

**A Practical Guide for Assessing the Relative Value of  
Standard and High Definition H.264 Videoconferencing**

<b>Polycom VS 4000 (Our current codec)</b>		<b>Polycom VS 7000 E (SD recommendation)</b>		<b>Polycom HDX 9002 (HD recommendation)</b>	
Discount Price, no People and Content & no cameras	\$7,000.00	E and I Pricing including + People and Content + 1 camera	\$ 6,818.00	E and I Pricing + 1 HD camera + People and Content	\$ 18,500.00
Addition camera cost: NA		Additional camera cost: NA		Additional HD camera discount price: \$4000.00	
SKC discount Codec Maintenance: \$625.00		SKC discount Codec Maintenance: \$552.00		SKC discount Codec Maintenance: \$930.00	
				Discount HD Camera Maintenance: unknown	
<b>5-year actual cost of ownership</b>	<b>\$10,850</b>	<b>5-year projected cost of ownership including 5% annual maintenance increase.</b>	<b>\$9,868.00</b>	<b>5-year projected cost of ownership including 5% annual maintenance increase. (codec and 1 HD camera only)</b>	<b>\$23,639.00</b> Includes purchase price of 1 HD camera with maintenance <b>Add ~ \$5500</b> for 2 <sup>nd</sup> HD camera with maintenance
Highest quality codec: H.263		Default codec H.264		Default codec H.264	

Standard CVN Video Rate: 512 or 768 Kbps	Standard CVN Video Rate: 512 or 768 Kbps	Minimum HD required Video Rate: 1 Mbps Ideal HD Video Rate: 2 Mbps <sup>1</sup> Standard Definition Video Rate: 512 or 768 Kbps
Localized multipoint capacity: 3 additional sites at 384 Kbps. Minimum bandwidth requirement per room: 1.2 Mbps (Function included by default)	Localized multipoint capacity: 3 additional sites at 384 Kbps. Minimum bandwidth requirement per room: 1.2 Mbps (add ~ \$1000 for license)	Localized multipoint capacity: 3 additional sites at 1 Mbps. Minimum bandwidth requirement per room: 4 Mbps (add ~ \$1000 for license)
MGC MCU compliant: YES	MGC MCU compliant: YES	MGC MCU compliant: Standard definition only. MGC HD upgrade or new 12 port IP only HD MCU platform DIR list: \$79,000 <sup>2</sup>
Resolution on 4:3 monitor with 4 CIF format 708 X 480	Resolution on 16:9 monitor with 4 CIF format 708 X 480	Resolution on 16:9 monitor with 720P format 1280 X 720
Video out signal: composite	Video out signal: component	Video out signal: component
<b>VS 4000 and VS 7000 E Quality Efficiency Comparison</b>		
<b>VS 4000</b>		<b>VS 7000 E</b>
Network congestion error recovery: Frame discard		Network congestion error recovery: Graceful picture quality degradation
Codec Efficiency: Baseline		Codec Efficiency: 48% more efficient <sup>3</sup>

<sup>1</sup> High Definition: The Evolution of Videoconferencing, Polycom Technology Brief, P.2, c. 2005

<sup>2</sup> <http://visionality.com/texas/Catalog/DIRCodianService.pdf>

<sup>3</sup> [http://www.polycom.com/common/documents/whitepapers/video\\_communications\\_h.264\\_pro\\_motion\\_polycom\\_video\\_advantage.pdf](http://www.polycom.com/common/documents/whitepapers/video_communications_h.264_pro_motion_polycom_video_advantage.pdf)

Motion quality: Baseline	Motion Quality: Pro-Motion retains both fields for superior performance.
Image Quality: Baseline	Image Quality: Twice as good as VS 4000 at any given bit rate. <sup>4</sup>

H. 263 and H. 264 Standard Definition frame comparison example<sup>5</sup>

Uncompressed



H.263 @ 191 Kbps

H.264 @ 163 Kbps



<sup>4</sup> [http://www.polycom.com/common/documents/whitepapers/video\\_communications\\_h.264\\_pro\\_motion\\_polycom\\_video\\_advantage.pdf](http://www.polycom.com/common/documents/whitepapers/video_communications_h.264_pro_motion_polycom_video_advantage.pdf), p. 2

<sup>5</sup> <http://mac.sillydog.org/qt/compare.php>

## HD Videoconferencing

### A Pragmatic Argument for HD Videoconferencing<sup>6</sup>

The LifeSize solution operates at a resolution of 720p (1280 x 720) resolution whereas standard definition video conferencing operates at 480p (640 x 480). For the demonstration, a 1 mbps stream was sent over the public Internet to Austin Texas from Las Vegas Nevada. Of that 1 mbps link, 900 kbps were allocated to video and 100 kbps were allocated to 100 kbps wideband audio.



