

Intel's Next Generation Integrated Graphics Architecture -Intel® Graphics Media Accelerator X3000 and 3000

White Paper

Ground breaking hybrid architecture for increased performance and flexibility for delivering a compelling graphics and video experience

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Gamers and Media enthusiasts have been long demanding better technology for unparalleled ultra-realistic visual experience and the demand will be even greater in the future. Intel has answered the current demand to support future technologies by unveiling its hybrid graphics architecture with the introduction of Intel® Graphics Media Accelerator 3000 (Intel® GMA 3000) family engine. This state-of-the-art hybrid architecture evolved as a balance between fixed function and programmability. The graphics engine of the Intel® Graphics Media Accelerator 3000 family consists of a scalable array of symmetric processing components known as execution units (EUs) which can be programmed to dynamically process graphics or media data alike. Programmability of the EUs adds flexibility and enables support for future graphics and media usages by upgrading the driver. Execution units support dynamic load balancing, multi-threading, and multi-functional data processing, resulting in increased performance to enable a more compelling gaming and visual experience for main stream users.

Intel's next generation architecture shows Intel's continued innovation by delivering greater flexibility and performance to meet the needs for the current and future consumer and corporate applications.

The new Intel Graphics Media Accelerator architecture with its greater performance and flexibility will be the basis for many new consumer and corporate applications. For consumers, the Intel® Graphics Media Accelerator X3000 engine supported on Intel® G965 Express chipset has been optimized for enhanced 3D to allow for greater game compatibility and realism with new video and display features to deliver a theater-like entertainment experience through Intel® Clear Video Technology. For corporate users, Intel® Graphics Media Accelerator 3000 engine incorporated in Intel® Q965/Q963 Express chipsets continues to offer stability, ease of use, and lower power consumption, in a cost effective solution. The Intel® Graphics Media Accelerator 3000 family engine is eligible for the Microsoft Windows Vista*Premium logo.

Intel's next generation Graphics Media Accelerator that provides new levels of graphics and video responsiveness in a cost effective solution. The Intel graphics engine is integrated into the Graphics Memory Controller Hub (GMCH) and enables a low power, reduced form factor solution compared to power-hungry discrete graphics cards.



Evolution of Graphics

Graphics architecture has undergone significant evolutionary changes in this decade to bring to life environments for ultra-realistic graphics and theater-like media on the screen. Yet the challenge to provide greater realism and natural images remains. The details of the nature that provide unparalleled realism include shades of color, smooth textured surfaces, and subtle lighting effects.

To create realistic-looking 3D objects, every image in a scene has to go through the 3D pipeline- geometry or vertex processing, lighting, rasterization, set up, texture mapping, pixel processing, and coloring before the image is rendered on the screen.

With the evolution of graphics technology, in every generation the programmability of each component of the 3D pipeline has evolved with improved performance and flexibility to process greater detail and visual effects. With the arrival of Intel's next generation graphics architecture the notion of fixed functions units and limited programmability for processing specific types of data has given way to generalized programmable engines supporting multi-functional data execution and processing, providing incredible flexibility and performance.

Figure 1 represents the evolution from 2000 to 2006. Further, more traditional architectures used fixed

