HARMAN
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WHITE PAPER

CONSIDERATIONS WHEN DESIGNING AND IMPLEMENTING VIDEO OVER IP

AKG AMX BSS crown dbx JBL PROFESSIONAL lexicon Martin Soundcraft STUDER

EXECUTIVE SUMMARY

Video over IP is a technology with tremendous potential. However, designing and implementing networked AV solutions can be confusing when there are so many conflicting viewpoints on what's important. In this white paper, we help overcome the "FUD" (fear, uncertainty, and doubt) about this important technology by explaining why it's important to have a variety of products and multiple configuration options—and why using the wrong configuration for the wrong application can greatly degrade your quality. You'll learn about important network capabilities such as 802.1x, LDAP/Active Directory user authentication, and SSL/TLS secure communication, find out how latency impacts a system (and when it doesn't matter), and be able to identify other important considerations such as mounting capabilities and accessory options.

CONTENTS

INTRODUCTION 3

SOMEONE YOU CAN DEPEND ON 4

VARIETY IS VITAL 4

MUST BE DESIGNED FOR THE ENTERPRISE NETWORK 8

REAL TRUTH ABOUT LATENCY 9

WHERE ARE YOU GOING TO MOUNT IT? 11

FULLY LEVERAGE THE POTENTIAL OF VIDEO ON THE NETWORK 11

INTRODUCTION

One of the biggest trends in the professional AV industry is networked AV, the ability to distribute audio and video signals over the IT network. This innovative approach allows for flexible, configurable and scalable installations that can easily be centrally controlled and managed, resulting in solutions with a lower total cost of ownership and fewer IT manager headaches. As such, the solution is a popular way of distributing audio and video signals.

At HARMAN, we understand this challenge well. After all, we were the industry pioneers in the category, with over 10 years of experience in networked AV, not to mention our nearly 30 years of experience in video distribution generally. After a decade developing and deploying products in this category, we've seen the many challenges that integrators and IT managers face when deploying video over IP. We also know that understanding what is actually important can be a really confusing topic.

Of course, it doesn't help that networked AV is a major AV industry trend, and with any major trend comes a lot of "FUD"—fear, uncertainty and doubt. Whenever there is a lot of clamoring for attention in a technology space, it's hard to differentiate between what matters and what's "fake news" and much ado about nothing.

This isn't to say that the specs don't matter. They do. It's just that what matters often gets lost amidst useless marketing speech, which is why we wanted to cut through the "FUD" around networked AV and explain what really matters when you're considering a video over IP deployment.

SOMEONE YOU CAN DEPEND ON

The first and most important thing you need to consider when selecting a networked AV solution is dependability. While this is certainly true regarding the quality of the product, dependability is also important when selecting a partner. Networks are fickle and finicky things, and each one is different. It's important to feel comfortable with the partner you choose, because when you run into complications or questions about how to achieve something or overcome an obstacle, you need someone with the experience to answer your questions.

HARMAN has been deploying video on the network for over 10 years. In that time, we've seen it all. From restrictive networks with very little bandwidth to huge network backbones looking to stream uncompressed video all over the place, we've encountered and addressed the many different applications and requirements that you might encounter, and so we know how to provide the best solution for those problems.

