CHAPTER 15

Video and Broadcast Components

This chapter presents the requirements and recommendations for video playback, video input and capture devices, and technologies for broadcast-enabled computers.

For an overview of the key issues for these components, see "Video and Broadcast TV Design Issues" in Chapter 2, "PC 99 Design Issues."

Additional requirements related to video and broadcast components are defined in the following chapters:

- Requirements related to graphics adapters and television (TV) output capabilities are defined in Chapter 14, "Graphics Adapters"
- Requirements related to displays are defined in Chapter 16, "Monitors"
- Requirements related to digital cameras and other digital image input devices are defined in Chapter 22, "Digital Still Image Peripherals"

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System Requirements for Video and Broadcast Components

This section summarizes the requirements for video and broadcast components. The aim of these guidelines is to help ensure that the PC adds features that compare to traditional consumer electronics TV and video devices, and that the PC also equals or exceeds the video quality available on the traditional devices. In particular, the assessment of picture quality includes image clarity, smooth resizing, and precision of frame delivery. Emphasis is placed on checking the accurate rendering of the highest motion content scenes.

Note: Some requirements in this chapter are designated as "required for all systems that support TV or DVD video playback." Because video playback is required for Entertainment PC systems, these requirements all apply for Entertainment PCs.

15.1. System meets PC 99 requirements for playback of MPEG-2 video from DVD-Video

Required for all systems that support TV or DVD video playback

Under Windows 98 and Windows 2000 Workstation, operating-system playback support for MPEG-1 is provided through DirectShow. This requirement refers to built-in system support for DVD-Video playback or any other Main Profile at Main Level (MP@ML) MPEG-2 source, whether decoding is provided as a hardware decoder, a software decoder, or a combination of the two.

Related requirements are defined in "MPEG-2 Video Playback Requirements" and "DVD-Video Playback Requirements" later in this chapter.

15.2. System meets PC 99 requirements for playback of MPEG-2 video from digital TV broadcasts

Consumer	*Office*	*Mobile*	*Workstation*	*Entertainment*
Recommended	*Recommended*	*Recommended*	*Recommended*	*Required*

If a PC 99 system includes support for decoding and viewing video from digital TV broadcasts, whether provided as a hardware decoder, a software decoder, or a combination of the two, the system must deliver video quality that meets MPEG-2 playback requirements defined in "MPEG-2 Video Playback Requirements" later in this chapter.

15.3. System supports PC 99 analog video input and capture capabilities

Recommended for all system types

If video capture capability is implemented in a PC 99 system, it must meet the requirements defined in "Video Input and Capture Requirements" later in this chapter.

All video input sources and capture devices must implement driver support as defined for WDM Stream class in the Windows 2000 DDK.

PC 99A clarification: All video input sources and capture devices must implement driver support as defined for WDM Stream class in "Kernel Streaming Drivers Design Guide" in the Windows 2000 DDK (online at http://www.microsoft.com/ddk/ddkdocs/Win2kRC1/ks-overview_4svn.htm).

15.4. System includes analog TV tuner

Recommended for all system types

For an Entertainment PC system, the analog TV tuner can be implemented as a cable tuner or broadcast tuner, or ideally, as a tuner capable of both.

For information about the supporting tuner device, see "Analog TV Tuner/Decoder and VBI Capture Requirements" later in this chapter.

15.5. System includes digital satellite receiver module

Recommended for all system types

If this capability is included in a PC 99 system, the implementation must include a satellite tuner, demodulator, de-scrambler, and drivers, and possibly a smart card that meet the requirements defined in "Digital Broadcast TV Requirements" later in this chapter.

15.6. System includes digital cable receiver module

Recommended for all system types

If a digital cable receiver module is included in a PC 99 system, the implementation must include a tuner, demodulator, de-scrambler, and drivers, and possibly a smart card that meet the requirements defined in "Digital Broadcast TV Requirements" later in this chapter.

The implementation should be in accordance with the OpenCable initiative and the de facto specifications established by cable companies.

15.7. System includes ATSC DTV support

Recommended for all system types

If this capability is included in a PC 99 system, it should include a receiver module with an 8-VSB tuner/demodulator required for terrestrial ATSC digital television (DTV) reception.

Receivers must support at least the ATSC formats of 480p60 and 720p24, otherwise known as HD0. Higher ATSC formats are allowed. Specifications and technical information are available at http://www.atsc.org.

Support for ATSC DTV includes meeting hardware and software requirements for a tuner/demodulator, MPEG-2 decode capabilities, and graphics adapters as defined in "Digital Broadcast TV Requirements" later in this chapter.

15.8. System includes DVB cable, satellite, or terrestrial receiver module

Recommended for all system types

If this capability is included in a PC 99 system, it should include a cable, satellite or terrestrial tuner, demodulator, an optional smart card or Digital Video Broadcasting (DVB) Common Interface, de-scrambler, de-multiplexer, and drivers that meet the requirements defined in "Digital Broadcast TV Requirements" later in this chapter.

Specifications and technical information are available at http://www.dvb.org. Support for DVB digital TV includes meeting hardware and software requirements for a tuner/demodulator, MPEG-2 decode capabilities, and graphics adapters as defined in "Digital Broadcast TV Requirements" later in this chapter.

15.9. System includes support for multiple digital TV delivery methods

Recommended for all system types

Digital TV services will be delivered by a multitude of different methods. All PCs, particularly Entertainment PCs, should have a good modularity scheme to allow the user to decide which delivery methods are used. This capability can be provided by external connectivity using the IEEE 1394 bus or by internal connectivity using Device Bay or other mechanical form factors.

15.10. System supports DV decoding and encoding

Recommended for all system types

A digital video compression codec is necessary for displaying video from digital camcorders and for compressing video from other sources. Typically the digital camcorder will supply digital video-encoded (DV-encoded) video to DirectShow. DirectShow includes a software DV codec that can provide the necessary functionality. Although this means that hardware DV decoding is not required, hardware decoding can be used to improve performance or lessen CPU loading. Other video data compression schemes can also be used.

Basic Features for Video and Broadcast Components

This section summarizes basic features required for all video and broadcast components.

Mobile PC Note Exceptions for mobile systems are defined in Chapter 6, "Mobile PC 99."

15.11. MPEG sources such as DVD or a receiver module support bus mastering

Required for all system types, with exceptions for mobile PCs

This requirement for bus mastering applies for the DVD drive and any receiver of broadcast MPEG streams. Bus mastering minimizes the CPU bandwidth needed to move data from an input source, such as a DVD drive or digital TV receiver module, to a host, and then finally to an MPEG decoder.

