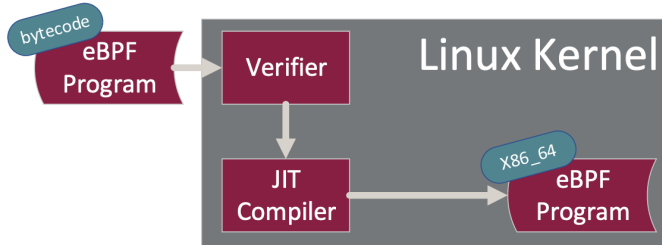


# Moving eBPF Verification Out of the Kernel

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## Background

- eBPF aims to allow loading verified and safe programs into the kernel
- Verification and JIT is done in kernel space
- eBPF vulnerabilities often target the verifier and the JIT
- Lack of a rigid testing framework for the verifier
- Verification is slow on embedded devices

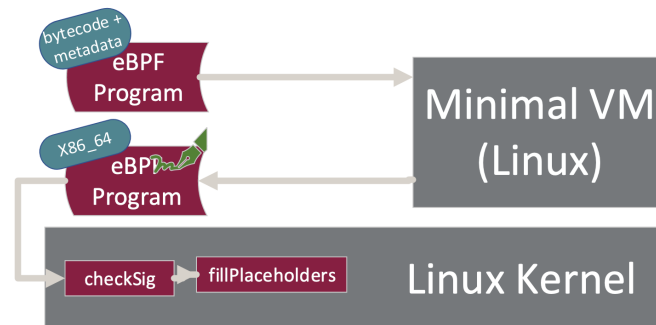


## Proposal

- The verifier and JIT should be moved outside of the host kernel
- Provide mechanism to confirm authenticity

## Design

- Provide a VM with a minimal kernel that performs verification and JIT
  - Pointer leaks only affect guest kernel
  - eBPF doesn't run inside VM
  - VM restarts from fresh state for every eBPF load
  - Output: Signed native machine code (e.g., x86\_64)
- Placeholders are made for relocs
- Host checks and runs output from VM in kernel
  - Safety is provided through signing
  - Only need to verify program once



- Design allows for offloading verification to a separate machine
  - Embedded devices

## Relocations

- Verifier fills in address to file descriptor
- Verifier and BTF are tightly coupled
  - Type-checking
- Verifier rewrites structs members to kernel structs
  - Two versions of structs are maintained
  - Separation provides safety
- What if the guest and host kernel version differs?