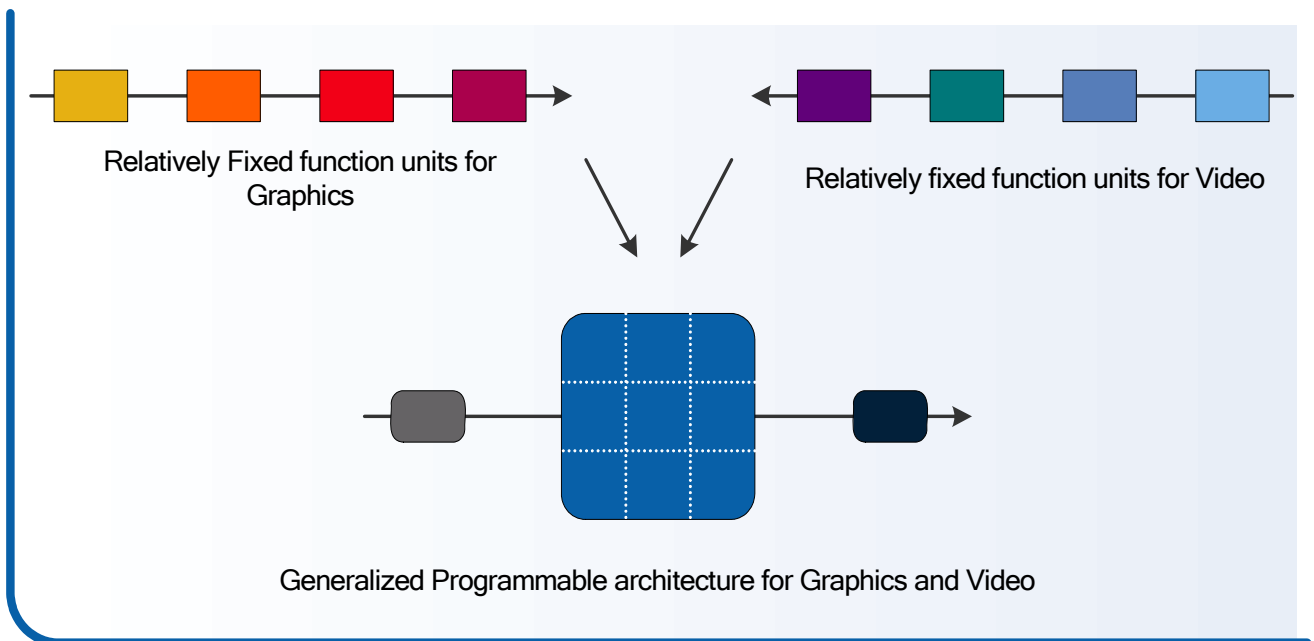


Figure 1. Graphics Evolution from 2000 to 2006



function processing units for processing a particular type of graphics or video data and each unit was optimized for speed. In traditional architectures there is an added cost to accommodate new features as the hardware needs to be upgraded. But

Intel's next generation GMA 3000 family architecture provides new levels of flexibility because of the programmable multi-functional and multi-threaded execution units (EUs) to easily enable new features by upgrading the driver suites.

Intel® Graphics Media Accelerator 3000 Family Innovations

With Intel's next-generation Graphics Media Accelerator, Intel continues to drive innovative platform enhancements that increase the overall performance for the end user. This next-generation Intel graphics architecture is designed to be extensible and offers extraordinary features. This section discusses the benefits of the Intel® Graphics Media Accelerator 3000 architecture features and innovations: programmability, dynamic load balancing, multi-threading, multi-function, 32 bit full precision compute, and dynamic and static flow control which enable more stunning graphics in games and video applications.

Programmability

The Intel® Graphics Media Accelerator 3000 architecture is programmable and fixed function technology balanced to achieve high flexibility and performance for graphics and video applications. The Intel® Graphics Media accelerator 3000 engine consists of programmable array of symmetric processing components known as execution units (EUs).

This programmability allows new graphics and video features to be added with the simple driver upgrades. Improved programmability means greater flexibility for independent software vendors (ISVs) and improved features for original equipment manufacturers (OEMs).

Dynamic Load Balancing

Dynamic load balancing is an architectural feature that enables faster processing of the graphics and video workloads for improved performance.

The Intel® GMA 3000 family graphics engine consists of a programmable array of symmetric execution units to process graphics and video data threads. These EUs can perform many tasks or process many kinds of graphics or video threads, which permits greater execution, parallelism, and load balancing among the available EUs and enabling efficient use of EUs while increasing video and graphics performance. With the previous fixed function units, each unit was limited to perform specific tasks or process specific threads, which resulted in



certain units being idle at any instant and as a result reducing efficiency.

Dynamic Load balancing increases the game play performance, enables greater realism, and enhances viewer fidelity.

Multi-functional

The Intel® Graphics Media Accelerator 3000 family is multi-functional and can easily switch between executing graphics-related tasks or video related tasks. The array of EUs can dynamically switch to process either graphics threads (for both vertex and pixel processing) or video threads (decode and post-processing) depending on the application being processed.

