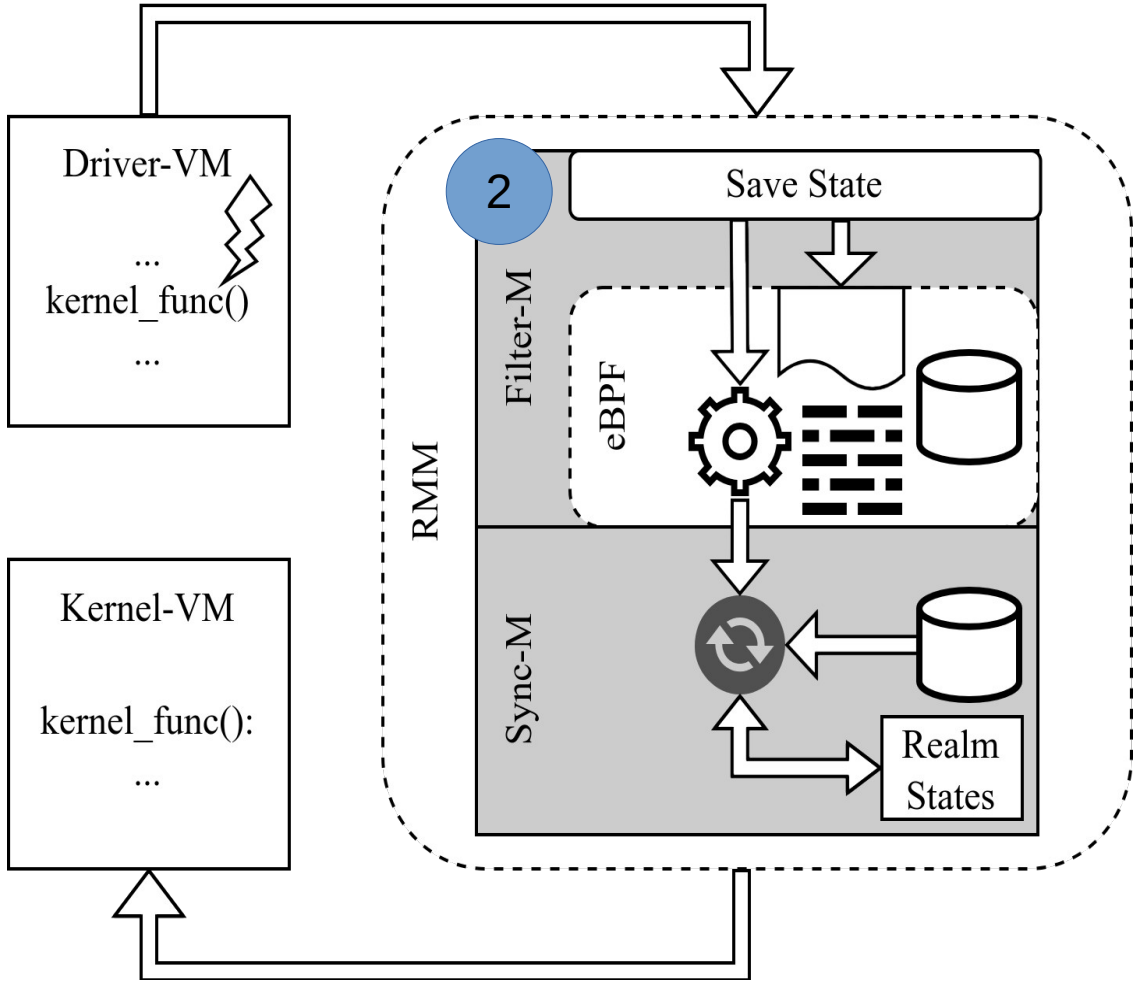
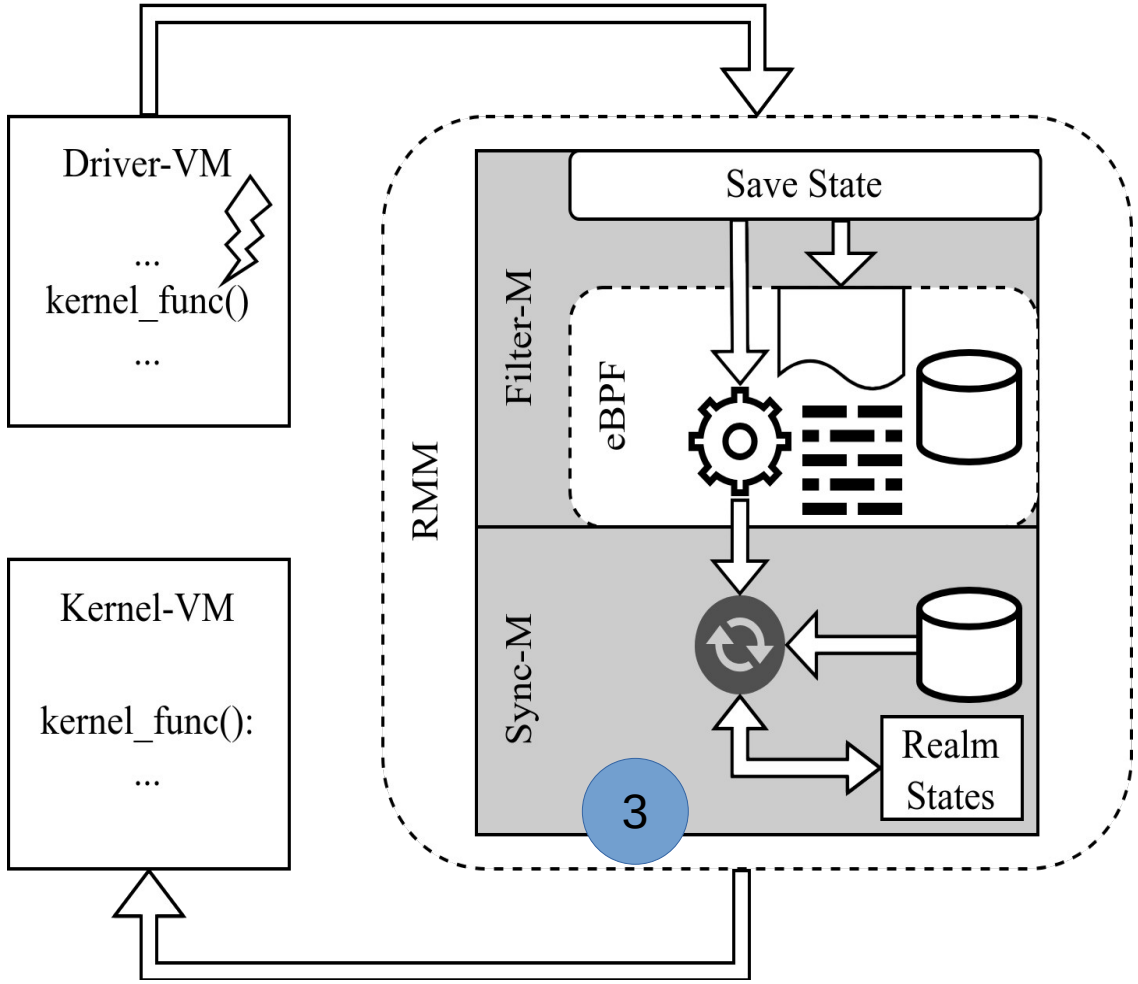
- Forward state, filter rules, config to the eBPF program



BarriCCAde – Runtime

- Extract information for accessed resource from sync config
- Synchronize resources according to config to kernel state



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- Improve (automatic) generation of Sync Configs
- Improve (automatic) generation of Filter Rules

Summary

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- BarriCCAde is a step forward to isolating vulnerable drivers
- Introduces novel resource synchronization technique based on debug information and trap based access forwarding to target closed source drivers
- Allows detection and blocking of malicious behavior via eBPF-based filters
- Minimal TCB increase by relying on novel Confidential Computing Architectures