This means that each stream must have a set of logical buffers (digital broadcast satellite and DVD require a minimum of 16 buffers) composed of physical data segments, with a minimum of 16 + 1 of up to 64K for each buffer. Each logical buffer can begin or end on any byte position in physical memory. Therefore, the first and last physical data segment can be smaller than a physical memory page, but the intervening segments will be contiguous multiples of the physical-memory page size.

As defined in Chapter 18, “Storage and Related Peripherals,” DVD drives and other ATA storage controllers and devices must support bus master DMA transfers.

15.12. Separate MPEG-2 hardware decoder for high-definition video does not cause PCI bus contention

Required

This requirement applies for any MPEG-2 decoder implemented in hardware, separate from the graphics adapter. Solutions that use software MPEG decoding or a combination of hardware and software decoding are equally valid if they meet the video quality requirements defined in these guidelines.

Mobile PC Note This requirement does not apply to mobile PCs.

It is expected that a hardware MPEG-2 decoder will typically be placed on the graphics adapter, either on the graphics chip itself, on the main graphics printed circuit board, or as a plug-on daughter card. This is because of the electrical problems with feeding uncompressed digital video at high-definition rates over ribbon cable and the potential bandwidth limitations associated with feeding it over the PCI bus.

Oversubscription Issues on PCI Bus. Great care must be used in configuring uncompressed video streams that run across the PCI bus. PCI does not have any preferential access management mechanisms or other isochronous features. It is entirely possible to create a configuration where the bus is oversubscribed. Although this presents no real problem to asynchronous transfer streams, oversubscription can cause serious errors in isochronous or real-time streams, such as video.

It is not possible to create an effective solution with simple configuration or usage limits because some configurations can easily support multiple “standard definition” raw video streams. Certain other configurations with PCI boards are known to be problematic for a single NTSC capture stream, even though the board itself operates fine.

For this reason, OEMs and system integrators must take special care to ensure that the PCI video configurations they create work in all PCI loading scenarios likely to be encountered by that configuration.

It is anticipated that, in time, PCI arbitration mechanisms will improve and the PCI bus will be used less for disk traffic, both items leading to greater usable PCI bandwith being available. It is not possible to give a hard limit on acceptable PCI bandwidth usage for video streams and the responsibility for creating a reliable system rests with the system integrator. It is, however, the responsibility of IHVs to ensure that mechanisms are in place that will allow the systems integrator to properly tune the system operation.

Filter and Subsample Solutions. One possible solution is for IHVs to provide a facility to filter and subsample their streams in accordance with an empirically determined PCI bandwidth limit. IHVs could implement a settings tab control with a slider to set the available bandwidth. The slider would be, for example, 10 MB per second minimum and 132 MB per second maximum (the theoretical PCI maximum bandwidth). The default setting would be 30 MB per second, which is enough for a single uncompressed standard definition stream. Systems integrators would be able to adjust the slider to optimize performance in their particular application.

To keep scaling costs to a minimum, it is expected that most implementers will only use horizontal scaling, reducing the number of horizontal pixels. In situations where only a small amount of PCI bandwidth is found to be useable, the video will be a bit soft, but it will work without producing annoying artifacts or a bad user experience.

When a system that routes uncompressed video over the PCI bus is implemented, there must be no artifacts associated with the process of transferring video across the bus. The only exception allowable is a slight softening of the picture, provided that the process of filtering and sub-sampling has not introduced any artifacts. Particular artifacts that could be related to the process of transferring uncompressed video over the PCI bus and that must be avoided include: dropped frames, frame jitter that is either noticeable or causes genlocking to not function correctly, and black streaking related to missing pixel data.

Video Side Port Solutions. The other way of avoiding PCI congestion is to use a video side port. Video side ports that have host port or bi-directional capability, such as those that comply with *VESA Video Interface Port (VIP) Specification*, provide a useful way to attach additional functionality to the graphics chip. In addition to the obvious case of NTSC/PAL decoders, this is useful for optional functions and for functions that would not fit on the graphics chip, such as MPEG decoders and high quality de-interlacers.

Systems with multiple video sources that use the video port on the graphics adapter, including MPEG decoder, TV tuner/decoder, and capture functions on the system board or multiple Zoomed Video (ZV) ports, should offer a way to control the flow of video from multiple video sources into a single video port. Systems that use the video port on the graphics adapter must provide a method to

disable the decoder output. A separate external multiplexer (MUX) meets this requirement.

For video sources that have the ability to open circuit their output buffers, there should be a method for arbitrating among multiple devices to avoid bus contentions. At system power up, all devices must come up with their output buffers disabled.

It is advised that the video side port hardware implement a straightforward method for the software to command the device to disable its output buffers. In the future, this capability might be used by the operating system to avoid bus conflicts in the case of a soft restart.

Driver support for any video port implementation must be based on DirectDraw Video Port Extensions (VPE), as defined in the DirectX 5.0 DDK. For more information, see requirement 14.17, "Video port meets PC 99 specifications if present on graphics adapter." See also the white paper on DirectDraw VPE and kernel-mode video transport at http://www.microsoft.com/hwdev/devdes/vpe.htm.

Mobile PC Note

For mobile PCs, the ZV standard is recommended for CardBus peripherals. For more information, see Chapter 12, "PC Card," and Chapter 6, "Mobile PC 99."

15.13. PCI-based sources of uncompressed standard-definition digital video support bus mastering with scatter/gather DMA

Required

In the 1999–2000 timeframe, some generators of uncompressed digital video such as NTSC/PAL/SECAM decoders and some MPEG decoders, will be implemented on PCI cards. Some of these designs will want to send uncompressed video over the PCI bus. As noted earlier, great care must be taken to ensure that the sending of raw video over the PCI bus does not cause dropped video frames and that congestion on the bus does not stop other essential PC functions from being performed The practice of mild filtering and subsampling video to reduce the bit rate before sending it is an acceptable way of avoiding bus congestion.

PCI-based hardware for video display applications must support byte-aligned, multi-segment bus master DMA transfers. Devices that are sources (or sinks) for data must be capable of transferring data to or from multiple, non-contiguous host memory buffers that are byte aligned and odd sized. The device must support such byte-aligned, odd-sized, non-contiguous buffers using host memory-based buffer transfer descriptors. Bus mastering operations must also be able to operate on non-aligned, odd-length data.

PC 99A clarification: For information about implementing driver support, see the "Video Port Extensions to DirectX" topics in the Windows 2000 DDK (online at http://www.microsoft.com/ddk/ddkdocs/Win2kRC1/ddraw_7ehz.htm).

