Testability & Design for Test

Michael Stahl

SW Validation Architect

V1.4, Aug’24

Based on:

“Design for Testability”, Bryan Bakker

“Patterns of Testability”, Alan Myrvold

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Outline

- Testability terms
- Testability patterns
- Testability examples
- Tips

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Definitions

Design for Test

Take testing into account during design/architecture definition

Testability

“The capability of the software product to enable modified software to be tested.” (ISO 9126)

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Goals

- More efficient testing (find defects earlier, automation)
- Increase coverage of testing (manual and automatic)
- Enable (automatic) testing

Source: [Bakker]

Success with test automation depends on testability!

Bret Pettichord

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Terms

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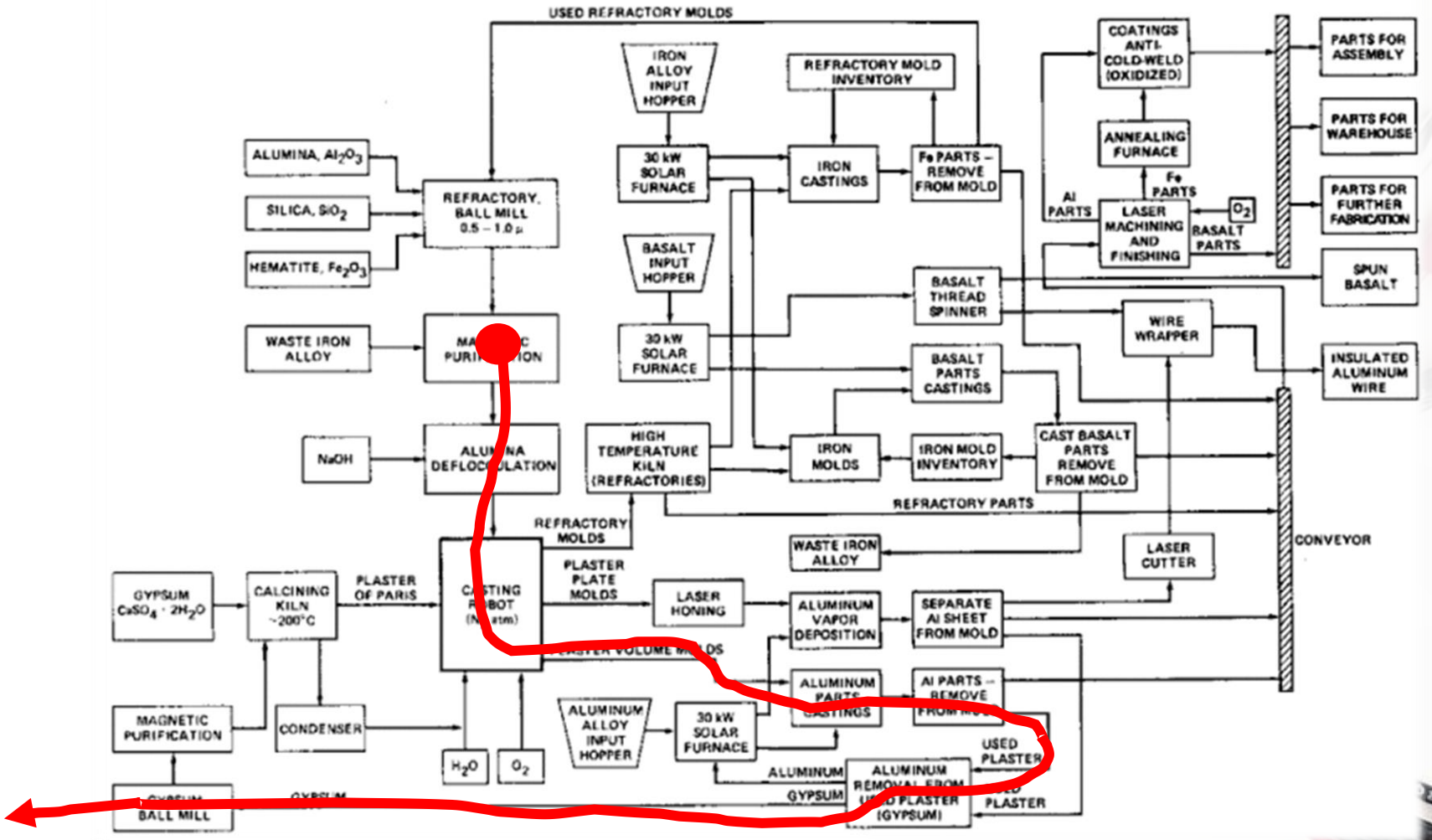
Observability



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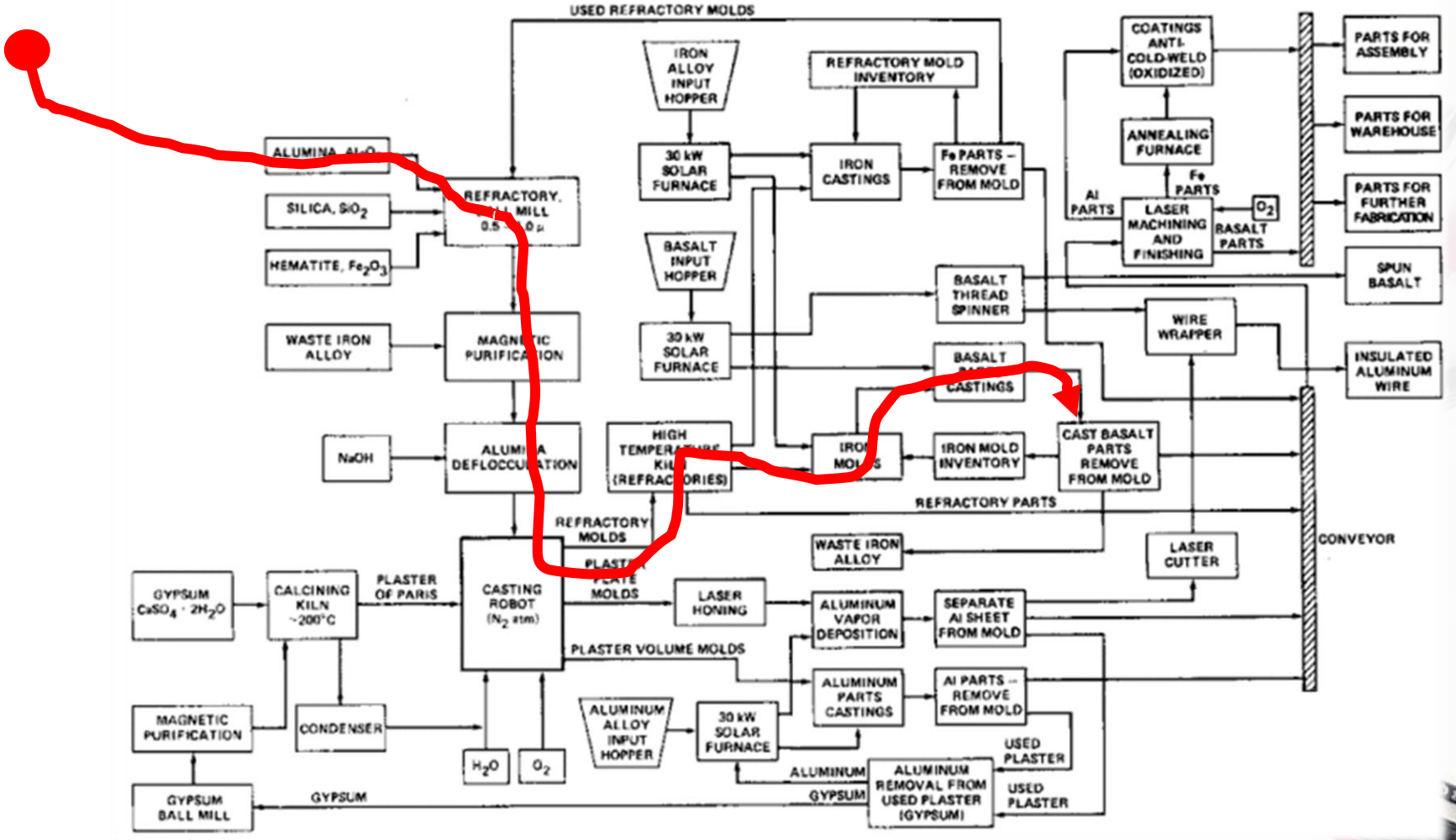
Controllability



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Testability = Visibility + Control

Cem Kaner | Bret Pettichord

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Testability hook

An interface through which one can control or observe the system

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Testability Patterns

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Testability Patterns

- APIs
- Interfaces
- Driver
- Mock
- Monitor
- Proxy
- Meter
- Sentinel
- Chicken bits

Sources: “Patterns of Testability”, Alan Myrvold (Microsoft), STAREast 2010

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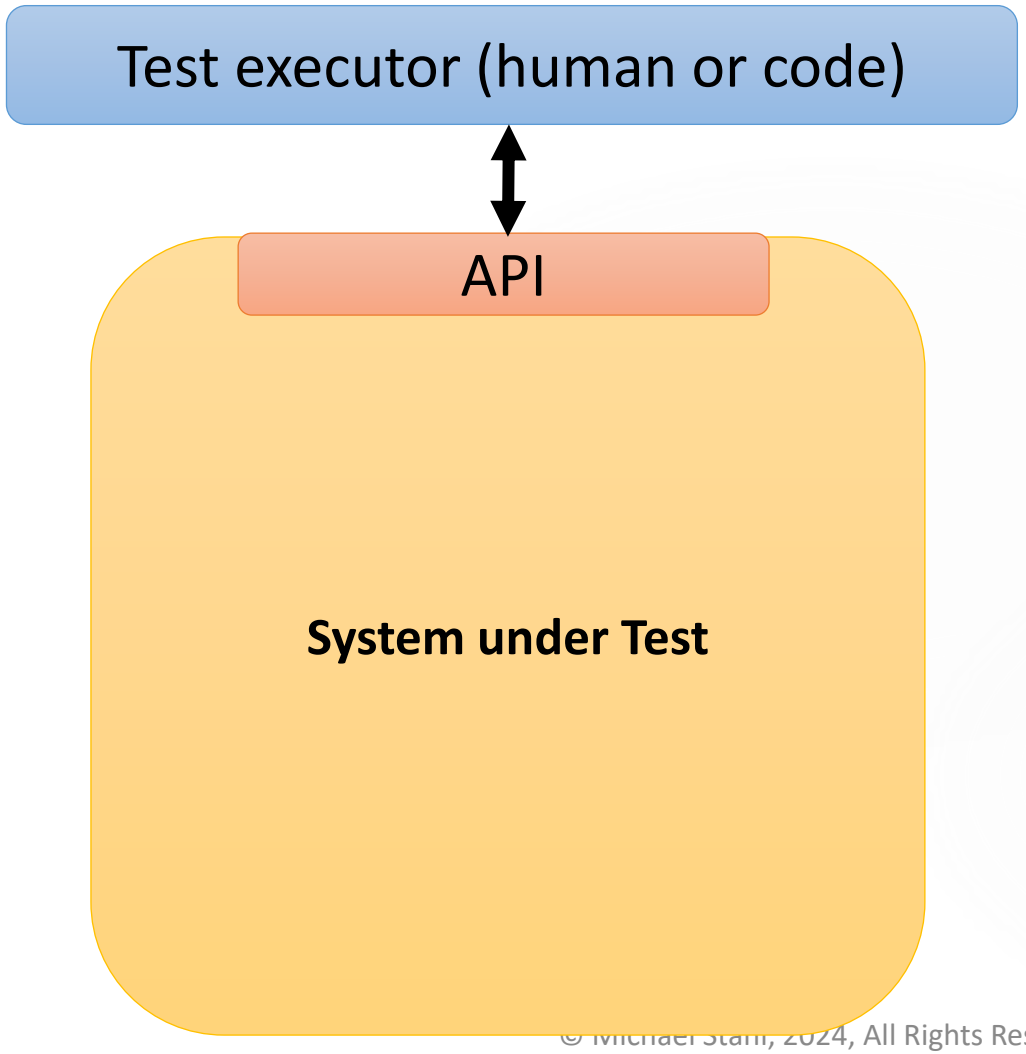
APIs



