Windows Media Center Requirements for TV Pipeline Formats and Media Streams

August 23, 2010

Abstract

This white paper provides information about the TV pipeline formats and media streams that are supported by Windows Media Center for the Windows®7 operating system. It provides guidelines for computer OEMs and vendors to integrate a tuner solution with Windows Media Center.

This information applies to the Windows 7 operating system.

References, resources, and specifications discussed here are listed at the end of this paper.

The current version of this paper is maintained on the Web at:   
 <http://www.microsoft.com/whdc/device/broadcast/pbda/TV_pipeline.mspx>

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Document History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date | Change |  |  |  |
| August 23, 2010 | Corrected hyperlink in “Resources”. | | | |
| June 29, 2009 | 1. Corrections to Tables 1, 2, and 3 (mainly spec names, which were also corrected in “Resources”).  2. Corrected decoder file name by removing extra “MS” prefix. | | | |
| May 21, 2009 | Added note that PBDA doesnot currently use Real-Time Transport Control Protocol (RTCP). | | | |
| April 13, 2009 | First publication | | | |

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# Overview

This white paper describes the following:

* The TV pipeline formats and requirements that Windows® Media Center for Windows 7 supports, such as media stream formats, codec, content protection, and captioning.
* The media parameters of streams that are compatible with Windows Media Center.

The parameter requirements for these streams, such as codecs, bit rates, and encryption profiles.

* The standards and protocols that are used in the Protected Broadcast Driver Architecture (PBDA), which include the following:

RTP: A Transport Protocol for Real-Time Applications

Moving Picture Experts Group 2 - Transport Stream (MPEG2‑TS)

Packetized Elementary Stream (PES)

Program Association Table (PAT)

Program Map Table (PMT)

More information on many of the specifications that are referenced in this document can be found in “Resources” at the end of this paper.

**Note**This white paper refers to the support that Windows 7 provides. Support that later Windows versions provide will probably change.

# TV Pipeline Formats and Requirements

This section describes the following:

* The TV pipeline stream and captioning formats that Windows Media Center supports.
* The content protection requirements of Windows Media Center .

## Stream Formats

Tables 1, 2. and 3 define the standard stream formats that Windows Media Center supports.

**Note**Windows Media Center for Windows 7 does not supportWide-Screen Signaling (WSS) format.

Table 1. Audio Stream Formats

|  |  |
| --- | --- |
| Stream | Specification |
| MPEG-2 | ISO/IEC 13818‑3:1998 |
| AC-3 (Dolby Digital) | ATSC Standard A/52B |
| Advanced Audio Coding (AAC) Low Complexity (LC) Profile | ISO/IEC 13818-7:2003 |
| High-Efficiency AAC (HE-AAC) | ISO/IEC 14496‑3:2005 |
| MPEG-1/Layer 2 | ISO/IEC 11172‑3:1993 |

Table 2. Video Stream Formats

|  |  |
| --- | --- |
| Stream | Specification |
| MPEG-2 | ISO/IEC 13818‑2:2000 |
| H-264 | ISO/IEC 14496-10:2005 / ITU-T H.264 |

Table 3. Other Stream Formats

|  |  |
| --- | --- |
| Stream | Specification |
| Transport Streams (TS) | ISO/IEC 13818-1:1996,  ISO/IEC 13818-1 Amendment 3 (2004) |
| Multimedia and Hypermedia Expert Group (MHEG) | ISO/IEC 13522‑5:1997 |
| Broadcast Markup Language (BML)—Specification for digital TV broadcasting | ARIB STD-B24 Version 4.0 |
| PBDA profile for music applications | Protected Broadcast Driver Architecture (PBDA 1.3.1) Part 1: Profile Microsoft |

## Captioning

Windows Media Center supports the following captioning formats:

* Integrated Services Digital Broadcasting (ISDB) captioning.
* Digital Video Broadcasting (DVB) subtitles.
* Teletext captioning.
* Analog captioning, such as vertical blanking interval (VBI) captioning on National Television System Committee (NTSC) video.
* EIA 608 captioning.
* EIA-708 captioning.
* Society of Cable Telecommunications Engineers (SCTE) 20 captioning.

For more information about this captioning format, refer to the “ANSI/SCTE 20 2004: Methods for Carriage of Closed Captions and Non-Real Time Sampled Video” specification.