15.14. All MPEG-2 decoders can accept an MPEG-2 elementary stream

Required

DirectShow provides the selection and de-multiplexing of MPEG transport streams and program streams. Stream filtering in hardware can be used to aid this process. DirectShow feeds the appropriate video stream such as Packetized Elementary Stream (PES) to the MPEG decoder. The decoder must be able to take MPEG in that form. PES format support without reliance on any packet sequence numbering is a requirement. Nonreliance on packet sequence numbering is necessary to support applications where packet sequence numbers cannot be created, for example, when audio and video come from separate sources, such as video from disc synchronized to audio from the Internet.

15.15. All MPEG transport stream information is available to the central host processor

Required

MPEG streams can come from a number of sources, including different PCI receivers, Device Bay-based receivers, a set-top box, a set-top computer, a network such as the Internet, or a video-conferencing camera, and so on. DirectShow provides support for selecting the required MPEG streams, de-multiplexing them, and feeding them to the appropriate decoder or subsystem. Stream filtering in hardware can be used to aid this process.

Recommended: When possible, the transport stream de-multiplexing is performed by the central host processor.

In the same way that it sends the video to the video decoder, the host software (comprising DirectShow and other components) also sends the audio to the audio decoder and the data services to the appropriate place. This is fundamental to the architecture for digital TV on PCs. On a particular PC, each subsystem could be implemented in software, hardware, or a combination of the two. The operating system needs to be able to manage all the different configurations.

It is not acceptable to implement an “around the side” hardware path from the receiver to the MPEG decoder. The requirement that all digital compressed video streams are routed using the central host software will also make it easier to migrate to video-capable home network environment, where the receiver functions and display functions will typically be in completely separate boxes. It is also fundamental for features such as automatic program recording.

15.16. Background tasks do not interfere with MPEG-2 playback

Consumer	*Office*	*Mobile*	*Workstation*	*Entertainment*
Required	*Recommended*	*Recommended*	*Required*	*Required*

This requirement applies to background tasks initiated by applications included with the PC. Video performance should be such that non-foreground tasks, such as downloading a web page or using answering-machine software, should occur without disrupting video playback from either TV or DVD sources.

When the user runs an application in the foreground that requires significant system resources, such as a game or video answering machine, the system must remain stable, avoiding a bad user experience.

For Consumer PC systems, this requirement applies only to applications that are started automatically by the pre-configured OEM software, such as programs in the Windows/Start Menu/Programs/Startup folder. This guarantees that the video experience “out of the box” is as good as or better than consumer TV and other A/V components.

For Entertainment PC systems, this requirement applies to all applications included with the system.

Examples of operations that must not interfere with MPEG-2 playback include the following:

- Answering the telephone to receive voice mail or fax. This applies only to telephony software included with the PC, not third-party software installed by the user. Notice that telephone answering must not be automatically disabled during MPEG-2 playback unless explicitly configured by the user.
- Running scheduled communications tasks such as automatic connection using the modem or ISDN to transfer e-mail and faxes, download cached Internet content, and so on.

Note: Programs that make intensive use of system resources or that are designed for interactive foreground operation are excluded from this requirement. This includes games, video and audio playback, speakerphone, and disk utilities such as error checking, defragmentation, and virus protection.

15.17. Video input, capture, and broadcast device support is based on DirectX foundation class and WDM Stream class

Required

The driver for any video or tuner/decoder device must use the DirectX foundation class to control all video data. The MPEG-2 decoder must support the current DirectShow APIs and must support the WDM Stream class driver architecture. The WDM Stream class must be used to support any data streaming. For information, see the DirectX 5.0 DDK and the Windows 2000 DDK. See also “Device Drivers and Installation for Video and Broadcast Components” later in this chapter.

15.18. All components meet PC 99 general device requirements

Required

This includes the basic requirements for a Plug and Play device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors. For more information, see

"PC 99 General Device Requirements" in Chapter 3, "PC 99 Basic Requirements."

MPEG-2 Video Playback Requirements

The requirements in this section apply for MPEG-2 decoders. All requirements apply for both software and hardware decoders or any combination of both unless otherwise noted in a specific requirement. The requirements in this section apply for devices that support playback of an MPEG-2 stream from any source, including DVD, digital TV receiver modules, hard drives, and so on.

Any PC 99 system that includes the ability to play MPEG-2 video must meet the requirements listed here to ensure quality playback of MPEG-2 data.

It is envisioned that many systems will have a single MPEG-2 decoder that does the decoding of both DVD and DTV originated sources. This statement is in no way intended to discourage the use of multiple "universal" decoders in the system, each capable of decoding both DVD and DTV.

For decoder driver requirements, see "Device Drivers and Installation for Video and Broadcast Components" later in this chapter. For related MPEG-2 audio playback guidelines, see requirement 17.15, "CD, DVD, and broadcast audio playback meet PC 99 requirements."

Mobile PC Note Exceptions for mobile systems are defined in Chapter 6, "Mobile PC 99."

15.19. MPEG-2 MP@ML playback meets PC 99 requirements

Required for all systems that support TV or DVD video playback, with exceptions for mobile PCs

All MPEG-2 decoder implementations, whether implemented as hardware, software, or a combination of both, must be capable of the following:

- **15.19.1 MPEG-2 MP@ML playback, with smooth motion portrayal.** Playback requirements include full-frame rate decode of MPEG-2 MP@ML input streams, up to and including the following frame sizes and rates:

  720 × 480 at 60 fields per second — 720 × 480 at 24 frames per second

  720 × 576 at 50 fields per second — 720 × 576 at 25 frames per second

  Decoded frame rate is measured at the graphics frame buffer. The actual rate at which video is displayed (or rendered) is defined in requirement 15.21, "MPEG-2 video decode implementations meet PC 99 quality requirements."

  The use of the term "smooth" includes ensuring that the frames are delivered with equal time between them. It is not sufficient to just produce the correct number of frames per second; they also need to be rendered at the correct times to produce smooth motion portrayal.

- **15.19.2 Rates for decoding and displaying data.** This requires MPEG-2 data rates with a peak rate of 15 Mb/s for Entertainment PC systems and a peak rate

of 9.8 Mb/s for all other PC 99 system types. This applies to both hardware and software MPEG decoding implementations.

