presented by

Replacing VGA, GOP implementation for UEFI

UEFI Summer Plugfest – July 6-9, 2011

Presented by AMD

Agenda

- What is GOP?
- Dual Boot: Legacy VGA BIOS or GOP
- Secure Boot Requirements
- GOP Readiness at AMD
- Call for action
- Q & A

Section Heading

What is GOP ?

What is GOP?

The Graphics Output Protocol (GOP) is enabled by UEFI driver to support graphic console output in the pre-OS phase.

The ultimate goal of GOP is to replace legacy VGA BIOS and eliminate VGA HW functionality.

What is GOP?

Some advantages of using GOP:

1. *Easier portability and fewer resource constraints*
2. *All GPUs within a platform become "equal"; no more unique "VGA enabled" GPU*
3. *No more messy and hard-to-maintain proprietary INT15 handshaking between platform and GPU*

What is GOP?

Some disadvantages of using GOP:

1. *OS or OS applications lose capability of changing display resolution and configuration if OS high performance display driver is not installed or functional.*
2. *Some common mobile functionalities like LCD backlight adjustment are currently not supported, and display switch in the pre-OS time is more complex to support.*

What is GOP?

Major differences between GOP driver vs. legacy VGA BIOS:

1. *Accessed through UEFI protocols vs. Interrupts and VGA/VBE interface*
2. *Boot only services vs. both boot and OS run-time services*
3. *Written in C instead of x86 assembler (not a spec requirement)*

What is GOP?

Examples of some interface differences between GOP and legacy VGA BIOS:

	Set a display mode	Retrieve EDID from a display device	Set/Get DAC Palette Format	Display Switch
GOP driver	EFI_GRAPHICS_OUTPUT_PROTOCOL.SetMode()	EFI_EDID_DISCOVERED_PROTOCOL	No need, GOP only supports (0.8.8.8) format	Reentrant with different childhandle in EFI_DRIVER_BINDING.Start () followed by a SetMode ()
Legacy VGA BIOS	Set VBE Mode AX=4F02h …	VBE DDC Extension AX=4F15h …	VBE Set/Get DAC Palette Format AX=4F08h …	Vendor specific VGA BIOS Extensions

Tips for Fast Boot GOP

- Only invoking **`GraphicsOutputProtocol`** with one GOP enabled GPU when **`GraphicsOutputProtocol`** is installed on multiple GPUs. SBIOS only needs to choose one but not all for graphic console output.
- Assign only one video output device to boot up with
  - Example: mobile platform only assigns LCD in **`Start()`** if lid is open
  - Saves time used for display detection & mode list construction
- Driver generates a limited GOP mode list
  - Don't list all modes, only list a limited set of modes needed in pre-boot
  - Note: MS requires 1024x768 32bpp as minimum GOP mode in WHQL
  - Both SBIOS and GOP can be beneficial as it saves time for SBIOS in mode query and GOP driver in the mode list generation

Important GOP Driver Notes

- When a GPU has no video output device physically connected during a GOP driver binding **`Start()`** execution, neither child handles nor **`GraphicsOutputProtocol`** will be created or installed.
  - The platform has to either use another GPU (in multiple GPU present case) or other protocols for console output.
- There could be some discrepancy between **`ACPI_ADR`**s defined/used by platforms and graphic vendors in **`RemainingDevicePath`**.
  - Example, **`ACPI_ADR`** for child device **`DFP1`** is defined 0x80010301 by platform but it's 0x00000210 by graphics vendor.
  - Need a translation on both platform and GOP driver side.

Important GOP Driver Notes

- Recommend platforms set **`RemainingDevicePath`** to **`NULL`** first time to invoke **`Start()`**
  - GOP driver can report back all physically connected video output devices.
  - Platforms can then pick up a set of specific active video output devices in next **`Start()`** with assigned child devices chosen from the connected ones.
- GPU HW can still claim VGA compatibility when booting with GOP driver.
  - However, no VGA resources (VGA memory, VGA IO and VGA Platte) are requested or used by needed by any SW components including GOP driver, and accessing those VGA resources has no effect too.

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Dual Boot: Legacy VGA BIOS or GOP

Dual Boot: Legacy VGA or GOP

The industry needs to provide both legacy VGA BIOS and GOP for a transition period. There is an extra cost/effort for both platform and graphic vendors.

