White Paper
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Choosing the Right Media Paths to Facilitate Hardware Acceleration

Media Solution for Retail Independent Software Vendors (ISVs)

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Executive Summary

This paper provides detailed guidance for choosing the right media-development Application Programming Interfaces (APIs) for different retail usage models and devices on Windows* 7 and Windows* 8 operating systems (OSs). When Independent Software Vendors (ISVs) make decisions on which approach to take for their own media applications, there are five key factors that may influence their decisions: hardware investment, software resource investment, performance, flexibility, and software implementation speed.

This paper provides detailed guidance for choosing the right media development APIs for different retail segments, from Entry to Mainstream and High-end.

This paper does not include implementation details, but does provide related media references, such as Intel® Media SDK and other media development APIs, to help ISVs develop their media content as the next step.

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Business Challenge

In today's retail environment, many retailers are creating retail solutions in digital format, such as advertisement walls in digital signage, intelligent Automated Teller Machines (ATMs), health-screening kiosks, digital vending machines, etc. Media plays an important role in those solutions beyond 2D/3D graphics and display.

For software companies whose products create or play back digital video content, developers must keep up with the changes in hardware, understand the hardware architectures and develop code that is optimized to partition workloads between the Central Processing Unit (CPU) cores and Graphics Processing Unit (GPU).

Running a media application can be resource intensive, therefore it is essential to optimize the media application to ensure that it takes advantage of video hardware acceleration for video processing. This, in return, allows the system to run more efficiently (to achieve optimal performance).

However, some ISVs are new to Intel technology and face challenges in adopting the right software development path for Media. This exposes the potential risk of poor system performance.

Additionally, some ISVs have been struggling with the complexity of a variety of hardware architectures and maintaining different code paths to support each architecture. Optimizing the code for better performance is time consuming and adds to the cost of resources.

To ensure that media applications deliver the best possible performance, this paper discusses different media methodologies to help ISVs decide when to use the Intel® Media SDK in their software-development design.

Solution

The following sections detail Intel's solution for how an ISV can choose the right media development APIs for different retail segments, from Entry to Mainstream and High-end.

Proposed Media Methodologies

Most ISV multimedia applications for Windows* are based on Microsoft* DirectShow* or Microsoft* Media Foundation (MF) framework APIs. They enable ISVs to handle and process various operations on media files. There are two approaches (refer to Figure 1) to optimizing the media applications and taking advantage of Intel video hardware acceleration:

a) Media Path without Intel® Media SDK

Both Microsoft* DirectShow* plug-ins and Microsoft* Media Foundation Transforms (MFTs) are integrated with Microsoft* DirectX* Video Acceleration (DXVA) 2.0, which allows ISVs to offload video processing workloads to the GPU by calling standard DXVA 2.0 directly.

b) Media Path with Intel® Media SDK

The Intel® Media SDK supports both Microsoft* DirectShow* plug-ins and Microsoft* MFTs for both media decoding and encoding. It interfaces with DXVA 2.0 to offload the video processing workload to the GPU.

