



Intel® 845G/GL Chipset Dynamic Video Memory Technology

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1. Introduction

This document describes the memory allocation and usage model for the Intel® 845G/GL chipset with the Intel® Extreme Graphics Drivers. This document assumes that the reader already has an understanding of the feature set of the Intel® 845G/GL chipset.

Note: this document is intended to address current feature sets, and does not mention future or proposed new features or functionality.

2. Overview

2.1 Dynamic Video Memory Technology

This document describes the method of memory allocation where operating system, application and video memory come from the one unified system memory pool known as **Unified Memory Architecture (UMA)**.

Dynamic Video Memory Technology (**DVMT**) is an enhancement of the UMA concept, wherein the optimum amount of memory is allocated for balanced graphics and system performance, through Direct AGP known as **Non-Local Video Memory (NLVM)**, and a highly efficient memory utilization scheme. DVMT ensures the most efficient use of available memory – regardless of frame buffer or main memory sizing – for maximum 2D/3D Graphics performance. DVMT dynamically responds to system requirements, and applications demands, by allocating the proper amount of display, texturing and buffer memory after the operating system has booted. For example, a 3D application when launched may require more vertex buffer memory to enhance the complexity of objects, or more texture memory to enhance the richness of the 3D environment. The operating system views the integrated graphics driver as an application, which uses Direct AGP to request allocation of additional memory for 3D applications, and returns the memory to the operating system when no longer required.

2.2 Legacy VGA/SVGA Memory

DVMT is a unique architecture that can use a variable amount of system memory for graphics, adjusting the balance depending on demand. The Intel 845G/GL chipset also supports the selection of three different sizes of pre-allocated memory: 512KB, 1MB, or 8MB. This amount is chosen via the system BIOS as a setup option. This pre-allocated memory selection is supplied for legacy VGA and SVGA graphics support, and compatibility.

Upon boot, the System BIOS will pre-allocate the amount selected (512KB, 1MB, or 8MB) from the top of the main system memory. This will be dedicated for VGA/SVGA graphics. An example of when VGA video memory is needed includes usage for high-resolution games and applications run from a DOS or a legacy operating system (OS), where there is no Intel Extreme Graphics Driver loaded. Once the OS boots this pre-allocated memory is not seen, and is not visible by the OS. The Intel 845G/GL integrated graphics device will treat this memory as a true dedicated frame buffer. If an OS is booted with an Intel Extreme Graphics Driver loaded, the pre-allocated memory will then be reclaimed for use by the graphics driver, but the OS may never use this memory, and it is not available to applications except as video memory.

Note: The BIOS **pre-allocates** memory that the OS is not aware of, nor is the OS capable of reclaiming this memory. The Intel Extreme Graphics Driver **allocates** by requesting memory, from the OS, through OS supported memory allocation methods.

3. DVMT 2.0 Video Memory Allocation

The Intel Extreme Graphics Driver determines the size of the pre-allocated memory needed and will make additional Non-Local Video Memory requests to achieve the amount needed for the display and application requirements.

3.1 Factors in Video Memory Size Variance

The video memory size in the Intel® 845G/GL chipset varies and is determined using several factors. The key factors are system resources and system activity. Unlike the Intel® 810 and 815 chipset family, the video memory size for the Intel® 845G/GL chipset is not static. It will vary in size as system requirements and demands vary. For example, when running a DVD in a window on the desktop, the memory is needed for the DVD and the background desktop, but when running a DVD full screen, the desktop frame-buffer may be discarded, or allowed to be paged back to disk. This is the most efficient memory utilization.

A DVD is just one of many activities that could affect memory allocation. This section will describe some of the factors that aid in the request made to the OS for page locked memory. The OS does not always grant the graphics driver's memory request.

3.2 Base Allocations

Part of the video memory allocation is independent of system activity. These are base allocations that the driver requests at the time it loads. For Intel® 845G/GL chipset-based platforms, the driver allocates 204KB for the command ring buffer and cursor/context buffer memory on all operating systems.

Once loaded, the operating system and graphics driver allocates the buffers that the driver needs for performing graphics operations. The total video memory allocated includes memory for commands, frame buffer (resolution), Z-buffer, GDI data, and off-screen memory.

3.3 Maximum Allocations

When all video memory is being allocated from system memory, the total video memory allocation is capped to an upper-limit ensuring the best usability and performance of the OS, applications and graphics.

The Intel 845G/GL chipset-based platform supports a minimum of 128 MB of system memory. With **128 MB** of system memory, the Intel Extreme Graphics Driver will limit the video memory to **32 MB**.

On driver versions up to but not including **PV11.1**;
With **greater than 128 MB** of system memory, the Intel Extreme Graphics Driver will limit the video memory to **48 MB**.