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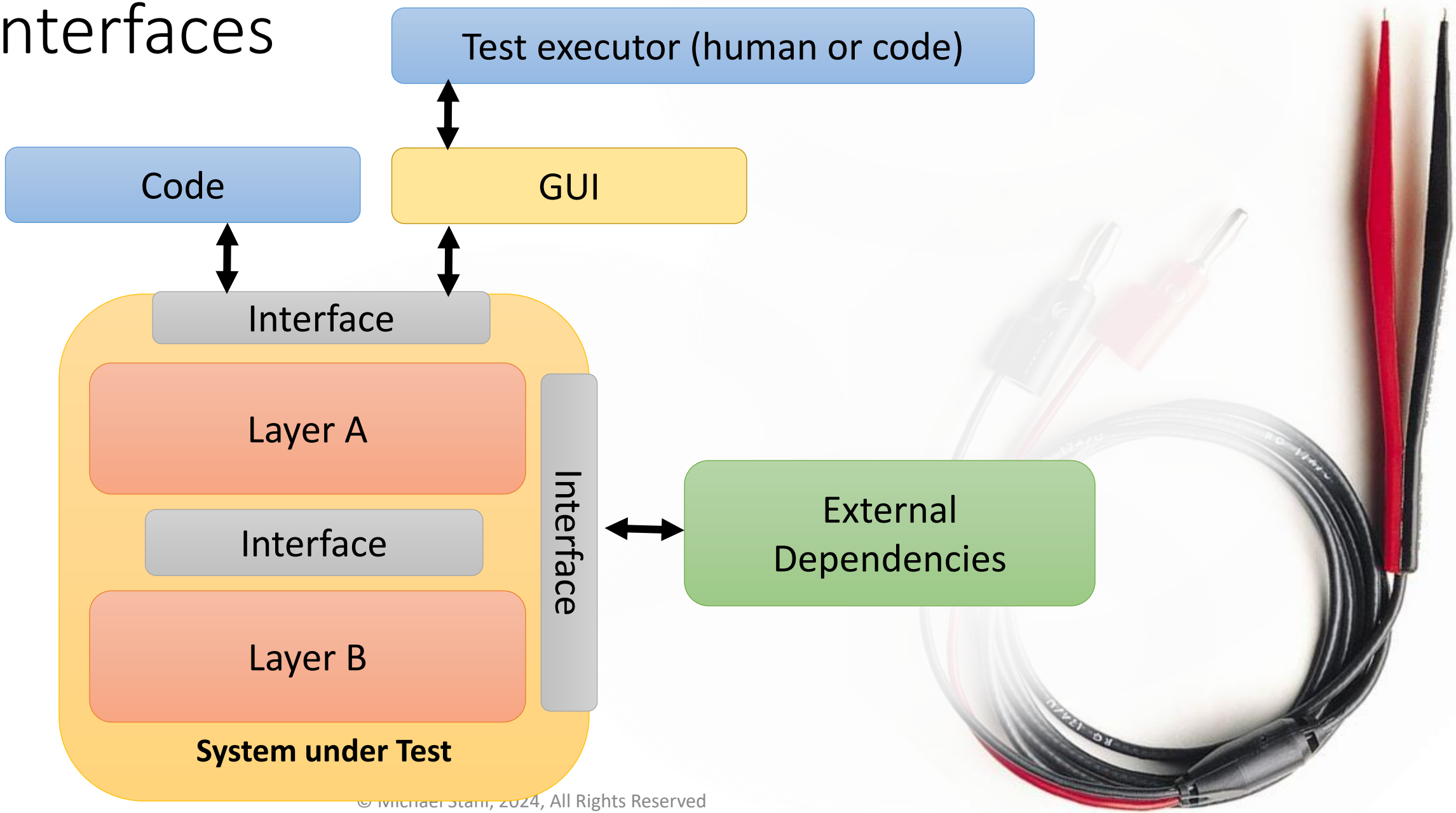
Interfaces



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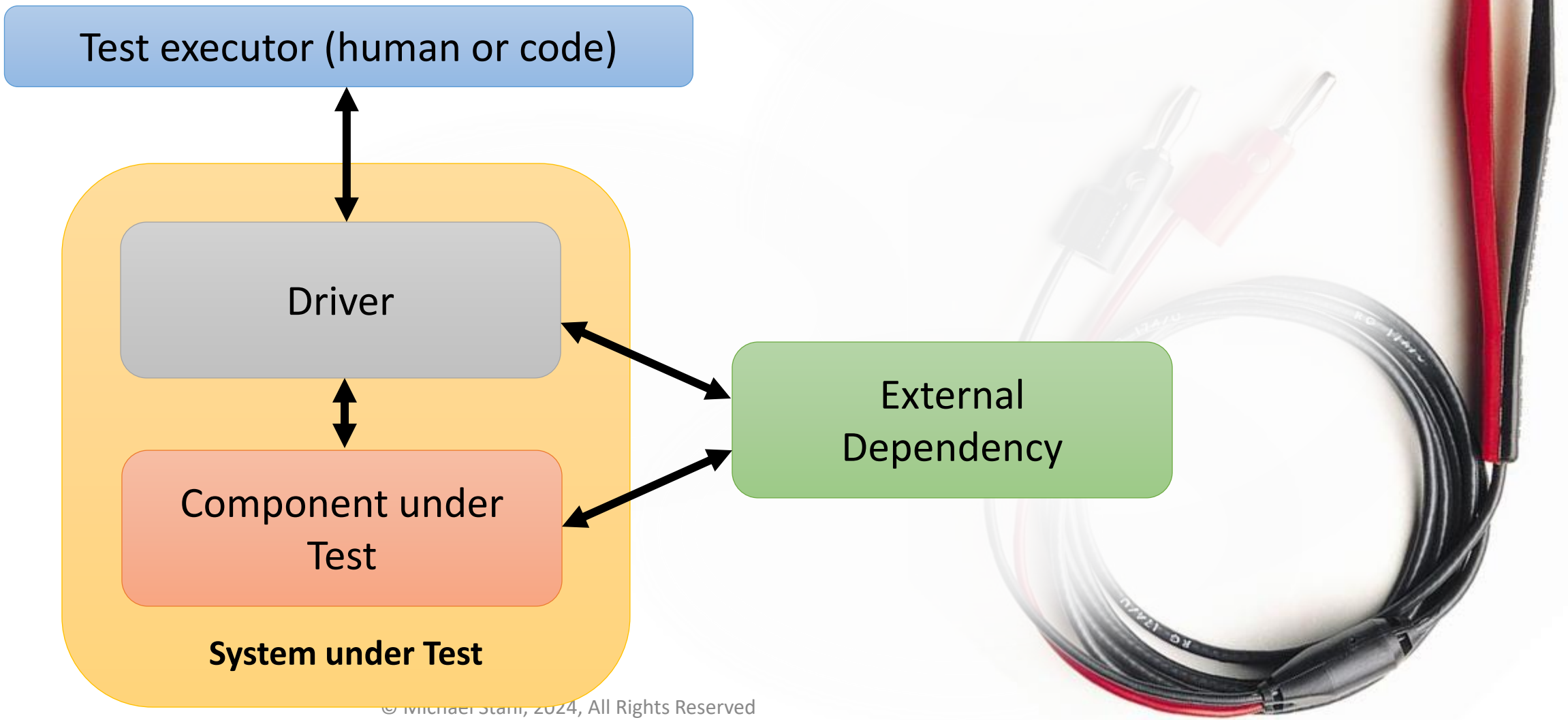
Driver



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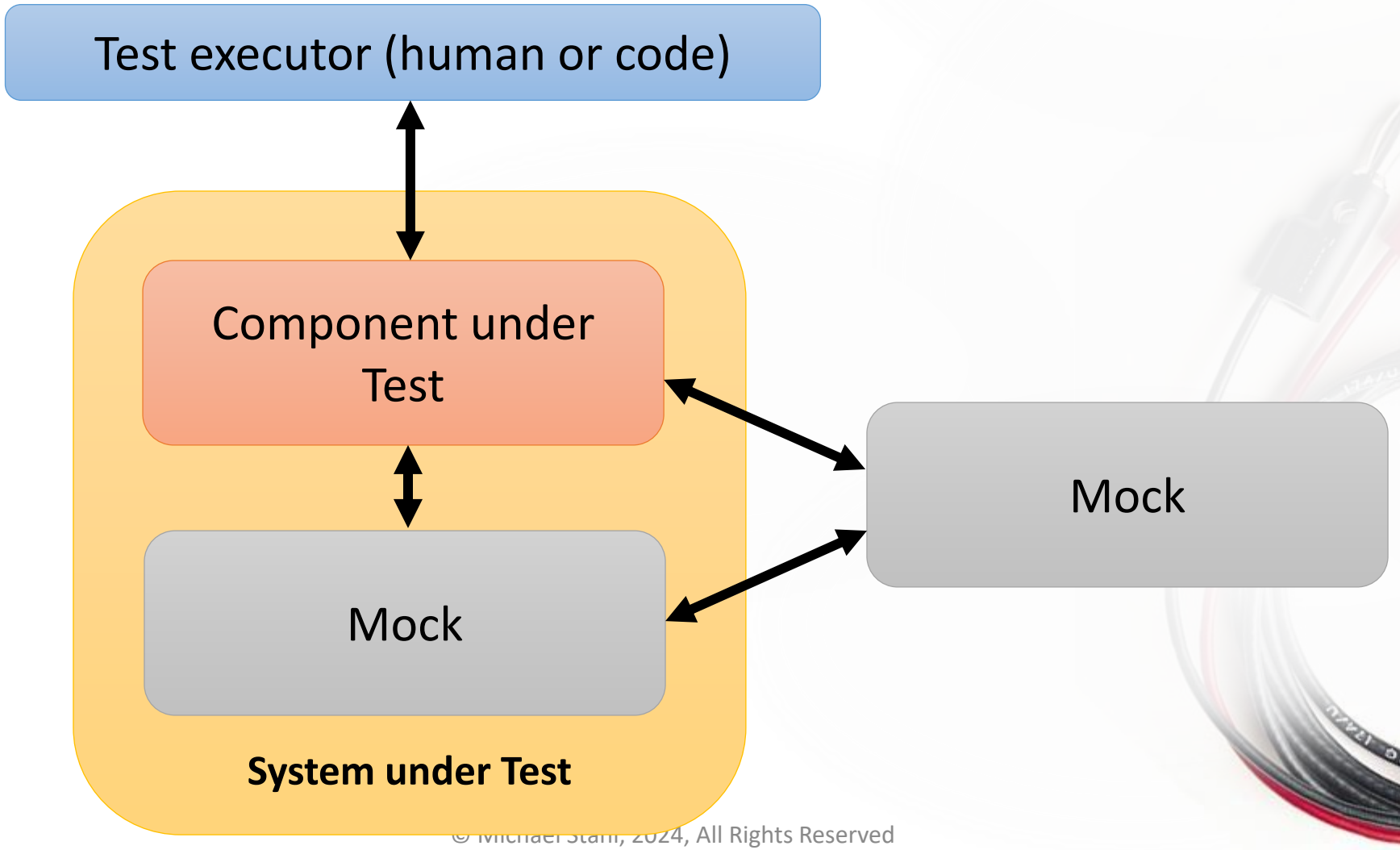
Mock