15.20. MPEG-2 playback for ATSC, DVB, or other digital TV systems meets PC 99 requirements

Consumer	*Office*	*Mobile*	*Workstation*	*Entertainment*
Recommended	*Recommended*	*Recommended*	*Recommended*	*Required*

All digital TV MPEG-2 video decoder implementations, whether implemented as hardware, software, or a combination of both, must support at least the ATSC formats of 480p60 and 720p24, otherwise known as HD0. Higher ATSC formats are allowed.

The formats required for an ATSC DTV receiver are contained in Table 3 of *ATSC Digital Television Standard* (A/53), available at http://www.atsc.org. A DVB receiver can be specified as either a SDTV or HDTV device at either 25 Hz or 30 Hz. The video formats required for each device are defined in ETR 154, available for DVB members at http://www.dvb.org. The viewing experience when decoding these formats must meet or exceed that obtainable on consumer digital TVs.

Because of the uncertainty surrounding the ATSC Table 3 formats, it is advised that MPEG decoders allow for 720 horizontal pixels for the 480 vertical lines formats in addition to the 704 horizontal pixels specified in Table 3.

An ATSC DTV receiver is not required to decode and display all video formats in native resolution. The MPEG-2 decoder and graphics adapter can process the video to convert the video to a higher or lower resolution to match the capabilities of the graphics adapter and display subsystem.

15.21. MPEG-2 video decode implementations meet PC 99 quality requirements

Required for all systems that support TV or DVD video playback, with exceptions for mobile PCs

PC 99A clarification: The Joe Kane Video Essentials disk with the Snell and Wilcox Zone plate test pattern is proposed to be used to assess the quality of the video display.

The following are required for MPEG decoder implementations, whether they are just MP@ML MPEG decoders or full digital-TV MPEG decoders.

- **15.21.1 Smooth frame delivery.** Video frames must be displayed within one-half frame of the intended display time. All the video fields and frames from the MPEG source should be decoded: all 60 fields per second from a 480i source and all 60 frames per second from a 480p60 source.

  This requirement is satisfied for implementations in which video frames are completely rendered into a DirectDraw surface and flipped using the

DirectDraw Flip API or a hardware autoflip within one-half frame of the intended display time.

No frame dropping or repeating is allowed except for the dropping or repeating of a single frame for synchronization purposes, which must not occur more than once per minute for a stable source. When changing sources, frame dropping can occur more often for the first three minutes after the new source is present. This exception allows long-time constant phase-locked loops to acquire the new timing.

- **15.21.2 Synchronized audio and video.** Audio and video must be synchronized to within one and a half video frames. This synchronization must not be allowed to drift out over time.
- **15.21.3 No tearing.** This requires proper video buffering, such as double or triple buffering.
- **15.21.4 Correct display of multiple aspect ratio content.** The material must, by default, be displayed according to the aspect ratio information in the MPEG header. The option for the user to change the aspect ratio—stretch, shrink, or crop—can be provided.
- **15.21.5 Output of all remaining frames at the end of the data sequence.** This requirement ensures output of all remaining frames when the decoder receives one of the following:
  - A sequence_end_code message, which differs from an Ipin::EndOfStream() function call
  - A time discontinuity
- **15.21.6 Splicing MPEG.** Decoders must properly interpret the Closed_Gop flag by dropping B frames before the first I frame after either a data discontinuity is received or the Broken_Link flag is set.

See the related video and MPEG-2 support requirements for graphics adapters, such as YUV (4:2:0 and 4:2:2) off-screen overlay surface and up/down interpolated scaling, as defined in “Hardware Acceleration for Video Playback” in Chapter 14, “Graphics Adapters.”

15.22. De-interlacing of standard-definition video meets PC 99 requirements

Required for all systems that support TV or DVD video playback

Standard-definition video is defined as 480i60(30) or 576i50(25), otherwise known as 525i/60 and 625i/50 if the blanking interval is included. These standard-definition signals must be properly de-interlaced to produce the required progressive output for mixing with graphics and sending to the PC monitor.

Because the PC monitor is typically capable of displaying high resolution, it is important to extract as much resolution as possible from the standard-definition interlaced signals. The minimum requirement is to use the weave method, which is typically used for film-originated material, and the bob method, which is typically

used for video-originated material. Combined vertical spatial and temporal interpolation using at least two input fields is highly recommended for Entertainment PC systems.

Good quality de-interlacing is also required for video delivered by analog means. It is expected that most PCs will implement a single high-quality de-interlacer and will allocate it to either analog or digital sources.

15.23. MPEG-2 decoder supports the pull-down algorithm

Recommended

An MPEG-2 software or hardware decoder should be able to detect and behave accordingly when 3:2 pull down (or any other algorithm) is being used to display 24-fps video. The kernel-mode video transport component in DirectDraw 5.0 requires this information from the decoder in order to know when a particular redundant field algorithm is being used so it knows which fields to skip.

For more information, see the DirectX 5.0 DDK.

PC 99A clarification: For information about implementing driver support, see the "Video Port Extensions to DirectX" topics in the Windows 2000 DDK (online at http://www.microsoft.com/ddk/ddkdocs/Win2kRC1/ddraw_7ehz.htm).

DVD-Video Playback Requirements

In addition to the requirements in the previous section, the following requirements apply for systems that provide DVD-Video playback software and hardware. The goal for DVD and other audio/video (A/V) playback is to ensure that the end-user experience is the same or better than with a stand-alone DVD player.

Mobile PC Note Exceptions for mobile systems are defined in Chapter 6, "Mobile PC 99."

15.24. DVD decoder driver correctly handles media types, time discontinuity, and decode-rate adjustment

Required

Vendor-supplied minidrivers for DVD, MPEG-2, and AC-3 decoders must:

- Use the correct media types, including validation of all format block fields on connection and on every IPin::QueryAccept message.
- Query for IMediaSample2 on every received media sample to test for a time discontinuity bit.

  It is also acceptable to query on every video/audio frame to reduce CPU overhead.
- Adjust the decode rate in response to IPin::NewSegment() calls for video and subpicture.

For details about APIs, see the DirectShow documentation in the Microsoft Platform SDK.

15.25. DVD decoder supports subpicture compositing and closed captioning

Required for all system types, with exceptions for mobile PCs

The system must be capable of displaying subpicture data as well as providing closed-captioning support for all such data stored on the disc. This requires YUV offscreen overlay surface support as defined in requirement 14.14, "Hardware supports video overlay surface with scaling."

Subpicture streams must be supported as defined in *DVD Specification, Version 1.0,* from Toshiba Corporation.

Note: Alpha blending, or a driver-implemented simulation implemented in the driver, is required for static menus.