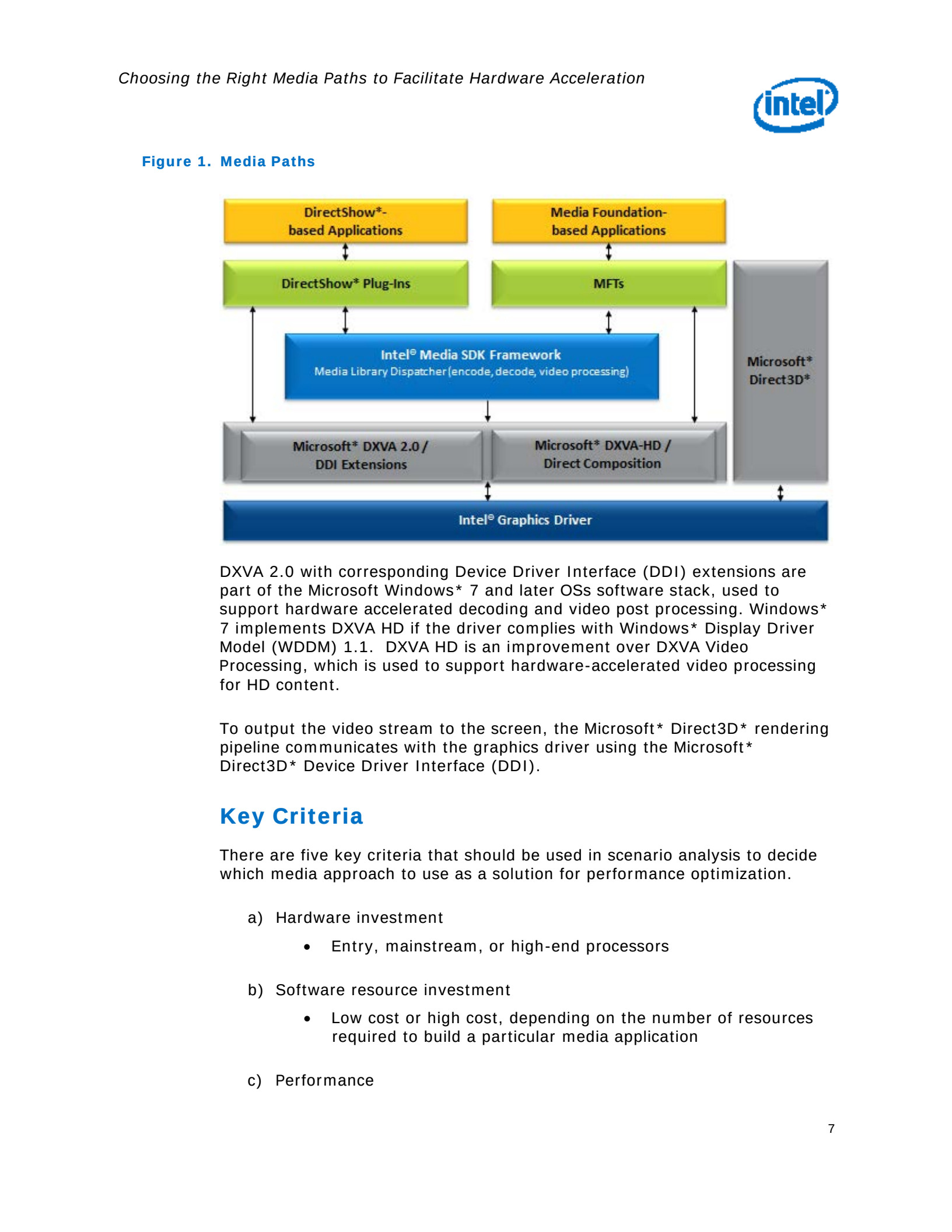


Figure 1. Media Paths

DXVA 2.0 with corresponding Device Driver Interface (DDI) extensions are part of the Microsoft Windows* 7 and later OSs software stack, used to support hardware accelerated decoding and video post processing. Windows* 7 implements DXVA HD if the driver complies with Windows* Display Driver Model (WDDM) 1.1. DXVA HD is an improvement over DXVA Video Processing, which is used to support hardware-accelerated video processing for HD content.

To output the video stream to the screen, the Microsoft* Direct3D* rendering pipeline communicates with the graphics driver using the Microsoft* Direct3D* Device Driver Interface (DDI).

