Unit Testing Framework for Operating System Kernels

Walter, Maxwell; Karlsson, Sven

Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

Unit Testing Framework for Operating System Kernels

Maxwell Walter and Sven Karlsson
Technical University of Denmark

Problem

- We need a way to test a new OS kernel as it is being developed
  - Before hardware drivers are fully implemented
  - With multiple different hardware setups
- Current methods rely on manual information retrieval

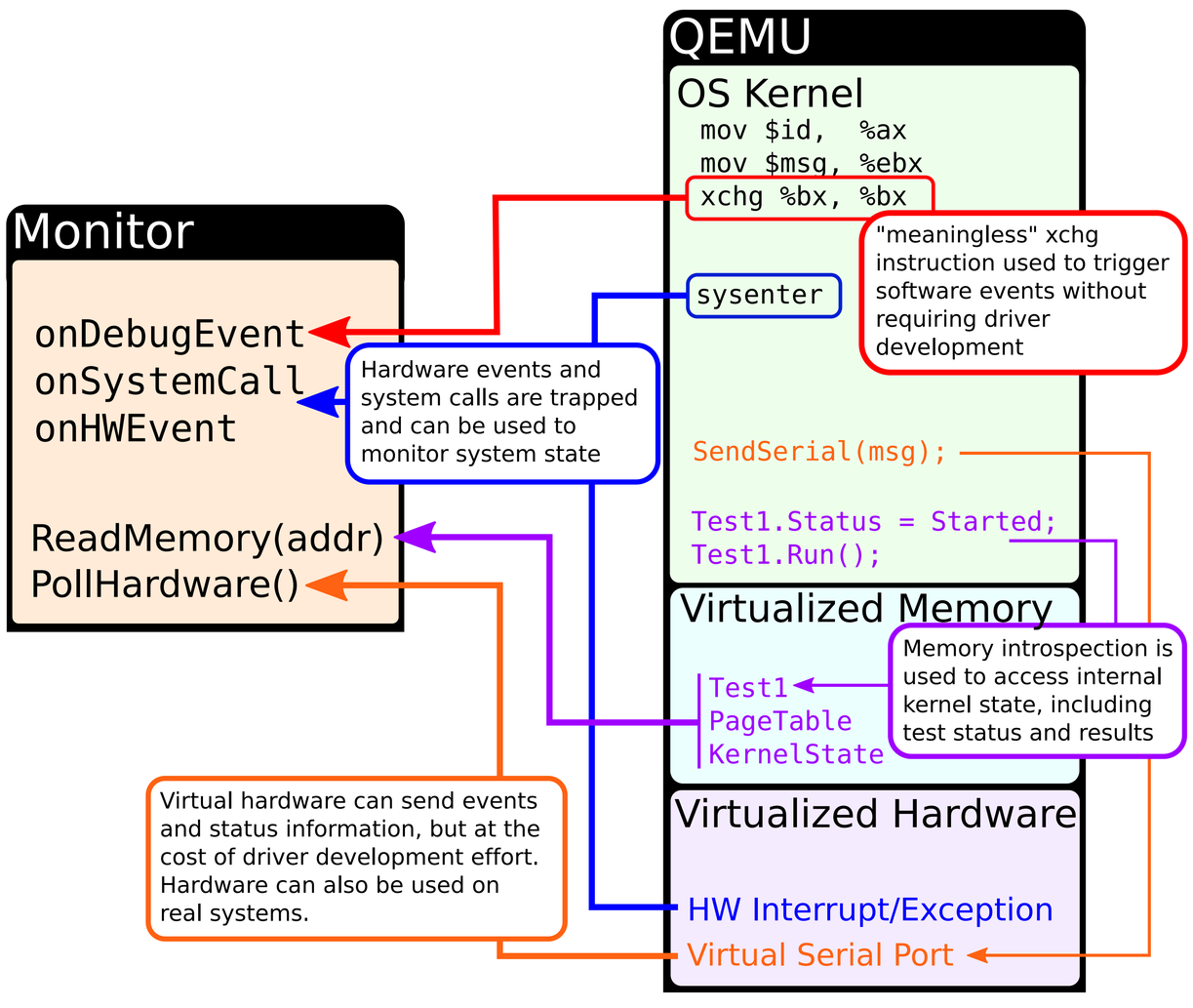
Approach

- Run the OS kernel in a **virtual machine** (VM)
  - Use **QEMU** as our virtualization platform
  - Create virtual hardware configurations as needed
  - Use virtual machine introspection (VMI) to access internal state
- Create an in-kernel **Testing API** that
  - Provides a way to create, start, and report on tests
  - Provides software test points for VMI

Contributions

- A **testing framework** for operating system kernels consisting of
  - A management interface for testing HW configurations
  - A test monitor interface for accessing kernel and VM state
  - An in-kernel testing API