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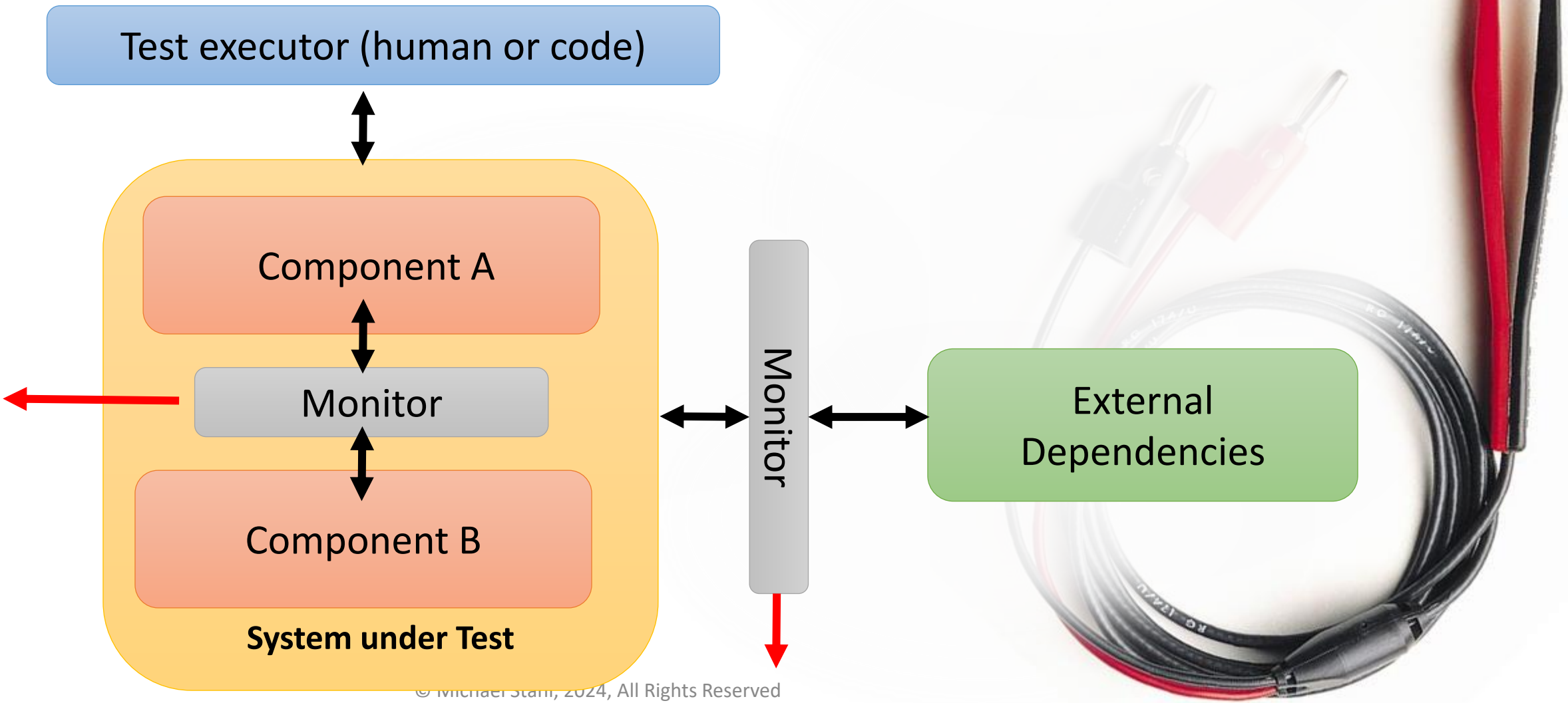
Monitor



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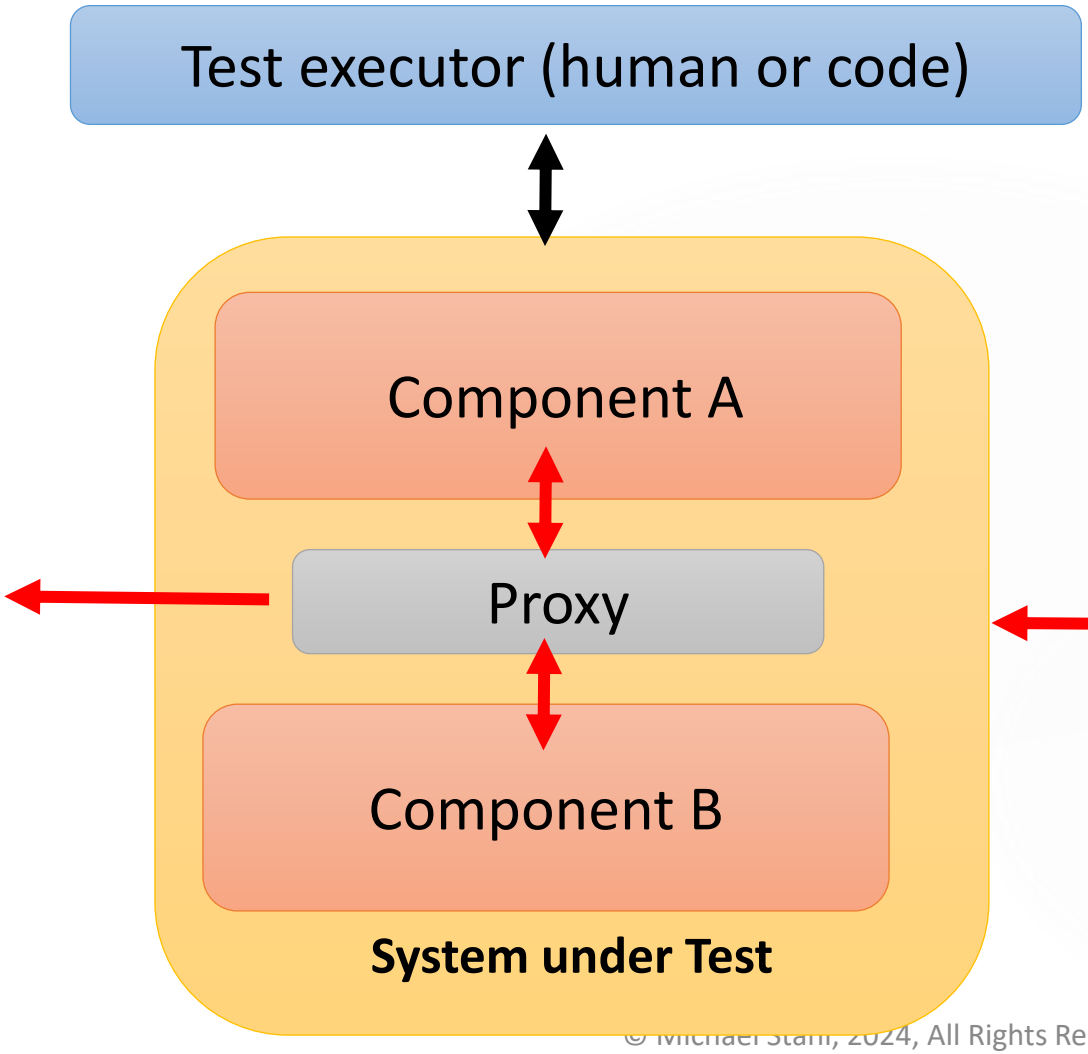
Proxy



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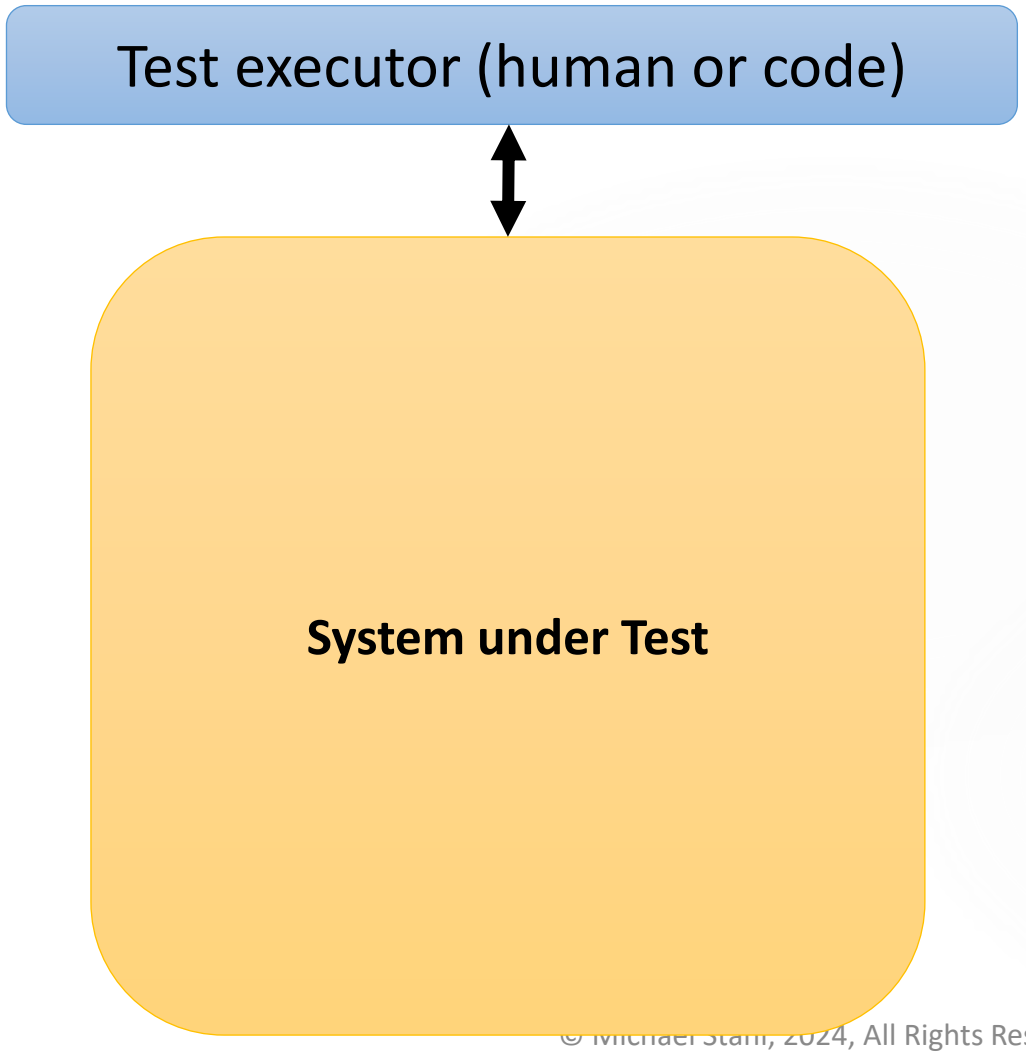
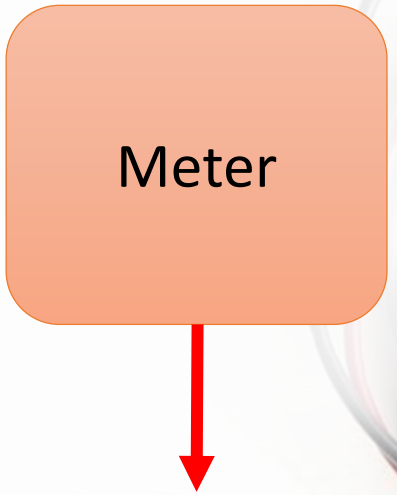
Meter





