HCK-CI: Enabling CI for Windows guest paravirtualized drivers

Kostiantyn Kostiuk - Software engineer, Daynix

https://github.com/HCK-CI

Agenda

- virtio-win drivers
- Why do we need CI for virtio-win drivers?
- What is WHQL certification and what are HCK\HLK?
- How we can leverage WHQL certification for CI?
- What are the challenges with WHQL certification?
- Automating WHQL certification
- Examples of configuration and usage

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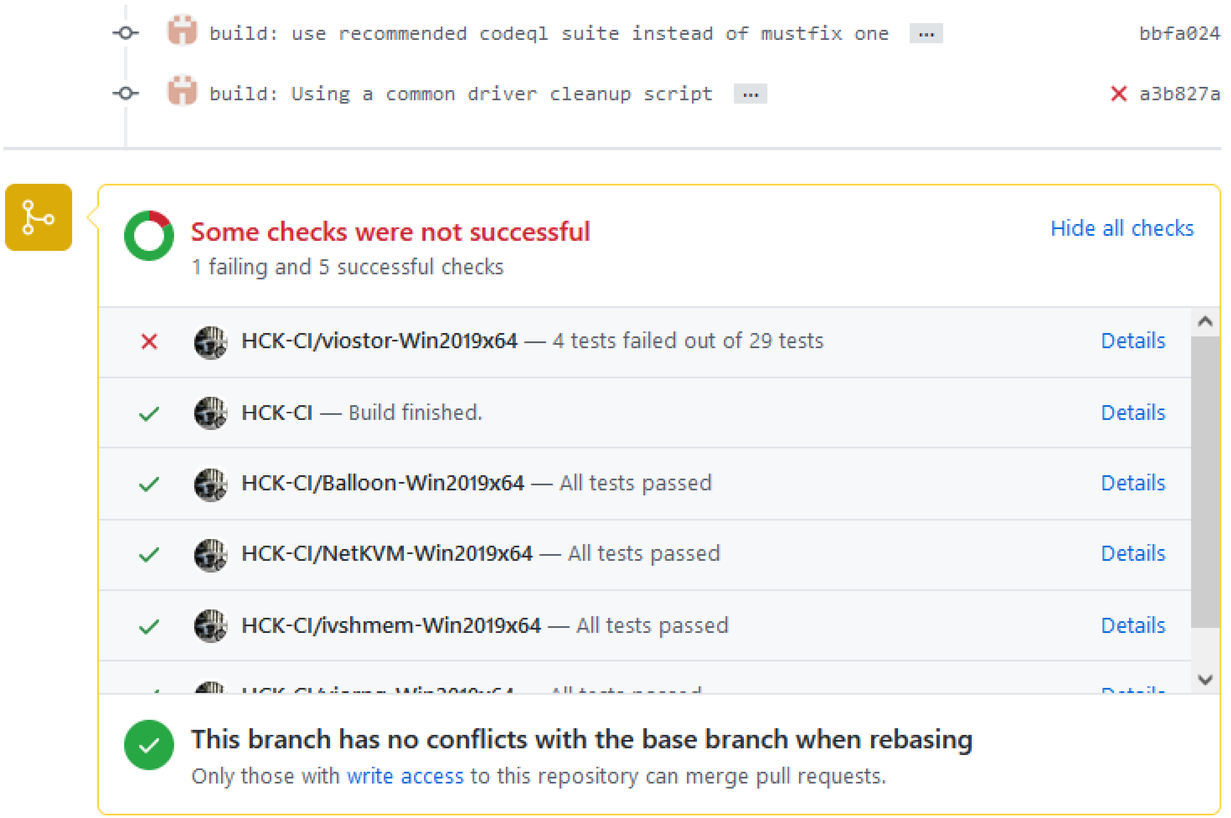
VirtIO-Win

- Upstream: https://github.com/virtio-win/kvm-guest-drivers-windows/
- Drivers for the major virtio devices:
  - virtio-net
  - virtio-blk, virtio-scsi
  - virtio-balloon, virtio-serial, virtio-vsock, virtio-input, virtio-rng
  - virtio-gpu

Why do we need CI for virtio-win?

- Enable easy upstream contribution
- We want PRs to pass WHQL certification tests for each driver category
- Not easy to setup and execute



What are WHQL and HLK\HCK?

- Microsoft driver certification
- HLK and HCK are the test kits used for certifications

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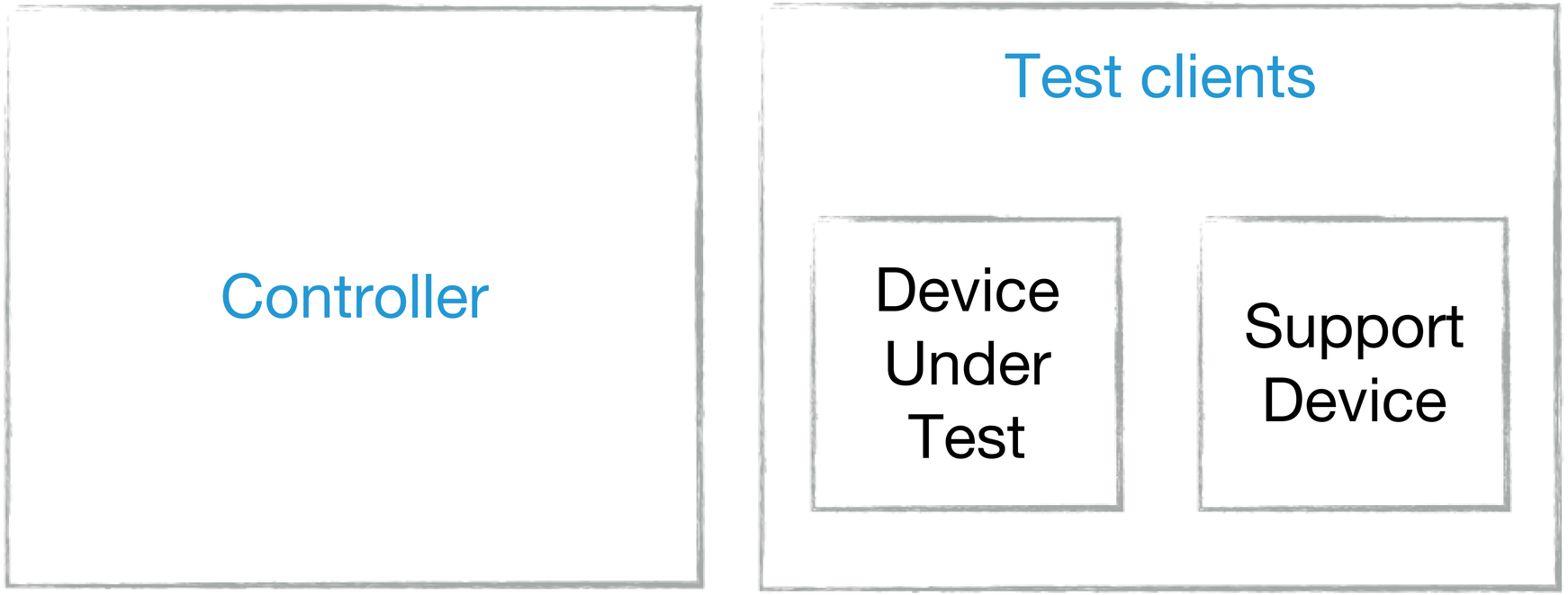
VM types



