MEDIA PRE-PRODUCTION RECOMMENDATIONS

VERSION 1.2

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General Recommendations

This guide provides settings, standards, and recommendations for using the RayV Broadcaster.

This guide includes the basic requirements; however, it can be adapted to a client's special needs.

Note: *This guide is not a replacement for the required early integration and testing that must be performed.*

Source Video Recommendations

The following sections contain recommendations for the source video in the RayV Broadcaster.

Frame Rate (FPS)

It is recommended to use fixed as opposed to variable frame rates. The following are frame rates that are recommended for use with the RayV Broadcaster:

- 23.97 FPS
- 24 FPS
- 25 FPS
- 29.97 FPS
- 30 FPS

Resolution

The source video resolution must be equal to or greater than RayV's broadcast resolution. The following are recommended resolutions for source video:

- 480p
- 576p
- 720p

***Note**: The use of interlaced video is not recommended.*

***Note**: It is recommended that the aspect ratio match the resolution (i.e., "square pixels").*

QUALITY

Over the course of broadcasting, the video quality of the original source diminishes and cannot be restored. Therefore, it is crucial to receive high quality video content, which exceeds the quality expected from RayV's broadcast.

***Note**: Using extremely high-quality video content may result in serious bandwidth and computation challenges. It is essential to find the correct balance.*

SOURCE AUDIO RECOMMENDATIONS

The following are recommendations for source audio:

- It is highly recommended to use stereo.
- The preferred sampling rate is 44.1 KHz.
- The use of multi-channel audio (more than 2 channels) is not recommended and is only partially supported.
- Only 16 bit audio resolution is supported.
- Multiple audio tracks or languages are not supported.

HARDWARE RECOMMENDATIONS

To avoid problems when broadcasting with RavY Broadcaster, only use easily replicated systems, such as branded servers and workstations.

Use the CPU-ID freeware to generate a complete, accurate description of the hardware.

Unlike most applications where specifying the CPU's clock speed is enough to determine performance, in media encoding, the CPU architecture is often more important than clock speed.

CPU ARCHITECTURE

The following table lists the CPU architecture and the H.264 preset values.

Table 1: CPU Architecture

CPU Architecture	H.264 Preset	
	Normal	High
Core 2	*K*=1.8	*K*=0.8
Nehalem	*K*=3.3	*K*=2.0

K is a constant that depends on the CPU architecture (i.e., Core2 or Nehalem) and on the H.264 preset (i.e., Normal or High). The bigger *K* is, the less CPU the encoding uses. *K* is used for calculating the CPU clock speed (see *Calculating CPU Clock Speed* on page 4).

The following is the formula for calculating *K*.

$$K = \frac{W_{max} \times H_{max} \times FPS}{nCores * ghz} \times \frac{1}{1000000}$$

OR

$$K = \frac{nInstances \times 448 \times 336 \times FPS}{nCores * ghz} \times \frac{1}{1000000}$$

Where:

- *GHz* is the required clock speed of each CPU core.
- *W* is the target encoding's video resolution width (i.e., 640).
- *H* is the target encoding's video resolution height (i.e., 480).
- *FPS* is the target encoding's video frames-per-second (i.e., 30Hz).
- *nCores* is the total number of cores in the system (i.e., 8 for a G6 with 2 CPUs, each with 4 cores).
- *nInstances* is the number of broadcasters at 448 x 336 that can be run on the machine (without dropping frames or reducing FPS), until it is loaded at ~80% CPU.

CALCULATING CPU CLOCK SPEED

The following is the formula for calculating the CPU clock speed.

$$ghz = \frac{W \times H \times FPS}{nCores} * \frac{1}{1000000 \times K}$$

where:

- *GHz* is the required clock speed of each CPU core.
- *W* is the target encoding's video resolution width (i.e., 640).
- *H* is the target encoding's video resolution height (i.e., 480).
- *FPS* is the target encoding's video frames-per-second (i.e., 30Hz).
- *nCores* is the total number of cores in the system (i.e., 8 for a G6 with 2 CPUs, each with 4 cores).
- *K* is a constant that depends on the CPU architecture (i.e., Core2 or Nehalem) and on the H.264 preset (i.e., Normal or High). The larger *K* is, the less CPU the encoding takes (see *CPU Architecture* on page 3).

HARDWARE PLATFORMS

The following table lists the hardware platforms for the RayV Broadcaster.

