Constructing a Stable and Verifiable Computer Forensic System

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Introduction

- This talk is about validation of computer forensic software
  - Difficulties validating and using computer forensic tools on general purpose operating systems
  - What can we do with open source software, including TSK & Linux, to help?

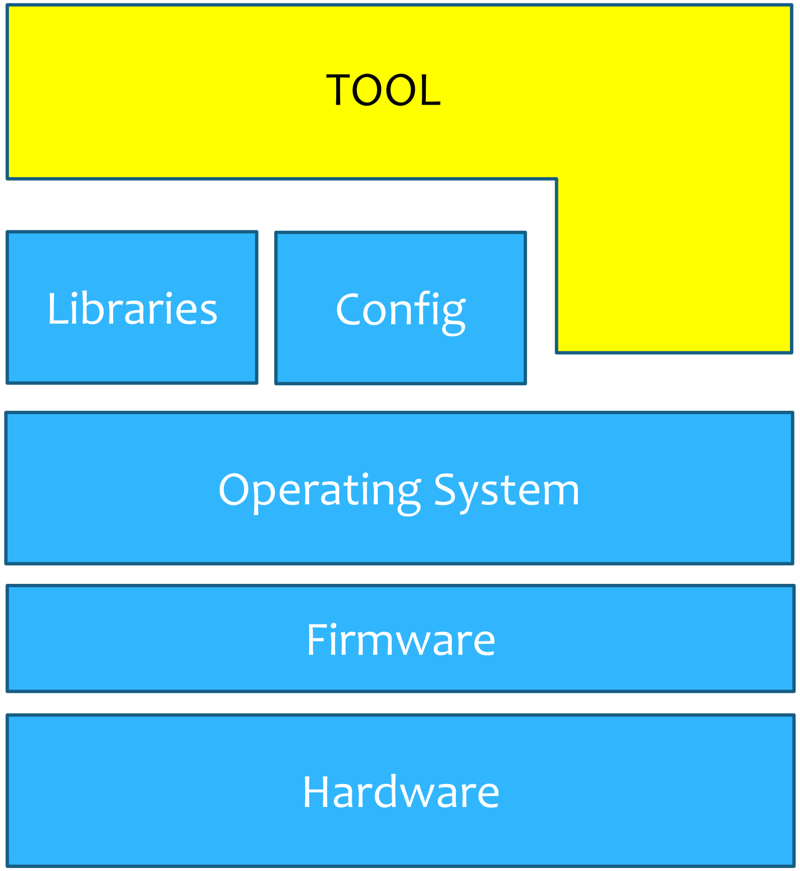
Definitions

- **Tool** – Computer forensic software executing within a general purpose operating system
- **Positive Validation** – Ability to extrapolate from successful test(s) that tool is correct.
- **Negative Validation** – Ability to demonstrate through unsuccessful test(s) that tool is incorrect.

An Experiment

- Hypothesis – Change in OS environment can cause a correct tool to give incorrect results
- Tested – EnCase v6.18 & Linux (Debian Lenny)
- Results
  - Modification of OS TZ database broke date/time calculations (EnCase & Linux, EnCase broken anyway)
  - Modification of OS codepage/NLS definitions broke keyword searching (EnCase, Linux inconclusive)

Tool in a General Purpose OS



"Correct" tool provided by vendor

Relies upon proper operation of operating system, firmware and hardware

Conclusions from Experiment

- Generic positive validation of a tool ("Tool X v1.4 works correctly") is not possible
- A successful validation test means tool works on that particular computer *or one with the same characteristics (equivalence)*
- Faults can originate from
  - OS patches (e.g. US DST patch for Windows)
  - Misconfiguration
  - Security compromise (anti-forensics)
  - Changes in date and/or time

Computer Forensic System

- **Computer Forensic System** – Tool plus all hardware and software capable of influencing the behaviour of the tool.

- How can you ascertain the scope of a system?
  - Includes specific hardware & software
  - Examine source code (for open source tools)
  - strace/ptrace/Process Monitor (closed source)?

