Goodbye SMI - ACPI and Graphics Driver/System Firmware Interface

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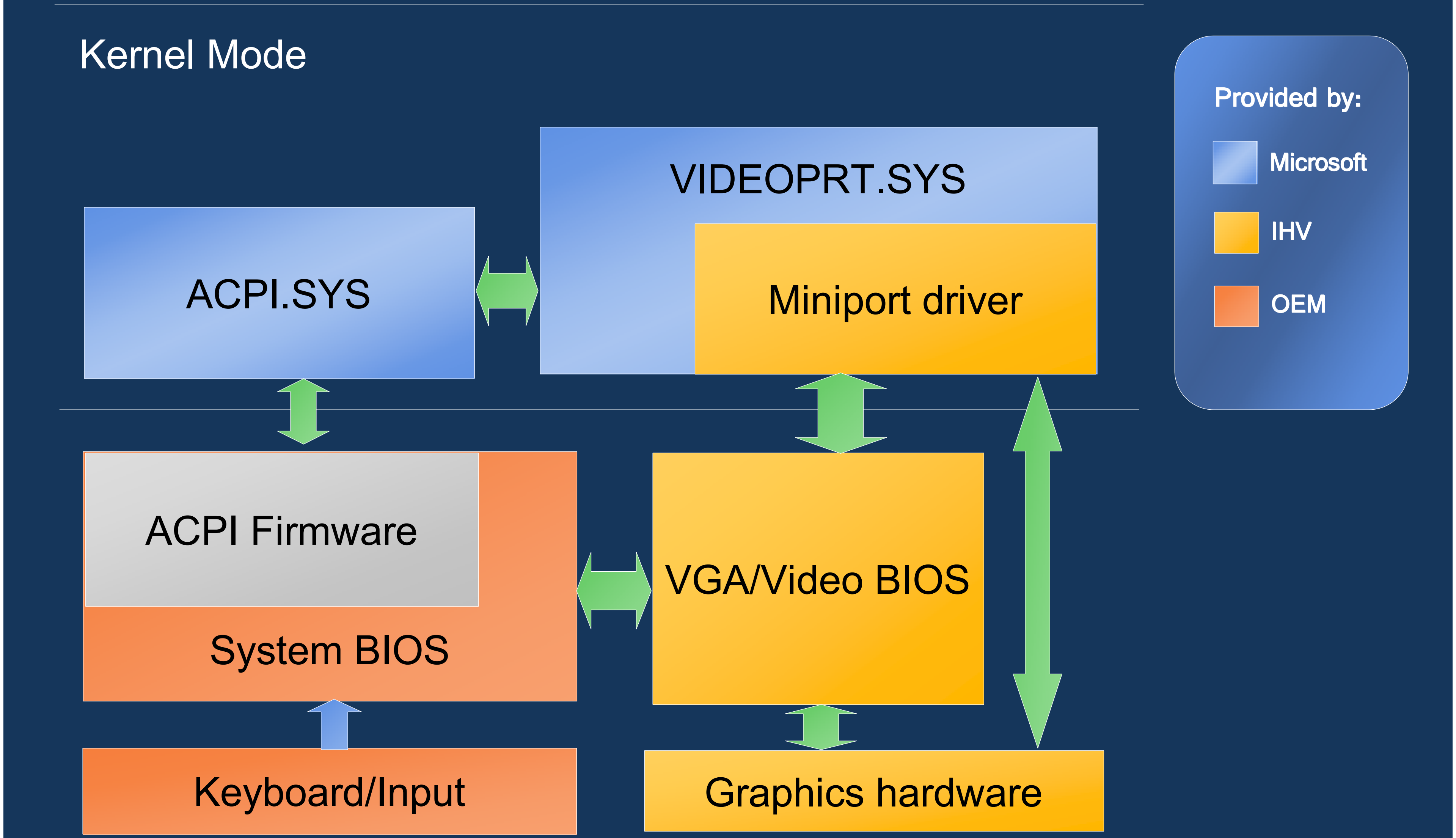
Session Outline

- Where this session applies
  - Booted OS and an active device driver
  - No coverage for pre-boot environment
- The intricate art of component communication
  - Where Video BIOS, System Firmware, driver and OS need to work together for display hotkey and custom functionality support
  - Problems with current approach for Windows codenamed “Longhorn”
- What can be done?
  - The new interface to ACPI in LDDM
  - ACPI Mechanisms available for use

Where Does This Session Apply?