Table 2: Hardware Platforms

Purpose	Details
High-end Server	HP 360G6, 2x CPU, E5520 2.26 GHz
Mid-end Server	HP 360G6, 1x CPU, E5520 2.26 GHz
Mid-end Server	Dell 2950, 2x CPU
Low-end Server	Dell R300
Mid-end Workstation	Dell Optiplex 960

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System Requirements

The following are the minimum software, hardware, and bandwidth requirements for the RayV Broadcaster.

Operating Systems

The Broadcaster runs on the following 32-bit operating systems:

- Windows 2003 SP2
- Windows XP SP2
- Windows Vista

Hardware Requirements

See *Hardware Selection* on page 2.

Viewer CPU Requirements

A Pentium 4 level machine is recommended for normal quality channels.

The following machines are recommended for high quality channels and full screen viewing:

- Intel® Pentium® 4 2.4GHz
- Intel Core 1.6GHz (SSE2-enabled processor is required for AMD systems)

Bandwidth Requirements

See *Broadcaster's Upload Bandwidth* on page 12 and *Player's Download Bandwidth* on page 13.

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VIDEO FILES

The following sections describe the recommended settings and considerations when using video files.

RECOMMENDED SETTINGS

The following table lists the recommended video file settings.

Table 3: Video File Settings

Name	AAC/H.264 720 p	AAC/H.264 576 p	AAC/H.264 480 p
Container	MPEG4 (.mov)	MPEG4 (.mov)	MPEG4 (.mov)
Video codec	H.264/AVC Baseline profile Progressive Fixed FPS<30 720 p 7000 kbps	H.264/AVC Baseline profile Progressive Fixed FPS<30 576 p 3500 kbps	H.264/AVC Baseline profile Progressive Fixed FPS<30 480 p 2500 kbps
Audio codec	AAC LC profile 44.1 kHz Stereo 64 kbps	AAC LC profile 44.1 kHz Stereo 64 kbps	AAC LC profile 44.1 kHz Stereo 64 kbps

CONSIDERATIONS

It is recommended to use H.264/AAC codecs with the MPEG4 container as it matches RayV's internal standard.

CONTAINER FORMATS

The following are acceptable container formats:

- .avi files
- .wmv files
- .flv files

CODEC FAMILIES

The following are acceptable codec families:

- Moving Picture Exports Group (MPEG)
- Windows Media Video (WMV) (not all codecs are supported equally)

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VIDEO CAPTURE

The following sections describe the recommended settings and considerations when using video capture.

RECOMMENDED SETTINGS

The following table lists the video capture settings for the RayV Broadcaster.

Table 4: Video Capture Settings

Name	NTSC	PAL	720p	1080i
Hardware	Osprey-530 A validated server	Osprey-530 A validated server	Osprey-700 A validated server, Xeon 55XX based	Osprey-700 A validated server, Xeon 55XX based
Video	480p video SD-SDI	576p video SD-SDI	720p video 25/29.97/30 Hz HD-SDI	1080i video 25/29.97/30 Hz HD-SDI
Audio	Stereo Embedded in SDI	Stereo Embedded in SDI	Stereo Embedded in SDI	Stereo Embedded in SDI

CONSIDERATIONS

The following are things to consider when using video capture.

HD CAPTURE IS HARD TO MAINTAIN

As opposed to SD capture (which requires up to 250 mbps bandwidth over the PCI lane), a full HD capture requires ~6 times more bandwidth (up to 1500 mbps).

If a capture cannot maintain uninterrupted data flow to memory (as a result of high bandwidth), problems such as audible clicks, video frame drops, or freezes may occur.

Always Use Tested Configurations

- Never assume that a capture card will work on any given system.
- To avoid problems, always use easily replicated systems, such as branded servers and workstations.
- If you change the motherboard and/or chipset, perform a re-test of the system.

Using Multiple Cards on The Same PC

- You must test the system if you use multiple cards of the same model.
- The system is likely to fail if you mix multiple cards from the same vendor and different models.

Video Capture Guidelines

The following table displays the preferred video capture guidelines.

Table 5: Preferred Video Capture Guidelines

Preferred	Discouraged
Digital Capture	Analog Capture
Professional Interfaces ■ SDI (Digital) ■ Component video (Analog) ■ AES/EBU XLR audio (Digital) ■ XLR audio (Analog)	Consumer Interfaces ■ HDMI (Digital) ■ Composite video (Analog) ■ S-Video (Analog) ■ RCA audio (Analog)
Video Interfaces with Embedded Audio ■ Embedded SDI (Digital) ■ HDMI (Digital)	

Capture Cards Are Sensitive to Computer Architecture

To successfully deploy a capture card-based solution, it is important that the motherboard and chipset are appropriate and compatible.

