

High Definition Video Conferencing and the Ohio K-12 Network

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Purpose

The purpose of this document is provide the reader with information regarding the current status of the eTech Ohio video network, as it relates to high definition video conferencing, and to provide guidance on how and when to move forward with implementing this technology into their networks.

Intended Audience

Members of the eTech Ohio video network; the Ohio K-12 Network Advisory Committee; the Ohio K-12 Technical Sub-Committee; the OhioDL.Org.

Background

Ohio has long been considered a leader in the deployment and use of video conferencing in the K-12 environment. The Ohio K-12 Network continues to operate one of the largest educational video conferencing networks in the United States, with over one-thousand units spread out across the state. Programs such as Telecommunity, and Inter-active Video Distance Learning (IVDL), which were initiated in the mid-to-late 1990's, were instrumental in putting Ohio on the map as a leader in distance learning.

Since that time, we have witnessed many changes in the distance learning arena, including, but not limited to the following:

- Changes in technology – migrating from H.320/ISDN, to ATM, to H.323 IP based systems
- Dramatic decreases in pricing - room systems that used to cost \$75K to \$80K in the mid-1990's can be equaled by systems costing \$6K to \$8K today.
- Increased capabilities – today's systems provide far more capabilities and greater performance than the systems of ten years ago, specifically in terms of information sharing.

One of the more notable changes being introduced into the video conferencing market today is the availability of High Definition (HD) video codecs. There are numerous manufacturers currently offering HD video products, and the question that many video conferencing coordinators face today is, should they implement these HD codecs into their network, and if so, when? As with many technical questions today, the answer is a definite "it depends".

Overview - What is HD video conferencing

The current video conferencing systems in place operate in the standard definition (SD) format. These systems provide 525 lines of resolution (technically 480 lines are visible) at up to 30 frames per second, and are commonly referred to as 480i. This format is still very suitable for video conferencing applications, and when using screen sizes of less than 32", will meet most of your conferencing needs. The reason that the screen size is mentioned here when discussing the picture quality, is because the images displayed on your monitors are actually tiny dots of information, known as pixels. The SD format, when displayed on a typical 4:3 aspect ratio monitor, will display 153,600 pixels (640x240). On a smaller screen, this will provide a very good, fluid picture – however when the screen size gets larger, the number of pixels remain the same, and the displayed image is not as crisp and clear as on the smaller monitor.

In contrast, a high definition output will display either 720 lines or 1,080 lines of resolution. Most HD video conferencing systems available today operate as 720p. Compared to the SD format above, a 720p HD output would display 691,200 pixels on the same monitor, or roughly four times the number of pixels. As we move into true high definition at either 1080i or 1080p, the number of pixels increases significantly to 1,036,800 and 2,073,600 respectively. It stands to reason that a significantly higher number of pixels in the same amount of space will provide a truer visual image. The number of lines of resolution, and the pixel counts are not the only factors in rating video quality, however when all other things are equal, these are both significant factors.

Pros and Cons

As with any new technology, there are pros and cons to consider when trying to decide whether or not to adopt and implement this technology into your network. Listed below are a few of the known pros and cons of implementing high definition video conferencing.

Pros

Improved picture quality – The increase in lines of resolution, and the number of pixels provides for better image quality, especially on today's larger, 16x9 aspect ratio display devices.

Better motion handling - In addition to the added lines of resolution and pixel count, many of the newer HD codecs have improved digital signal processor (DSP) chips, enabling them to provide better motion handling capabilities, resulting in smoother a picture.

Enhanced encoding schemes – Prior to the HD standard, most video systems were based on the encoding scheme known as common intermediate format (CIF), and used the H.261 and H.263 video algorithms. Although the H.263 algorithm supported better encoding schemes (4CIF and 16CIF), most video units did not have the computational power to take advantage of these enhanced schemes. Starting around 2004, the H.264 video algorithm was introduced for video applications at lower bit rates. Video conferencing providers began increasing the computational power of the DSP's to take advantage of the H.264 video compression techniques. With this increased performance, manufacturers were able to support the 4CIF encoding scheme, which is a much more efficient and enhanced version of the CIF scheme. By comparison, the 4CIF scheme provides roughly twice the number of pixels as the normal CIF scheme.

Cons

Limited Installed Base - In the immediate future, there will be a limited amount of HD units in the network with whom to conference with, and therefore many of the advantages listed above will not be realized until the installed base increases significantly.