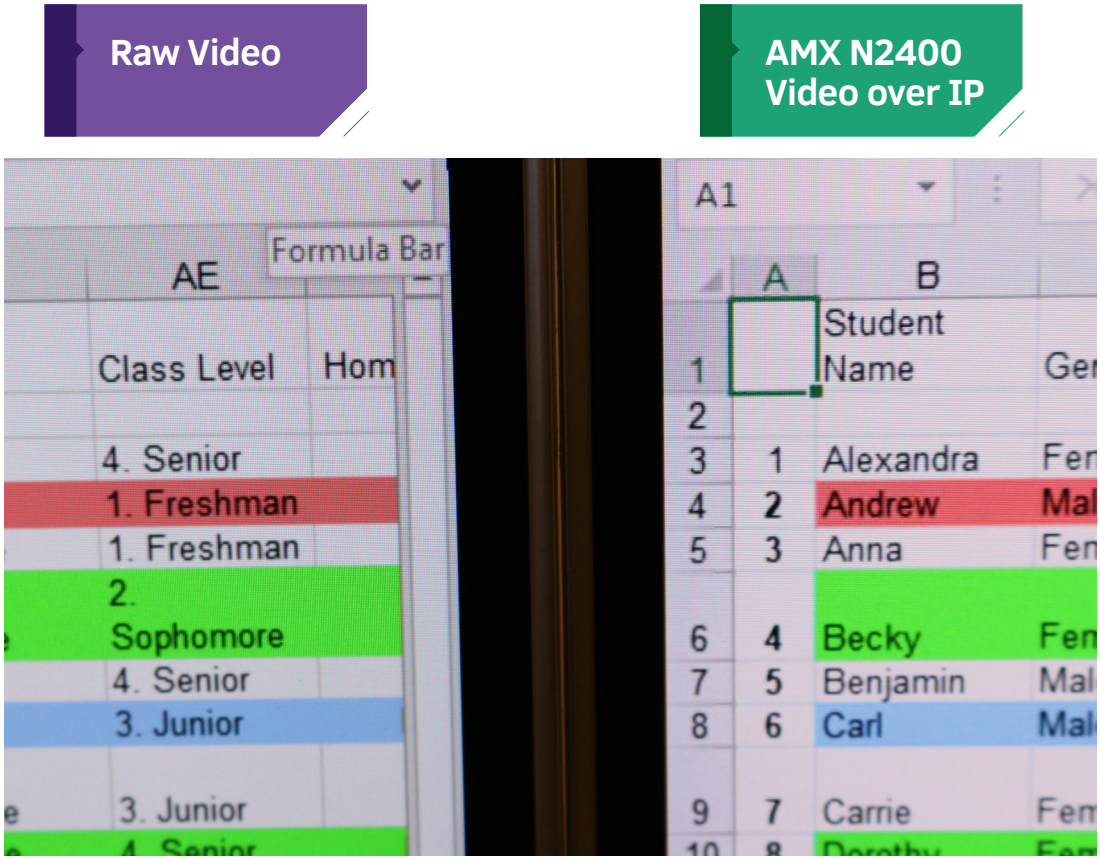
VARIETY IS VITAL

The biggest variable when it comes to working on the network is not the device. It's the network. Every network is different, and every IT manager has a unique posture that is reflected in the way their network is designed and the requirements they put in place. As such, not every networked AV device and setting will fit perfectly for every application. Because the needs of the applications vary, it's important that a range of product options are available as well.

Without a suitably broad product range, customers are often left trying to fit a square peg into the proverbial round hole. Sure, you can adjust settings to meet bandwidth requirements, but doing so could result in a solution that costs more or could be better served by a different product. And if the application

requires connectivity options your device doesn't support, such as streaming over fiber or SDI input connectivity, that's not something you can simply adjust for in a setting. That's why HARMAN offers a broad range of networked AV options with different capabilities and price points. For any application, HARMAN has a product to meet your requirements.

That said, variety of configuration capabilities is also important, because different applications require different approaches for setup and implementation. Consider this side-by-side image of an encoded image and a raw, unencoded image:

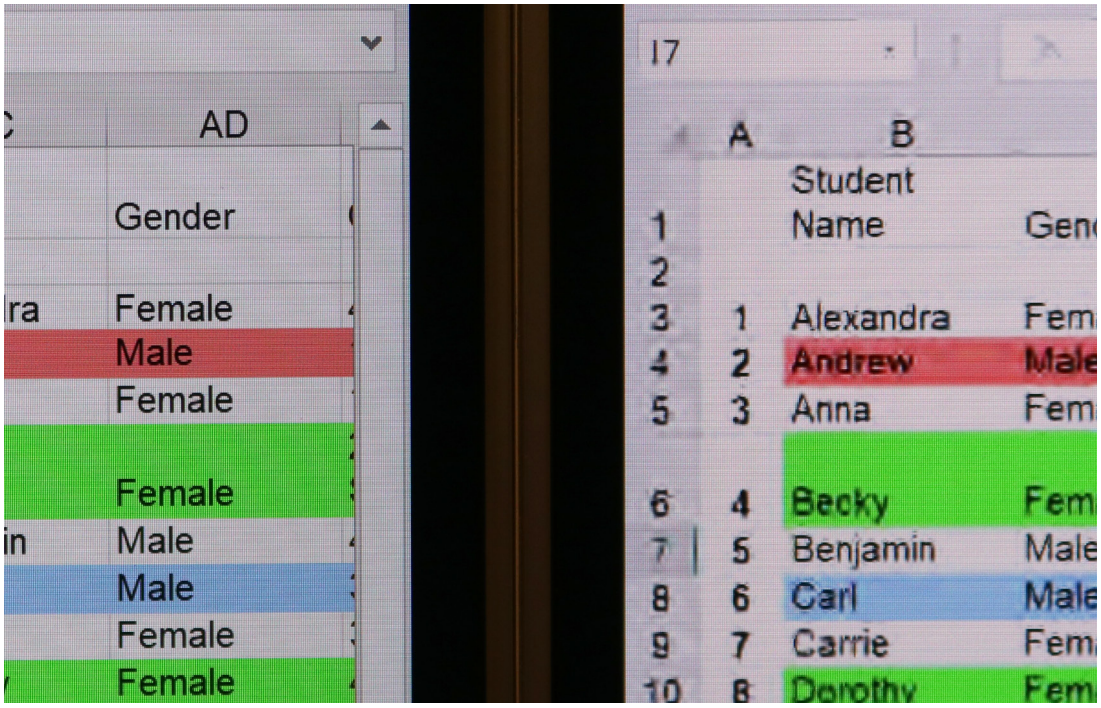


The two images here look similar because the encoder device (on the right) has been setup and configured to handle graphic imagery from a PC with thin, one-pixel-wide lines and a high refresh rate. Encoders that are setup to handle motion video (Blu-ray movies, for example), may not display PC graphics as clearly, because motion video does not have fine lines and typically has a lower refresh rate.

Take this example:

Raw Video

AMX N2400 Video over IP (20% Quality)

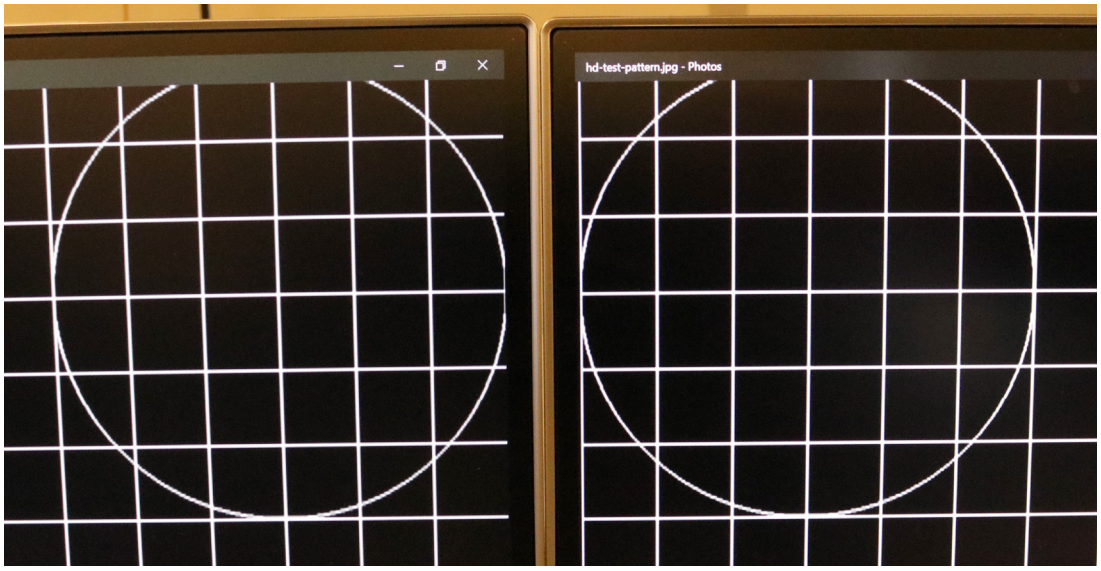


In this example, the "quality" slider for the encoded video (right) has been reduced to 20%. This setting reduces video quality but also reduces bandwidth, minimizing the network impact of the traffic. This quality setting is clearly too low for a spreadsheet, but would be entirely acceptable for motion video. As is, the video has artifacts which add a halo effect around words and other items, and while some lines are fairly sharp, any area of the image that has high frequency and high contrast together is degraded worse. Such artifacts are often not noticeable in motion video, but are clearly seen in computer graphics.