- Some chipsets (such as the Intel S5000 used on HP G5) are designed for disk I/O and give low priority to their PCI bus. Often the HD cards perform poorly on those chipsets.
- On certain motherboards, some PCI lanes (often denoted as southbridge lanes) have lower priority. Often the HD cards perform poorly in these lanes.

SUPPORTED CARDS

The following table displays the settings for supported cards.

Table 6: Supported Cards

Use	To Capture	Video Input	Audio Input
Viewcast Osprey 530	Flexible Digital/Analog SD on older systems	SDI, composite (BNC), S-Video	Balanced stereo (2 x XLR), unbalanced stereo (2 x RCA), embedded SDI, AES/EBU digital audio (XLR)
Viewcast Osprey 230	Inexpensive Analog SD	Composite (BNC), S-Video	Balanced stereo (2 x XLR), unbalanced stereo (2 x RCA)
Viewcast Osprey 700	Digital SD/HD on Xeon 55XX CPUs	HD-SDI	Embedded SDI

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STREAMING MEDIA

The following are supported protocols and considerations for streaming media.

SUPPORTED PROTOCOLS

Microsoft's MMS streaming protocol family is supported (but not recommended), since it works differently in various OS versions. Furthermore, disconnections and loss are common.

Note: *RayV Broadcaster is planning support for receiving MPEG-TS stream and Macromedia's RTMP stream.*

CONSIDERATIONS

Often, due to limited bandwidth as well as live, real-time streaming requirements, streaming media uses much lower bitrates than video files or video capture. As a result, increasing the source bitrate may actually decrease viewing quality. This limits the quality and level of service RayV can offer when building a solution.

Note: *Bitrate is always specified in kilobits per second (kbps).*

Therefore, it is not recommended to build a solution based on streaming outside of a private broadband network, unless special provisions and considerations are taken.

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VIDEO QUALITY CONSTRAINTS

The following considerations should be taken into account when selecting the best video quality for a channel:

- Broadcaster CPU
- Broadcaster upload bandwidth
- Player CPU
- Player download bandwidth

BROADCASTER CPU

The Broadcaster consumes more CPU power when using higher quality video.

***Note**: Make sure that the Broadcaster machine runs with a CPU consumption of less than 75%.*

If there are unexpected CPU peaks, quality can drop, which will cause one or more of the machine CPU cores to consume 100% of the CPU's resources.

BROADCASTER UPLOAD BANDWIDTH

Higher bitrates require higher upload bandwidth for the Broadcaster. Therefore, the upload bandwidth should be at least double the channel bitrate. For example, a 500 kbps channel requires 1 Mbps to upload the bandwidth.

If there are unexpected bandwidth peaks, quality can decrease, which will cause the Broadcaster to use all of the available upload bandwidth.

Player CPU

Users with up-to-date machines should not have any CPU problems when viewing channels of any video quality. However, users with older machines (Pentium 4, Celeron, PowerPC, etc.) or newer slow machines (Netbooks), may have CPU issues with higher video qualities.

The following parameters (in order of importance) can influence the CPU consumption on the viewer's machine:

- **Resolution**: A larger resolution uses more CPU power to decode, manipulate, and display video.
- **Display Size**: Displaying the video on a large display area (i.e., full screen) or a large, external, HDTV screen uses more CPU power.
- **Bitrate**: A higher bitrate uses more CPU power to process and decode data.
- **Encoding Quality**: More advanced encoding on the Broadcaster uses more CPU power to decode.

As a result, some users will not be able to watch certain channels or will not be able to watch video in full screen mode.

Player Download Bandwidth

A higher video bitrate means that users with limited download bandwidth will not be able to watch certain channels. In general, a higher video bitrate increases the probability of network problems.

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QUALITY CONFIGURATION

When analyzing video quality (whether using presets or manually configured), it is recommended to actually view the channel to find the minimal configuration that provides sufficient quality.

To analyze video quality you can:

- **Use the actual channel content to check quality**. For example, if you generally view a sports channel, then watch a basketball game. If you view a general channel, then watch various different types of content. Different content is displayed differently when compressed with the same quality parameters.
- **View the channel from the customer's perspective**. Watch from a reasonable distance and for a period of time. Make sure you are comfortable with the quality in various scenes.