15.26. Subpicture decoder correctly handles subpicture properties and other functions

Required for all system types, with exceptions for mobile PCs

The minidriver for the subpicture decoder must be able to:

- Set the subpicture properties
- Turn the subpicture compositing on and off
- Set the highlight rect parameters

For more information, see the Microsoft DirectX 5.1 SDK and the DirectX 5.0 information in the Windows 2000 DDK.

PC 99A clarification: For information about implementing the minidriver for the subpicture decoder, see the Microsoft DirectX 5.1 SDK (online at http://www.microsoft.com/DirectX/dxm/help/ds/Ref/propset_dvd_subpicture.htm) and "DVD Support in Windows 98 and Windows 2000" in the Windows 2000 DDK (online at http://www.microsoft.com/ddk/ddkdocs/Win2kRC1/dvdx_6p0w.htm).

15.27. System supports seamless DVD-Video 1.0 navigation

Required

This requirement includes menu navigation, video selection, and language and subpicture track selection in support of the user's ability to navigate DVD-Video discs. Test sources must include, but are not limited to, the following:

- Matsushita Electronics Incorporated (MEI) test disc
- Joe Kane Productions Video Essentials disc

For any system capable of playing back a DVD-Video title, DVD playback must use the latest released version of the Microsoft DirectShow Navigator/Splitter filter. In particular, it must use the most recent versions of:

- IDvdGraphBuilder
- Microsoft DirectShow DVD Navigator
- Microsoft DirectShow Overlay Mixer

The requirement to use the DirectShow Navigator/Splitter filter is not intended to preclude the use of differentiating product features and enhancements.

15.28. All DVD video decoders must support Line21 closed-caption data

Required

All DVD video decoders must support Line21 closed-captioned data output compatible for use with the DirectShow Microsoft Line21 decoder filter. In addition to ensuring closed-captioned output for the hearing impaired, it enables applications that use the Line21 channel on DVD as a data channel for non-Line21 data.

15.29. System provides a licensed CSS copyright protection scheme

Required

The system must provide a licensed content scramble system (CSS) implementation and support for CSS-encoded DVD-Video discs to ensure proper protection for content produced in accordance with CSS, including regionalization and analog video protection/analog protection system (APS).

Playback of regionalized movies must be handled in accordance with the CSS requirements and the interfaces as defined in the Mt. Fuji 2.0 specification for Phase II regionalization (RPC II). Version 2.0 of the Mt. Fuji specification will be proposed to the Small Forms Factor committee as SFF 8090 Version 2.0 Revision 1.0. Implementations for PC 99 systems should conform to this specification if it is approved in the 1999–2000 time frame.

PC 99A clarification: Phase II regionalization (RPC II) is not required until after January 1, 2000.

> **Important:** As noted in the disclaimer for *PC 99 System Design Guide*, Intel and Microsoft do not make any warranty of any kind that any item developed based on these specifications, or any portion of a specification, will not infringe any copyright, patent, trade secret, or other intellectual property right of any person or entity in any country. It is your responsibility to seek licenses for such intellectual property rights where appropriate. Intel and Microsoft shall not be liable for any damages arising out of or in connection with the use of these specifications, including liability for lost profit, business interruption, or any other damages whatsoever.

For more information about copyright protection requirements, see requirement 18.31, “DVD device supports copyright protection.” For information about CSS or to obtain a CSS license, contact MEI at http://www.mei.co.jp/, or contact the CSS licensing entity when it is established.

Video Input and Capture Requirements

This section summarizes requirements based on capabilities that support video capture in the Windows 98 and Windows 2000 operating systems. If analog video capture is implemented, the requirements in this section must be met.

For requirements related to digital cameras and other digital image input devices, see Chapter 22, “Digital Still Image Peripherals.”

15.30. Analog video decoder such as NTSC/PAL/SECAM meets PC 99 quality requirements

Required

If an analog video decoder is implemented in a PC 99 system, it must meet this requirement.

The analog video decoder must provide proper separation of the luminance and chrominance portions of the signal by employing a 2-D line comb filter or equivalent design.

Video decoders such as those for NTSC or PAL must be capable of decoding full-resolution composite signals at 720 samples per line with 8-bit luminance and chrominance sampling. Support for decoding to YUV 4:2:2 data format is required, while support for decoding to the other video formats of YUV 4:2:0 or YUV 4:1:1 can also be provided as an alternative.

Recommended: Luminance and chrominance separation should be done by employing a 2-D line comb filter or other equivalent design. Future versions of this guide are likely to require the use of a 2-D line comb filter or an equivalent design.

PC 99A clarification: The compatibility tests for PC systems will determine whether there is excessive cross color, hanging dots, or other artifacts that could degrade the viewer experience. A laser disc player with the Joe Kane Video Essentials disk with the Snell and Wilcox Zone plate test pattern is proposed to be used to assess the video quality.

15.31. Analog video capture device outputs video data at 3.7 MB/sec, minimum

Required

Recommended: Video capture devices support hardware or software compression for enhanced functionality.

Systems with capture devices must be capable of capturing 3.7 MB per second to disk.

15.32. Video input or capture device provides raw sampled VBI data

Required

The raw vertical blanking interval (VBI) data must be decoded in software to provide enhancement data, web pages, and information about elements such as video formats and time code.

15.33. Digital video camera uses external bus support

Required

Digital video cameras must provide connectivity using physical wire and driver support to new external buses with isochronous capabilities, particularly USB and IEEE 1394 for high frame-rate devices.

For video conferencing cameras intended for the upgrade market in the 1999–2000 timeframe, it is acceptable to use a direct connection to a purpose-built PCI card using a proprietary interface. This implementation is not preferred and is unlikely to be acceptable in future versions of this guide.

Mobile PC Note On mobile PCs, it is acceptable to use Zoomed Video or CardBus solutions.

15.34. Video input image orientation identification meets PC 99 requirements

Required

RGB pixel formats must be described with a BITMAPINFOHEADER that has a negative biHeight value to indicate that the vertical orientation of the image is top-down, but using the sign of biHeight to indicate orientation is only valid for RGB (uncompressed) formats. The exception is that WDM minidrivers for capture devices are required to only advertise positive biHeight for RGB.

For other compression types described with a FOURCC code in the biCompression field, the FOURCC code uniquely identifies the compression and orientation. It is not valid to describe the orientation with the sign of biHeight.

Common YUV formats such as UYVY, YV12, and YUY2 are top-down oriented. It is invalid to store an image with these compression types in bottom-up orientation. The sign of biHeight for such formats must always be set positive by drivers producing such formats, and the sign must be ignored by any driver receiving such formats. For proprietary compression formats with an associated FOURCC, any orientation is acceptable, but must always be the same for all bitmaps of that FOURCC.