## Content Protection Requirements

To implement Windows Media Digital Rights Management (WMDRM), Windows Media Center requires tuners that handle protected content.

WMDRM is a technology that extends protected content to consumer electronics devices. For example, WMDRM applies to digital media receivers, such as the OpenCable Unidirectional Receiver (OCUR), that are connected to devices, such as a computer, that transmit over home networks.

For information on WMDRM for PBDA, refer to the “PBDA Specification (Part 3: WMDRM) [1].”

For more information about WMDRM, refer to the “Protected Broadcast Driver Architecture (PBDA 1.3.1) Part 3: Windows Media DRM on PBDA“ specification, which is part of the overall PBDA specification.

# Parameters of Streams That Are Compatible with Windows Media Center

This section helps hardware developers to understand the format of the audio/video streams that their tuners must provide and to develop filters that Window Media Center can use.

Windows 7 provides an inbox *.dll* file that is named *MSMPEG2VDec.dll,* which complies with the parameters and feature requirements for H.264 video decoders. This .dll provides the following functionality:

* *MSMPEG2VDec.dll* supports MPEG-2 video and H.264/AVC, and is used as the video decoder in Windows Media Center, primarily for digital video disc (DVD) and TV playback.
* *MSMPEG2VDec.dll* exposes both a DirectShow filter and a Media Foundation Transform (MFT). The DirectShow filter supports MPEG-2 video and an H.264/AVC decoder.

In Windows Media Center, the name of this decoder is “Microsoft H264 Video Decoder (MFT)”.

In Windows Media Center, most standard-definition channels are encoded as MPEG‑2 video streams, whereas most high-definition channels are encoded by using H.264.

The following are parameters and feature requirements of the H.264 and MPEG-2 video decoders that *MSMPEG2VDec.*dll for Windows 7 supports:

* The H.264 video decoder supports Baseline, Main, and High Profiles up to level 5.1.
* The H.264 video decoder does not support Film Grain Technology.
* The MPEG-2 video decoder supports Simple and Main Profiles, and Low, Main, High, and High-1440 Levels.
* If available and when applicable, either decoder uses Microsoft® DirectX® Video Acceleration (DXVA) to offload aspects of decoding to a graphics processing unit (GPU).
* The MPEG-2 decoder supports MPEG-1 and MPEG-2 video n 4:2:0 chroma formats, including the more popular Main Profile at Main Level (MP@ML) and Main Profile at High Level (MP@HL) formats. The decoder does not support the 4:2:2 chroma formats.
* The MPEG2 decoder supports both legacy DXVA (v1) and DXVA (v2).
* The H.264 decoder supports DXVA (v2), but only for Main and High Profiles.
* To support playback of protected DVDs, the decoders support Content-Scrambling System (CSS) for key negotiation and descrambling operations.
* To support playback of premium digital cable channels in a Windows Media Center computer, the decoders support the necessary authentication and Digital Rights Management (DRM v3) through the **IMFSampleProtection** interface.
* The decoders must be able to handle MPEG2 and H.264 streams without I-frames by keeping an internal counter for the frames that are received.
* The following are the requirements for WMC trick modes:
* FF1:3x (30-second commercial in 10 seconds)
* FF2:10x (30-second commercial in 3 seconds)
* FF3: 100x (30-minute show in 18 seconds)
* RW1: 3x
* RW2:10x
* RW3: 100x
* Forward Slow motion: 0.5x
* Reverse Slow motion: 0.5x
* Forward Frame Skip: 1-frame stepping always
* Reverse Frame Skip: 0.5s – 1 frame
* For Windows Media Center, smooth full-frame trick play is used for 3x fast forward for Standard Definition (SD) H.264, 6x for SD MPEG-2 video, and 3x for High-Definition (HD) MPEG-2 video.
* The decoders support the standard GPU-based content protection that Microsoft currently proposes and implements.
* If the downstream component is not a renderer—such as an enhanced video renderer (EVR), a video mixing renderer (VMR), or VMR9—the decoders avoids dynamic format changes. For example, for 1080i content, the decoders outputs 1080 height instead of 1088.

# Protocols and Validation Tools

Many specifications and recommendations in the market cover implementations of the following audio and video stream formats:

* MPEG-2
* AVC
* AAC
* ATSC
* DVB

Although Microsoft does not provide general audio/video validation tools, many other companies produce a wide variety of tools and conformance test suites.