Note: *During the testing period, verify that the Broadcaster CPU consumption does not exceed the allowable limits.*

GENERAL GUIDELINES

The following are general guidelines regarding quality parameters:

- Sometimes, it is better to set the resolution to correspond with the video source. For example, if the source has a resolution of 640x480, it is beneficial for the channel video resolution to be 640x480 or 320x240. In this case, resizing the video is not necessary to make the video more efficient and higher in quality.
- If the content has black padding (for example, 16:9 content that is squeezed to 4:3), the resolution can be increased since the black areas do not use a lot of bandwidth or CPU power.
- If a sharper picture is preferred over smooth motion, increase the resolution without changing the bitrate.
- Try to enhance the source quality as much as possible. For example, when using capture cards, choose SDI digital input over analog input.

- If the source quality is not sufficient, it is useless to invest in improving bandwidth and resolution. For example, there is no point in using a resolution of 640x480 at 648 kbps for a source that is 320x240 at 400 kbps.
- The bandwidth the viewer uses for watching the channel is the video and audio bitrates combined with an overhead of 10%.

Audio Presets

The RayV Broadcaster contains presets for audio, which should be specified according to audio content and available bandwidth:

- Low/medium bitrate channels with non specialized content: 64 bkps
- High bitrate channels and movie content: 96 kbps
- Channels with music content: 128 bkps

Encoding Presets

The RayV Broadcaster contains encoding presets for video and audio, including both 4:3 and 16:9 aspect ratio settings.

The Broadcaster displays the total media bitrate for the channel, based on the audio and video bitrate. However, the player's bandwidth will be slightly higher and can vary due to the nature of peer-to-peer protocols.

Note: *Usually a 10% overhead above the total media bitrate is needed.*

Configuring Custom Video Encoding

The resolution and encoding quality can be customized for special cases. The following are examples of special cases:

- To avoid loss of quality in the image resizing process, the channel resolution can match the source resolution.
- If the channel content is very dynamic, it requires more bitrate. Alternatively, if the channel content is very static, it requires less bitrate.
- In order to avoid image resizing on the player's side, the channel can be displayed in a fixed resolution.

Video resolution and bitrate values are interdependent. They also depend on the video frame rate (FPS). The RayV Broadcaster provides a built-in quality calculator to help you calculate the desired video quality.

To adjust the resolution and bitrate values:

1. Enter the source video frame rate (usually 24, 25, or 30).

Note: *The values you enter in the quality calculator have no influence on the encoding.*

2. Enter the required bitrate and resolution.

   In most cases, you want to specify the required bitrate first and then find which resolution gives you the quality value that best fits your content. Higher quality values mean better video quality, however different content types require different quality values.

   The following bitrates are needed for different video content:

   - 100 – Talking heads
   - 200 – Sports
   - 300 – Space Explosions

3. After setting the bitrate and resolution, watch the channel to evaluate the actual quality.

   If the quality is not sufficient for a static picture, increase the resolution. If the quality is not sufficient for motion pictures, increase the bitrate or lower the resolution. Repeat this process until the best quality for the content is achieved.

CHANGING THE DEFAULT H.264 CONFIGURATION

Even if the Broadcaster CPU is not sufficiently powerful, you can still obtain high quality. You can reduce the encoding quality while keeping the same bitrate and resolution. Changing the encoding settings can influence the CPU consumption and increase or decrease the video quality accordingly.

The following sections describe the encoding settings that you can modify.

PRESETS

The H.264 preset directly controls the amount of analysis the encoder performs in order to encode the video. The presets are ordered from the least amount of analysis (least CPU usage, lower quality), to the most amount of analysis (higher CPU usage, better quality).

PROFILES

You can change the following H.264 profiles:

- **Baseline Profile** – Suitable for CPU-limited hardware (such as, iphones or mobile phones.)
- **Main I/P Profile** – B-frame disabled. Suitable for certain applications (such as flash VOD) that do not support the H.264 B-frames feature.
- **Main I/P/B Profile** – Can be used instead of high profile in case MPEG-LA licensing or patent issues arise.
- **High Profile** – The default profile, which enables all H.264 features.

RATE CONTROL

The advanced H.264 rate control feature adjusts how the encoder adheres to the bitrate constraints, enabling media/engine co-operation. This feature should not be modified.