Key Criteria

There are five key criteria that should be used in scenario analysis to decide which media approach to use as a solution for performance optimization.

a) Hardware investment

- Entry, mainstream, or high-end processors

b) Software resource investment

- Low cost or high cost, depending on the number of resources required to build a particular media application

c) Performance

- Moderate or high performance, depending on the usage model

d) Flexibility/Configurability/Scalability

- Limited or many, depending on how many codecs (video formats) an application can support
- Scalable or not, depending on the ability of the application to support more video streams

e) Software Implementation Speed

- Short or long application-development time, depending on the complexity of the application

Entry Retail Device

Introduction

Processing	Intel® Atom™/Celeron®/Pentium® processors
Display	Support dual display, but typically have only single display
General Media Experience	Decode and display one to two 2D/3D/HD content

The entry retail device is for the device using Intel® Atom™/Celeron®/Pentium® processors, where the device can generally support dual display, but typically uses only a single display. In general, the entry device is used to decode and display one to two 2D/3D/HD content. The recommended usage model is the display playing one constant stream; it is responsive, but not nearly as fast as Mainstream and High-End retail devices.

Use-Case Scenario 1

Company X wants to build digital signage software that supports one to two zones for playing advertisements in HD. The digital signage solution is to be played on two independent 1080p-supported displays. High performance is not required.

Intel Recommendation:

Criteria	
Hardware Investment	Intel® Atom™/Celeron®/Pentium® processors
Software Resource Investment	Low cost
Performance	Moderate
Flexibility/ Configurability/Scalability	Limited video codecs, capable of decoding one to two video streams
Software Implementation Speed	Shorter time – it is a simple, media application

Recommended Media Path: Media Path without Intel® Media SDK

Use-Case Scenario 2

Company Y wants to design Point-of-Sale (POS) software with an Intel® dual-core technology Intel® Atom™ processor. It is a value-touch POS system that supports advertisement video on the secondary display.

Intel Recommendation:

Criteria	
Hardware Investment	Intel® Atom™ processor
Software Resource Investment	Lower cost
Performance	Moderate
Flexibility / Configurability / Scalability	Value touch, limited video codecs
Software Implementation Speed	Shorter time – it is a simple media application

Recommended Media Path: Media Path without Intel® Media SDK

Mainstream Retail Device

Introduction

Processing	Intel® Core™ i3 or Intel® Core™ i5 processors
Display	Have multiple displays - typically dual
General Media Experience	Decode and display multiple 2D/3D/HD local or streamed content

The Mainstream retail devices use the Intel® Core™ i3 and the Intel® Core™ i5 processors, which are more powerful processors than the entry-level Intel® Atom™, Celeron® and Pentium® processors. While the Mainstream retail devices support multiple displays, the most common usage model is dual display. The device can decode and display 2D/3D/HD content. It provides good performance overall and good interactive responsiveness.

Use-Case Scenario 1

Company A provides a digital signage solution that supports three independent 1080p displays. The system will support up to five zones with interactive-rich media and anonymous-viewer analytics.

Intel Recommendation:

Criteria	
Hardware Investment	4th Generation Intel® Core™ i5 processor
Software Resource Investment	Higher cost
Performance	High
Flexibility / Configurability / Scalability	Multi-touch, supports a variety of video codecs, scalable for decoding multiple video streams
Software Implementation Speed	Longer time – it is a more complex, interactive software

Recommended Media Path: Media Path with Intel® Media SDK

Use-Case Scenario 2

Company B plans to come out with a multi-touch-supported vending system that works on one to two High-definition (HD) displays. The system supports touch-interactive HD content, social media and gesture recognition.

Intel Recommendation:

Criteria	
Hardware Investment	Intel® Core™ i3 or Intel® Core™ i5 processors
Software Resource Investment	Higher cost
Performance	High
Flexibility / Configurability / Scalability	Multi-touch, gesture recognition, supports a variety of video codecs, scalable for decoding multiple video streams
Software Implementation Speed	Longer time – it is more complex and configurable, interactive software

Recommended Media Path: Media Path with Intel® Media SDK

High-End Retail Device

Introduction

Processing	Intel® Core™ i5 or Intel® Core™ i7 processor
Display	Multiple to many displays
General Media Experience	Decode and display multiple to many 2D/3D/HD content

The high-end retail devices using Intel® Core™ i5 and Intel® Core™ i7 processors generally have faster CPU performance than Intel® Core™ processors in the Mainstream category. High-end devices have more capabilities than mainstream devices, thus they are intended to support multiple to many displays, allowing them to decode and display 2D/3D/HD content with the highest performance overall. The high-end devices are also the most responsive from an interactive perspective.