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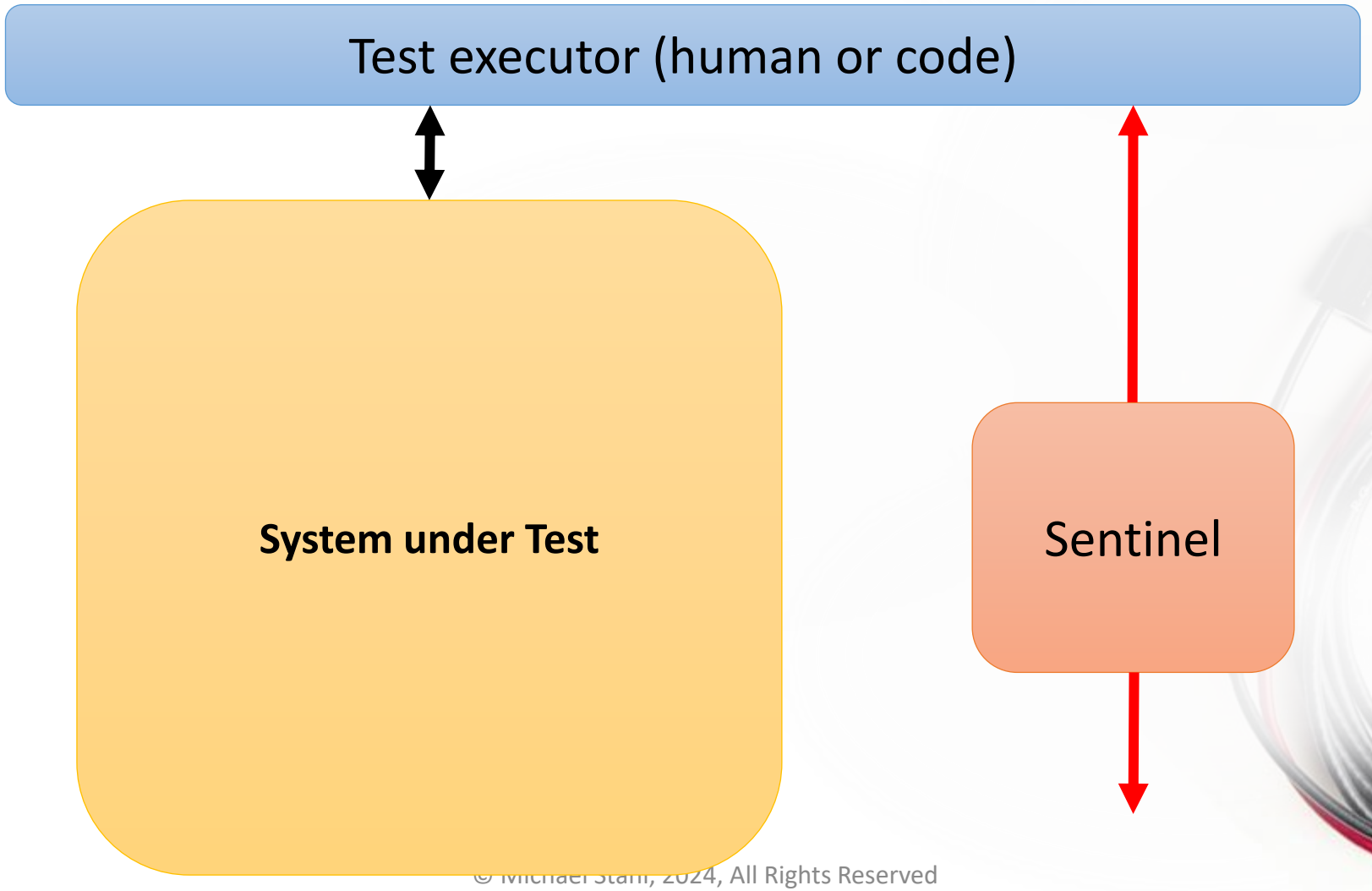
Sentinel



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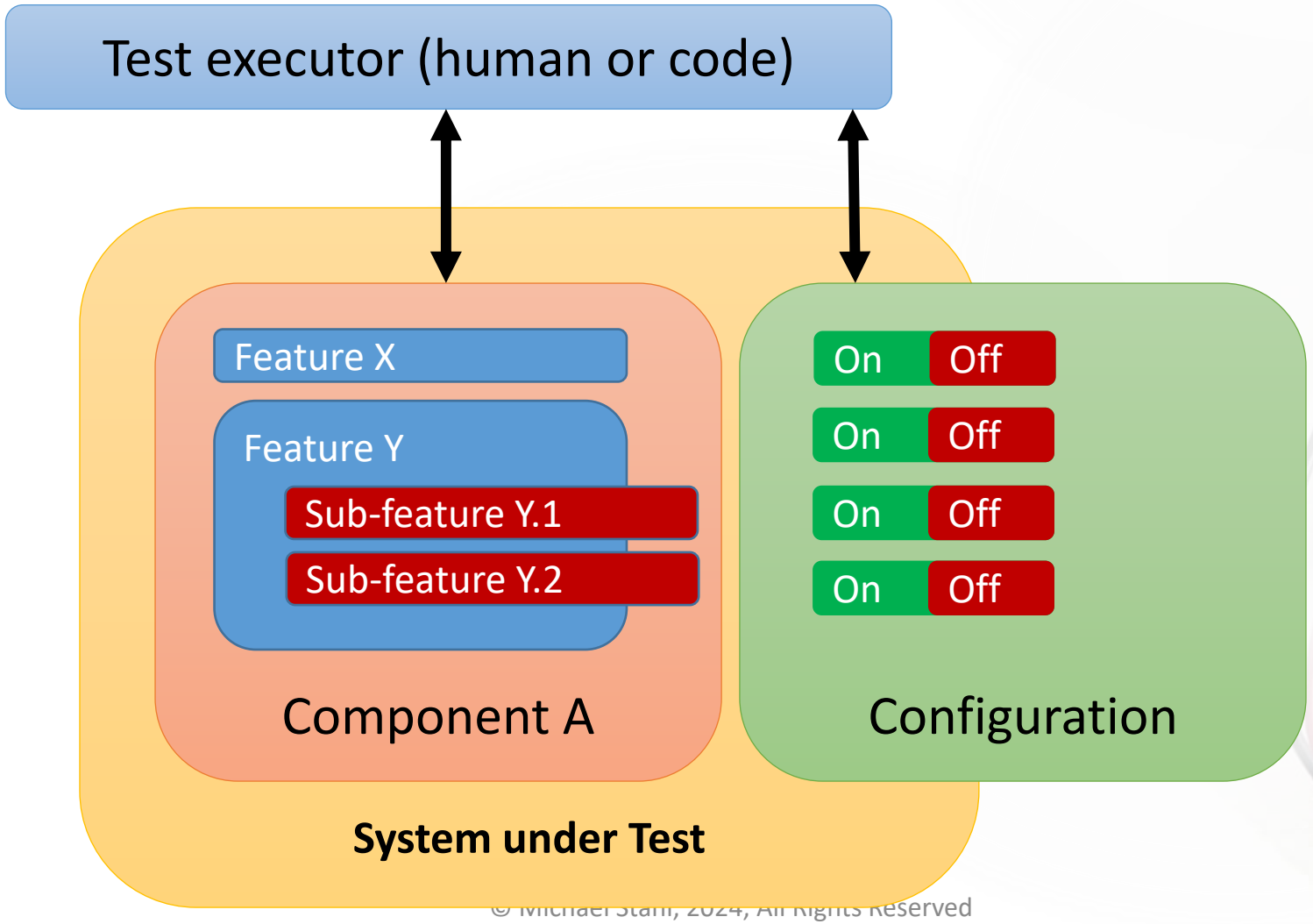
Chicken Bits



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Testability examples (and patterns)

Examples contributed by:
- Issi Hazan
- Nathan Elhayani
- Shmuel Gershon

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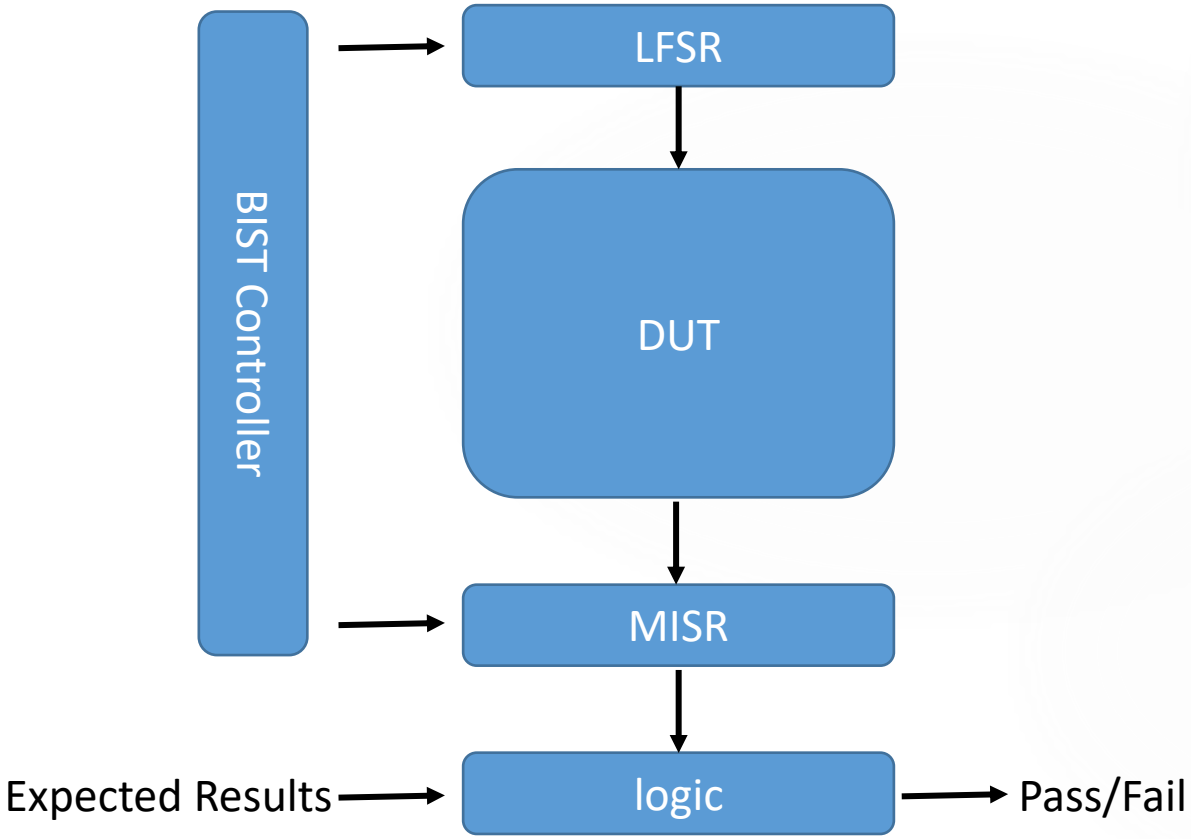
BIST (driver, monitor)

Exhaustive exercise of combinational logic



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Internal counters (monitor, interface)

Internal counters whose value is available with a special API call

- “get” API – lower risk

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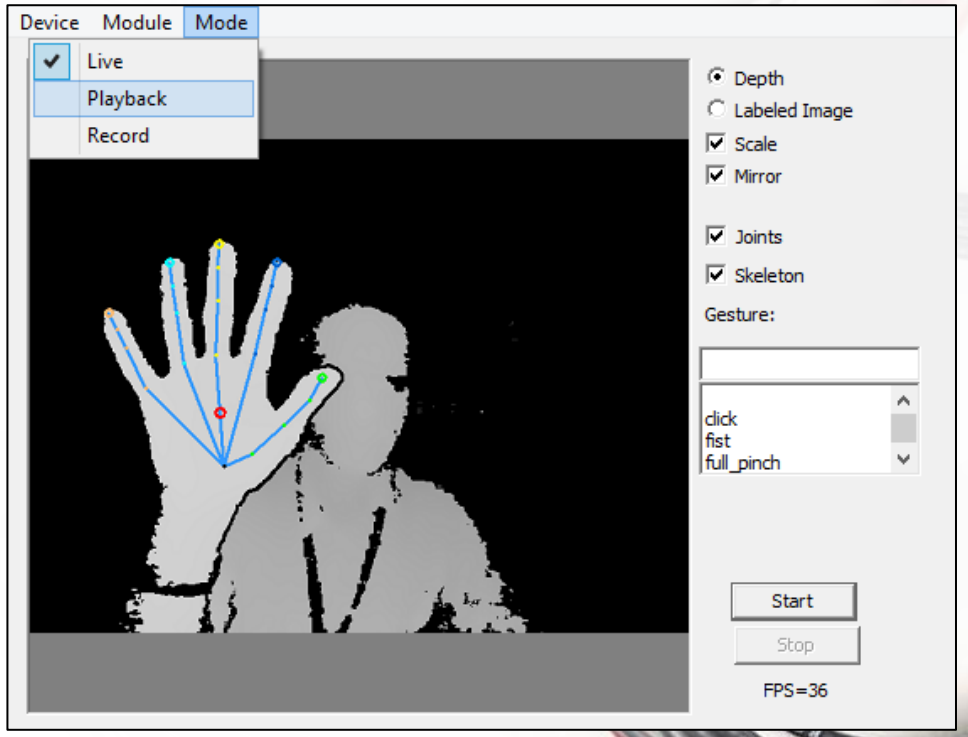
Emulators / Simulators (mock)