Analog TV Tuner/Decoder and VBI Capture Requirements

This section defines requirements for analog TV tuner/decoder capabilities and VBI data capture capabilities in support of the Windows Broadcast Architecture. This architecture is designed to enable a wide range of data broadcasting services, including the use of decoded data captured from broadcast TV signals during the VBI, as well as from video scan lines. All analog TV decoders must include VBI capture capabilities.

For more information about the Windows Broadcast Architecture and capabilities supported by Windows operating systems, see the Windows 2000 DDK and the white papers available from http://www.microsoft.com/dtv/.

Some requirements in this section specify support related to National Association of Broadcast Transmission Standards (NABTS) data or other locale-specific formats. Devices designed for locales that support other standards do not have to meet these requirements. However, some requirements specify NABTS as an example data format; in these cases, the device must meet the requirements for relevant locale standards.

15.35. Analog TV tuner/decoder supports PC 99 audio and video performance

Required

The audio and video performance capabilities required for a TV tuner/decoder are similar to the MP@ML MPEG quality requirements defined in “MPEG-2 Playback Requirements” earlier in this chapter, including the following:

- Data is delivered at full field rate with smooth delivery and no duplicated or dropped fields
- Audio and video playback is synchronized to within one and a half video frames
- Video output quality includes proper de-interlacing as defined in requirement 15.22, “De-interlacing of standard-definition video meets PC 99 requirements”
- No tearing
- Multiple aspect ratio content is displayed correctly

15.36. Analog TV tuner/decoder includes stereo audio decoder and supports SAP

Recommended for all system types

It is expected that the market will strongly favor stereo implementations. This recommendation includes support for a secondary audio programming (SAP) channel.

For devices designed for use in Europe and South Africa, the device should support Near-Instantaneously Companded Audio Multiplex (NICAM 728) as the standard for digital multichannel sound transmission.

15.37. VBI capture oversamples VBI data at least four times

Required

To ensure accurate data reception, data transmitted on all lines of the VBI must be oversampled at least four times the NABTS data bit rate (or locale-specific data bit rate). For example, if there are 288 bits of NABTS data on a scan line, approximately 1,152 one-byte samples, plus the necessary margin, must be captured per scan line. This represents the number required for timing tolerances in the NABTS specification and also for timing uncertainties within the capture hardware.

15.38. VBI capture makes VBI data available to the CPU for processing

Required

Raw data samples from VBI lines must go into host memory for access by the CPU. This data is used to read data encoded into broadcast transmissions, such as closed captioning, V-chip information, NABTS, and Teletext.

Digital Broadcast TV Requirements

The requirements in this section apply for any type of system that implements a digital broadcast subsystem, whether receiving satellite, cable, or terrestrial broadcasts. Such capabilities are recommended, but not required, for all system types. These capabilities are especially recommended for Entertainment PC systems.

It is expected in the 1999–2000 timeframe that receiver modules will be implemented in the following form factors: Device Bay modules, PCI modules, external modules or set-top boxes using the IEEE 1394 bus, and solutions such as set-top computers. A receiver module that is limited to low bit-rate transmissions, less than 5 Mb/s, could be implemented using USB. Device Bay is a good solution for receivers requiring conditional access systems, but conditional access systems can also be implemented with any of the other receiver types.

Digital broadcast and satellite support as defined under these guidelines includes all the requirements for hardware decoder capabilities and driver support as defined in this chapter, plus support for the DirectX foundation class, as defined in the Windows 2000 DDK.

15.39. Digital broadcast module can receive all streams contained in the particular transport stream

Required

This can be a receiver for cable, satellite, or terrestrial digital TV broadcasts. The receiver module must provide data tuning, demodulation, conditional access, and other network-specific functions.

The receiver module must be able to receive both normal broadcast network-related information, such as MPEG video, audio, and program guide information, as well as data-stream information.

The receiver card must provide a way to allow the host to obtain PCR and other transport stream fields, such as the discontinuity indicator bit, when the card is performing PES packet building. In this mode, the relevant information must be made available by the driver to the host. In addition, the receiver card must provide a mode in which the host can obtain full MPEG-2 transport or program stream headers, and data for selected elementary streams.

15.40. Digital broadcast module can receive full bandwidth from each frequency

Required

The receiver module must be able to receive all information transmitted on any tuner or transponder frequency. If de-multiplexing is performed on the receiver module, the stream selection and routing must be controlled by software running on the host processor.

15.41. Digital broadcast module can receive a minimum of 16 simultaneous elementary streams

Required

The receiver module must be able to simultaneously receive on the same carrier frequency and send to the host either a transport stream or the complete set of elementary streams and accompanying data. Any receiver doing transport stream splitting—a receiver that provides a proprietary conditional access scheme—must support a minimum of sixteen elementary streams being sent to the host. The streams can be of any type, such as sixteen simultaneous data streams. These streams, identified by unique service channel IDs (SCIDs) or program IDs (PIDs), are subdivisions of bandwidth on a single tuner frequency.

The receiver module must provide a means for the host processor to control the de-multiplexing of the transport stream (containing the multiple data streams) or pass the complete transport stream to the host processor for software de-multiplexing. The fundamental criterion is that the resulting MPEG elementary streams are routed by the software running on the host processor.

Recommended: More than 24 simultaneous elementary streams.

15.42. System can simultaneously receive two or more broadcast frequencies

Recommended

The ability to tune to multiple frequencies results in better concurrent data and video operation. With two tuners/decoders, the viewer could watch a video on one frequency and download web pages on the other. This also enables picture-in-picture or multiple data streams on different channels or transponders.

Two or more physically separate tuner/decoder modules can be used for this, but a better solution is to have a single receiver module capable of receiving multiple channels. This allows the possibility of using one conditional access smart card for multiple channels.

15.43. Digital broadcast module provides support for conditional access

Recommended

Receiver modules should support conditional access mechanisms for any subscriptions, pay-per-view events, and other network-specific access-control mechanisms available on the broadcast services for which they are designed.

In many cases, this is a removable smart card that has been paired with code and run on a secure processor on the card. Device Bay provides a convenient way of incorporating a smart card slot, but it is not the only way.

For the separate yet related issue of copy protection, the link from the receiver to the host must be a secure link. It must conform to whatever copy protection scheme is mandated in connection with the terms for the conditional access.

15.44. Digital broadcast module provides signal quality and other diagnostic information

Required

The receiver module must be able to self-test and provide diagnostic information such as signal strength, cable short-circuit events, and the status of any input fuse or circuit breaker.