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Certification overview

Device certification

- Networking
- Storage
- USB
- Other categories

System certification

(SVVP for hypervisors)

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Different kits

HCK

Windows 7

Windows 8

Windows 8.1

Windows Server 2008R2

Windows Server 2012

Windows Server 2012R2

HLK

HLK1607

Windows 10, Windows Server 2016

HLK1809

Windows 10, Windows Server 2019

HLK2022

Windows Server 2022

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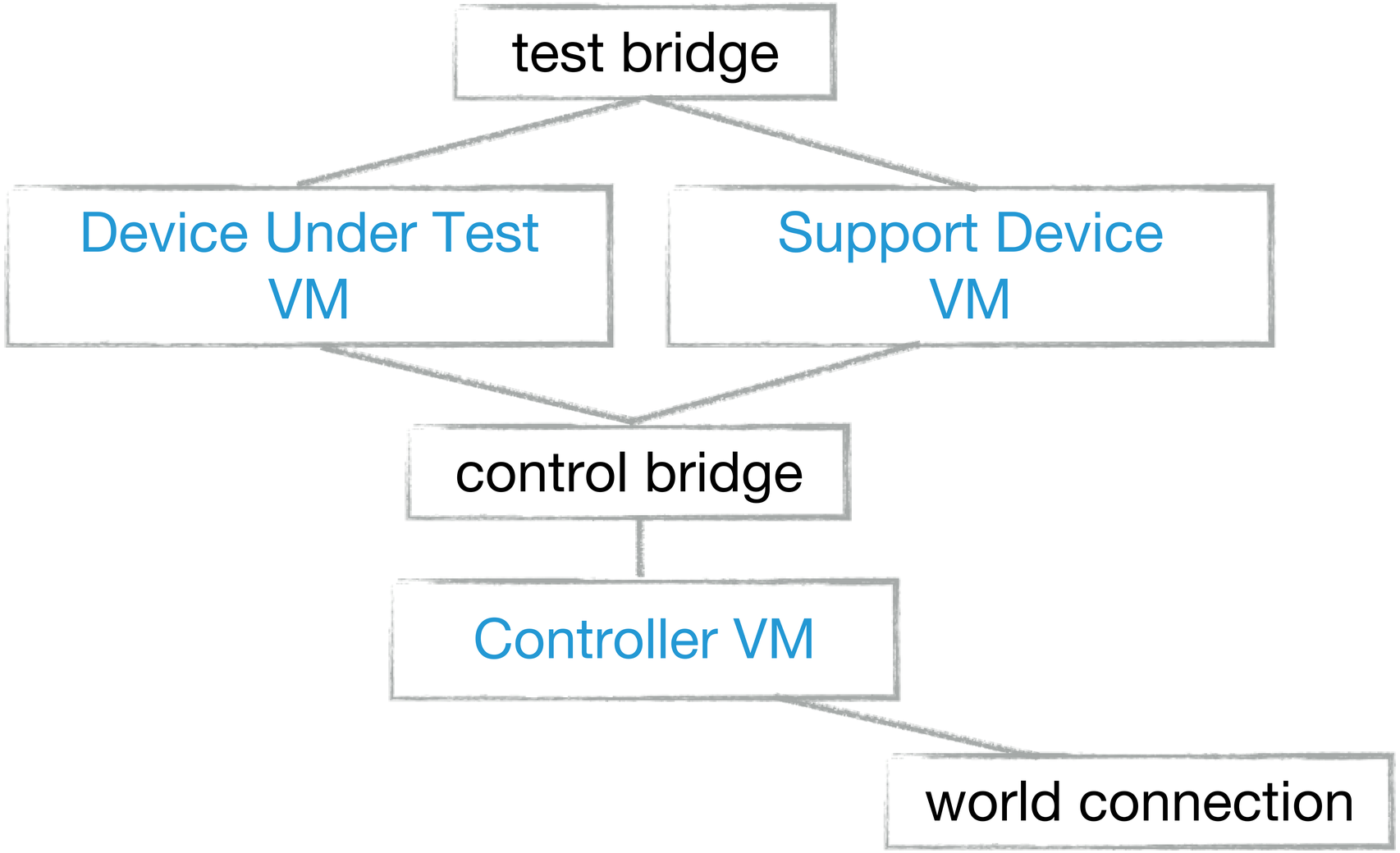
Sample configuration - network