Use-Case Scenario 1

Company C plans to design a digital signage system to work on four displays using collage mode (4kx2k). The system supports five+ zones and is extremely interactive with multi-touch and gesture recognition enabled, anonymous-viewer analytics, and streamed, HD content.

Intel Recommendation:

Criteria	
Hardware Investment	4th Generation Intel® Core™ i5 processor
Software Resource Investment	Higher cost
Performance	Best performance
Flexibility / Configurability / Scalability	Multi-touch, supports a variety of video codecs, gesture-recognition enabled and anonymous-viewer analytics, scalable for decoding multiple video streams
Software Implementation Speed	Longer time – a more complex media application, extremely interactive and responsive

Recommended Media Path: Media Path with Intel® Media SDK

Use Case Scenario 2

Company D plans to design an interactive vending machine with face recognition that is integrated with social media applications, such as Facebook*. It supports 3D/HD streamed, advertisement content that works on multiple HD displays.

Intel Recommendation:

Criteria	
Hardware Investment	4th Generation Intel® Core™ i7 processor
Software Resource Investment	High cost
Performance	Best performance
Flexibility / Configurability / Scalability	Multi-touch/Gesture, supports a variety of video codecs, scalable for decoding multiple video streams
Software Implementation Speed	Longer time – it is a more complex and interactive media application

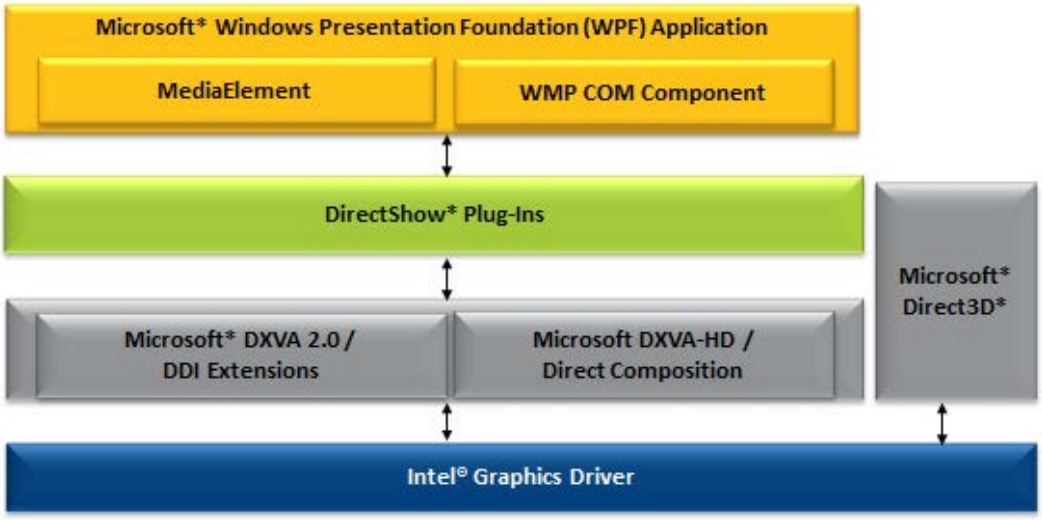
Recommended Media Path: Media Path with Intel® Media SDK

Media Path without Intel® Media SDK

ISVs can build Microsoft* DirectShow* or Media Foundation applications with the Microsoft* DirectShow* plug-ins/Microsoft* MFTs calling directly to standard DXVA 2.0 APIs for video decoding and processing.