- Hotkey support when graphics driver is running
- Custom display & graphics features that are not supported by standard OS and ACPI methods
  - Often the hardware state needs to be synchronized between OS, graphics driver, system & video BIOS
  - On WindowsXP, the graphics driver can't directly communicate with the ACPI system firmware
  - Video BIOS is a resource mediator between the system firmware and the driver.
    - Driver can call VideoPortInt10 function to pass execution and parameters to Video BIOS via IHV specific BIOS functions
    - ACPI firmware may generate a SMI, then issue Int10h from there to do the same to set and retrieve status

Driver-Firmware Communication



Kernel Mode

VIDEOPRT.SYS

ACPI.SYS

Miniport driver

ACPI Firmware

System BIOS

VGA/Video BIOS

Keyboard/Input

Graphics hardware

Provided by:

- Microsoft
- IHV
- OEM

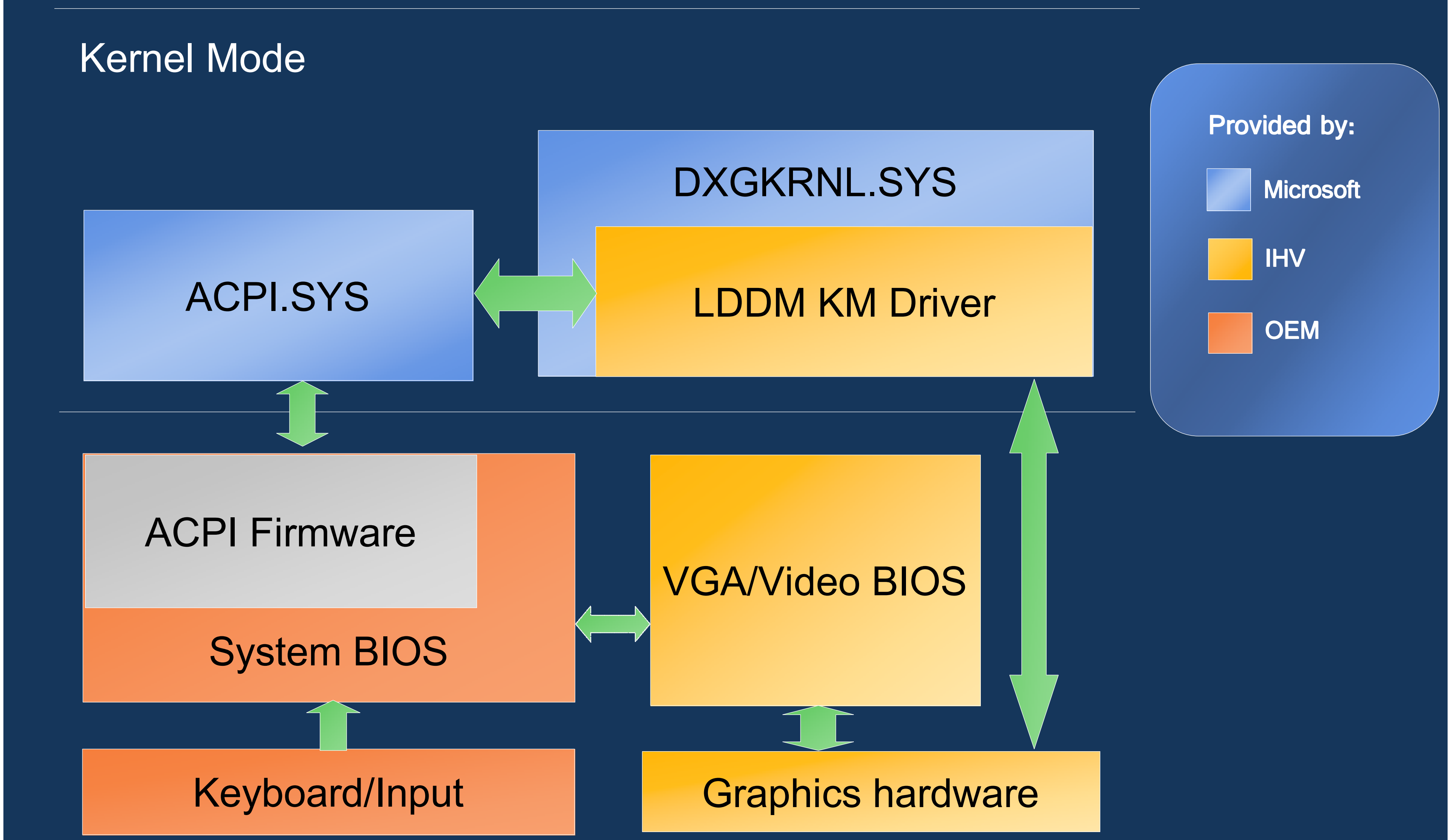
General Issues and Challenges

- SMM is not OS/developer friendly
  - Everything else is stopped while executing SMM code
  - Some Video BIOS functions (e.g. display detection) may potentially take some time to finish
  - May cause problems for time-sensitive OS functions
  - Requires x86 assembly language for development
  - May not be available on some platforms