Microsoft uses many technologies for PBDA, and this section provides an introduction to important standards that are used in TV.

## Real-Time Transport Protocol (RTP)

RTP defines a standardized packet format for delivering audio and video over the Internet. It is frequently used in streaming media systems with Real Time Streaming Protocol (RTSP) as well as in videoconferencing and push-to-talk systems.

RTP is usually used with the Real-Time Transport Control Protocol (RTCP). RTCP is used to monitor transmission statistics and quality-of-service information. When RTP is used with RTCP, RTP is usually originated and received on even-numbered ports, whereas RTCP uses the next higher odd port numbers.

**Note**PBDA doesnot currently use RTCP.

Windows Media Center has the following requirements for RTP:

* The media transform device (MTD) must use an RTP header size of 12 bytes.
* The MTD must not send fractional transport stream (TS) packets. All 188 bytes of the packet must be sent.
* PBDA devices that reset the RTP sequence number to 1 upon every tune of the device must use the Sync Source ID RTP header field (bytes 8 through 11). The value of this header field must change for every tune of the device.
* PBDA devices that do not reset the RTP sequence number each time the device is tuned must not use the Sync Source ID field.
* The value of the Sync Source ID field s must remain constant for the current channel that the PBDA device uses.

For more information about RTP requirements for PBDA devices, refer to “Protected Broadcast Driver Architecture (PBDA 1.3.1) Part 2: Bindings – IP – UPNP,“ which is part of the overall PBDA specification.

For more information about the RTP, refer to the “RTP: A Transport Protocol for Real-Time Applications” specification.

## Real-Time Streaming Protocol (RTSP)

RTSP is used in streaming media systems. It allows a client to remotely control a streaming media server by issuing VCR-like commands such as “play” and “pause”. RTSP also allows time-based access to files on a server.

PBDA-IP binding has the following requirements for RTP:

* The setup, play, and teardown services must be implemented.
* The media sink device (MSD) must ask for a block size of 16,384 bytes.

For more information about RTSP requirements for PBDA devices, refer to “Protected Broadcast Driver Architecture (PBDA 1.3.1) Part 2: Bindings – IP – UPNP,“ which is part of the overall PBDA specification.

For more information about the RTSP, refer to the “Real-Time Streaming Protocol (RTSP)” specification.

## MPEG-2

The MPEG-2 standard describes a combination of lossy video compression and lossy audio compression methods. These methods permit storage and transmission of movies by using currently-available storage media and transmission bandwidth. MPEG-2 is widely used as the format of digital television signals that are re-broadcast by terrestrial, cable, and direct broadcast satellite TV systems.

PES is a specification—defined by the MPEG communication protocol—that allows an elementary stream, such as the output of an audio or video encoder, to be divided into packets. The elementary stream is packetized by encapsulating sequential data bytes from the elementary stream inside PES packet headers. A typical method of transmitting elementary stream data from a video or audio encoder is to first create PES packets from the elementary stream data and then to encapsulate these PES packets inside TS packets or a program stream. The TS packets can then be multiplexed and transmitted by using broadcasting techniques such as those used in ATSC and DVB.

The Program Association Table (PAT) lists all programs that are available in the TS. Each program in PAT is identified by a 16-bit value that is called a program number and has an associated 13-bit packet ID (PID) value for its Program Map Table (PMT). A program number value of 0x0000 specifies the PID that is used to find the Network Information Table (NIT). If such a program is not present in the PAT, the default PID value (0x0010) must be used for NIT. The TS packets that contain PAT information must have PID values of 0x0000.

The PMT contains information about the programs that are available in the TS. Each program corresponds to one PMT. Each PMT describes which PIDs contain data that is relevant to the programs and provides metadata about the streams in their constituent PIDs. Although technically not required, each PMT should be transmitted on a separate PID.

The PES, PAT, and PMT specifications, along with the MPEG-2 standard, can be acquired through the International Organization for Standardization (ISO).

# Resources

For the latest information about the Microsoft Windows family, see the [Windows Web site](http://www.microsoft.com/windows) at <http://www.microsoft.com/windows>.