The Multi-functional feature supported on the new generation Intel® Graphics Media Accelerator 3000 family enables

Multi-threading

The Intel® Graphics Media Accelerator 3000 family engine has a massively threaded architecture. The whole array of symmetric execution units has been designed to process multiple threads of graphic or video data simultaneously. In traditional graphics architecture, as the compute frequency increases, the time it takes to read or write memory is longer for the EUs and more idle periods will appear while waiting for access to the memory. However, Intel's next-generation architecture reduces these inefficiencies due to its multi-threading capability; EUs have many threads to choose from at any instant in time and with multi-threading capability can automatically switch to execute ready threads while the other threads may be waiting on memory

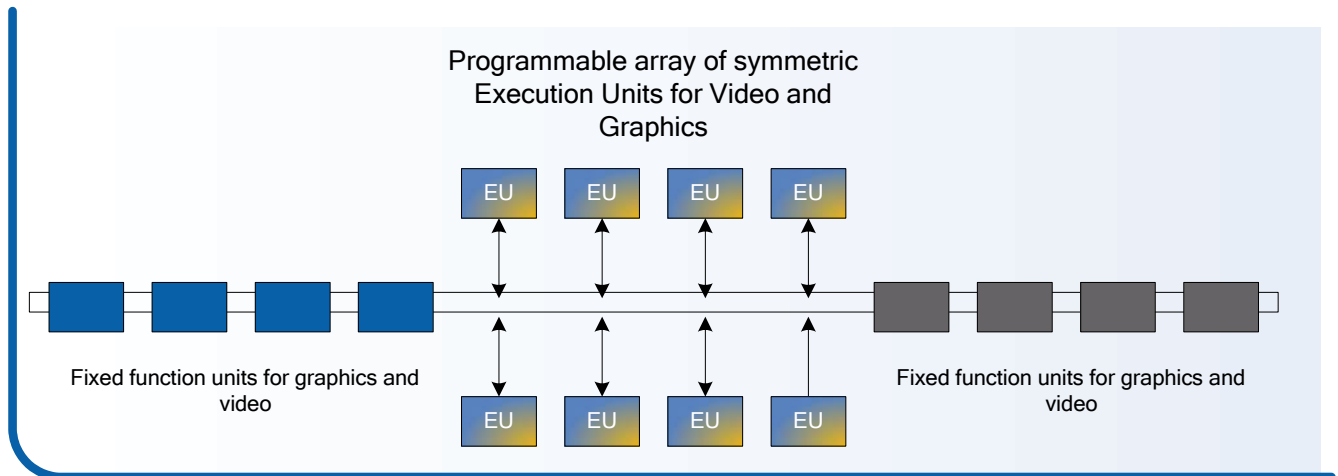
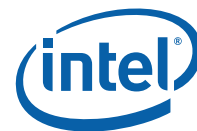


Figure 2. Intel's Next Generation Graphics Architecture Overview.

smaller real estate and lower power requirements and provides more appealing graphics and video performance.

access. When the current thread process is completed, each EU then switches to the next highest priority thread.



Multi-threading helps to boost the shader performance and increase game and media delivery speed for stellar visual performance.

Figure 2 shows balance between fixed function and programmability. The symmetric array of EUs is programmable, multi-threaded, multi-functional and supports dynamic load balancing.

Dynamic and Static Flow Control

Dynamic and static flow control is a new feature supported on the Intel® GMA 3000 family. It moves the baseline up and provides consistent features between discrete graphics cards and integrated graphics engine. This feature enables creating shaders with conditional control which will allow developers to create more advanced and complex effects or allow more

flexibility in code generation and management.

32-Bit Floating Point Compute

Advanced animations and real-time effects are compute-intensive and demand high precision to maintain image quality. Intel's next generation graphics engine supports 32-bit floating point precision on operations throughout the pipeline. The 32 bit floating point operation offers a higher range to handle an image or a scene than a fixed point.

The 32-bit precision floating point operations enhance the visual experience of 3D games with increased visual quality and allow for incredible levels of detail by delivering improved real time lighting effects such as blooming, refraction and light maps.

Intel® G965 Express Chipset with the Intel® GMA X3000

The Intel® G965 Express chipsets that incorporate Intel® Graphics Media Accelerator X3000 runs at 667 MHz and supports a dual channel memory bandwidth of up to 12.8 GB/s and dynamic video memory of 384 MB for enabling an enhanced consumer gaming and video experience. This section lists the enhanced graphics and video features supported on the Intel® G965 Express chipset based platforms because of Intel® GMA X3000.