You can also see this in this black and white test pattern:

Raw Video

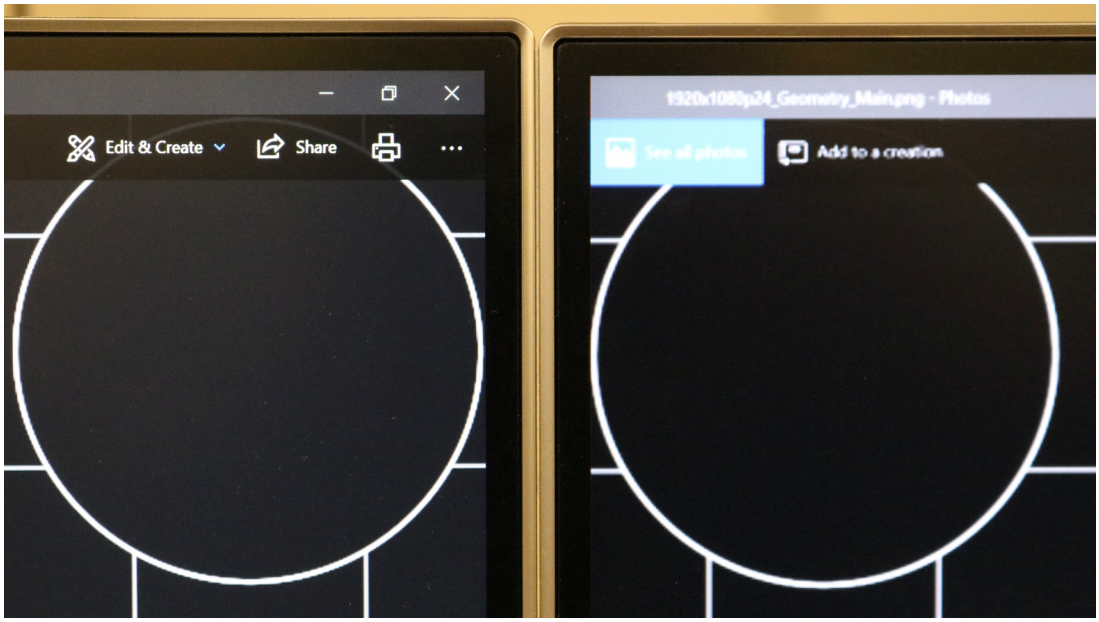
AMX N2400
Video over IP



In the image above, we can see both images are clear. As with the spreadsheet example, this is using a configuration setting that is designed for this application, which is why the lines are crisp and the contrast between the blacks and whites is stark. However, take this image:

Raw Video

AMX N2400
Video over IP
(720p Downscaling)



In this image, although the blacks still remain just as dark as they do in the raw image, the text is blurry and the lines are not as crisp. This is because the image is being downscaled to 720p resolution from the original 4K60 4:4:4. Because the downscaling is occurring at the decoder (not before encoding), this doesn't reduce bandwidth. However, it could be necessary when the source signal is at a higher resolution than what the display is capable of handling. As you can see, the image here is degraded, and would be better served by using a lower resolution at the source rather than downscaling at the display. Such impact would again not likely be as noticeable in motion video, but for PC graphic applications, it is not the ideal approach.

It's important to note that none of these setting options are "bad" settings. Some of the settings are simply the wrong setting for the application. Encoder configurations always require tradeoffs between desired video quality and available network bandwidth, and different applications and source content types have different requirements for where the configuration should fall along that spectrum. That's why having broad configuration capabilities is important.

MUST BE DESIGNED FOR THE ENTERPRISE NETWORK

Networked AV solutions that are to be deployed on the enterprise network should be designed to work on the network. What this really means is that the devices should have the capabilities that are required by IT managers, and they should be able to work within the IT manager's existing network structure.

HARMAN understands what's needed to meet these requirements. We've been selling network-capable devices to enterprise customers and governments around the world for decades. All AMX networked AV products use technology like SSL/TLS for secure communication to all of our end devices, and our AMX N8000 Series management appliances and N2400 Series devices also support 802.1x for network access control and Active Directory user authentication via LDAP. These capabilities ensure the devices can meet an organization's security requirements, resulting in a smooth and successful deployment.

Devices should also be network manageable. That's why HARMAN's networked AV solutions support central management of the endpoints, with the AMX N8000 Series controllers offering system configuration, task automation, scripting, and video wall building. The browser-based interface offers a graphic matrix of all of the devices in the network, offering easy point and click control distribution and switching, as well as management of all of the connected devices. And, because AMX offers PoE capability with their networked AV solutions, IT managers can remotely power cycle any device, making it simpler to troubleshoot problems in the field.