- Replace real input with recorded or artificial input
  - RealSense Playback
  - Sensors
  - Loopback
- The code must support it
  - Appropriate injection point
  - Timing considerations



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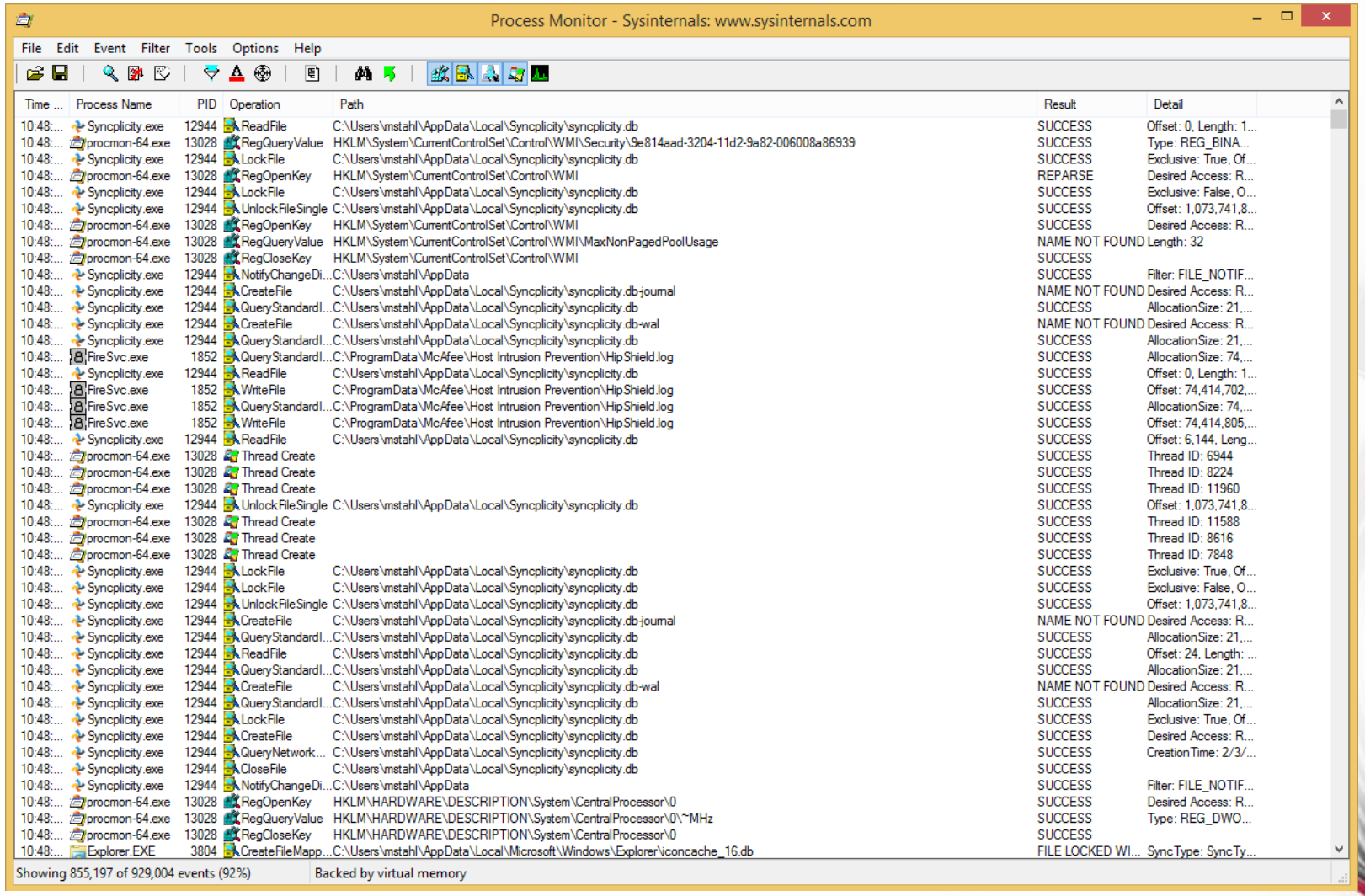
Windows Registry keys (Procmon: monitor)



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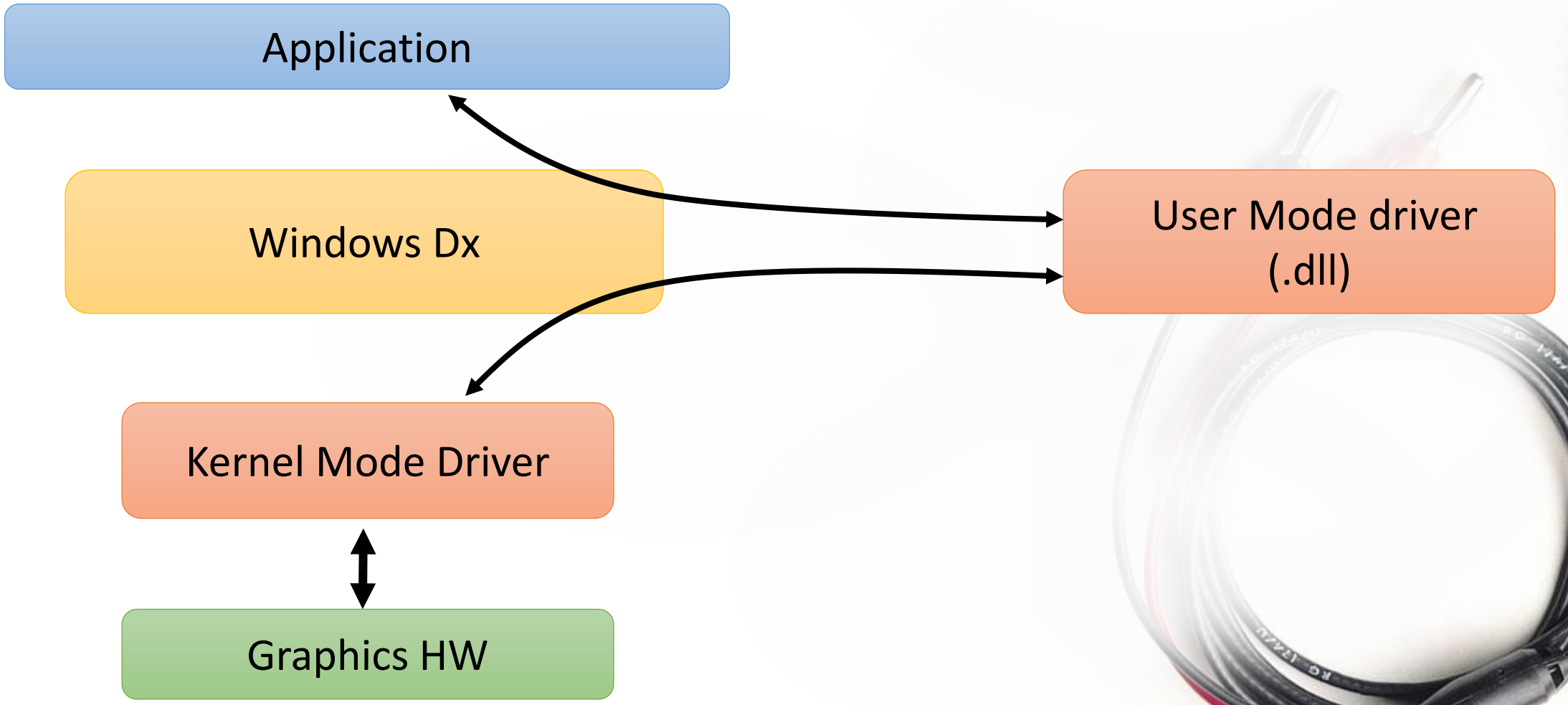
Graphics stack (Windows)



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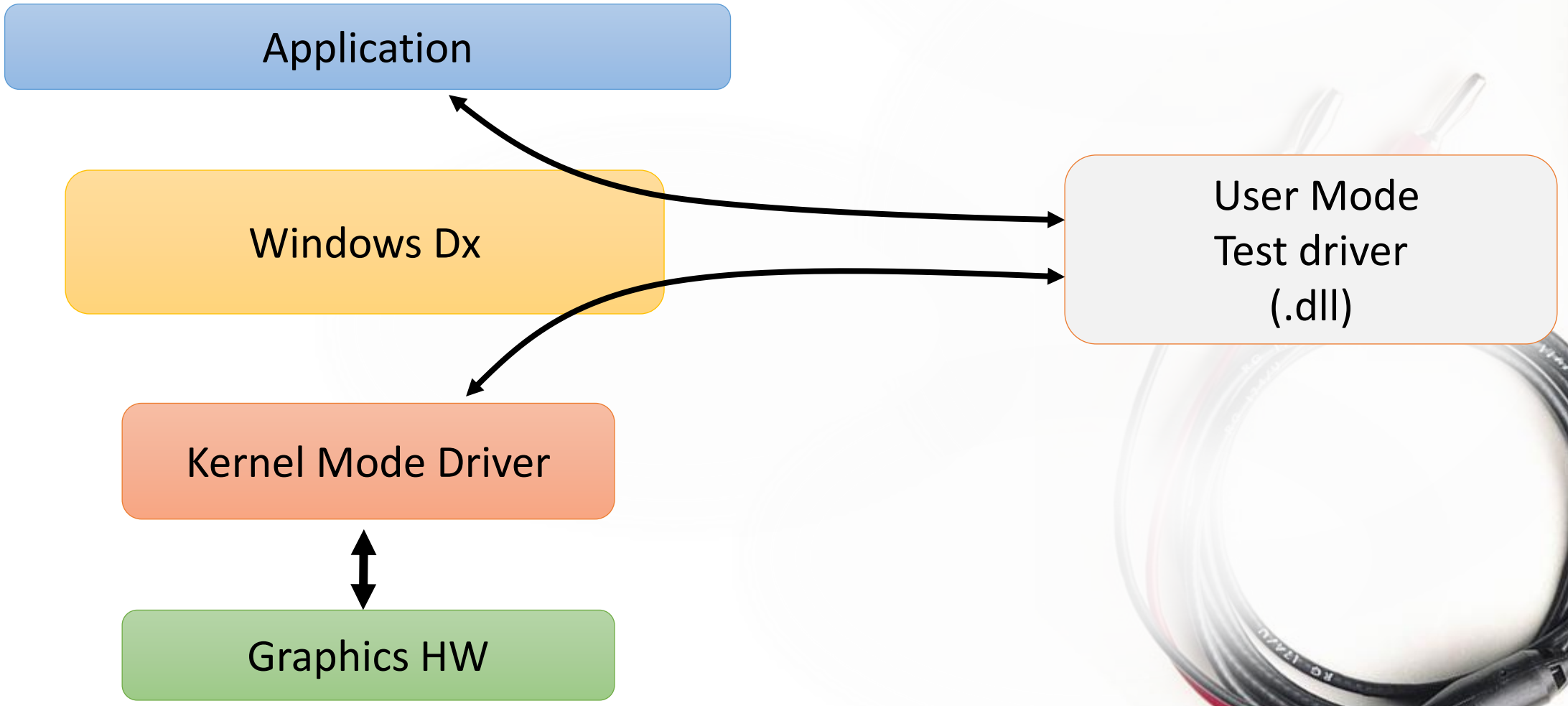
DLL replacement (Mock)