High Definition versus Standard Definition video conferencing

In the picture above showing an HD and SD picture side by side, I thought it was odd that there didn't seem to be too much difference between the images at a distance besides the fact that the HD image fills the entire wide screen. This is surprising because a 720p image has 3 times the pixels of a 480p stream yet the two images looked similar in smoothness from a distance. When I moved to normal viewing distances, I could definitely see a lot more detail in the HD image yet the difference wasn't as obvious as you would think it should be since the SD image wasn't any more pixelated than the HD image. Then it struck me that the reason there wasn't any more pixelation in the SD image was because nearly all modern large screen displays use anti-aliasing technology that removes the pixelation of lower resolution video sources by up sampling them to maximum resolution.

This brings up an interesting technological debate since both video streams use the same data rates of 1 million bits per second. This means that the HD stream obviously has to be compressed 3 times as much as the SD stream to fit in to the same 1 mbps pipe. The only difference is that the SD stream starts out at a lower quality level but doesn't get chopped down as much with compression as the HD stream. Since most modern displays up sample SD video sources to HD resolutions anyways, it would seem to be a wash between the SD and HD solution. But this clearly isn't the case since the HD image

<sup>6</sup> <http://blogs.zdnet.com/Ou/?p=207>

is noticeably superior in detail but this sounds like we're getting a free lunch so what could explain this? What's happening is that lower resolution of the SD image indiscriminately throws away finer detail by starting with 3 times fewer pixels whereas the H.264 video compression algorithm has the luxury of picking and choosing what it wants to discard if it had a higher resolution stream to work with. The end result is that while HD video conferencing at 1 mbps can't truly deliver three times the quality of an SD video conferencing at 1 mbps since only 3 mbps HD stream can, it can approximate three times the quality and come close to it under most circumstances when where is little movement or change in the video.

The bottom line is that HD video conferencing is fundamentally superior to SD video conferencing even when you give both of them the same bit rate and you display both on an up sampling display. The really big question is if you should buy it. As it turns out, the \$12,000 price tag (list) is the same that you would pay for a high-end standard video conferencing system anyways from any of the more established players in the industry. With all the extra quality in sound and video, it makes video conferencing a lot closer to a face to face meeting so it may end up saving you a lot of travel expenses. With a clear technological lead, LifeSize seems to be on the way up in the world of video conferencing.

*Note: The quoted price is for the LifeSize Team model. The LifeSize Room system retails for around \$19,500 including 1 HD camera.*

### The Point of Diminishing Returns

There are other factors that need to be taken into consideration. The Imaging Science Foundation (ISF) states the most important aspects of picture quality are (in order): 1) contrast ratio, 2) color saturation 3) color accuracy, 4) resolution.<sup>7</sup>

Visual acuity in discerning noticeable improvement of a high definition image over its standard definition counterpart can be a fine line. Optimal seating distance from this image depends on the size of the display and the acceptable range from the ability to discern improvement (the furthest point away from the monitor) to the loss of all benefit where sitting too close results in a viewer resolving the individual pixels, making the image seem grainy and unrealistic.<sup>8</sup> Moreover, there is a specific ideal seating distance for any given size of monitor and any given image resolution. Further away or nearer from this ideal distance results in varying degrees of benefit until the point where all benefit is lost.

Skeptical? Take the test yourself. Using a Firefox browser, go to: <http://alteredbeast.i8.com/480vs720.html> . Hover over the images with your mouse to convert 480P images to 720P images. Now step away from the monitor and have a colleague perform the mouseover. Keep stepping back as the conversion is repeated. At some distance from your monitor you will lose the visual acuity to discern between resolutions.