- GOP for UEFI Class 3
- Legacy VGA BIOS for UEFI Class 2 or Legacy Boot

Two simplest options to enable dual boot:

1. *Merge legacy VGA BIOS and signed GOP driver in one hybrid OptionROM image for add-on cards.*
2. *SBIOS built with separate legacy VGA BIOS and GOP driver for a single signed SBIOS image.*

Dual Boot: Legacy VGA or GOP

ROM Header1	...	PCIR Header 1
VGA BIOS Image Uncompressed and Unsigned		
ROM Header 2	...	PCIR Header 2
Generic GOP UEFI Display Driver Image Compressed and Signed		

Hybrid ROM image on a graphic add-on card

Dual Boot: Legacy VGA or GOP

A more advanced option could be …

- Generic GOP driver (graphic vendor specific) on platform, merged with SBIOS or from boot disk
- Driver supports a large number of different add-on graphic cards that only carry legacy VBIOS
- Generic GOP driver only needs to be updated periodically for bug fixes or feature enhancement
- Reduces GOP maintenance work on both platform and graphic card vendor side
- Eliminate Option ROM size constraint (save cost)

Dual Boot: Legacy VGA or GOP

Proposal to handle multiple GPU adapters under UEFI boot …

- BIOS can enable all GOP enabled GPUs
- Only startup GPUs w/o OptionROM
- Only invoke GraphicsOutputProtocol for graphic console output with GPU that has the video output device connected

Section Heading

Secure Boot Requirements

Secure Boot Requirements

Who should sign the GOP image on add-on graphic cards?

GOP driver image will need to be signed and authenticated in order to support secure boot. On mobile platform, signing is obviously platform vendor's but not graphic vendor's responsibility. However, for add-on graphic cards, who should be signing remains a question.

We believe it should be graphic card vendor's responsibility, otherwise, it will create a huge business impact if an add-on card needs different platform vendors to sign for different platforms. Distribution of the public key is a problem, however.

Secure Boot Requirements

What if a GOP driver needs to load an unsigned legacy VGA BIOS image?

In certain GOP application schemes like a hybrid image (legacy VGA BIOS and GOP) on an add-on graphic card, the GOP driver could load the legacy VGA BIOS image to retrieve some configuration data. *This could be considered an unsafe practice* to secure boot as the legacy VGA BIOS image doesn't get the same signature and authentication as the GOP.

Three possible solutions …

Secure Boot Solutions for GOP

1. *Duplicate the configuration data in both legacy VGA BIOS and GOP driver. The disadvantage: requires a larger ROM, raising the cost.*
2. *Apply the same authentication to both legacy VGA BIOS and GOP?*
3. *Have graphic vendors do their private hash on the legacy VGA BIOS image and let the GOP driver authenticate it in execution to ensure safety.*

Section Heading

GOP Readiness at AMD

GOP Readiness at AMD

- AMD has been delivering prototype GOP UEFI 2.3.1 compatible drivers for both its integrated (Ontario/LIano and forward) and discrete GPU (Evergreen, etc.) products to IBVs, platform vendors and OS vendors.
- AMD GOP driver was the first GOP driver to boot Windows Next in legacy-free mode.
- AMD is currently making changes to its GOP driver to further honor the UEFI spec and accommodate certain mobile features that platform vendors requested. Our production GOP driver should be ready no later than the end of 2011.

GOP Readiness at AMD

- AMD is also adding options to its public web-based VBIOS config/build tool and creating another tool
  - APU/GPU customers can build multiple VBIOS and GOP images with different options (EDK tool path vs. EDK2, x64 vs. IA32 etc.) and package the images as needed.
- AMD Windows Next KMD Display Driver has successfully retrieved VBIOS config data from GOP
  - Delivering multiple configurations in the multiple-GPU case is currently under verification.
- AMD is developing GOP specific SCT test cases based on standard SCT test suites.

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Call for Action

Call for Action

AMD encourages more system vendors, SW vendors, OEMs to get our GOP enabled add-on graphic cards or platforms to test. We should work together to enable a smooth GOP transition, and we are open for discussions and special requirements.

Call for Action

In addition, some potential UEFI spec enhancement or changes were identified during our GOP implementation, we would like to work with you to verify some ideas and bring the change proposals to the USWG.

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Questions?