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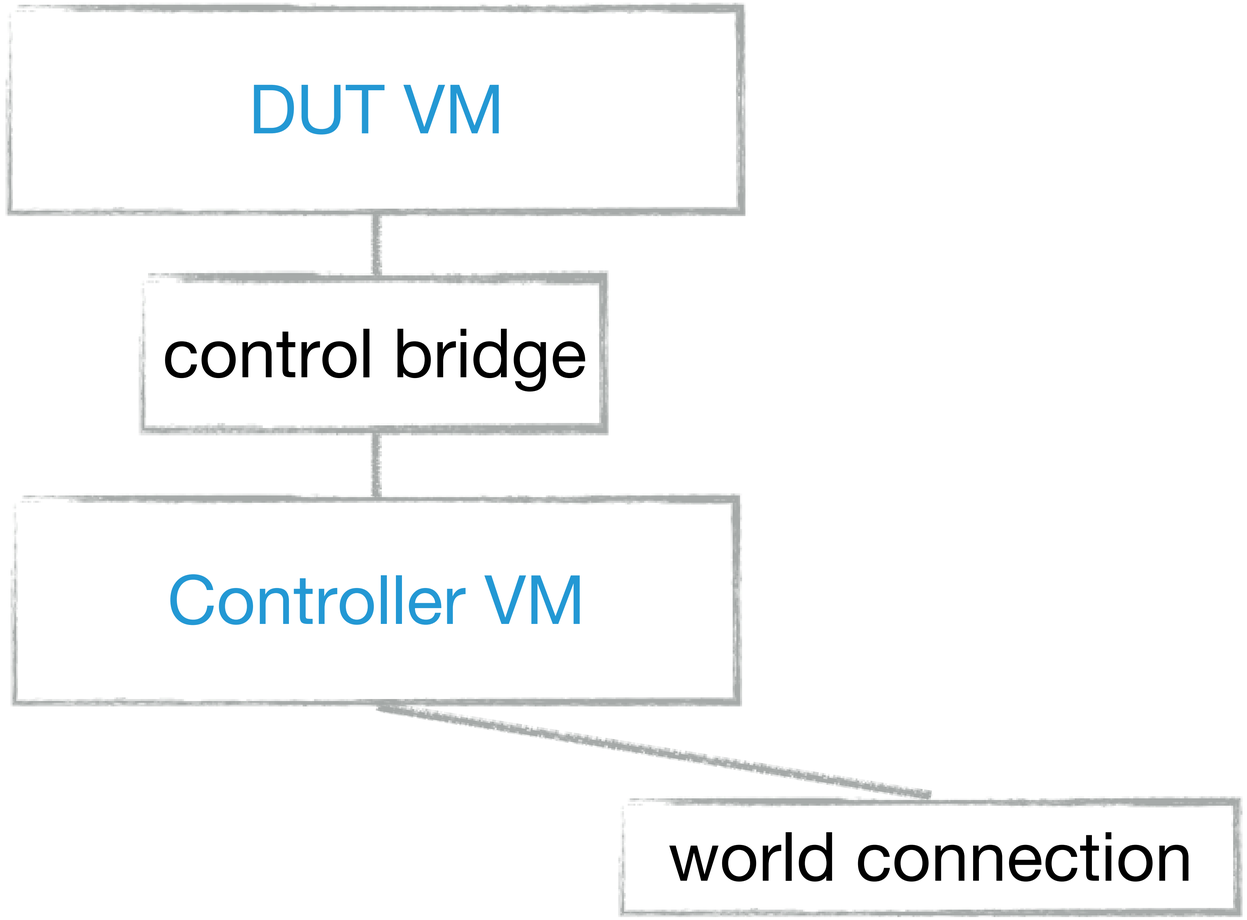
Sample configuration - other devices



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What do we need?

- Run certification tests as part of CI process
- Can be used by individual developer
- The ultimate goal - to be used for actual certification

History: VirtHCK

- Used by individual developer
- Orchestrates network and storage for the test
- Runs VMs on top of QEMU-KVM

What should be automated?

Guest automation

Guest communication layer

Host Automation: VM and networking orchestration

Test manager and reports

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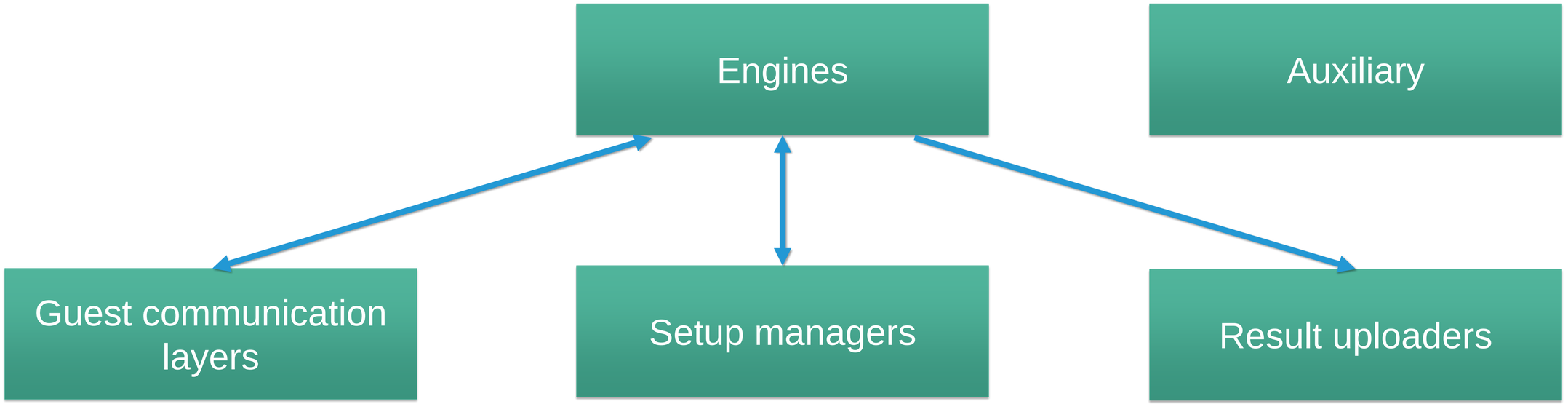
AutoHCK - architecture



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Guest automation - toolsHCK

- Driver installation (including test certificate)
- HCK\HLK studio control using MS API
  - Orchestration of HCK\HLK setup
  - Running tests
- Filter and playlist application
- Get back the results in a parsed human readable manner and test package

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toolsHCK - examples

- createpool “NetKVM-pool”
- createproject “NetKVM-Win2022x64”
- createprojecttarget “PCI\VEN_1AF4&DEV_1000&SUBSYS_00011AF4&REV_00\3&267A616A&0&20” “NetKVM-Win2022x64” “CL2” “NetKVM-pool”

toolsHCK - examples

- queuetest “bbcc1b46-d0bf-46c8-85b4-2cd62df34a20” “PCI\VEN_1AF4&DEV_1000&SUBSYS_00011AF4&REV_00\3&267A616A&0&20” “NetKVM-Win2022x64” “CL2” “NetKVM-pool”
- listtestresults “bbcc1b46-d0bf-46c8-85b4-2cd62df34a20” “PCI\VEN_1AF4&DEV_1000&SUBSYS_00011AF4&REV_00\3&267A616A&0&20” “NetKVM-Win2022x64” “CL2” “NetKVM-pool”
- createprojectpackage “NetKVM-Win2022x64” [<package>]