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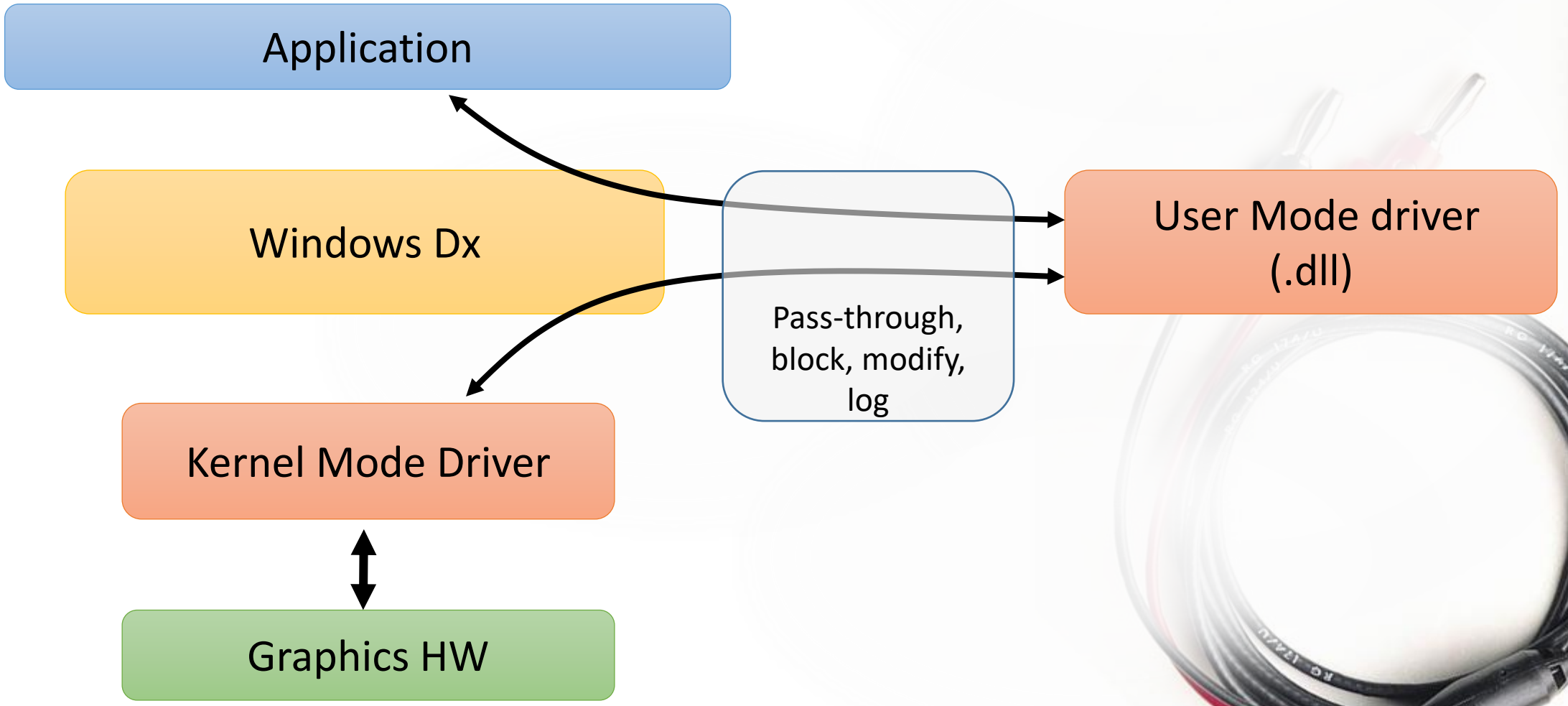
MITM type proxy



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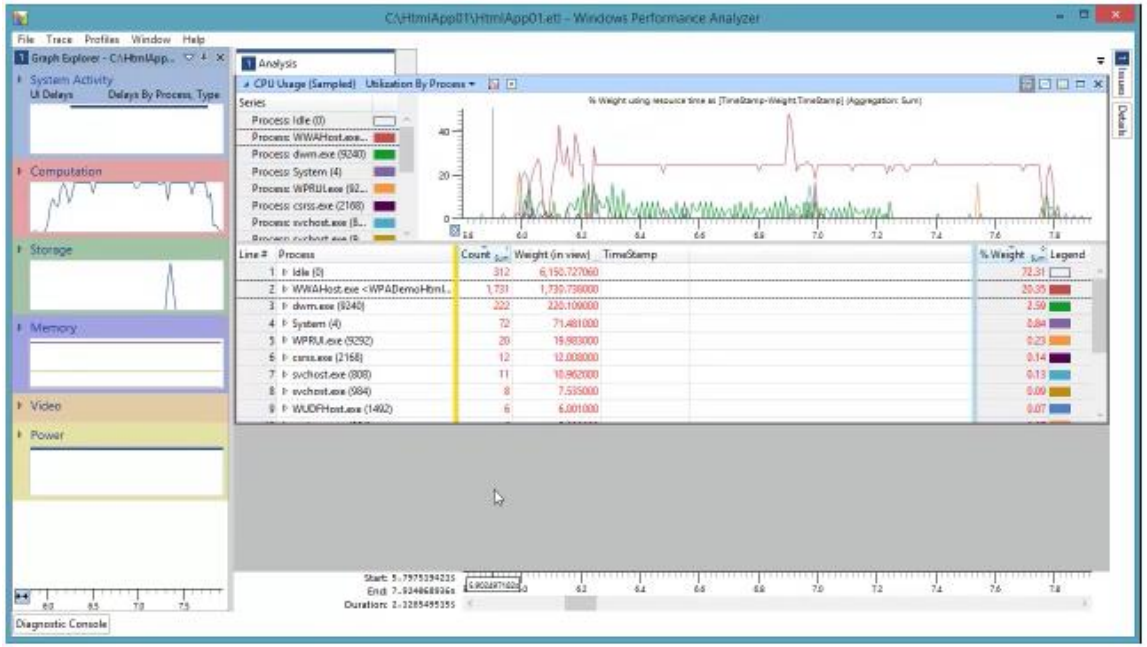
Event Tracing for Windows® (monitor; sentinel)

- ETW: A general-purpose, high-speed tracing facility
- Works for User-mode applications and kernel-mode device drivers
- Dynamic disable/enable; Minimum disturbance
- Bonus: timestamp, process and thread ID, processor number, and CPU usage data of the logging thread



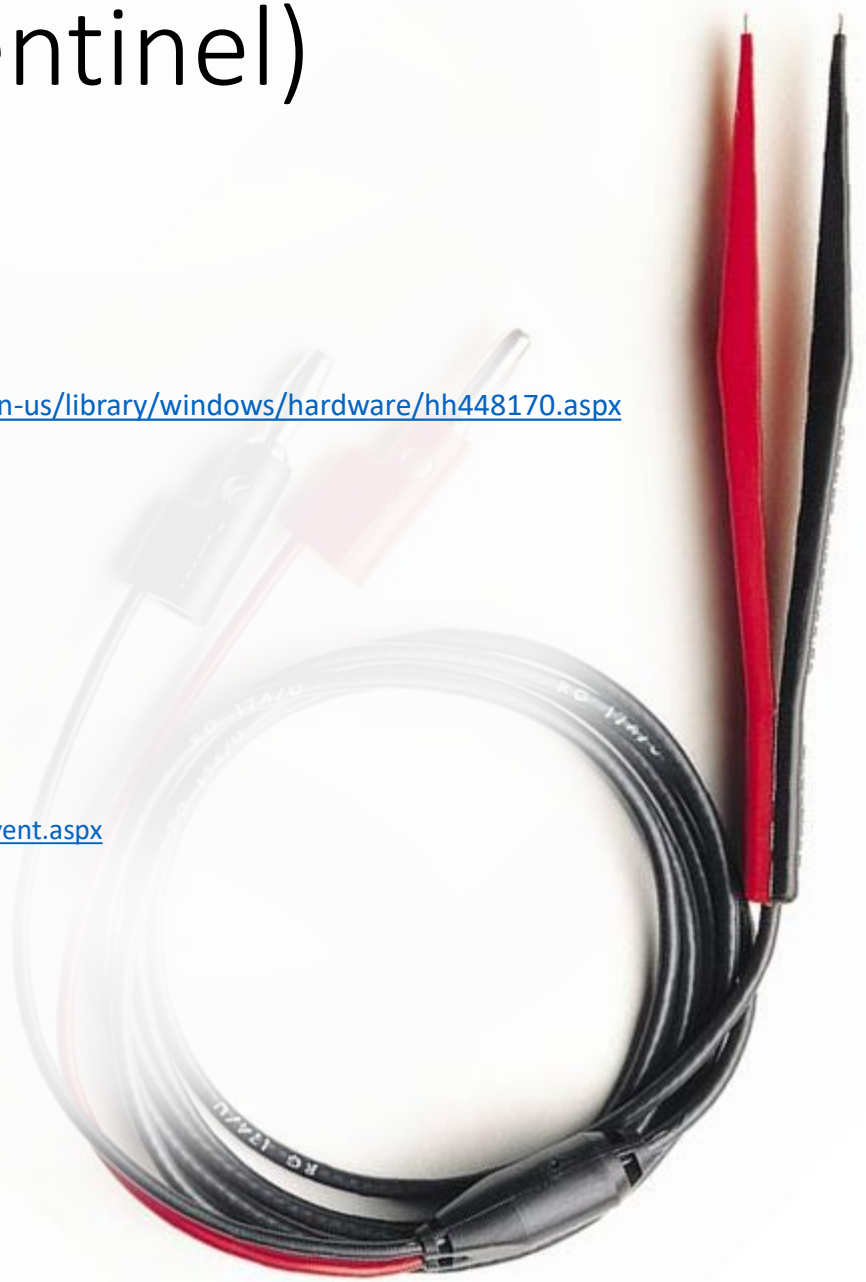
Event Tracing for Windows® (sentinel)

Tools to work with Event Tracer:

- Logman https://technet.microsoft.com/en-us/library/cc753820.aspx
- Windows Performance Analyzer (WPA) https://msdn.microsoft.com/en-us/library/windows/hardware/hh448170.aspx

Adding ETW to your app:

- Multiple tutorials and much info on the web
- SimpleMonitor sample
  http://blogs.msdn.com/b/vancem/archive/2012/12/20/and-end-to-end-etw-tracing-example-eventsource-and-traceevent.aspx