3D Graphics Features

Shader Model 3.0

Shader Model 3.0 is a high level shader language used by developers for vertex and pixel processing. Shader Model 3.0 ensures greater compatibility and performance for DirectX* 9.0 based applications. Shader Model 3.0 consists of Pixel Shader 3.0 and Vertex Shader 3.0



Vertex Shader 3.0

Used for vertex processing.. Vertex Shader 3.0 enables unique and stunning visual effects in 3D games through object deformation, motion blur, and fish eye lens effects. With Vertex Shader 3.0 the original objects can be reshaped in any manner and add surface detail to enhance realism through displacement mapping.

Pixel Shader 3.0

Used for pixel processing. Pixel Shader 3.0 enables complex animations in gaming with realistic shading, lighting, and textures.

Hardware Geometry Processing

Hardware geometry processing helps to accelerate the game play and improve game capability. Transform and Lighting (T&L) processes are very compute intensive. Hardware Transform and Lighting (T&L) helps offload geometry processing-vertex shading, clipping and set up from the processor to the graphics engine. This allows the processor to perform more intensive calculations for artificial intelligence, physics, and improved sound effects thereby increasing the overall platform performance.

Hardware geometry processing can enable greater game compatibility and increase game play.

High Dynamic Range

Stunning lighting effects are critical to bring more realistic environments to life on the screen. The Intel® G965 Express chipset with Graphics Media Accelerator X3000 supports high dynamic range for visual enhancements through floating point operations for vertex and pixel shading, texture mapping and color blending. The human eye is more sensitive to light than color so High dynamic range (increased blooming, refraction and light maps) is very important in delivering ultra-realistic images and scenes.

Intel® Clear Video Technology

The Intel Graphics Media Accelerator X3000 supports Intel® Clear Video Technology which enables a high definition theater experience for consumers. Intel® Clear Video Technology enables enhanced high definition video playback, improved picture quality, vibrant colors, and advanced display capabilities on the PC to deliver a richer and more appealing media experience. Intel® Clear Video Technology has the following features and benefits.

Advanced De-interlacing

Intel® Graphics Media Accelerator X3000 enables hardware accelerated pixel adaptive de-interlacing algorithms that enable sharper images and improved picture quality when playing back interlaced content such as recorded video and television programs.



Advanced De-interlacing reduces static and motion artifacts, improving the clarity and precision of the video picture for display on modern progressive televisions and PC monitors.

MPEG-2 Hardware Acceleration

Hardware acceleration of MPEG-2 decode enables seamless playback of high definition (HD) video including dual stream to deliver a smooth playback experience without dropped frames or stuttering. Hardware acceleration of inverse discrete cosine transform (iDCT) and motion compensation allows for greater multitasking, delivers higher frame rates and lower processor utilization for high definition (HD) video playback.

ProcAmp

ProcAmp enables vivid colors and bright media playback. ProcAmp provides improved user controls for brightness, saturation, hue and contrast calibration. These settings can be applied directly to the video stream independent of the desktop settings. By allowing the user to enhance low color saturation, boost low lit scenes or faded color film. ProcAmp helps to enhance the consumer experience of sharing high-quality videos in any environment.

WMV9 HD decode

Intel® GMA X3000 enables hardware accelerated decode of WMV9 HD content allowing playback of higher bit rate content. This also enables smooth playback of high definition videos while

freeing up the processor for other important tasks.

Advanced Display Connectivity

Intel® Clear Video Technology supports new display capabilities including HDMI to provide a true digital media experience. This also offers easy connection to HDTV and PC monitors.

HDMI- This technology supports uncompressed digital audio and video (standard, enhanced or high-definition) plus multi-channel audio on a single cable. This interface provides high quality audio and video through a simple and easy connection between the set-top box, DVD player, and television.

Microsoft Windows Vista* Support

The Intel Graphics Media Accelerator 3000 family is eligible for Microsoft next operating system Windows Vista* Premium logo. The state of the art architecture of Intel® GMA 3000 family enables key components such as Shader Model 2.0 or better, support for WDDM driver (Intel® GMA X3000 only) 3D hardware acceleration capabilities equal to DirectX9.0c (Intel® GMA X3000 only), 32 bits per pixel, video memory of 384 MB for Intel® GMA X3000 and 256 MB for Intel® GMA 3000 and dual channel memory bandwidth up to 12.8 GB/s. These components enables users to take full advantage of the Windows Vista* operating system features for better digital (movies, video, and music) entertainment, photo, and gaming experiences.