Guest communication layer - rtoolsHCK

- Communication between Controller VM and the test manager on the host using WinRM
- Communication between the Controller and Client VMs
- A gateway to toolsHCK

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Host automation – AutoHCK

- Creates VMs images with corresponding software
- Orchestrates network and storage for the test
- Creates snapshots that will be used for the tests
- Runs VMs and monitors their status

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Test Manager - AutoHCK

- Manages test configurations
- Platforms, OSes, devices, HLK / custom test play lists, test black lists, HLK filter
- Orchestrates test setup in HLK studio and run the tests
- Monitors test process

Report Manager - AutoHCK

- Result uploading
  - uploading results to DropBox
    - Parsed HLK\HCK results
    - Mini-dump files, if BSOD occurred during the tests' run
    - Symbol and binary files for debugging
  - updates Github pull requests with CI status
- HLK test package

Installation

Server requirements

Processor	12 x vCPUs (minimal)
Memory	14 GB RAM (minimal)
Storage	512 GB (SSD is preferred)
Host OS	Linux based
Internet connection	Recommended

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Installation

- Project source:
  - AutoHCK
  - toolsHCK
  - HLK-Setup-Scripts
  - extra-software

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Configuration

- JSON – Format
- Global configuration
- Setup managers
- Engines

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Configuration

- Global configuration
  - config.json
  - drivers.json
  - svvp.json

```
{
    "iso_path": "/home/hck-ci/HCK-CI/iso",
    "extra_software": "/home/hck-ci/HCK-CI/extra-software",
    "workspace_path": "/home/hck-ci/HCK-CI/workspace",
    "ip_segment": "192.168.0.",
    "id_range": [ 2, 90 ],
    "winrm_port": "5985",
    "repository": "virtio-win/kvm-guest-drivers-windows",
    "toolshck_path": "./toolsHCK.ps1",
    "studio_username": "Administrator",
    "studio_password": "*******",
    "result_uploaders": [ "dropbox" ],
    "test_engine": "hcktest",
    "install_engine": "hckinstall",
    "setupmanager": "qemuhck",
    "time_out": "9"
}
```

Configuration

- Setup managers
  - qemu_machine.json
  - physhck.json

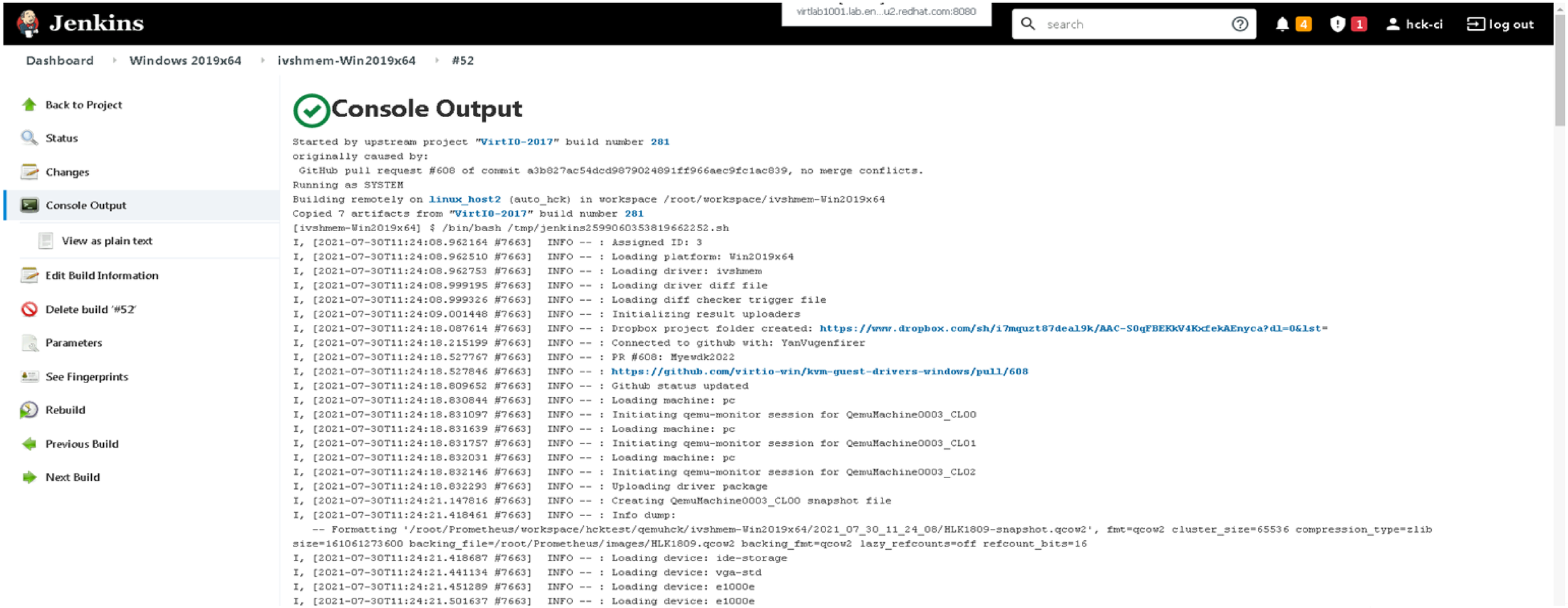
```
[
  {
    "name": "PhyWin2016",
    "st_ip": "10.20.30.40",
    "kit": "HLK1607"
  },
  {
    "name": "PhyWin2019",
    "st_ip": "10.20.30.41",
    "kit": "HLK1809"
  }
]
```

Configuration

- Engines
  - hlkinstall.json
- HLK Install
  - studio_platform.json
  - kit.json
  - iso.json
- HLK Test
  - <platform>.json

```
{
  "name": "Win2022x64",
  "kit": "HLK2022",
  "st_image": "HLK2022.qcow2",
  "clients": {
    "c1": {
      "name": "CL1",
      "cpus": "4",
      "memory": "4G",
      "winrm_port": "4002",
      "image": "HLK2022-C1-Win2022x64.qcow2"
    },
    "c2": {
      "name": "CL2",
      "cpus": "4",
      "memory": "4G",
      "winrm_port": "4003",
      "image": "HLK2022-C2-Win2022x64.qcow2"
    }
  }
}
```