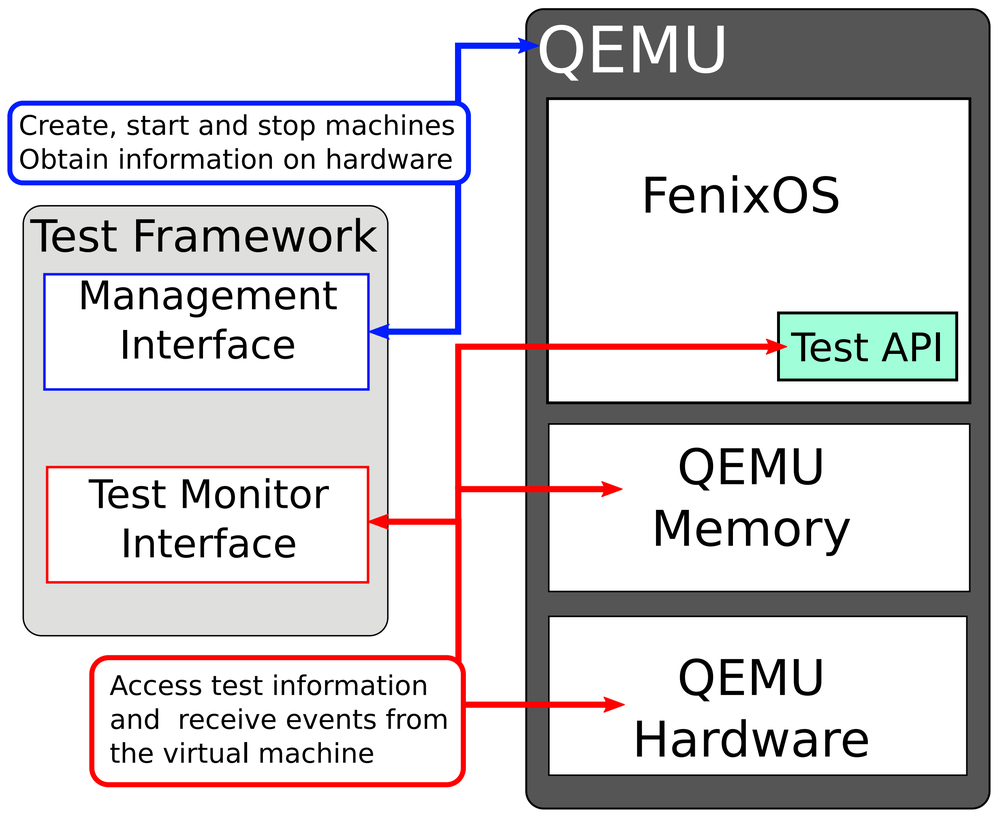
Framework and VM Communication



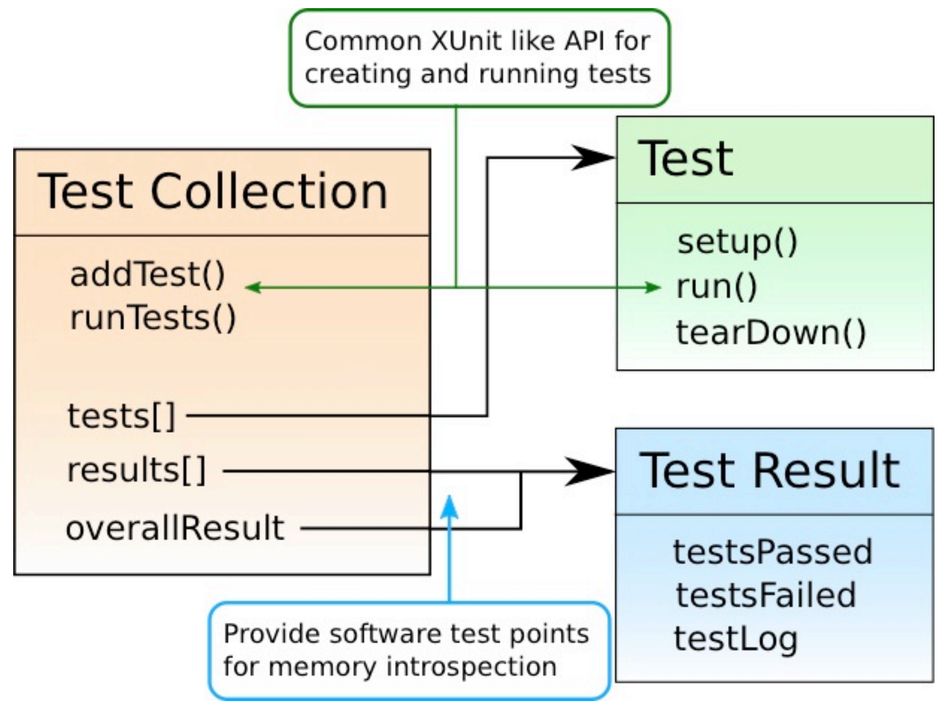
Framework Limitations

- Virtualized environments present idealized, not real, hardware
  - Introduces potential inaccuracies into testing
  - Can be partially mitigated with hypervisor and HW pass-through
- Dynamic data may not be available for introspection
  - Locations may be unknown
  - Data may change before or while it is being observed

Architecture



In-kernel Test API



Conclusions

- The testing framework is currently being used for development
  - Provides status information before HW and memory is initialized
  - Ensures future development does not break working code
- A sample GUI using the framework is shown below
  - Uses memory introspection to retrieve information