Recommended: Error rate information should also be provided. Because these modules are connected to public networks, these capabilities are essential to the carriers who need to diagnose problems in the system.

It should be possible to easily replace a faulty module. Device Bay provides a convenient way of achieving this without having to open the PC’s enclosure, but it is not the only way to meet the requirement.

Systems should provide a simple method of aligning satellite dishes and terrestrial antennae. This might include some combination of signal strength, signal-to-noise ratio, and uncorrected Forward Error Correction (FEC) errors.

15.45. Digital broadcast receiver module supports general-purpose data cryptography

Recommended

The digital broadcast receiver module should be able to provide both symmetric and asymmetric encryption. If the receiver decrypts the broadcast data, it should re-encrypt for communication with other devices. Whatever conditional-access encryption is used should be supported. The asymmetric encryption, such as RSA public Key, or Elliptic Curve public Key, for the exchange of control information and data keys plus a high-speed symmetric encryption should be used for data transmission, such as data encryption standard (DES) or Blowfish block cipher. Hardware anti-tampering countermeasures should be implemented.

This capability is separate from, and completely independent of, other digital broadcast capabilities.

All private keys should be stored in protected RAM and ROM—stored within the device so that they cannot be easily read using physical means. The manufacturer also should sign the public keys, and the digital signature should be stored within the decryption hardware. Furthermore, there should be a capability for revocation. That is, when a key is known to be broken, that information will be broadcast; devices should be able to recognize whether it is connected to a device with a certification that has been revoked.

The cryptography device need not be directly on the receiver module; it can be a high-speed smart card or PCI device on the system board if it meets the functional specifications.

15.46. Digital broadcast receiver module supports stream filtering

Recommended

The digital broadcast receiver module should be able to filter out unneeded data streams in order to reduce bus activity and CPU usage. Streams allow data broadcasters to dynamically subdivide their broadcast bandwidth among many data streams of differing size.

15.47. ATSC DTV tuner/demodulator is fully implemented

Required

If an ATSC DTV tuner/demodulator is implemented, it must meet the requirements for packetized data transport structure, and modulation and transmission systems as specified in *ATSC Digital Television Standard* (A/53), available at http://www.atsc.org.

15.48. Stream splitting is supported using DirectShow filters

Recommended

This function should be provided using DirectShow. Stream splitting is done on the host CPU using DirectShow filters in the same manner as support is implemented for DVD video input data streams.

PC 99 Design for Video and Broadcast Components

This section summarizes requirements related to the design initiatives defined in Part 1 of this guide.

Plug and Play and Bus Design for Video and Broadcast Components

The items in this section summarize requirements for Plug and Play and other resource-related and bus-related capabilities.

15.49. Each hardware device has a Plug and Play device ID

Required

Each device must have a Plug and Play device ID as required for the bus it uses, as defined in Part 3 of this guide.

For video and broadcast hardware, a device can be implemented as a single function device or as part of a multifunction device. In the case of a multifunction device, all memory and register resources for this functionality must be distinct and separate from any other functions.

15.50. Dynamic resource configuration is supported for all devices

Required

The operating system must be capable of automatically assigning, disabling, and relocating the resources used by a device when necessary, using the method required for the related bus class. All configuration settings must be capable of being made through software, with no system reboot required.

When the end user changes a device or adds it to the system, setting resource assignments must not require changing jumpers or switches on either the adapter or the system board. In the event of an irreconcilable conflict with other devices on the system, the operating system must be capable of disabling the device to prevent the system from stalling. A disabled device must not claim any resources while disabled.

Video side port bus settings are an exception to this requirement. These settings might require jumpers to be moved for some sophisticated configurations.

15.51. Dependent video device is not independently enumerated

Required

If a video device is implemented as a dependent device on a multifunction adapter, it must not be independently enumerated. Instead, its parent must be responsible for installing and loading its driver and for updating the registry on its behalf. See also requirement 3.21, “Multifunction add-on devices meet PC 99 device requirements for each device.”

Device Drivers and Installation for Video and Broadcast Components

This section summarizes the requirements for video and broadcast components.

15.52. Device drivers and installation meet PC 99 requirements

Required

The manufacturer does not need to supply a driver for a device if the device passes compliance testing for PC 99 using a driver provided with the operating system. If the manufacturer supplies a driver, it must comply with requirement 3.16, "Device driver and installation meet PC 99 requirements." The basic requirements include driver support for unattended installation and Help file support if special driver parameters are used.

All video components must use a WDM minidriver instead of a Video for Windows (VfW) driver. For information about WDM driver support, see the Windows 2000 DDK. See also the related articles on WDM support at http://www.microsoft.com/hwdev/wdm/.

Drivers for hardware decoders and for the audio and video subsystems must be implemented as described in the Windows 2000 DDK in order to support DirectShow, DirectDraw 5.0 VPE, and WDM.

15.53. Software drivers are installed during hardware driver installation

Required

Any additional required device-dependent software such as software codecs or NDIS transports must be installed during the device driver installation routine and must be included in the device INF file.

15.54. Applications provided with device meet Win32 requirements

Required

Video and image editing applications bundled with the device must support DirectShow.

Any Windows-based applications provided with the device must meet software compatibility requirements as defined by the Microsoft Platform SDK. Applications installed with the device must use a standard Windows-based installation method as defined in the Microsoft Platform SDK.

15.55. NDIS 5.0 miniport driver provided for digital broadcast receiver

Required

IP data carried in a transport stream, either encapsulated in the MPEG-2 private section format or PES, must be available through the system IP stack using an NDIS 5.0 miniport driver. Drivers for each device must be supplied by the device vendor or network provider.

For information about NDIS 5.0 driver support, see the Windows 2000 DDK.