REAL TRUTH ABOUT LATENCY

One of the first questions anyone asks when it comes to a networked AV solution is, "What's the latency?" This is an understandable reaction, and it's an easy to handle benchmark of the product's performance. Latency is the amount of time between when the video source sends the signal and the output device receives it. There could, of course, be latency outside of the video distribution process (depending on the products involved), but for this discussion, we're just talking about latency in the video distribution system.

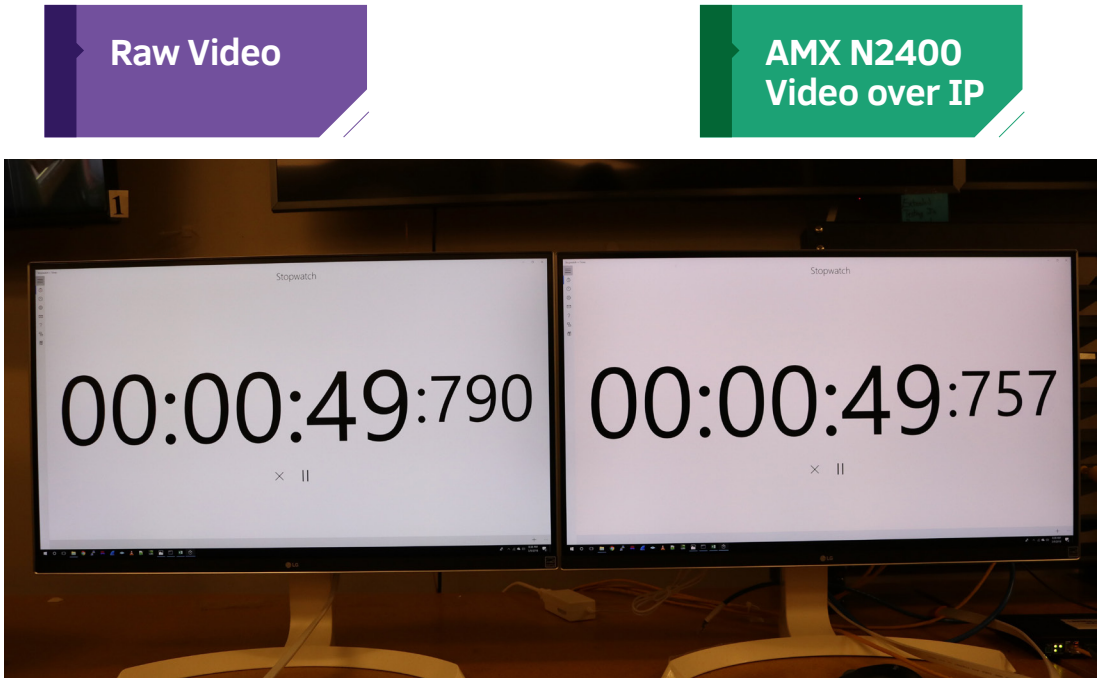
The perceivable impact of latency is a delay between what is happening at the source and what people see on the screen. If the latency is long enough, certain applications can be negatively impacted. In an image magnification scenario (where there are cameras on screen in the same room as the person speaking), the action on the screen could be delayed by some amount from what is happening live. If there is a lot of latency and you're using a computer shown on a display in the room, the mouse on the screen could appear to be slow to respond to a user's movements (though it's really a delay between when you move the mouse and when you see the changes on the screen).

Now, it's important to remember: latency is an inherent part of how video over IP distribution works. The conversion of the video signal to an IP signal and back takes a *very small* amount of time, but it does take time. There is simply no such thing as "zero latency" video over IP distribution. As technology improves, the latency gets reduced, but "zero latency" simply can't happen. It's physically impossible for electrical signals to instantaneously be converted to data, transmitted over a data line, and then converted back into electrical signal at the other end.

A hummingbird's wings move at an average of 53 times per second, slower than 60fps video.

That said, the latency in modern video over IP solutions really is extremely small, measured in milliseconds. For normal 30fps motion video, a single frame lasts 33 milliseconds. Even for a PC or similar device running at a high frame rate of 60fps, it's still 17ms for each frame.

So let's think about how short one frame of 60fps video lasts. If you consider the latency of two comparable products from different manufacturers, you're usually talking about the difference of maybe a couple milliseconds. Forget trying to see a hummingbird's wings flap. The average hummingbird flies at about 53 flaps per second. To be able to see the difference of two or three milliseconds, you'd need to be able to detect a single flap of a *housefly's* wings.