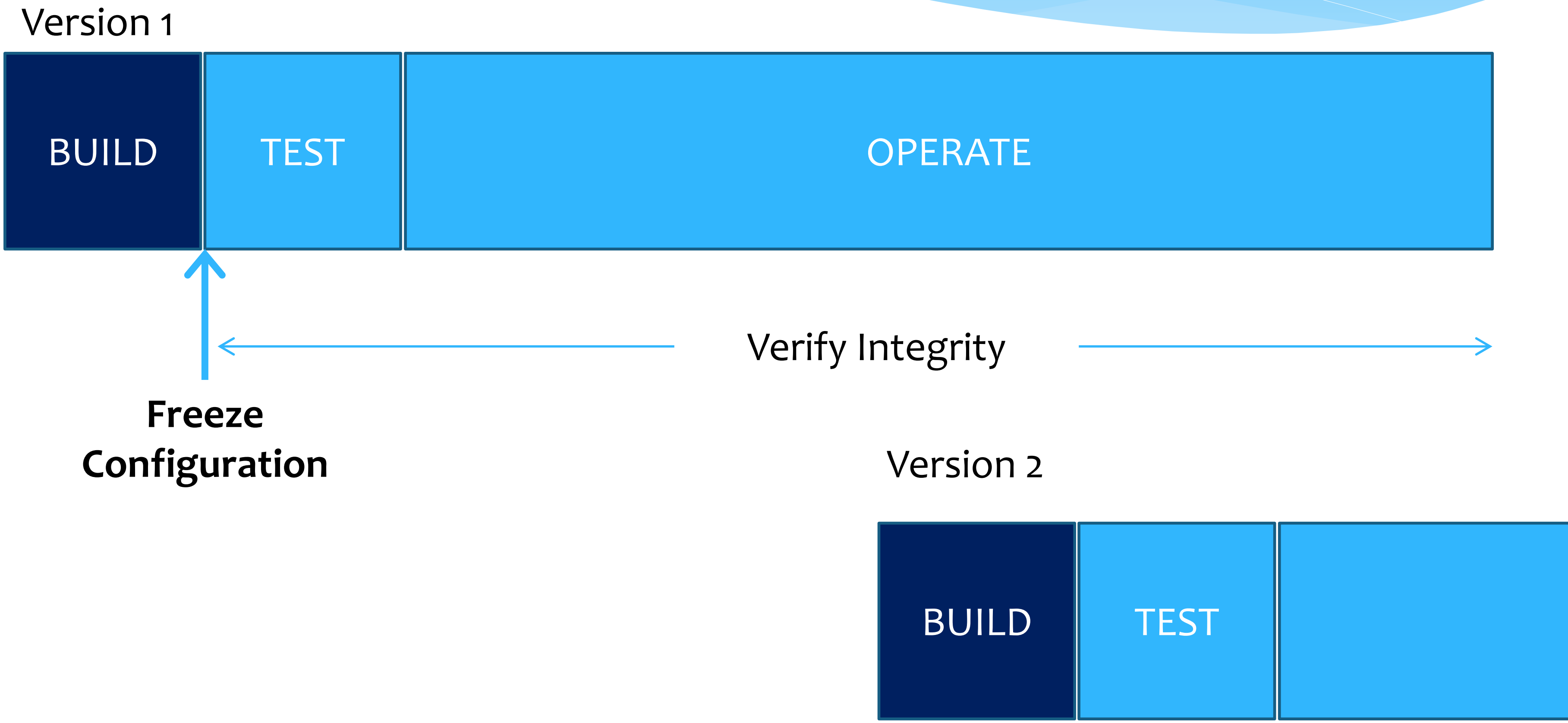
But … License Restrictions!

- The terms of the software license for most closed source tools prohibit reverse engineering and similar activities
  - It may not be legal to examine the tool in sufficient detail to identify what OS services, libraries and configuration data it relies on
  - A dead end for closed source?

Constructing a Stable and Verifiable System using Linux, TSK, etc

- A “forensic appliance”
  - Based upon general purpose OS & open source software
  - Automatic updates disabled
  - Configuration control software (e.g. Puppet)
  - Integrity verification software (e.g. Tripwire)
  - Verification of hardware & firmware using diagnostics & burn-in software
  - Access evidence data via Lustre, NFS, CIFS or web services.
- Clusters comprised of many appliances

Appliance Life Cycle



Hardware Qualification

- Need to establish reliable operation of hardware and firmware
- Vendor diagnostic software
- Burn-in software
- Memtest86+
- IPMI/Hardware monitoring for early detection of problems
- Verify disk operation – prefer hardware RAID

Build Phase

- Select stable software (ad-hoc updates not possible)
- Minimal software install
- Automated configuration management (e.g. Puppet "ensure => *version*")
- Freeze Configuration
  - Disable automated updates (lock file, null sources.lst)
  - Install & configure tripwire

Test Phase

- Conduct sufficient testing to support positive validation of all components of system
- Tests should compare output of software on system with known correct results
- Keep detailed records of tests and results (may be required as evidence)

Operational Phase

- Monitor integrity of system (e.g. via tripwire and IPMI/BMC/iLO/etc)
- Occasional repetition of test suite (e.g. when the appliance is not required)
- Maintain logs of which data is processed by what appliance
- Beware of security vulnerabilities – the only way to apply patches is to restart the build, test, operate cycle!

Optimisation

- Want maximum “operate” for minimum “build + test”
- Key is to prove an appliance is equivalent to one that was positively validated
  - Identical hardware – qualify each unit, but build & test only once then mass deploy?

Conclusion

- Generic validation of a tool is not possible as behaviour depends on OS correctness & configuration
- Validation tests must take into account all software & hardware factors that may influence outcome
- Necessary to obtain maximum “operation” time for minimum “build+test”
- Construction of “forensic appliances” using open source software is a convenient way to achieve this goal