Intel® Q965, Q963 Express Chipset with the Intel® GMA 3000

Intel Q965 and Q963 Express chipsets incorporate Intel's next generation graphics engine - Intel Graphics Media Accelerator 3000.

Intel® GMA 3000 graphics engine core runs at 667MHz, supports up to 12.8GB/s of memory bandwidth and video memory of 256 MB and offers great advantages to the corporate world.

Quality and Stability

All the critical components (such as software drivers, corporate applications and hardware) are built, tested and validated by Intel for providing the highest quality platforms. Intel® Graphics Media Accelerator 3000 supports Intel® Stable Image Platform Program (SIPP) for reducing the qualification and deployment costs and delivering stable platforms to the corporate world. The unified driver stack supported on the Intel Q965/Q963 Express chipset family allows businesses to reduce software qualification and maintenance costs across all platforms while enhancing the stability of their platforms.

Next Generation Client

The Intel® Graphics Media Accelerator 3000 is optimized for Windows Vista* Aero experience and is capable of supporting the Microsoft Windows Vista* Premium logo program.

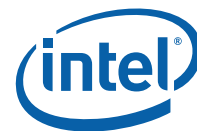
The Intel® GMA 3000 family supports both ADD2 and Media Expansion cards (MECs). When combined with an ADD2 or MEC, the Intel® Q965 Express chipset can support dual independent displays enabling a business user to expand their visual workplace without constant toggling between applications.

Lower Cost and Power

Intel® Graphics Media Accelerator 3000-enabled systems provide reduced system costs, reduced power needs, and reduced noise through passive thermal solutions without sacrificing the performance business users need when compared to more expensive power-hungry discrete graphics cards. The lower power enables greater form factor flexibility for space restrictive environments.

Graphics and Video Features

Intel® Graphics Media Accelerator 3000 supports DirectX 9.0c, Shader Model 2.0, 256 MB of video memory, and dual independent display through ADD2 and MEC cards. These chipset capabilities and features allow for enhanced productivity with unsurpassed quality and stability for corporate usages.



Graphics Memory

Memory bandwidth is important in delivering a quality graphics and media user experience. With the introduction of Intel® Fast Memory Access technology and Intel® Flex Memory Technology, Intel was able to dramatically reduce the memory latency and configure the memory for maximum utilization.

Intel® Fast Memory Access technology supports DRAM controller enhancements such as just in time scheduling, command overlap, out of order scheduling, and opportunistic writes designed to reduce the memory latency and increase the memory access speed.

The Intel® 965 Express chipset family memory controller can be configured to support single channel mode, dual channel asymmetric mode, and dual channel symmetric mode configurations. Intel® Flex Memory Technology helps to deliver the stunning system performance by efficiently configuring asymmetric memory configurations to deliver dual channel performance on shared size while not requiring matched memory pairs.

These memory performance improvements correlate to an improved Microsoft Windows Vista* experience on the Intel® 965 Express chipset family platforms, since performance scales with memory bandwidth.

The Intel GMA 3000 family supports Intel® Dynamic Video Memory Technology 4.0. The system memory is shared by both graphics and system usages. Intel® Dynamic Video Memory Technology 4.0 ensures that the graphics applications are allocated memory depending on the requests and the allocated memory is released to the system once the application is closed. This technology allows for up to 384 MB of memory for Intel® G965 Express chipset and 256 MB of memory for Intel® Q965/Q963 Express chipset being allocated to the graphics engine in the next-generation architecture. This provides more memory for intensive applications for maximum system performance.



Summary

The Intel® Graphics Media Accelerator 3000 family is a new state-of-the-art hybrid innovative architecture forming a balance between fixed function and programmability, designed to offer greater flexibility for new features on the go, outstanding graphics and video performance, power to support tomorrow's complex graphics and video features, and usages. This is a true leap ahead in graphics architecture and provides a foundation for future graphics media accelerators on Intel platforms.