Video and Broadcast Component References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

Advanced Television Systems Committee (ATSC) standards
National Association of Broadcasters, (800) 368-5644
Society of Motion Picture and Television Engineers, (914) 761-1100
E-mail: mktg@smpte.org
http://www.atsc.org

ANSI/SMPTE 12M
SMPTE Recommended Practice (RP) 136 and time-code standards
Society of Motion Picture and Television Engineers
http://www.smpte.org/stds/stsubj.html

DTV and broadcast architecture white papers
http://www.microsoft.com/dtv/

DVD Specification, Version 1.0, Toshiba Corporation.
http://www.toshiba.com

EIA Standard #ANSI/EIA-516-88: "Joint EIA/CVCC Recommended Practice for Teletext: North American Basic Teletext Specification (NABTS)"
Electronic Industries Association
http://www.tiaonline.org

IEC Publication 461
http://www.iec.ch

Matsushita Electronics Incorporated (MEI) test disc
http://www.mei.co.jp

Microsoft DirectDraw VPE and kernel-mode video transport white papers
http://www.microsoft.com/hwdev/devdes/vpe.htm

Microsoft DirectShow
http://www.microsoft.com/directx/overview/dshow/

Microsoft Windows 98 DDK, Windows 2000 DDK, and DirectX 5.0 DDK
http://www.microsoft.com/ddk/
(or MSDN Professional subscription)

PC Card Standard Guidelines
PCMCIA
2635 North First Street, Suite 209
San Jose, CA 95134 USA
Phone: (408) 433-2273
Fax: (408) 433-9558

E-mail: office@pcmcia.org
http://www.pc-card.com/bookstore.htm

SFF 8090 (Mt. Fuji specification) and other SFF specifications
FaxAccess: (408) 741-1600 (fax-back)
Fax: (408) 867-2115
ftp://fission.dt.wdc.com/pub/standards/SFF/specs/

VESA Video Interface Port (VIP) Specification
Video Electronics Standards Association (VESA)
Phone: (408) 435-0333
Fax: (408) 435-8225
http://www.vesa.org/standards.html

Video Essentials test disc from Joe Kane Productions, Inc.
http://www.videoessentials.com

WDM driver support white papers
http://www.microsoft.com/hwdev/wdm/

White papers and guidelines for Microsoft operating systems
http://www.microsoft.com/hwdev/bpc/

Checklist for Video and Broadcast Components

If a recommended feature is implemented, it must meet the requirements for that feature as defined in this document.

Consumer	Office	Mobile	Workstation	Entertainment
15.1. System meets PC 99 requirements for playback of MPEG-2 video from DVD-Video				
Required for all systems that support TV or DVD video playback				
15.2. System meets PC 99 requirements for playback of MPEG-2 video from digital TV broadcasts				
Recommended	*Recommended*	*Recommended*	*Recommended*	*Required*
15.3. System supports PC 99 analog video input and capture capabilities				
Recommended for all system types				
15.4. System includes analog TV tuner				
Recommended for all system types				

Consumer	Office	Mobile	Workstation	Entertainment
15.5. System includes digital satellite receiver module				
Recommended for all system types				
15.6. System includes digital cable receiver module				
Recommended for all system types				
15.7. System includes ATSC DTV support				
Recommended for all system types				
15.8. System includes DVB cable, satellite, or terrestrial receiver module				
Recommended for all system types				

15.9. System includes support for multiple digital TV delivery methods
Recommended for all system types

15.10. System supports DV decoding and encoding
Recommended for all system types

15.11. MPEG sources such as DVD or a receiver module support bus mastering
Required for all system types, with exceptions for mobile PCs

15.12. Separate MPEG-2 hardware decoder for high-definition video does not cause PCI bus contention
Required

15.13. PCI-based sources of uncompressed standard-definition digital video support bus mastering with scatter/gather DMA
Required

15.14. All MPEG-2 decoders can accept an MPEG-2 elementary stream
Required

15.15. All MPEG transport stream information is available to the central host processor
Required

15.16. Background tasks do not interfere with MPEG-2 playback
Required Recommended Recommended Required Required

15.17. Video input, capture, and broadcast device support is based on DirectX foundation class and WDM Stream class
Required

15.18. All components meet PC 99 general device requirements
Required

15.19. MPEG-2 MP@ML playback meets PC 99 requirements
Required for all systems that support TV or DVD video playback, with exceptions for mobile PCs

15.20. MPEG-2 playback for ATSC, DVB, or other digital TV systems meets PC 99 requirements
Recommended Recommended Recommended Recommended Required

15.21. MPEG-2 video decode implementations meet PC 99 quality requirements
Required for all systems that support TV or DVD video playback, with exceptions for mobile PCs

15.22. De-interlacing of standard-definition video meets PC 99 requirements
Required for all systems that support TV or DVD video playback

15.23. MPEG-2 decoder supports the pull-down algorithm
Recommended

15.24. DVD decoder driver correctly handles media types, time discontinuity, and decode-rate adjustment
Required

15.25. DVD decoder supports subpicture compositing and closed captioning
Required for all system types, with exceptions for mobile PCs

15.26. Subpicture decoder correctly handles subpicture properties and other functions
Required for all system types, with exceptions for mobile PCs

15.27. System supports seamless DVD-Video 1.0 navigation
Required

15.28. All DVD video decoders must support Line21 closed-caption data
Required

15.29. System provides a licensed CSS copyright protection scheme
Required

15.30. Analog video decoder such as NTSC/PAL/SECAM meets PC 99 quality requirements
Required

15.31. Analog video capture device outputs video data at 3.7 MB/sec, minimum
Required

15.32. Video input or capture device provides raw sampled VBI data
Required

15.33. Digital video camera uses external bus support
Required

15.34. Video input image orientation identification meets PC 99 requirements
Required

15.35. Analog TV tuner/decoder supports PC 99 audio and video performance
Required

15.36. Analog TV tuner/decoder includes stereo audio decoder and supports SAP
Recommended for all system types

15.37. VBI capture oversamples VBI data at least four times
Required

15.38. VBI capture makes VBI data available to the CPU for processing
Required

15.39. Digital broadcast module can receive all streams contained in the particular transport stream
Required

15.40. Digital broadcast module can receive full bandwidth from each frequency
Required

15.41. Digital broadcast module can receive a minimum of 16 simultaneous elementary streams
Required

15.42. System can simultaneously receive two or more broadcast frequencies
Recommended

15.43. Digital broadcast module provides support for conditional access
Recommended

15.44. Digital broadcast module provides signal quality and other diagnostic information
Required

15.45. Digital broadcast receiver module supports general-purpose data cryptography
Recommended

15.46. Digital broadcast receiver module supports stream filtering
Recommended

15.47. ATSC DTV tuner/demodulator is fully implemented
Required

15.48. Stream splitting is supported using DirectShow filters
Recommended

15.49. Each hardware device has a Plug and Play device ID
Required

15.50. Dynamic resource configuration is supported for all devices
Required

15.51. Dependent video device is not independently enumerated
Required

15.52. Device drivers and installation meet PC 99 requirements
Required

15.53. Software drivers are installed during hardware driver installation
Required

15.54. Applications provided with device meet Win32 requirements
Required

15.55. NDIS 5.0 miniport driver provided for digital broadcast receiver
Required