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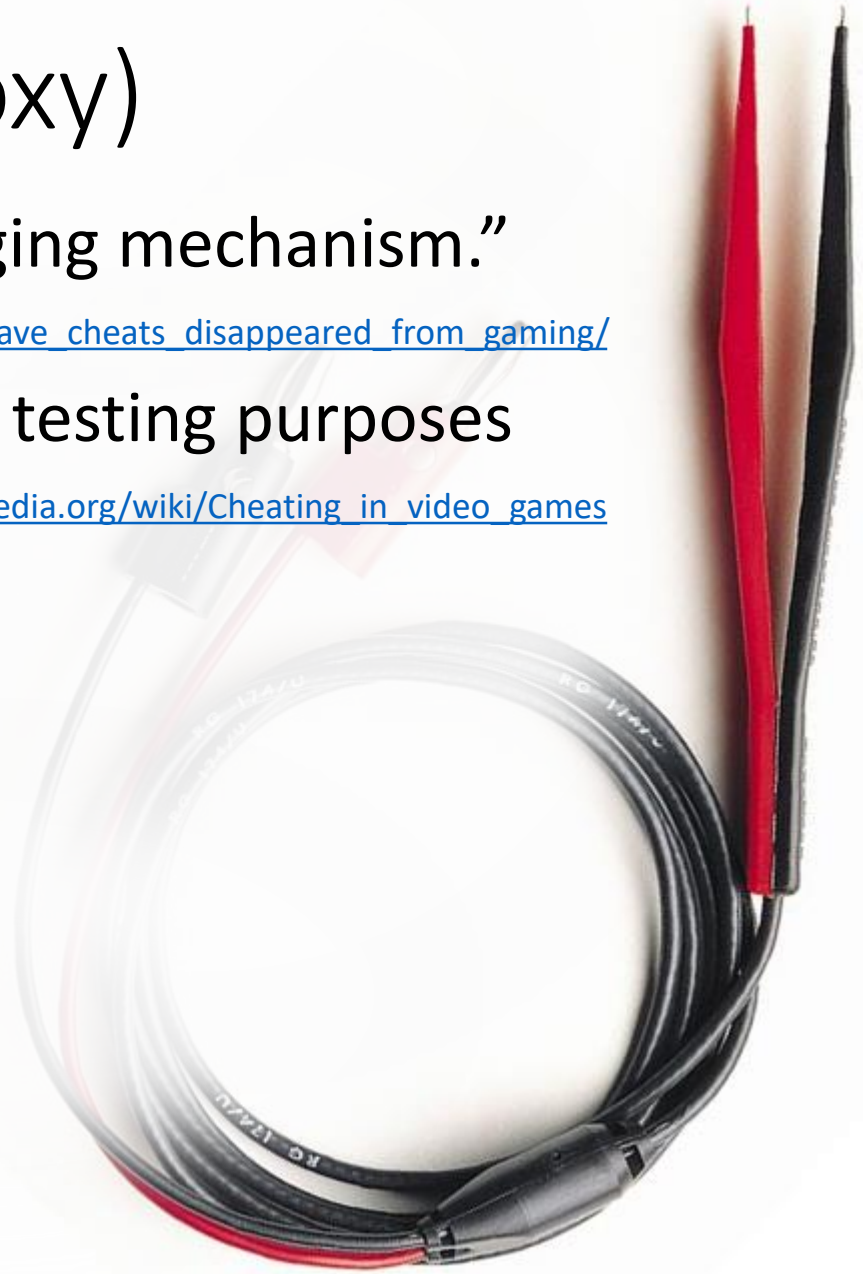
Game Cheats (non-monitor proxy)

- “Cheats were originally introduced as a debugging mechanism.”

ZorbaTHut on http://www.reddit.com/r/truegaming/comments/kklqi/why_have_cheats_disappeared_from_gaming/

- The first cheat codes were put in place for play testing purposes

http://en.wikipedia.org/wiki/Cheating_in_video_games

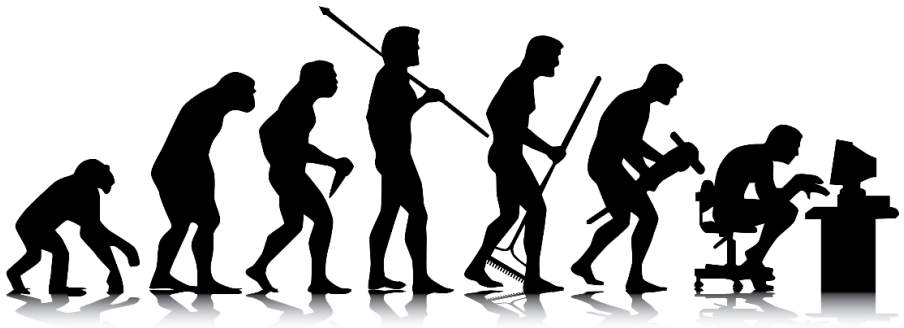


Counter rollover

"When the Incoming Packet Counter reaches the maximum value, it shall roll-over to 0, and the Rollover Counter shall increment by 1."

At 100,000 packets/second…

32-bit counter: Roll-over in 12H
64-bit counter: Roll-over in 5,849,424 years



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Counter rollover testability hook (proxy)

32-bit counter:

- SetCounter(int count);
- Registry key
- …

64-bit counter… who cares?

In the long run…. we are all dead

- John Maynard Keynes (1883-1946)

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Log-Watch (monitor)

- Runs in the background
- Looks for pre-configured words in a log file
- Generates alert when these words show up

Notes on Log-Watch:

- A good example for “monitor”
- Very slow (at least on my machine…)
- Created by James Bach, www.satisfice.com

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Logs

- Debug prints
- Log files of all kinds
- --verbose mode

Example: Unix mail

```
> mail -v bret@pettichord.com
Subject: testability example
Sample text.
.
Cc:
bret@pettichord.com... Connecting to
    mx.io.com. via relay...
220-deliverator.io.com ESMTP Sendmail
    8.9.3/8.9.3; Fri, 12 Jan 2001
    15:34:36 -00
220 Welcome to Illuminati Online,
    Fnord!
>>> EHLO eris.io.com
250-deliverator.io.com Hello
    IDENT:wazmo@eris.io.com
    [199.170.88.11], pleased tu
250-8BITMIME
250-SIZE 5000000
250-DSN
250-ONEX
250-ETRN
250-XUSR
250 HELP
>>> MAIL From:<wazmo@eris.io.com>
    SIZE=67
250 <wazmo@eris.io.com>... Sender ok
>>> RCPT To:<bret@pettichord.com>
250 <bret@pettichord.com>... Recipient
    ok
>>> DATA
354 Enter mail, end with "." on a line
    by itself
>>> .
250 PAA07752 Message accepted for
    delivery
bret@pettichord.com... Sent (PAA07752
    Message accepted for delivery)
Closing connection to mx.io.com.
>>> QUIT
221 deliverator.io.com closing
    connection
```

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Source: [Pettichord]

Tips

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Panic Early and Avoid the Rush

- There is a reason it’s called Design for Testability
- Tools that help development will happen and will be maintained
- If possible: make it official (e.g. requirements)

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Think of…

- Simulation of the environment
  - Testing without HW
  - Negative testing
- Support for test automation
  - Replace mechanical switches/buttons
  - Test without the UI
  - Record and playback
- Support for debug
  - Logging/Tracing
- Components isolation

Source: [Bakker]

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Increase testability by correct design

- Decoupling
- Support for the testability patterns
- Clear (and documented…) interfaces
- Reduce options
- Reduce number of states
- Limit “infinity”

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Don’t re-invent

- Use existing interfaces (Widows registry; ETW)
- Use existing tools

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http://commons.wikimedia.org/wiki/File:Triple_Rotacaster_commercial_industrial_omni_wheel.jpg / Rotacaster Wheel Pty Ltd

Test hooks in Production release

- Considerations
  - Probe effect
  - Security considerations
  - Maintenance considerations
- Options:
  - Debug version
  - Compile-out on Gold release
  - Release-Internal
  - Left in, undocumented
  - Left in and published

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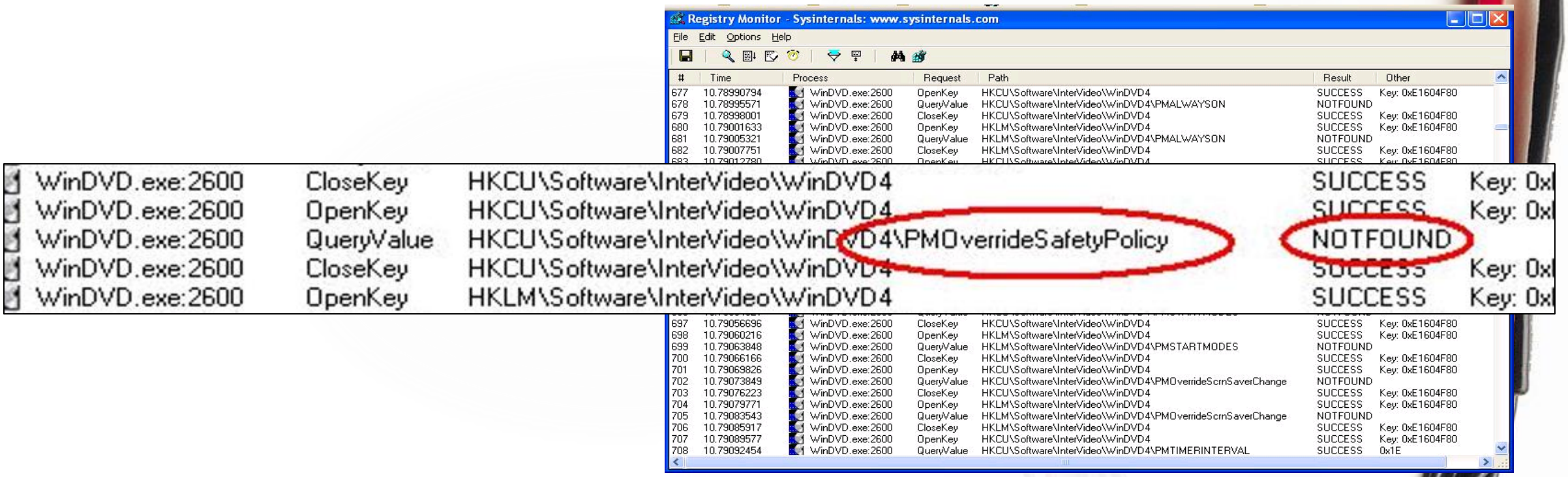
Test hooks protection



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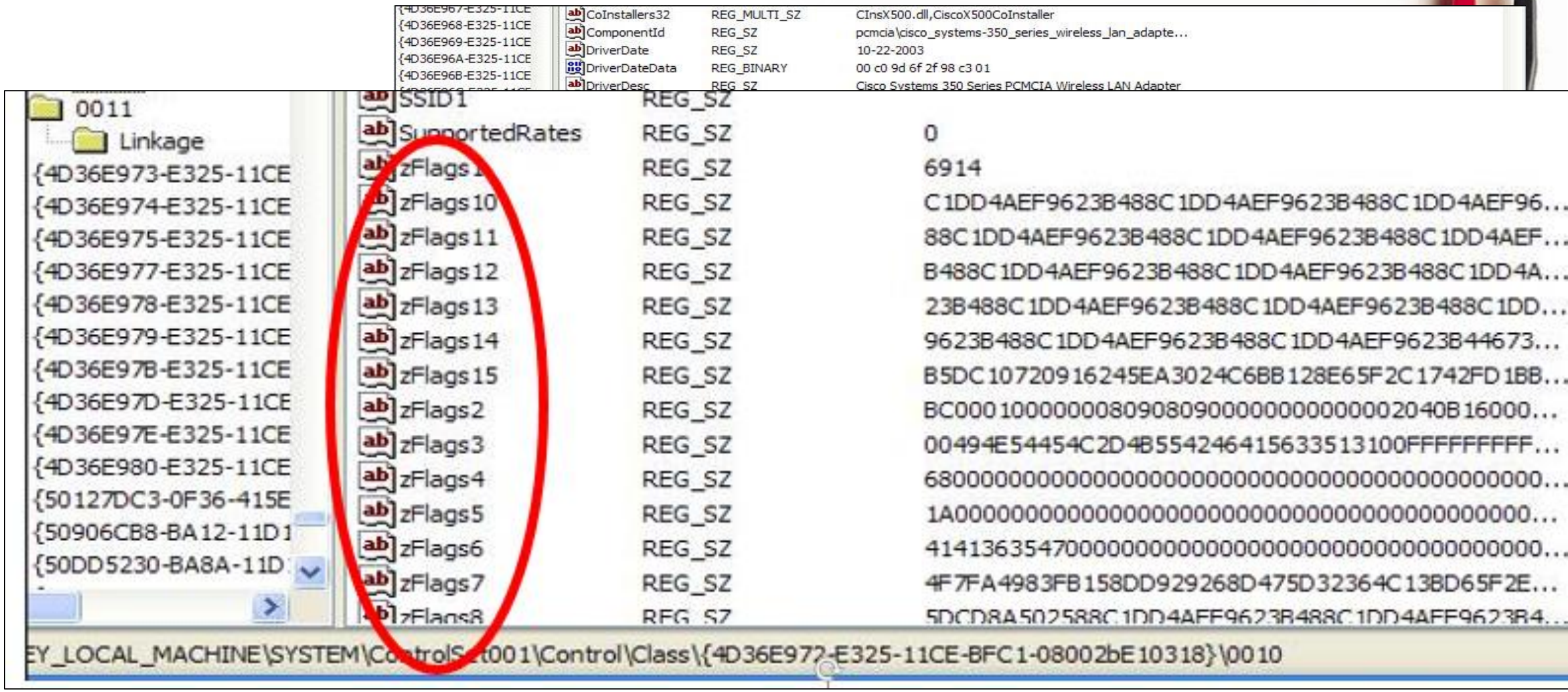
Test hooks protection by obscurity and encryption