Optional software - Jenkins



Optional software - Sentry

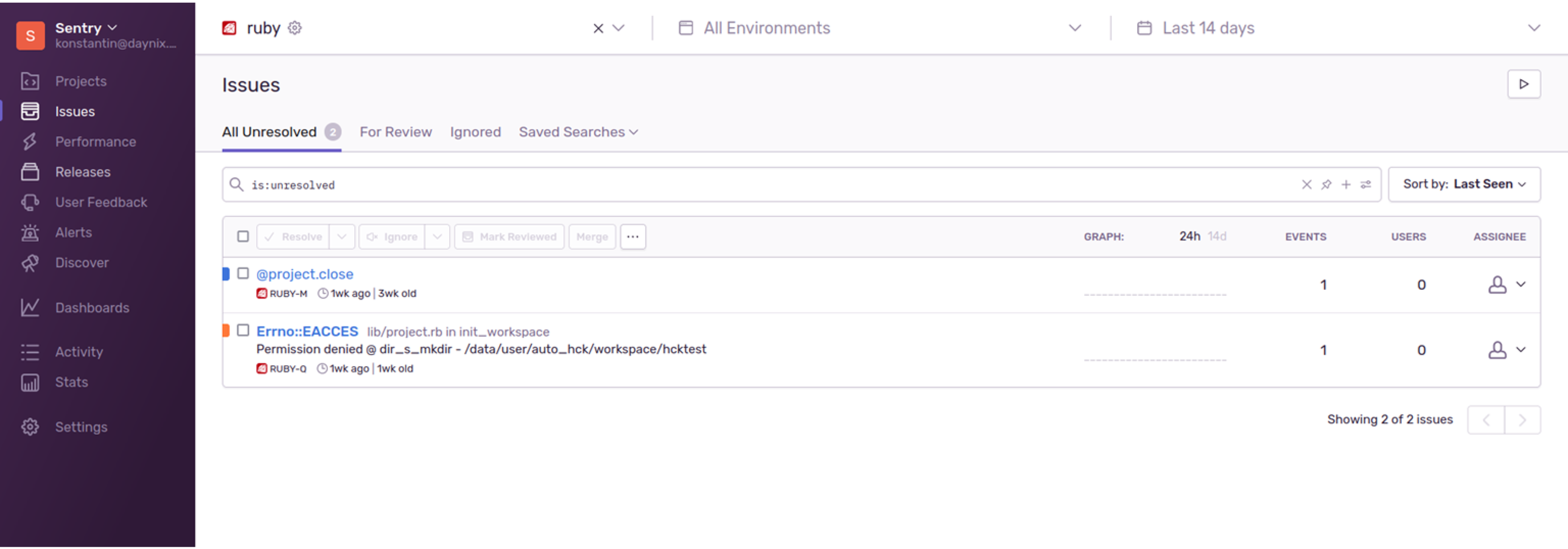


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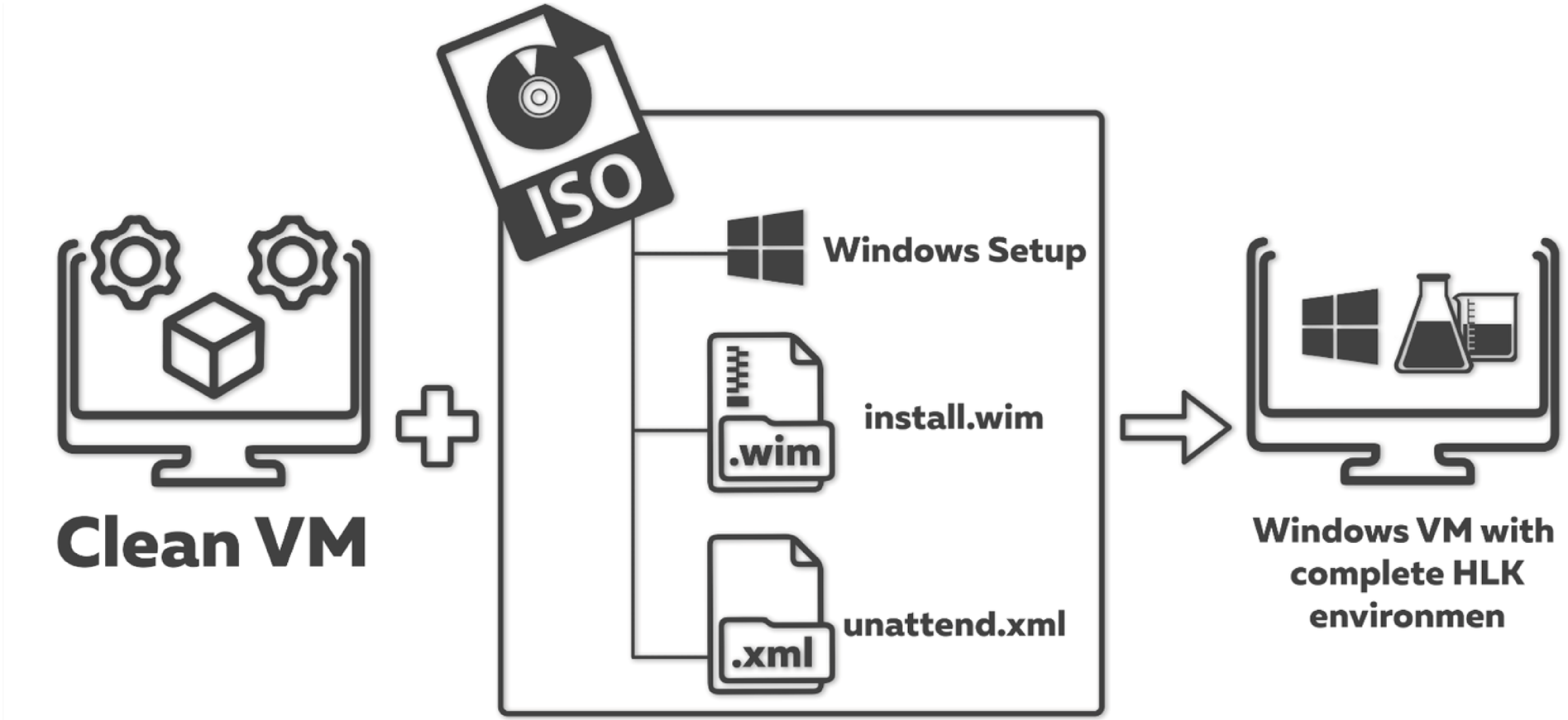
Image installation