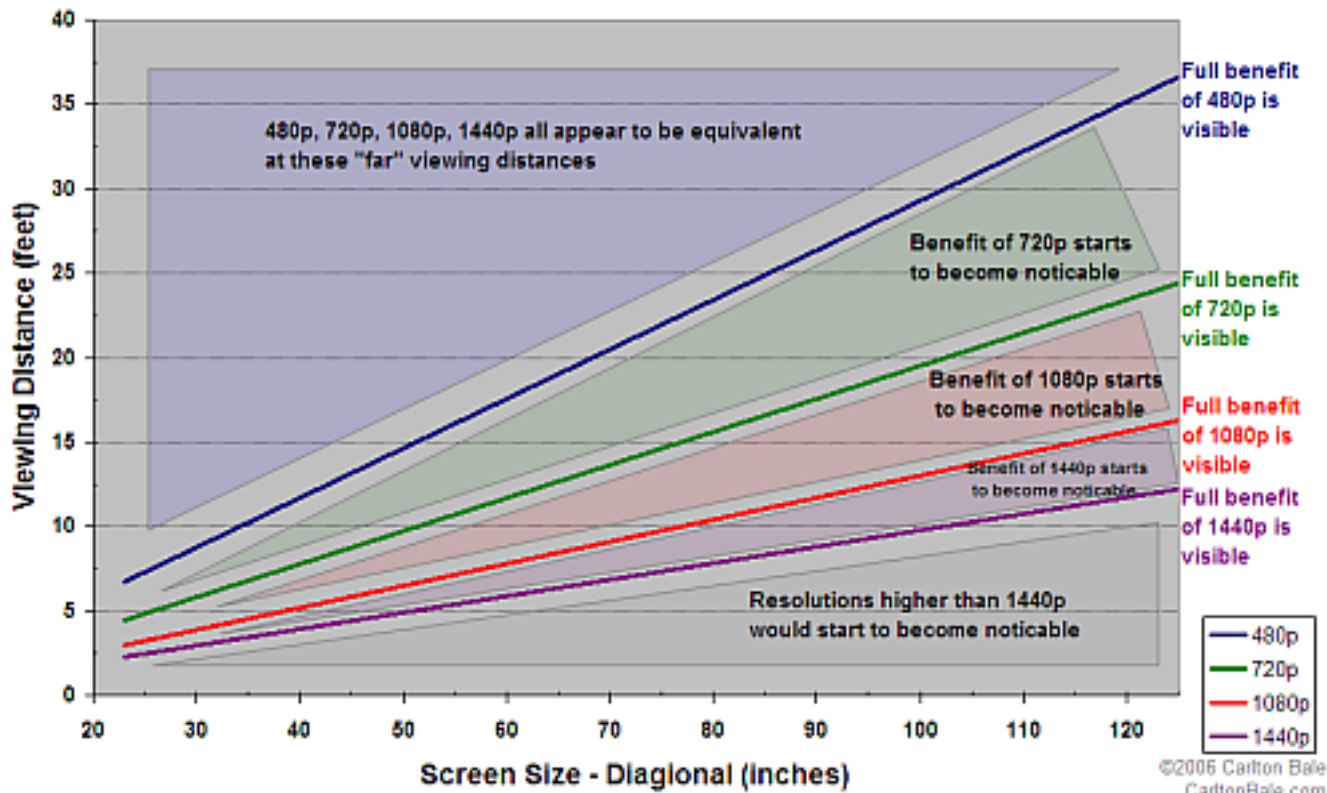
Standard television resolution is equivalent to 480 I or 480 P. 480 is the number of vertical lines and the I stands for interlaced video as in broadcast video where each frame is comprised of interlaced even and odd fields. The P stands for progressive scan which is used in LCD and plasma monitors. The following chart shows that "for a **50-inch screen**, the benefits of **720p vs. 480p** start to become apparent at viewing distances **closer than 14.6 feet** and become fully apparent at **9.8 feet**. For the same screen size, the benefits of **1080p vs. 720p** start to become apparent when **closer than 9.8 feet** and become full apparent at **6.5 feet**. In my opinion, 6.5 feet is closer than most people will sit to their 50" plasma TV (even through the THX recommended viewing distance for a 50" screen is 5.6 ft). So, most consumers will not be able to see the full benefit of their 1080p TV"<sup>9</sup>

<sup>7</sup> <http://www.practical-home-theater-guide.com/Tv-viewing-distance.html>

<sup>8</sup> [http://proav.pubdyn.com/Market\\_Trends/April2006WillTelepresenceSaveVideoconferencing.htm](http://proav.pubdyn.com/Market_Trends/April2006WillTelepresenceSaveVideoconferencing.htm)

<sup>9</sup> <http://www.carltonbale.com/2006/11/1080p-does-matter>

### Viewing Distance When Resolution Becomes Important: Screen Size vs. Viewing Distance



Note: The attached excel document, Copy of theatre\_calculator\_V3.6 is an interactive tool intended to help you design your room for either standard or HD videoconferencing. Based on room dimensions and seating arrangements, it can help determine the ideal monitor size to maximize the benefits of HD or to help improve standard videoconferencing.

## FAQs

**1. Will the MGC 100 support multipoint conferences with HD systems?**

Yes, but at standard resolutions only. H.264 and ProMotion are fully supported by the MGC platform. In order to upgrade to an HD MCU, funding would need to be identified.