Example 1: Creating a Windows* Presentation Foundation (WPF) Media Application Using Windows* Media Player (WMP) Control

Figure 2. Example of a WPF Application Using WMP Control



This example shows a Windows*-based media application using WPF and hardware-accelerated Microsoft* DirectShow* plug-ins. The MediaElement control is used to play video content. When playing a file in MediaElement, the Windows* Media Player (WMP) control is loaded. For video playback to work, WMP must be updated to version 10 or higher. The types of media it can play depend primarily on the kind of codecs installed on the machine.

Microsoft* DirectShow* plug-ins offload the video-processing pipeline to hardware through DXVA 2.0 API. This provides better performance. For Windows* 7 and later OSs, it implements DXVA 2.0 HD for video processing of HD content if the graphics driver complies with WDDM 1.1.

To render video content to display, it uses Enhanced Video Renderer (EVR) with custom presenter over Direct3D*.

Advantages:

1. Using this media path, there is no processing/hardware constraint for development as long as the platform supports Windows*.
2. The Windows* Presentation Foundation (WPF) allows a media application to integrate various types of content (for example, the media application can incorporate video, 2D content, 3D content, animated transitions between a sequence of images, or a combination of any of the above).

Limitation:

1. The supported media type of WPF is based on the codecs and plug-ins of the installed Windows* media player. Thus, it will only play what is supported by WMP.

   To check the supported formats in WMP:
   http://msdn.microsoft.com/en-us/library/cc189080.aspx

2. There is a potential memory leak issue using multiple MediaElements.

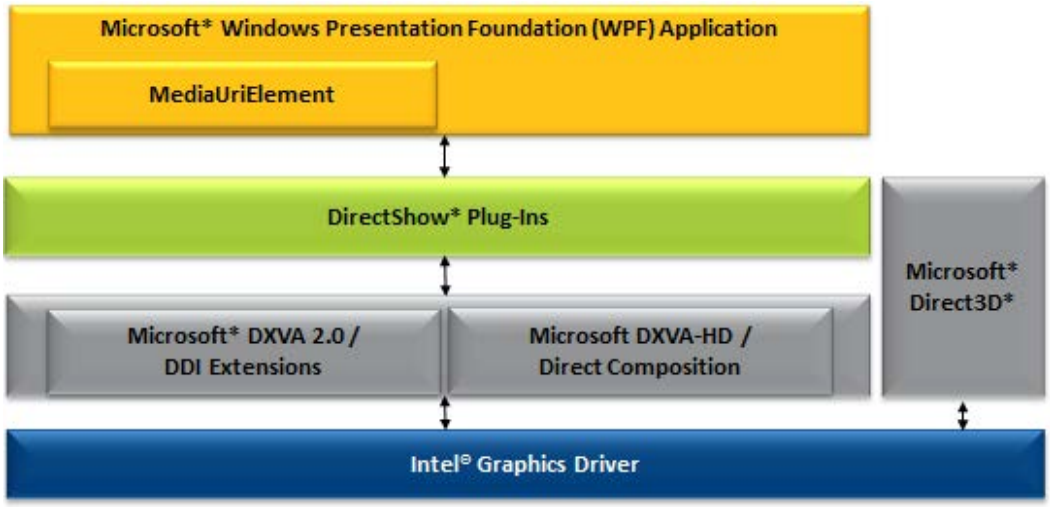
3. There might be a slow performance issue when in full screen mode.

4. Supporting Microsoft* DXVA can be a challenging area for developers. Some developers take a great deal of time developing DXVA specifications, with much trial and error putting video in a player.

Example 2: Creating a Windows* Presentation Foundation (WPF) Media Application with MediaUriElement

The following figure provides an example of Windows* WPF application with MediaUriElement.

Figure 3. Example of a WPF application with MediaUriElement



This is another WPF media-application example with MediaUriElement control that is similar to MediaElement, but does not require WMP Component Object Model (COM). It resolves the memory leak issue faced by MediaElement.