Beginning with driver version **PV11.1**, the video memory for systems with **greater than 128 MB** is increased to **64 MB**. This was done to improve graphics performance.

3.4 Memory Allocation examples

In the following scenarios, formulas are provided to calculate what the driver may request for video memory. Note: The driver utilizes pre-allocated memory before it makes a request to the OS. Also, the memory calculated below is in addition to the 204KB that is allocated once the driver is loaded.

3.4.1 Acronym Definition

Abbreviation	Definition
PDTH	Primary Desktop Height
PDTW	Primary Desktop Width
PDTCD	Primary Desktop Color Depth (Bytes: 8bit = 1 Byte, 16bit = 2 Bytes, 32bit = 4 Bytes)
DVDH	DVD Height
DVDW	DVD Width
DVDCD	DVD Color Depth (Bytes)
GH	Game Height
GW	Game Width
GCD	Game Color Depth (Bytes)

Table 1. Acronyms

3.4.2 Memory Requirements Formulas

Scenario	Formula	Comments
Idle Desktop	$(PDTH \times PDTW \times PDTCD)$ $800 \times 600 \times 2 = 960000 \text{ Bytes, } 937.5\text{Kb}$	Desk only memory usage. $800 \times 600 @ 16\text{bit color} = \sim 1 \text{ Mb}$
DVD in Window	$(PDTH \times PDTW \times PDTCD) + (DVDH \times DVDW \times DVDCD)$	This takes into account the desktop and DVD that is playing.
Full Screen DVD	$(DVDH \times DVDW \times DVDCD)$	Discard the desktop because it cannot be seen.
Game in Window	$(PDTH \times PDTW \times PDTCD) + 4 \times (GH \times GW \times GCD)$	This takes into account the desktop and the game that is being played. Note: The game could be triple buffered and utilize the Z/W buffer. That is why there is a 4X multiplier.
Full Screen Game	$4 \times (GH \times GW \times GCD)$	Discard the desktop because it cannot be seen.

Table 2. Memory Usage

4. Reported Video Memory

In systems using an Intel® Direct AGP chipset, such as the Intel 845G/GL chipset with **Intel® Extreme Graphics Drivers**, end users will be presented with various messages/displays concerning “video memory size”. This section describes the messages displayed by the operating system, video BIOS and driver.

4.1 Video BIOS POST message

Users may first be presented with “video memory size” messaging in the video BIOS “splash” or “boot” message. This message displays the amount of main system memory that will be used solely for video BIOS purposes. DOS, for example, will use only this memory for display. Video BIOS will use either 512KB, 1MB, or 8MB based on system BIOS settings. From the operating system perspective, this memory is logically removed from the system so that it is invisible (for example, a 128MB system using an 8MB setting in system BIOS will report 120MB of TOTAL system memory). This is the pre-allocated memory already mentioned in section 2.2

4.2 Windows* NT*4.0 / 2000 / XP Display Properties “Adapter” Tab

Microsoft Windows* NT* 4.0, Windows 2000 and Windows XP operating systems contain an “Adapter” tab that is located in the “Display Properties” / “Settings” / “Advanced” dialog in Windows 2000 and Windows XP and is located in the “Display Properties” / “Settings” / “Adapter” dialog in Windows NT 4.0. This tab displays the maximum amount of frame-buffer memory possible by the graphics device.

4.3 Microsoft* DirectX* Diagnostic Tool

The Microsoft* DirectX* Diagnostic Tool is included in most versions of Windows. On the “Display” tab of this utility, there is an item labeled: “Approx. Total Memory.” The amount of video memory listed on this tab varies among Windows versions, DirectX versions, graphics driver versions, and the current video mode. In Windows 98 configurations, the amount reported will typically be .5 MB to 5 MB or higher, depending on screen resolution and applications running.

On Windows 2000 and Windows XP only, the video memory size reported in the Microsoft* DirectX* Diagnostic Tool is always 32 MB. This graphics driver change is to support applications and games that use the same method as the DirectX Diagnostic Tool to determine the amount of video memory. Microsoft Plus! for Windows* XP is one such application. The reported memory will be 32 MB, even if system memory is more than 128 MB.

4.4 Video Memory Checks in DirectX* Games

Some games that use DirectX for graphics display will check for available video memory in order to confirm that the system meets the minimum requirements to run the game. There are a number of different methods used to determine available video memory:

- Some games use a DirectX call to get the amount of local video memory. Games that use this method to check for 8 MB or more of local video memory in Windows 98 may fail to install or run with DVMT.
- Some games may request that *only* local video memory be allocated for performance reasons. With DVMT, only non-local video memory may be available for the game, resulting in the game failing to run.

In most cases, a patch for the game can correct either of these issues.