**2. Can I mix standard definition cameras with an HD camera in an HD conference?**

Yes. But any time the standard definition camera is selected as a source, there would be a noticeable decline in image quality.

**3. What are the ramifications of purchasing an HD system with only a single HD camera?**

The HD camera would need to be aimed at the primary subject of the room. If the class was used predominately as an origination site with an instructor, it would be used as an instructor camera. When the class was used as receive site, students would appear in standard definition at remote locations

**4. What factors should be considered in this decision?**

Bandwidth availability, operations budgets and application. Each end to end HD transmission should be allocated 2 Mbps per conference. For sites experiencing budget conflicts between computer support and videoconference maintenance, HD could prove expensive. If classes are data intensive and the instructor's style is more along the lines of a "talking head", then HD is probably not worth it. If, on the other hand, the subject requires high detail for demonstration purposes, then HD may well be worth the investment.

**5. Will HD have a significant impact on the efficacy of distance education videoconferencing?**

Probably not. According to the Handbook of Distance Education, while well designed video components may raise student interest, for most applications audio may supersede video as a fundamental element in the learning process and "How necessary the inclusion of video, particularly high-quality video, is to the process of learning from a distance is debatable."<sup>10</sup>

**6. Is there really a significant improvement with the VS 7000 E over the VS 4000?**

Yes. In addition to H. 264's new error correction algorithms, Pro-motion and the codec's 48% increase in efficiency, the VS 7000 E's component outputs will greatly reduce color bleeding and add crispness to the image.

**7. Can the VS 7000 E's image be further improved by certain monitors?**

Yes. An important factor in choosing an HD screen is how well it handles standard definition 480i video (digital cable signals are, in theory, progressive scan but translated to interlaced formats to accommodate the majority of televisions). HDTV generally reformats the content through a process known as upsampling or upconversion, which converts the interlaced content to 480p progressive scan, which is the same resolution found on DVD movies. A chip inside the television handles this conversion and some do it better than others. The most accurate upconversion processors are made by a company called Faroudja, which also packages its technology on boards from Genesis Microchip. Look for DCDi and TrueLife deinterlacing and image enhancement as part of a screen's feature set to make sure you are getting the best possible processing for standard definition video.<sup>11</sup> The VIZIO P50HDTV10A P50 - 50" Plasma HDTV is an example of DCDi technology. It retails for around \$1600. This is highly recommended for HD sites that will using only a single HD camera.

<sup>10</sup> Handbook of Distance Education, Michael Grahame Moore and William George Anderson, Routledge Publishing, 2003; p. 315.

<sup>11</sup> [http://www.jakeludington.com/ask\\_jake/20050116\\_5\\_hdtv\\_shopping\\_tips.html](http://www.jakeludington.com/ask_jake/20050116_5_hdtv_shopping_tips.html)

**8. What is upsampling?**

Upsampling involves creating new pixels by selectively copying pieces of the surrounding pixels using various mathematical techniques to interpolate what the video signal would look like at a different resolution. A good upconverting DVD player scales the DVD video using fast processing electronics and intelligent algorithms. It can detect and compensate for motion, scene transitions, foreground and background objects, and noise from video in real time and handle each situation intelligently. The scaled-up video is rich in detail, with little or no visible artifacts introduced by the upconversion process.<sup>12</sup>

**9. If we have only 2 or 3 T1s for WAN connectivity and multiple rooms, should I purchase HDTV?**

If the prospects for any near term changes are pretty low, then no. Why spend 2 to 3 times in Cap-ex and maintenance for functions that should only cost a fraction of the price?

**10. Will the price of ownership of HD videoconferencing decrease over time?**

It's very likely. For Polycom, the next logical implementation will be 1080 P. With new manufacturers entering the HD market, competition and the implementation of newer standards is bound to result in lower prices.

**11. Is it acceptable to have a combination of HD and standard videoconferencing rooms?**

Absolutely. With a managed schedule, HD rooms can be reserved for administrative and point to point conferences.

**12. With adequate bandwidth and an appropriate budget, should I convert all rooms to HD videoconferencing?**

Yes, if you have a perceived need for the technology and an understanding that not all videoconferences will be in high definition, then absolutely.

**13. With an understanding that some videoconferences will be in high definition and some in standard definition, what is a good rule of thumb for investing in HD now?**

Probably the 50/50 rule. If more than 50% of conferences are bound to be in HD, then it's probably a good time to invest. Assess the volume of content by your current customers. Where is most of your video going? Will they have broadband and make the jump to HDTV?

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<sup>12</sup> <http://www.oppodigital.com/Getting-Most-out-of-DVD-on-HDTV-Display.html>