Media Path with Intel® Media SDK

Introduction

The Intel® Media SDK is a cross-platform API for developing media applications with hardware-acceleration capabilities for video decoding, video encoding, and video pre/post processing (VPP). Intel® Media SDK helps developers write software that accesses hardware acceleration for video codecs, with automatic fallback on software, if hardware acceleration is not available.

The latest Intel® Media SDK 2013 is optimized to support the 4th generation Intel® Core™ and Intel® Atom™ processor-based tablets. The new SDK includes enhanced support for Windows* 8, Microsoft* DirectX* 11, fully accelerated MPEG2 encode and MPEG/JPEG decode, and a Windows* Store development sample. Use of Intel® Media SDK 2013 also includes free licensing and source for integration with Open-Source projects and Open CL* video workloads.

Why Intel® Media SDK?

Intel® Media SDK importance for software companies

- **Supporting Future Graphics Architectures**

  Software developers are aware that optimizing and tuning software code for a particular platform requires a thorough understanding of the architectural design of the platforms and feature functionalities. With the release of the Intel® Media SDK, programming teams no longer need to master multiple graphics architectures. This single API offers a universal solution to handling video pre-processing, encoding, decoding, and transcoding for Intel® HD Graphics and future Intel architectures that are scheduled for release.

  As the Intel® Media SDK automatically supports upcoming Intel hardware releases, the potential for future savings in development costs is also high.

- **Enhancing Developer Productivity**

  Supporting Microsoft* DirectX* Video Acceleration can be challenging from a development perspective. Using the Intel® Media SDK alleviates the complexities. It is a simple, easy-to-use interface that provides integral support for DXVA, which addresses the frustrations of many developers who have struggled to implement DXVA specifications.

Also, Intel® Media SDK includes x86 legacy support. This allows systems that lack graphics hardware acceleration to revert to software implementation for decoding and encoding that will be optimized to take advantage of the processor.

- **Delivering Great Performance**

  The Intel® Media SDK assures a high-performance solution for video decoding and encoding. As the Intel® Media SDK includes support for upcoming graphics platforms, developers can write code once and it is portable to many Intel platforms. Performance is built into the process and these benefits will also extend to future releases.

Intel® Media SDK Supported Platforms

The Intel® Media SDK provides hardware-acceleration capabilities for video pre-processing, encoding, decoding, and transcoding for a broad selection of hardware platforms including:

- 2nd, 3rd and 4th generation Intel® Core™ processors that have Intel® HD Graphics
- Intel® Atom™ processor-based tablets

Note: Intel® Media SDK supports Windows* 7 and Windows* 8 operating systems (32-bit and 64-bit)

Platforms without Intel graphics hardware-acceleration capabilities still obtain the benefit of tuned, optimized, and multi-threaded software-based video encoding, decoding, and transcoding.

Intel® Media SDK-Supported Video Codecs and Pre/Post-Processing

In general, the latest Intel® Media SDK 2013 accelerates the following video codecs and pre-processing features:

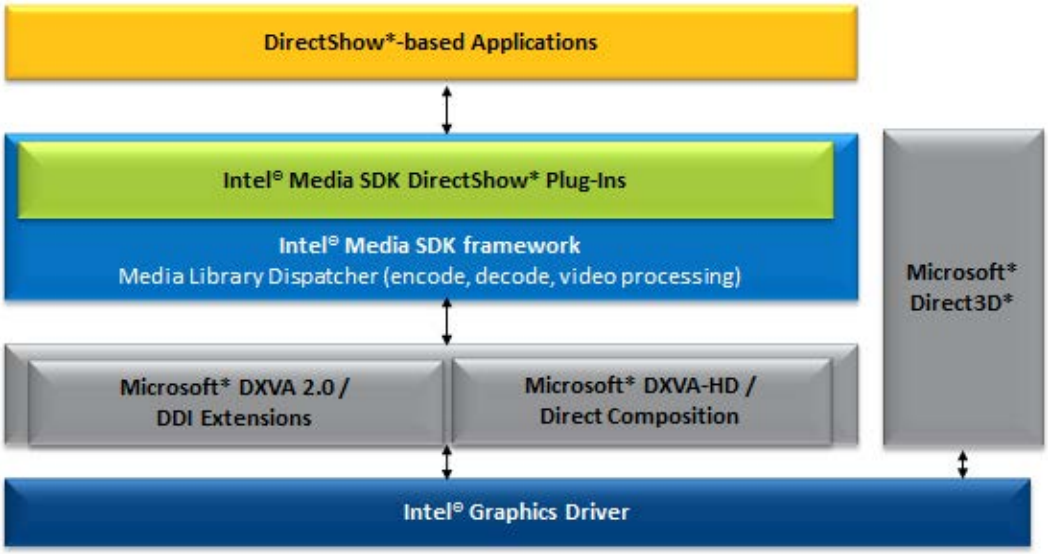
- Video Encoders: H.264, MPEG-2, MJPEG, and Multiview Video Coding (MVC) for stereoscopic 3D support. MJPEG is software-only.
- Video decoders: H.264, MPEG-2, MJPEG/JPEG, VC-1, and MVC.
- Pre and post-processing: deinterlacing/inverse telecine, resizing, color conversion, denoising, frame rate conversion, brightness, contrast, hue, saturation control, sharpening, image stabilization

Note: The supported accelerated video codecs and pre- and post-processing vary between different Intel platforms. Refer to the respective platform Product Requirements Document (PRD) for more details.

Microsoft* DirectShow*-based Application with Intel® Media SDK

The media path for Microsoft* DirectShow*-based applications with Intel® Media SDK.

Figure 4. Microsoft* DirectShow*-based Application with Intel® Media SDK



Microsoft* DirectShow* provides comprehensive facilities and is flexible. It is used by a wide range of developers and continues to be considered the architecture of choice for third-party developers today.

However, with the introduction in recent years of an alternative multimedia platform called Microsoft* Media Foundation, Microsoft is in the process of discontinuing Microsoft* DirectShow*.

Today, the Intel® Media SDK does not provide any production-ready components or APIs for Microsoft* DirectShow*. However, Intel provides some sample Microsoft* DirectShow* plug-ins that allow developers to build their own Microsoft* DirectShow* applications.

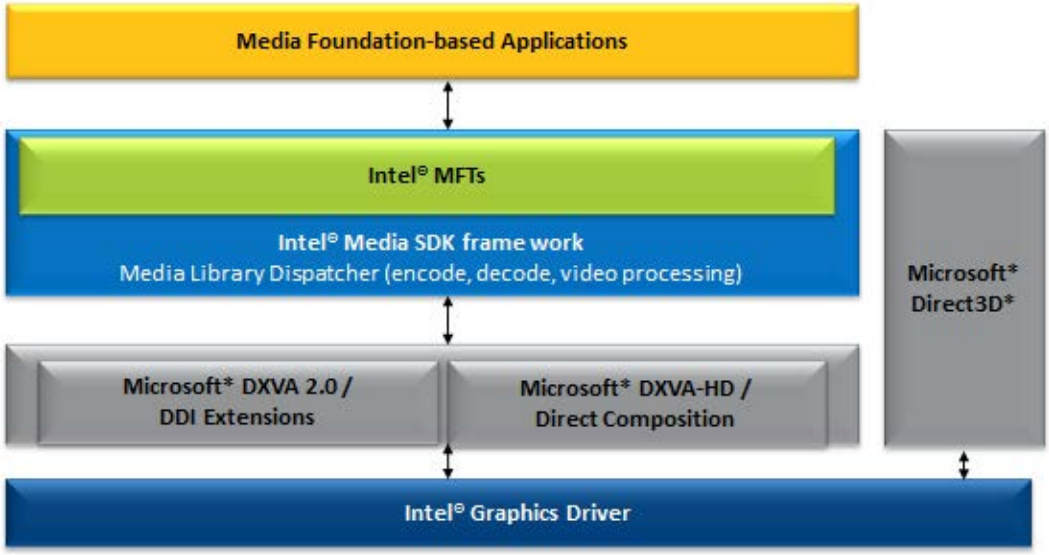
The sample supports the following input/output formats:

- H.264 Advanced Video Coding (AVC)
- VC-1 Windows* Media (WMV)—decoding only
- MPEG-2 Video
- MVC—decoding only

Microsoft* Media Foundation-based Application with Intel® Media SDK

The following figure shows the media path for Microsoft* Media Foundation-based applications with Intel® Media SDK.

Figure 5. Microsoft* Media Foundation-based Application with Intel® Media SDK



Microsoft* Media Foundation Transforms (MFTs) are a new flavor of Microsoft* DirectShow* plug-ins. Intel provides production-ready, hardware-accelerated Microsoft* MFTs, which are delivered as part of the Intel® Graphics driver release. Intel provides sample Microsoft* MFTs for developers to use to build their own Microsoft* Media Foundation applications.

The samples support the following input/output formats:

- H.264 (AVC)
- VC-1 (WMV)—decoding only
- MPEG-2 Video—decoding only

Additionally, Microsoft* Media Foundation offers a more secure Digital Rights Management (DRM)-protected environment compared to Microsoft* DirectShow*.

Starting Development with Intel® Media SDK

This paper does not describe how to implement media applications with Intel® Media SDK, but it provides some key resources to help developers get started with the Intel® Media SDK:

- Intel® Media SDK Tutorial: A quick-start tutorial that helps developers understand key Intel® Media SDK use cases: http://software.intel.com/en-us/articles/intel-media-sdk-tutorial
- Intel® Media SDK Developer's Guide: A detailed Developer Guide to help you get started developing applications quickly and easily with the Intel® Media SDK: http://software.intel.com/en-us/articles/intel-media-developers-guides
- Intel® Media SDK Samples: Source code samples accompanied by whitepapers to help you get started with Intel® Media SDK: http://software.intel.com/sites/default/files/article/265550/mediasdk-2013-sample-guide.pdf
- Intel® Media SDK Forum: Check out the Intel® Media SDK Forum to get your questions answered at http://software.intel.com/en-us/forums/intel-media-sdk

Conclusion

Some Retail ISVs have limited capital and must balance expenditures between developing good media applications and providing good platform support. Intel® Media SDK provides a standardized API that meets the coding demand on a wide range of Intel hardware platforms for most ISV's media applications. This paper provides guidance on how to choose the right media development path for different retail segments, from Entry to Mainstream and High-end. Going forward, ISVs can assess the suitability of adopting Intel® Media SDK for building an effective media application that takes advantage of the Intel® Processor Graphics hardware acceleration.

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- Microsoft* Media Foundation

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Acronyms

API Application Programming Interface

ATM Automated Teller Machine

AVC Advanced Video Coding

codec coder/decoder

COM Component Object Model

CPU Central Processing Unit

DDI Device Driver Interface

DRM Digital Rights Management

DXVA Microsoft DirectX* Video Acceleration

EVR Enhanced Video Renderer

GPU Graphics Processing Unit

HD High-Definition

ISV Independent Software Vendor

MF Media Foundation

MFT Media Foundation Transforms

MVC Multiview Video Coding

OS Operating System

POS Point of Sale

SDK Software Development Kit

VPP Video Pre/Post Processing

WDDM Windows* Display Driver Model

WMP Windows* Media Player

WMV Windows* Media Video

WPF Windows* Presentation Foundation