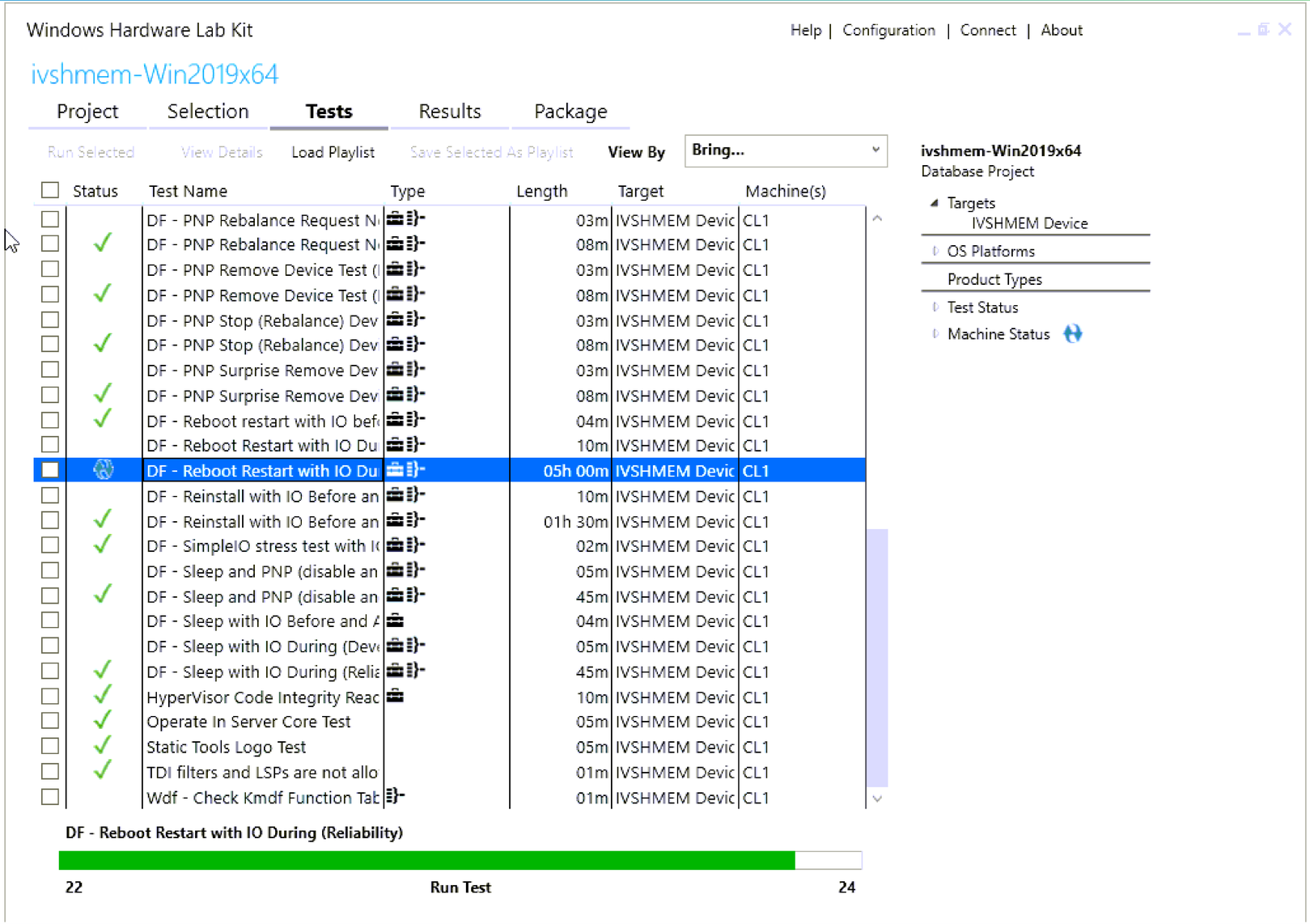
ruby ./bin/auto_hck install -p Win10_2004x86

