WHQL process for Windows drivers and what the community can learn from it

Yan Vugenfirer - yan@daynix.com
Dmitry Fleytman - dmitry@daynix.com

Agenda

- What is WHQL
- Sample tests overview
  - HW compliance tools
  - NDIS tester
  - Driver verifier
  - Device path exerciser
  - Sleep and PNP
  - Static code verification
- Known issues from the past
- Let’s talk

What is WHQL

- The Windows certification program (previously known as the Windows Logo Program) for devices and system
- Uses comprehensive toolkit for the tests (HCK starting from Windows 8, previous name WLK)
- Certified binaries are digitally signed

Certification types

- Certifications for known device types
- Unclassified certifications for devices that fall outside of specific class (for example ballon and virtio-serial).
- System certifications (including SVVP).

HCK test kit

- Introduced with Windows 8 (previous kit know as WLK)
- Includes control server and ability to run tests on different machines
- Test groups for each certification type
- Ability to add own tests for additional testing outside the certification process
- Stand alone test can be extracted for testing \debugging

HCK test kit - sample tests

- **PCI compliance** - will test for:
  - Invalid values specified in registers
  - Read-only registers that can be written to
  - Writable registers that cannot be written to
  - Registers that are supposed to clear on a write of 1 but don’t
  - Registers that are supposed to retain their values through a reset but lose them
  - Devices (and in some cases, systems) that hang when certain values are written
  - Unimplemented features and/or capabilities that are required by the specs

HCK test kit - sample tests

- **NDIS tester**
  - Actually two test kits due to MS legacy
  - Include comprehensive network tests
    - Send\receive
    - Stress tests (MPE)
    - Offload, VLAN, priority, packet filtering and etc
    - And many others

HCK test kit - sample tests

- **Driver verifier**
  - In a background for many tests
  - A great debugging tool unrelated to WHQL certification
  - Replaces the calls to OS functions
  - Captures deadlocks, memory leaks, memory corruption

HCK test kit - sample tests

- **Device path exerciser**
- The device path exerciser test identifies drivers that do not correctly handle the following calls:
  - Unexpected I/O requests to the driver
  - Query requests with buffers that are too small to contain all the data to be returned.
  - IOCTL/FSCTL requests with missing buffers, buffers that are too small, or buffers containing meaningless information.
  - IOCTL/FSCTL requests with direct I/O or neither I/O data access in which the data is changing asynchronously.
  - IOCTL/FSCTL requests with invalid pointers for requests using neither I/O.
  - IOCTL/FSCTL requests and fast path query requests in which the mapping of the user buffer changes asynchronously, causing the pages to become unreadable.

HCK test kit - sample tests

- Sleep and PNP (disable and enable) with IO
  - The test cycling through different sleep states
  - There are variations of IO and PNP (disable\enable) during, before and after power transitions

HCK test kit - sample tests

- **Static code verification**
  - Not part of the kit - but the logs are required for network and storage drivers
- Prefast
- Static driver verifier

Past experience

- NDIS tester (MPE)
  - Detected transfer hangs with vhost.
- Different functionality tests (offload\VLAN) - corner cases with virtio. Were very useful during vmxnet3 implementation in QEMU.
- PCI compliance

Let’s talk

What can be done today

- Use PCI compliance for new devices (for example virtio2 pci configuration space implementation)
- Use MPE subtest in NDIS tester for each change in QEMU or host networking
- Sleep and PNP tests to check S3\S4 support

In the future?

- Driver verifier and device path exerciser are a great example of tools that enhance overall system robustness and stability
- We definitely need something similar for Linux
- Static code verification?

In the future?

- QEMU and virtualization:
  - Automation (virt-test as a framework?)
  - Device acceptance tests
    - Similar tests for each device types and system can be a great regression test kit
    - Testing changes in the host subsystems (for example vhost)
    - We are missing comprehensive tests for balloon and virtio-serial

Let’s talk

Useful links

- Windows Certification Program Policies and Processes - http://msdn.microsoft.com/en-us/library/windows/hardware/hh852370
- Windows 8 Hardware Certification Requirements - http://msdn.microsoft.com/en-us/library/windows/hardware/hh748200
- Windows Hardware Certification Kit (HCK) - http://msdn.microsoft.com/en-us/library/windows/hardware/hh833788

Useful links

- Device Path Exerciser Overview - http://msdn.microsoft.com/en-us/library/windows/hardware/ff544856(v=vs.85).aspx
- Driver verifier - http://msdn.microsoft.com/en-us/library/windows/hardware/ff545448(v=vs.85).aspx
- Sleep Tests (Device Fundamentals) - http://msdn.microsoft.com/en-us/library/windows/hardware/jj673017(v=vs.85).aspx

Useful links

- PCI compliance for systems- http://msdn.microsoft.com/en-us/library/windows/hardware/jj124420.aspx
- Windows 8 Hardware Certification Resources and Support - http://msdn.microsoft.com/en-us/library/windows/hardware/hh852371
- SVVP - http://www.windowsservercatalog.com/svvp.aspx

Useful links

- Download HCK - http://msdn.microsoft.com/en-US/windows/hardware/hh852359
- virt-test - https://github.com/autotest/virt-test/wiki
- Static driver verifier - http://msdn.microsoft.com/en-us/library/windows/hardware/gg487498.aspx
- Prefast - http://msdn.microsoft.com/en-us/library/windows/hardware/gg487345.aspx