Video over IP solutions targeting in-room applications, like the AMX N2400 Series, can distribute 4K60 4:4:4 video with a latency of less than two 60fps frames. In the image above, you can see this clearly, with the encoded image (on the right) 33ms behind the raw video (on the left). Because the latency in these applications is pretty much imperceptible to begin with, any latency differences between different products are so miniscule that any thousandths of a second delay will be immaterial to any real world application.

In fact, latency in video over IP is so low that manufacturers like HARMAN actually put in the ability to manually add latency back into the system. AMX networked AV products are often used in video wall applications, so adding a couple frames of latency into the system ensures that all of the decoders within the video wall are synced.

Auto Sync Control	☑ Enable
Auto Sync Rate	8000000
Auto Sync Max Pull	1100
Maintain Aspect Ratio	☐ Enable
Enable SNMP	☐ Enable
Ultra Low Latency Mode	☑ Enable
Interleaved Multicast Streams	☐ Enable
Low Power Mode	☐ Enable
Frames of Latency	0

That said, there are encoders which can result in multi-second latency, but they are designed for specific applications. H.264 encoders (like the AMX N3000 Series) are

very popular because the H.264 encoding format is very low bandwidth and, as such, can be transported across the internet. However, compressing the video the amount that is required to be such a small file size takes more time. As such, H.264 often has too much latency for in-room distribution. If you're wanting to send video over the internet, on the other hand, it's the way to go, as latency in that application is unimportant. Again, variety is vital.

The point is that, while latency is important, it only really matters when:

A. The source device and the viewer are in the same room

AND

B. The latency is high enough to be perceptible by the user.

In other situations, factors like video quality, compression size, security, etc., will be more important.

WHERE ARE YOU GOING TO MOUNT IT?

The real beauty of networked AV deployments is that you can send video wherever you need it to go without needing a big rack full of AV gear somewhere. On the output side, this means having a decoder for every display. However, if you want to avoid that rack full of gear, you need to know where you're going to put the decoder.

The most practical answer to this question is to put the decoder behind the display. However, if you're going to do that, you need to be sure that the decoder is thin enough to fit. You'll also need to consider how you're going to power it if it is behind the display, because power plugs typically come at a premium in these applications. That's why the AMX networked decoders are small enough to mount behind the display and are powered over Ethernet. That makes for a fast and clean install wherever you want the video to go.

FULLY LEVERAGE THE POTENTIAL OF VIDEO ON THE NETWORK

Networked AV is more than simply encoders and decoders. When video is placed on the network, a number of exciting possibilities open up, but you need the products and capabilities to leverage that. For example, there is an "A" in networked AV, after all. A good networked AV solution should be able to leverage audio on the network just as easily as it can video.

That's why AMX networked AV encoders are capable of outputting source audio signals over AES67 for use as part of the distributed audio solution without any additional wiring. Likewise, the decoders can take audio from an AES67 network and combine it with a video signal. For applications needing analog audio sources or outputs, an AMX audio transceiver can stream stereo audio over the network as well as convert digital audio signals to analog outputs.

Another common application for networked AV is for video walls and digital signage. These applications often require a lot of video signals coming together, and thus is a perfect application for networked AV. That's why it's important that your networked AV application be able to accommodate the creation of video walls and also be able to handle video windowing. AMX's line of windowing processors can combine up to four networked video inputs into a single IP video output in a range of configurations, making the creation of these innovative video wall and signage applications much easier.

Of course, I haven't even gotten to features like the recording of video on the network, which HARMAN has solutions for as well. The point is that there are a lot of really interesting things that are possible when video is streaming multicast on the network. However, for that "video everywhere" vision to be possible, you need all of the pieces to really accomplish it. That's why having a broad portfolio of products and accessories is so important.

As you can see, there are a lot of things to consider when looking at a networked AV deployment, and I've barely scratched the surface. Thankfully, HARMAN has a team of experts who are ready and able to answer your questions.

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About HARMAN Professional Solutions

HARMAN Professional Solutions (harmanpro.com) is the world's largest provider of professional audio, lighting, video and control products. HARMAN's best-in-class integrated solutions help customers to deliver the highest-quality results for concert tours, cinema, retail, corporate, government, education, large venues, hospitality and more. With brands that include AKG®, AMX®, BSS Audio®, Crown International®, dbx Professional®, DigiTech®, JBL Professional®, Lexicon Pro®, Martin®, Soundcraft® and Studer,® HARMAN Professional Solutions offers the most proven, innovative, and comprehensive solutions for the entertainment and enterprise markets. For more information, visit http://pro.harman.com/.