Running sample test

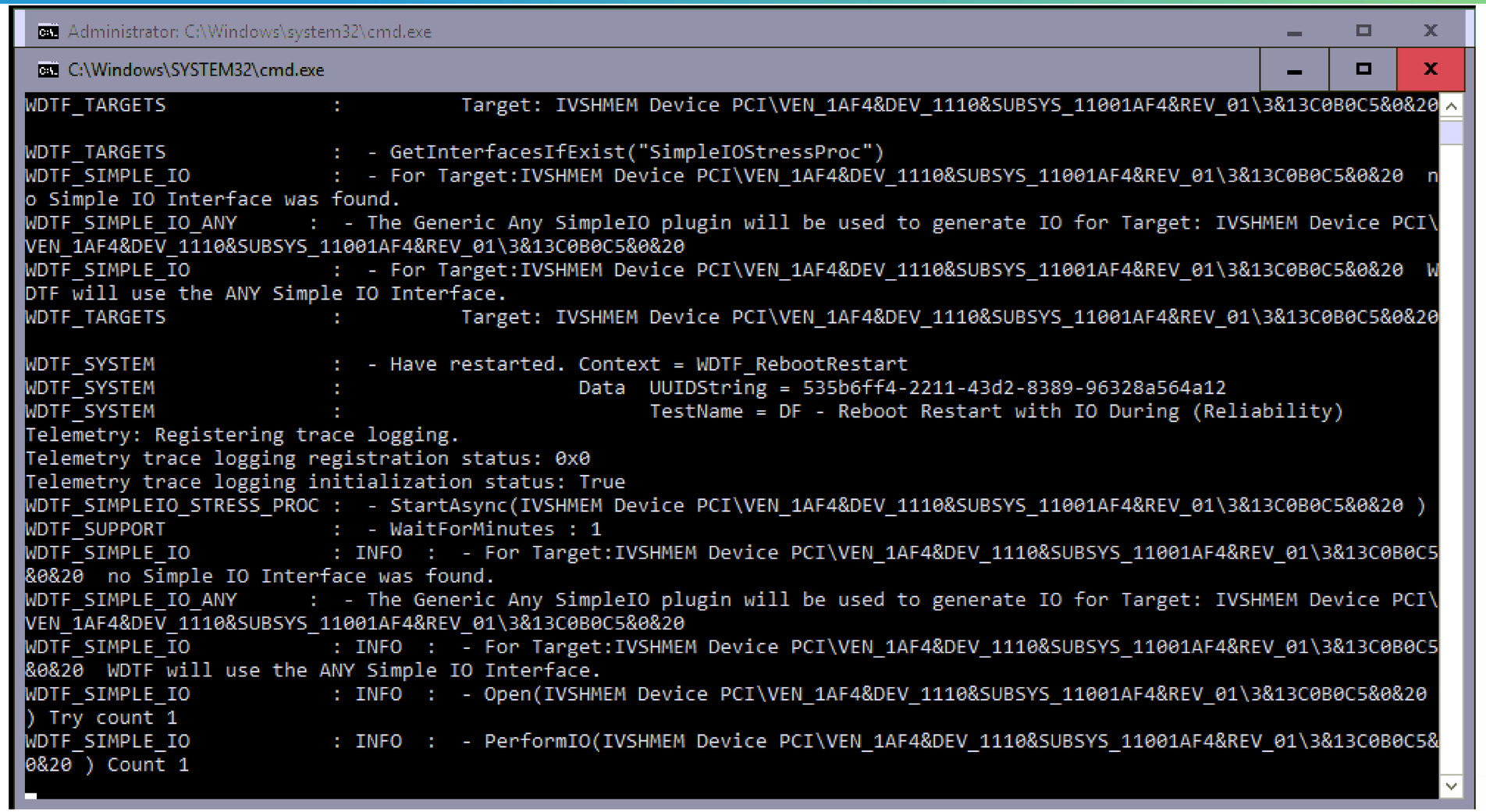

```
I, [2021-08-25T00:15:36.465688 #22317]  INFO -- : >>> Currently running: DF - Sleep with IO During (Reliability) [00:45:00]
I, [2021-08-25T00:20:27.038361 #22317]  INFO -- : Applying filters on finished tests
I, [2021-08-25T00:21:20.460527 #22317]  INFO -- : Github status updated
I, [2021-08-25T00:21:21.437649 #22317]  INFO -- : Passed: DF - Sleep with IO During (Reliability)
I, [2021-08-25T00:21:21.437788 #22317]  INFO -- : Test information page: https://docs.microsoft.com/en-us/windows-hardware/test/hlk/testref/9d87d997-f451-4a3d-852c-90367d4d3864
I, [2021-08-25T00:21:24.146337 #22317]  INFO -- : Test archive successfully created
I, [2021-08-25T00:21:27.520875 #22317]  INFO -- : Tests results logs updated via the result uploader
I, [2021-08-25T00:21:28.917326 #22317]  INFO -- : Test archive uploaded via the result uploader
I, [2021-08-25T00:21:28.917598 #22317]  INFO -- : <<< Passed: 20 | Failed: 0 | InQueue: 2
I, [2021-08-25T00:21:38.928046 #22317]  INFO -- : Adding to queue: DF - Reinstall with IO Before and After (Reliability) [01:30:00]
I, [2021-08-25T00:21:48.070334 #22317]  INFO -- : >>> Currently running: DF - Reinstall with IO Before and After (Reliability) [01:30:00]
I, [2021-08-25T00:38:25.438541 #22317]  INFO -- : Applying filters on finished tests
I, [2021-08-25T00:39:17.476092 #22317]  INFO -- : Github status updated
I, [2021-08-25T00:39:18.567195 #22317]  INFO -- : Passed: DF - Reinstall with IO Before and After (Reliability)
I, [2021-08-25T00:39:18.567345 #22317]  INFO -- : Test information page: https://docs.microsoft.com/en-us/windows-hardware/test/hlk/testref/8dd417ab-e523-4bf0-a971-7c27d99ff5b2
I, [2021-08-25T00:39:22.503789 #22317]  INFO -- : Test archive successfully created
I, [2021-08-25T00:39:27.018756 #22317]  INFO -- : Tests results logs updated via the result uploader
I, [2021-08-25T00:39:28.263472 #22317]  INFO -- : Test archive uploaded via the result uploader
I, [2021-08-25T00:39:28.263768 #22317]  INFO -- : <<< Passed: 21 | Failed: 0 | InQueue: 1
I, [2021-08-25T00:39:38.274602 #22317]  INFO -- : Adding to queue: DF - Reboot Restart with IO During (Reliability) [05:00:00]
I, [2021-08-25T00:39:47.754999 #22317]  INFO -- : >>> Currently running: DF - Reboot Restart with IO During (Reliability) [05:00:00]
```

```
ruby ./bin/auto_hck test \
  --platform Win2019x64 --drivers ivshmem \
  --driver-path "${HOME}/workspace/ivshmem-Win2019x64-build"
```