General Issues and Challenges

- Video BIOS is x86 “real mode” code
  - Limited to 64KByte size due to legacy PC architecture
    - Hard to customize/extend/debug (16bit x86 assembly)
    - Almost all of the available space is used for required functions
  - 64bit: no “virtual x86” mode, OS SW emulation layer
  - Requires use of VGA legacy resources (0xA0000 aperture, 0x3D4/0x3D5 I/O range, etc.) to program hardware
  - Requires fixed video memory range for any buffers
    - Video BIOS buffers are not available to OS/driver management
    - Hardware alignment requirements may cause video memory partitioning to allow fixed range that BIOS can use/reference

Driver-Firmware communication for LDDM



Longhorn LDDM Challenges

- VideoPortInt10 is deprecated in LDDM
- Graphics driver doesn’t “own” video memory management anymore
  - Video memory usage is virtualized by OS VidMM
  - Driver specifies video memory range(s) available to VidMM
- Longhorn has a “richer”, more responsive UI
  - Average video memory utilization may be higher than on XP due to desktop composition process and more graphical content being processed
  - Any video memory reserved for BIOS functionality can’t be used for other purposes
- Longhorn has explicit support for display hotplug
  - Arrival/departure of displays will be much more common and OS, driver, ACPI firmware and Video BIOS need to stay in sync

The New Interface to ACPI in LDDM

- LDDM allows the driver to directly interface to ACPI methods in VGA namespace via it’s DDI
  - DxgkCbEvalAcpiMethod()
  - Hotkey/Lid/Dock notification events can be forwarded by OS to the graphics driver via DriverInitializationData.DxgkDdiNotifyAcpiEvent()
  - Due to the new DMM (Display Mode Management) architecture of the LDDM, the graphics driver and OS are much better in sync regarding output device state, capabilities and display device topology
    - _DGS/_DSS methods will be handled by graphics driver
    - _DSS will update the ACPI FW with the _DGS state request as matched with the current display status detected by the driver
    - Workarounds done in ACPI FW for older OS to handle corner cases with output device detection and display topology are not necessary anymore

More Flexible Use of Available Methods

- _ROM method (VGA namespace)
  - Provide display devices’ ROM image if stored in proprietary format (e.g. PCI “ROM BAR” not available)
  - Allows configuration data transfer from ACPI FW to graphics driver, up to 4KB in size
  - Offset, Size parameter can be specified to request data (e.g. Offset <= 0xffff: Video BIOS ROM Image, Offset >= 0x10000: additional ACPI status and configuration data)
  - Limited use even on WindowsXP and earlier OS through VideoPortGetRomImage() in the driver (only length from beginning of “ROM” can be passed to the OS function)

Custom Methods in the ACPI VGA Namespace

- Allows handling custom display features that can’t be supported by standard ACPI methods without resorting to Int10h/SMI mechanisms
  - Faster and simpler code development
  - Safer interface from LDDM driver

Restrictions

- ACPI FW needs to explicitly check _OS/OSI
  - For any Windows OS before Longhorn, the new ACPI LDDM DDI mechanisms are not available
  - If _ROM method is sufficient as available on XP, that mechanism may be usable
- ACPI FW needs to be aware when LDDM device driver starts up and shuts down
  - _DOS method is used by LDDM driver to notify ACPI FW when it takes over device hotkey switching after DmStartDevice() and when it passes control back before DmStopDevice()
  - Better: have defined handover mechanism on DmStartDevice() and DmStopDevice() of the LDDM driver via ACPI method calls
  - When LDDM driver is not active, ACPI FW either disables functionality or has to handle it in a “pre-boot” fashion

Restrictions

- ACPI Thermal events currently don’t get forwarded to the graphics device
  - ACPI Thermal zones are currently not associated with devices in the OS
  - For critical notification (e.g. overheating) fallback mechanisms still need to be in place

Resources

- Provides Windows related Information for ACPI and Power management support: http://www.microsoft.com/whdc/system/pnppwr/powermgmt/default.mspx
- ACPI overview, tools and specifications http://www.acpi.info
- LDDM specification

Community Resources

- Windows Hardware & Driver Central (WHDC)
  - www.microsoft.com/whdc/default.mspx
- Technical Communities
  - www.microsoft.com/communities/products/default.mspx
- Non-Microsoft Community Sites
  - www.microsoft.com/communities/related/default.mspx
- Microsoft Public Newsgroups
  - www.microsoft.com/communities/newsgroups
- Technical Chats and Webcasts
  - www.microsoft.com/communities/chats/default.mspx
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