#### Microsoft

#### WHDC Web site:

Home page

<http://www.microsoft.com/whdc/default.mspx>

Protected Broadcast Driver Architecture (PBDA) Specification (Version 1.3.1)

<http://www.microsoft.com/whdc/device/broadcast/PBDA/pbda_spec.mspx>

#### Organization Specifications

Advanced Television Systems Committee

<http://www.atsc.org/cms/index.php/standards>

Digital Audio Compression Standard (AC-3, E-AC-3) Document A/52B

Video System Characteristics of AVC in the ATSC Digital Television System

Association of Radio Industries and Businesses

<http://www.arib.or.jp/english/html/overview/index.html>

ARIB STD-B24 Version 4.0: Data Coding and Transmission Specification for Digital Broadcasting

International Telecommunication Union

<http://www.itu.int/publications/default.aspx>

H.264: Advanced video coding for generic audiovisual services

Internet Engineering Task Force

<http://tools.ietf.org/html/>

Real-Time Streaming Protocol (RTSP)

Real-Time Transport Control Protocol (RTCP)

RTP: A Transport Protocol for Real-Time Applications

International Standardization Organization ISO Standards

<http://www.iso.org/iso/iso_catalogue.htm>

ISO/IEC 11172-3:1993: Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbit/s – Part 3: Audio

ISO/IEC 13522-5:1997: Information technology – Coding of multimedia and hypermedia information – Part 5: Support for base-level interactive applications

ISO/IEC 13818-1:1996: Information technology – Generic coding of moving pictures and associated audio information – Systems

ISO/IEC 13818-2:2000: Information technology – Generic coding of moving pictures and associated audio information – Part 2: Video

ISO/IEC 13818-3:1998: Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio

ISO/IEC 13818-7:2003: Information technology – Generic coding of moving pictures and associated audio information – Part 7: Advanced Audio Coding (AAC)

ISO/IEC 14496-3:2005: Information technology – Coding of audio-visual objects – Part 3: Audio

ISO/IEC 14496-10:2005: Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding

Society of Cable Telecommunications Engineers

<http://www.scte.org/content/index.cfm?pID=59>

ANSI/SCTE 20 2004: Methods for Carriage of Closed Captions and Non-Real Time Sampled Video

# Appendix: Acronyms

|  |  |  |  |
| --- | --- | --- | --- |
| Acronym | Meaning | | |
| AAC | | Advanced Audio Coding |
| ANSI | | American National Standards Institute |
| ARIB | | Association of Radio Industries and Businesses |
| ATSC | | Advanced Television Systems Committee |
| AVC | | Advanced Video Coding |
| BDA | | Broadcast Driver Architecture |
| BML | | Broadcast Markup Language |
| CSS | | Content-Scrambling System |
| DRM | | Digital Rights Management |
| DTV | | digital television |
| DVB | | Digital Video Broadcasting |
| DVD | | digital video disc |
| DXVA | | DirectX Video Acceleration |
| EVR | | enhanced video renderer |
| GPU | | graphics processing unit |
| HD | | High Definition |
| HE-AAC | | High-Efficiency Advanced Audio Coding |
| IEC | | International Electrotechnical Commission |
| ISDB | | Integrated Services Digital Broadcasting |
| ISO | | International Organization for Standardization |
| iTV | | Internet television |
| MFT | | Media Foundation Transform |
| MHEG | | Multimedia and Hypermedia Expert Group |
| MP@HL | | Main Profile at High Level |
| MP@ML | | Main Profile at Main Level |
| MPEG | | Moving Picture Experts Group |
| MPEG2-TS | | Moving Picture Experts Group 2 - Transport Stream |
| MSD | | media sink device |
| MTD | | media transform device |
| NIT | | network information table |
| NTSC | | National Television System Committee |
| PAT | | Program Association Table |
| PBDA | | Protected Broadcast Driver Architecture |
| PES | | Packetized Elementary Stream |
| PMT | | Program Map Table |
| RTCP | | Real-Time Transport Control Protocol |
| RTP | | Real-Time Transport Protocol |
| RTSP | | Real-Time Streaming Protocol |
| SCTE | | Society of Cable Telecommunications Engineers |
| SD | | Standard Definition |
| TS | | transport stream |
| VBI | | vertical blanking interval |
| VMR | | video mixing renderer |
| VPS | | Video Programming System |
| WMDRM | | Windows Media Digital Rights Management |
| WSS | | Wide-Screen Signaling |