The Intel GMA 3000 family has an extensible architecture; programmable and scalable for increased performance. The architecture is extensively multi-threaded, multi-functional; it can process graphics and media threads, and dynamically balances the thread processing among the symmetric array of execution units. This architecture enables an easy way to react with the changing environment of new usages of graphics or media features by upgrading to a new driver suite.

Higher memory bandwidth is critical to graphics and video performance. Intel® Flex Memory Technology, Intel® Fast Memory Access, and Intel® Dynamic Video Memory Technology 4.0 supported on Intel® 965 Express chipset family platforms provide higher memory bandwidth and reduced memory latency to deliver enhanced graphics and video effects. These technologies help to reduce the memory latency and efficiently configure the platform memory for the graphics engine and system usages.

The Intel® GMA 3000 family is optimized for many consumer and corporate solutions. For mainstream consumers, Intel® GMA X3000 offers enhanced 3D features such as Shader Model 3.0, 32-bit floating point compute, and hardware T&L for greater realism, and Intel® Clear Video Technology for an enhanced home theater digital entertainment experience. For corporate users, Intel® GMA 3000 offers easier access, greater stability, lower power consumption, and a more cost effective solution. The Intel® GMA 3000 family is Microsoft Windows Vista* Premium capable to take advantage of the latest consumer and corporate applications.



Graphics and Video Features of the Intel 965 Express Chipset Family

Platform	Intel® G965 Express Chipset	Intel® Q965 Express Chipset	Intel® Q963 Express Chipset
Hardware T&L	Yes	No	No
Floating Point Operations/Render Target	16 and 32 bit Floating Point	Fixed Point	Fixed Point
Vertex Shader Model	3.0 (Hardware)	2.0/3.0 (Software)	2.0/3.0 (Software)
Pixel Shader Model	3.0	2.0	2.0
MPEG-2 Decode	iDCT + Hardware Motion Compensation	Hardware Motion Compensation	Hardware Motion Compensation
WMV9 HD Decode	Hardware Acceleration	SSE/SSE2 Optimized Processor Support (S/w Only)	SSE/SSE2 Optimized Processor Support (S/w Only)
De-interlacing	Advanced De-interlacing (SD only)	Advanced De-interlacing (SD only)	Advanced De-interlacing (SD only)
Color Control (ProcAmp)	Brightness/Hue/Saturation/Contrast	N/A	N/A
Content Protection	COPP/PMP w/ HDCP	COPP/PMP w/ HDCP	COPP/PMP w/ HDCP
Display Support (through SDVO devices)	Dual Independent, HDMI	Dual Independent	Dual Independent
Display Support	RGB (QXGA) HDMI, DVI, HDTV (1080i/p, 720p), Composite, Component, S-Video (via Intel® SDVO)	RGB (QXGA) DVI, HDTV (1080i, 720p), Composite, Component, S-Video (via Intel® SDVO)	RGB (QXGA) DVI, HDTV (1080i, 720p), Composite, Component
Max Resolution	QXGA 75Hz (2048x1536)	QXGA 75Hz (2048x1536)	QXGA 75Hz (2048x1536)
Peak Memory Bandwidth	12.8 GB/s	12.8 GB/s	10.6 GB/s
Max Dynamic Video Memory (with DVMT 4.0)	384 MB	256 MB	256 MB
DirectX* API Support	DirectX* 9.0c	DirectX* 9.0c	DirectX* 9.0c
OpenGL* API Support	1.5	1.4 + Extensions	1.4 + Extensions
DirectX* VA Support	v.1.0/v.2.0	v.1.0/v.2.0	v.1.0/v.2.0
Microsoft Windows Vista* Support	Vista* Premium	Vista* Premium	Vista* Premium
Microsoft Windows* Driver Model	XPDM and WDDM	XPDM and WDDM	XPDM and WDDM
Linux*	Red Hat*, SuSE*	Red Hat*, SuSE*	Red Hat*, SuSE*

Learn More

You can learn more about Intel® G965, Q965, Q963 Express Chipsets at these Intel websites:

Intel Platforms

www.intel.com/platforms

Intel® 965 Express Chipset Family Datasheet

www.intel.com/design/chipsets/Q965_Q963/documentation.htm

Intel® 965 Express Chipset Family Memory Technology and Configuration Guide White Paper

www.intel.com/design/chipsets/Q965_Q963/documentation.htm



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