Thanks for attending the
UEFI Summer Plugfest 2011

For more information on
the Unified EFI Forum and
UEFI Specifications, visit
http://www.uefi.org

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But wait, there's more …

Wed (July 6)

- UEFI State of the Union (10:30am, Intel)
- Implementing a Secure Boot Path with UEFI 2.3.1 (1:00pm, Insyde)
- UEFI SCT Overview (2:30pm, HP/Intel)

Thu (July 7)

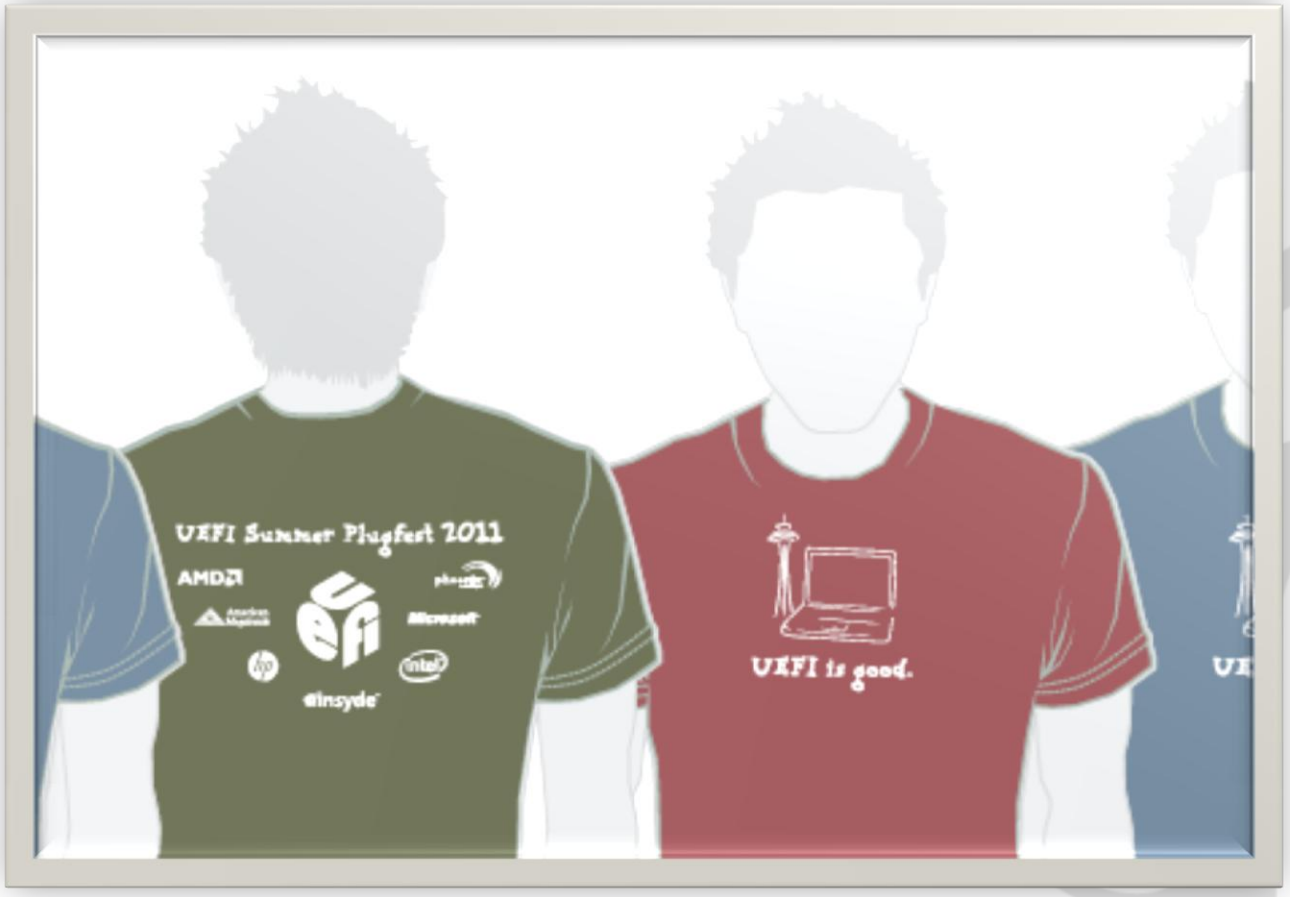
- Replacing VGA: GOP Implementation in UEFI (10:30am, AMD)
- UEFI prototyping using a Windows-hosted UEFI environment (1:00pm, Phoenix)
- EFI Shell Lab (2:00-4:00pm, "Thunder", Intel)
- GOP Enabling & Testing Lab (4:30—5:30pm, "Thunder", Intel)

Fri (July 8)

- Best Practices for UEFI Option ROM Developers (10:30am, AMI)

Download presentations after the plugfest at www.uefi.org

And don't forget your shirts …



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