Test hooks protection by proprietary process

How to disable Region protection from Samsung HT-TX35 DVD player

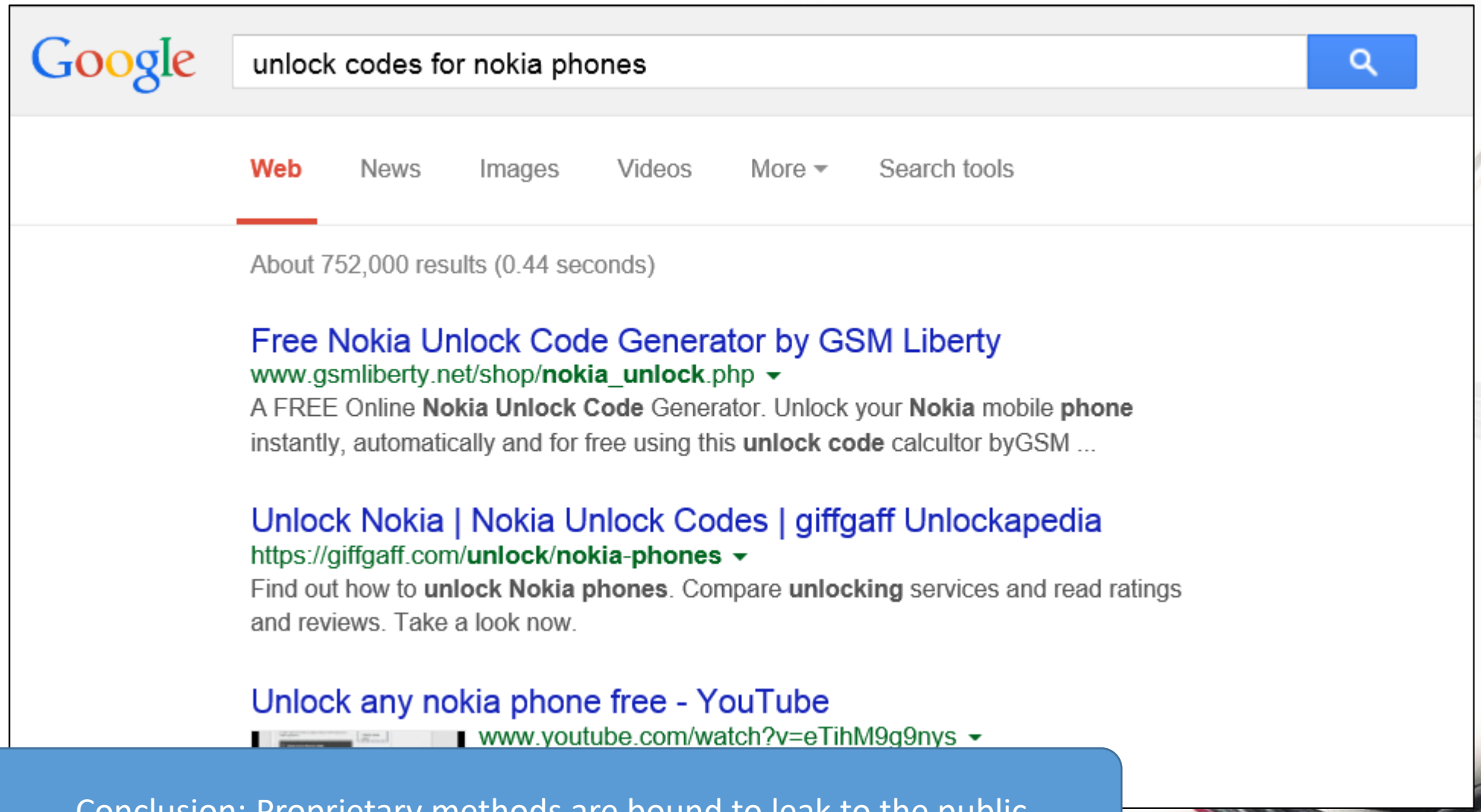
- Unplug the system for 30 seconds then plug it back in the mains
- Turn the player on with the remote
- Press Enter on the remote
- Press 8, 4, 2, 6, 9,
- Press Enter on the remote. The system will turn itself off
- Turn the player back on with the remote

You are now region free

Source: http://www.videohelp.com/dvdhacks/samsung-ht-tx35/8538

Conclusion: Proprietary methods are bound to leak to the public

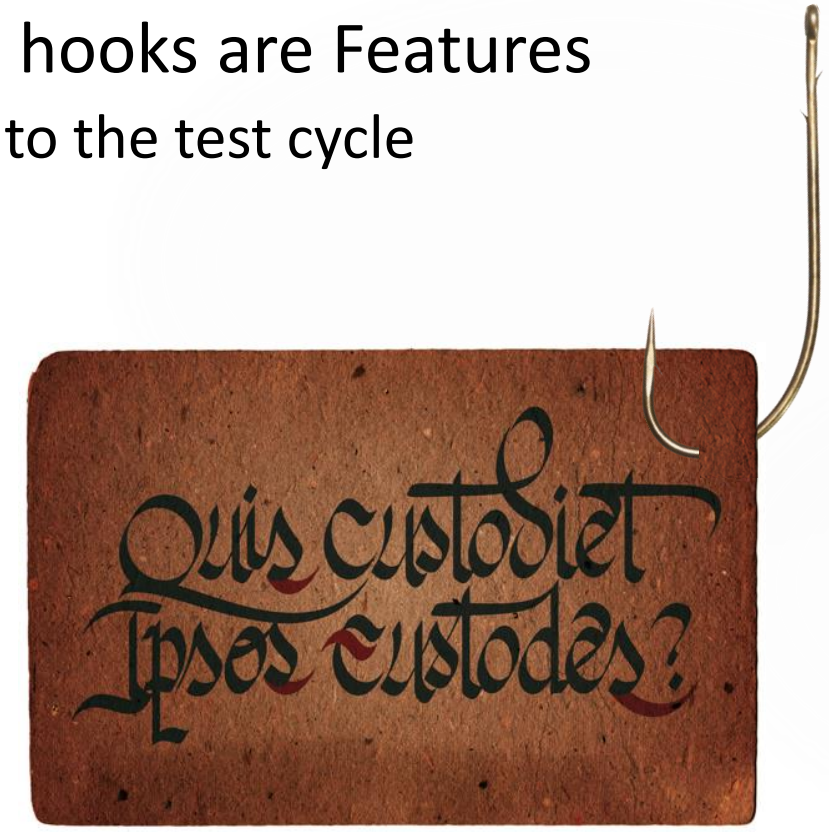
Test hooks protection by proprietary process



Conclusion: Proprietary methods are bound to leak to the public

Test your Hooks

- Test before using
- Test for regression
- Official hooks are Features
  - Add to the test cycle



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Sign: https://www.behance.net/gallery/12278491/Quis-custodiet-ipsos-custodes
Hook: Photography by User: MrX"

Summary

- Testability = Visibility + Control
- A design attribute
- Ask early
- Decide if to leave in production
- Use existing solutions where possible
- Test before Use

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Sign: https://www.behance.net/gallery/12278491/Quis-custodiet-ipsos-custodes
Hook: Photography by User: MrX"

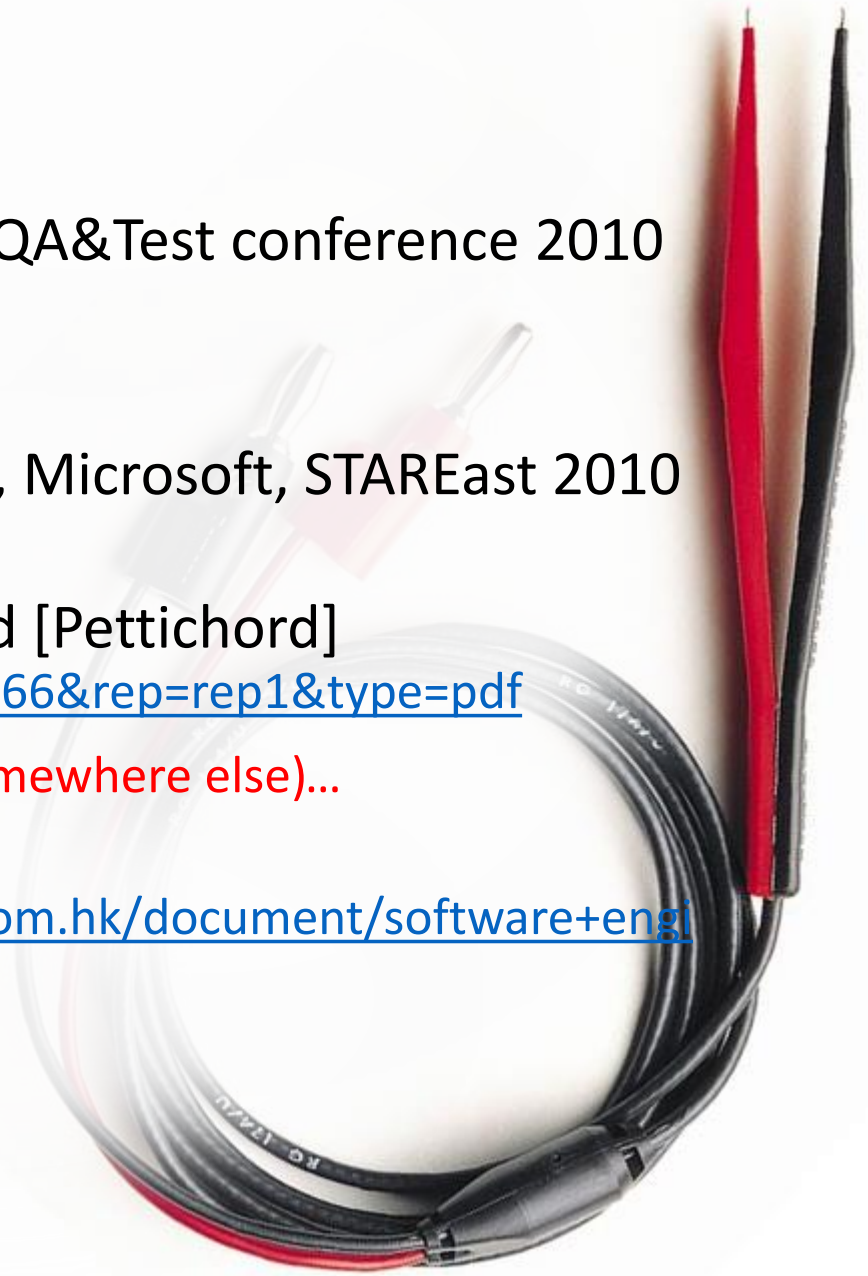
Reference

- “Design for Testability”, presentation by Bryan Bakker, QA&Test conference 2010 [Bakker] Design for Testability

- “Patterns of Testability”, presentation by Alan Myrvold, Microsoft, STAREast 2010 https://www.stickyminds.com/presentation/patterns-testability
- “Design for Testability”, presentation by Bret Pettichord [Pettichord] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.94.5966&rep=rep1&type=pdf

  (The above is a dead link and I could not find the presentation somewhere else)…

  …but this is probably the source for the presentation’s content: https://web.archive.org/web/20170808070122/http://carfield.com.hk/document/software+engineering/testing/design_for_testability_PNSQC.pdf



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