Running sample test



Running sample test



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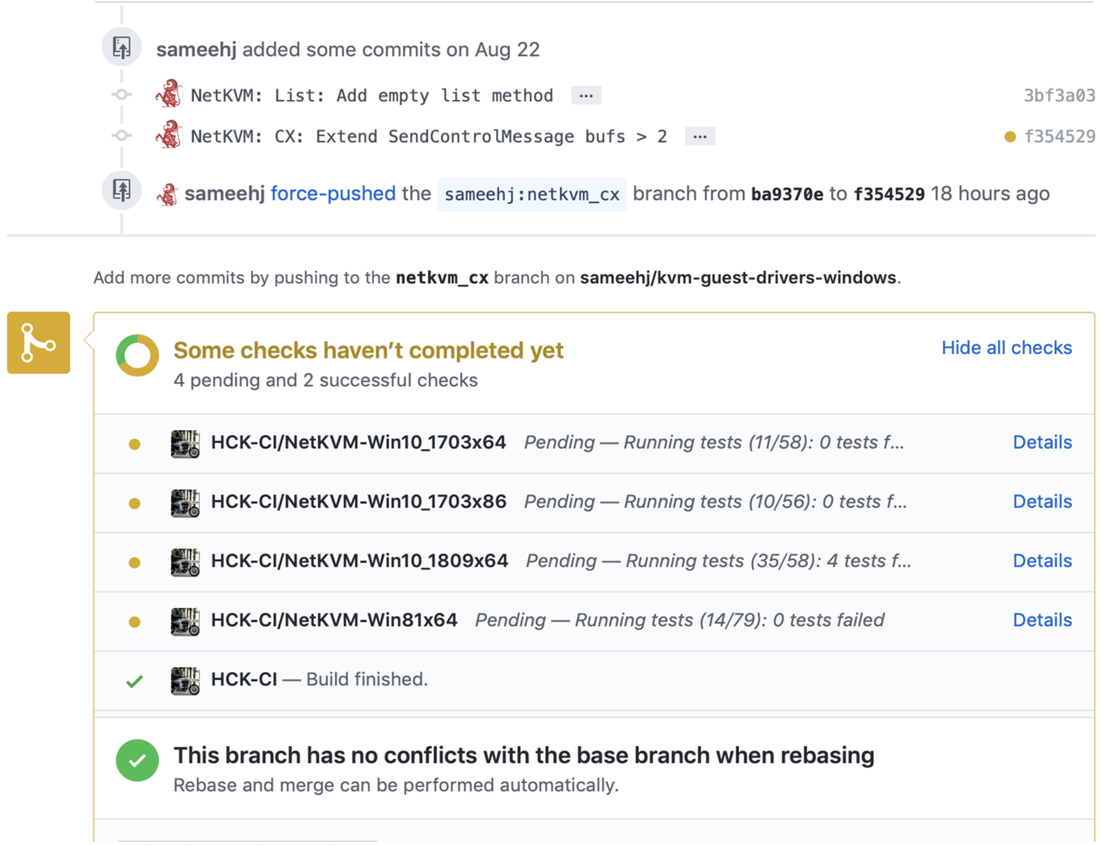
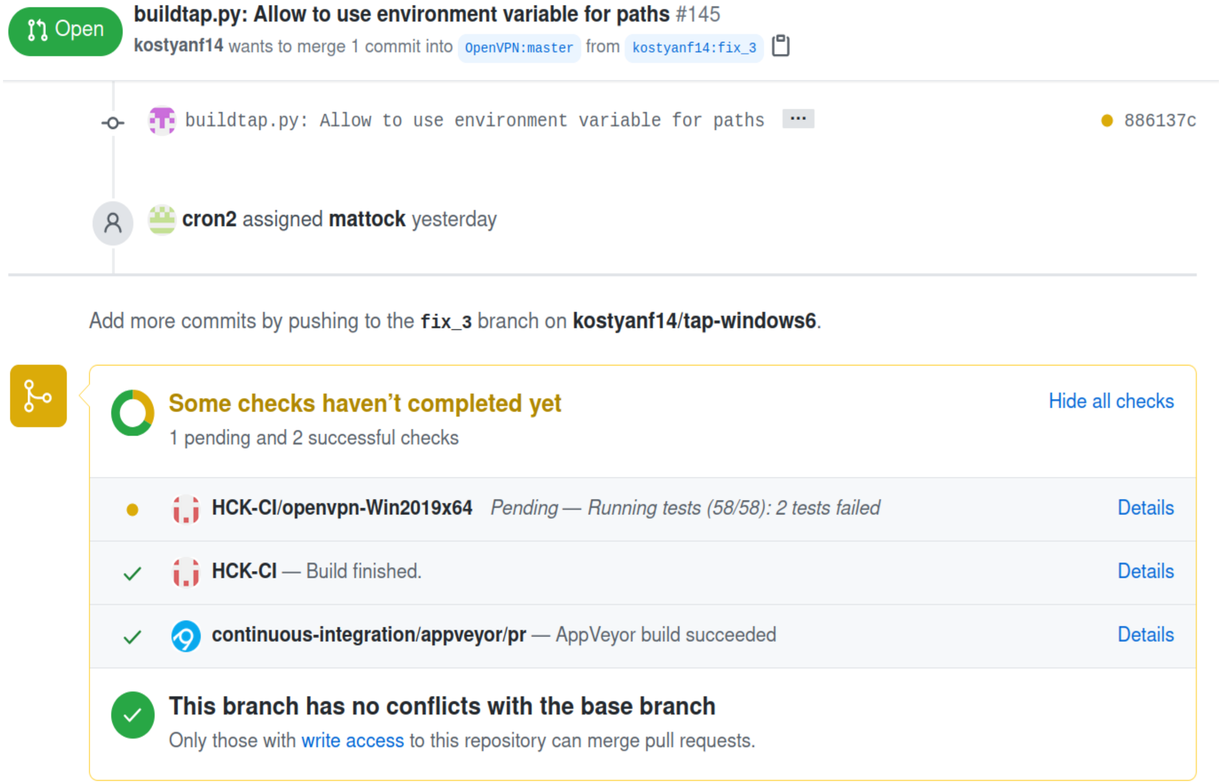
Projects using HCK-CI

virtio-win CI



OpenVPN CI



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Current Status

- Running as upstream CI for several projects
- Modular architecture allowing adding support for other hypervisors or bare metal support (vDPA on Windows)
- Support for automating SVVP (hypervisor) certification tests
- Integration with GitHub (modularity allowing integration with other services)
- Integration with DropBox to upload the results
- Parsing the results so they can be viewed by people without installation of HLK\HCK Studio

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Future

- Adding support for other hypervisors
- Adding support for additional results' storage

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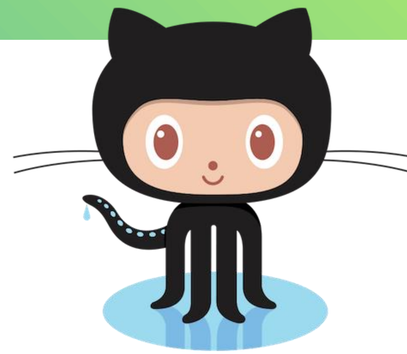
konstantin@daynix.com

Links – source code

- HCK-CI Framework source:
  - https://github.com/HCK-CI/AutoHCK
  - https://github.com/HCK-CI/toolsHCK
  - https://github.com/HCK-CI/HLK-Setup-Scripts
  - https://github.com/HCK-CI/extra-software
- virtio-win drivers source code (upstream CI):
  - https://github.com/virtio-win/kvm-guest-drivers-windows
- OpenVPN TAP-Windows driver source code (upstream CI):
  - https://github.com/OpenVPN/tap-windows6

Links – related information



- Windows Unattended Setup:
  - https://docs.microsoft.com/en-us/windows-hardware/manufacture/desktop/automate-windows-setup
  - https://docs.microsoft.com/en-us/windows-hardware/manufacture/desktop/update-windows-settings-and-scripts-create-your-own-answer-file-sxs
- HLK Test Reference
  - https://docs.microsoft.com/en-us/windows-hardware/test/hlk/testref/hardware-lab-kit-test-reference

Links – related presentations

- KVM Forum 2012 WHQL Process for Windows Drivers and What the Community Can Learn From It - Yan Vugenfirer, Daynix :
  - https://www.linux-kvm.org/images/8/82/2012-forum-WHQLAndTheCommunity.pdf
- HLK Test Reference
  - https://www.slideshare.net/YanVugenfirer/virt-hck-kvmforum2013

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