Bandwidth limitations - In order to take full advantage of the video enhancements of HD, users will need a minimum of 1mbps, and up to 2-4mbps of bandwidth to dedicate to their video units. These bandwidth requirements could result in limitations on who may be able to deploy these units, and may also increase the operating costs at these sites due to the cost of bandwidth and usage fees from your provider.

Costs – Although the difference in pricing between the SD and HD units continues to decrease, there is still a noticeable bump in pricing for the HD capabilities. In addition to the initial purchase price, there may also be increased operating costs depending on your environment. For those who are replacing their current systems, there may be the hidden cost of purchasing HD capable display units including monitors, and/or projection units.

Considerations

The decision to deploy a new technology or product into the network is seldom based solely on the availability of a newer, better product, but instead, is usually based on other factors, such as budgets, needs, and the status of your current environment. For most of you, the implementation of HD video falls into the latter category, and listed below are some of the considerations you should evaluate when making a decision on whether or not to implement high definition video.

1. **Bandwidth** – While improvements in video and audio quality can be realized at lower bit rates through the use of improved algorithms, the real gains come from the higher bandwidth (1-4mbps) applications. Is your network, both LAN and

WAN capable of handling these higher bandwidth applications ? Will your upstream provider be able to support these type of connections ?

2. Applications – What is your primary use of video conferencing, now and in the future ? Are they mostly “talking heads” type meetings, or are they more interactive – do they include virtual field trips, or other such activities ? Will these applications be able to benefit from the enhanced video and audio capabilities that HD can provide ?
3. Monitors – If you are replacing your existing codecs, what type of monitors do you currently have in place – are they capable of displaying an HD output – what about your projection devices ? If not, this could result in “hidden” cost that you weren’t planning on as you purchase new display units.
4. Cameras – Will cameras be included in your new system, or will you be reusing your existing ones – are they HD capable ?
5. Who you will be conferencing with – Will the majority of the people you will be conferencing with have HD systems, or will they have in the near future ? If not, will you realize a significant difference in your conferencing experience ?
6. Costs – Almost all decisions have a cost factor to consider – and this is no different. Will the additional cost of the HD codecs benefit your applications ? Will there be additional operating costs if you decide to utilize the higher bandwidth options?

These are just a few of the more significant factors that should be considered when making a decision on whether or not to implement HD video systems into your network, and individual cases will include other factors.

Manufacturers offering HD components

eTech Ohio is not recommending or suggesting that clients should, or must use products from the following vendors. However, the following list is intended to provide the readers with information on manufacturers who currently provide HD video conferencing products. This list is not intended to be a comprehensive one, and all clients are encouraged to do their own research to determine the best product for their environment.

- Cisco
- LifeSize
- Polycom
- Sony
- Tandberg

Readiness of the VNOc to support HD

The eTech video NOc currently operates four Polycom/Accord MGC100 video bridges. Within the restrictions outlined below, two of the four bridges are capable of supporting HD video conferencing in voice-switched, non transcoded modes up to 2mb streams. The remaining two bridges will be upgraded to handle HD applications during the summer months.

Restrictions

Continuous presence conferences are not supported in HD applications
Transcoding is not supported in HD applications

Polycom does not have plans to upgrade the MGC platform to support these capabilities. However, there are newer Polycom bridging products (RMX), as well as products from Codian which support these additional functions while in HD mode.

Conferences that need the restricted capabilities listed above will automatically be reverted to SD mode, and the conferences will be conducted as requested. As the installed base of HD products increases, eTech Ohio plans to upgrade the bridging capabilities to meet these new HD requirements.

Conclusion / Recommendations for deployment

High definition video conferencing products can provide an enhanced experience for distance learning applications, and will dominate future sales of these products moving forward, especially in the education market. Even in limited bandwidth situations, the improved DSP's available in many of the HD codecs can dramatically enhance the video and audio quality of distance learning applications, and provide users with a more fulfilling conferencing experience.

As outlined earlier in this document, there are many factors, other than functionality, to consider when deciding to implement HD video into your network. Some of the more critical factors include - your particular applications, availability of bandwidth, and of course cost.

In those cases where the existing codecs are fairly new (1 -3 years old), and are capable of utilizing the H.264 algorithm, and more specifically, the 4CIF encoding schemes, it is believed that the gains would be minimal from moving to an HD system unless specific application requirements dictate doing so. With that being said however, the video conferencing market will continue to migrate towards high definition products, and further enhancements to standard definition systems will begin to cease in the near future. For this reason, along with the noted enhancements that the HD platform can provide, we strongly encourage those of you who are considering making new investments in video conferencing technology, especially in applications where you are starting from scratch, to pursue purchasing high definition systems.