For "VC", Begin With "AV", Not Network

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In many ways, the application of conference technology into traditional presentation and meeting spaces seems like a natural extension of both the use of the spaces and the technology that has been integrated within them. [For the purpose of this discussion, we will consider the term or concept of "conferencing" to mean the more traditional concept of "teleconferencing" (implying an audio conference application) and "videoconferencing", since this includes both audio and video, and the rules and "best practices" for deployment apply equally to both.]

While many readers might expect a VC article written by Scott Sharer of CDG to be a detailed discussion about encoded AV sent across [via] the modern forms and protocols of digital networks, it is not. The most concise discussion of network topics appears in the "Voice and Data Communications Handbook", published by McGraw-Hill, a book of over 750 pages! Aside from the impossibility of tackling the scope of such a discussion here in only a few pages, experience has demonstrated time and again that the encoding and the transport of signals across the network is actually quite simple (unless you are trying to troubleshoot with your network provider, in which case the network is a great mystery, especially to them). All that being said, network is....*simple*, despite the fact that the form and method changes every day as the global telephone network adapts, grows, migrates, morphs and weaves throughout our personal and business culture. The really tough part of successful conference deployment is found, instead, in the traditional elements of audio, video, room layout – all of the areas that we might have assumed are "no-brainers" for experienced AV and presentation professionals of today. Far from being a "no-brainer", the actual space planning and AV technology deployment are still the great stumbling blocks of conferencing. Incomplete or incorrect planning and deployment on the room-side of the conference equation leads to 99% of all failure-to-deliver on expectation in this most powerful of communications. Why that is and how to avoid this pitfall is the subject of this short introductory paper.

For many people, the idea of a presentation space acting as a real-time videoconference presentation space is a simple step in the general application of technical elements. If the space in question has been developed for live local presentation, with the now typical elements of large screen projection of video and computer sources, live interaction and drawing via a whiteboard or flipchart, and with the ability to display the audio portion of any video element, along with, perhaps, voice reinforcement of the local presenter, then the natural assumption reached by most is that all we need to add is a camera to show the live image of the presenter and some sort of A-D digitizer (CODEC or COder-DECoder) attached to a network (to transport the information to another location), *and we are ready to conference*. Such is the result of traditional audio-visual thinking when it pigeonholes conferencing into a narrow subset of presentation. *Nothing could be further from the truth, or more dangerously insidious.* Any person who has encountered this approach knows how deficient the end-result will be when judged within the context of the ability of an end-user to achieve fluid, natural live two-way communication between two or more geographically dispersed groups.

Videoconferencing is, for those who implement <u>and</u> those who use the systems, a far less forgiving medium than those assembled for in-person meeting and presentation, and even small oversights result in devastating consequences unless we plan carefully. We also find that the elements that have the greatest impact on the success of a videoconference system for the end-user are determined at the outset by the space planner, integrator / reseller and AV systems providers.

It is often most useful to consider the proper planning and deployment of videoconference within the context of the separate elements of:

1. **Room or Space Plan**
2. **AV elements**

VC Room / Space Planning

We are well served to divide this section into the following sub-sections:

- Room Construction, including wall construction, windows, ceilings and HVAC
- Interior Design and Finishes
- Furniture Design, including placement and layout
- Room Acoustics and Acoustic Treatment
- Room Lighting

Room construction, including wall constructions, windows and window treatment, ceilings and HVAC – This subsection is the first place where we begin to manage the elements that are central to the success of VC deployment. The management of the initial layout and construction of the space *directly impact* the elements of acoustic characteristics and performance, general and ambient light control and overall comfort and ease-of-use for VC meeting participants.

We begin with general room requirements. In the first place, the total floorspace required for videoconference is much greater than we have become used to for general local presentation and meeting. In architectural terms it is not uncommon to find a rule-of-thumb applied that allows for up to 15 square feet of floorspace per participant in a traditional presentation or meeting room. If there is a front-of-room presenter position at a podium, and if there is some use of in-room technology (projection devices, whiteboards, etc.), then this figure may increase to as much as 20 square feet of floorspace per participant, but rarely that and virtually never any more than that. It is here that we have our first conflict. In videoconferencing we have to consider not only the issues related to local viewing and hearing but also those issues of being seen and being heard by people at the far-end(s) of the connection. This means that we must consider sight lines and angles of participant interaction that go beyond traditional presentation environments. As a general rule we should allow not less than 30 and are not generally compelled to allow more than 45 square feet of floorspace per participant within a videoconference space. Though 2-3 times what we are used to allowing, this amount ensures that local participants will see one another and the display of local and remote electronic images and will further ensure that participants at the far-end will see (and hear) everyone arriving into their location via the connection, and that all will see (and hear) at a level of quality that does not detract from the communications and, in the best deployment, that even enhances the communications.

Having determined the size of the space that is required we can then move on to the actual renovation or construction of the space itself. Again, the requirements here are generally less forgiving than those applied in local-only meeting spaces. In the most basic sense this is due to the fact that, by sheer definition, at least some of the participants in a conference-based meeting are not actually in our own room. As such, we cannot count on the typical human mechanisms (the human ears and brain and our ability to locate sound in three-dimensional space) to manage any acoustic anomalies. If we are, for example, in a room that is adjacent to a double-door entry to the building, then knowing this we are able to take the inevitable doorway noise into account as we filter the sounds we hear both inside our meeting room and that enter the room from that adjacent entryway. Within our own physical and local environment we have the ability to isolate local unwanted noise from local "sound of interest" (voices of other people, etc.) and place the unwanted noise into an inferior position in our conscious thought pattern. We are able to do this because we know where the noise is coming from and (usually) what is causing it. *We may be annoyed, but we are generally able to ignore it.* As soon as we add conferencing to the meeting equation, however, we add the element of electronic pickup and reproduction of all sounds. To the people at the far-end the unwanted noise is much more difficult (if not impossible) to ignore. They do not have the ability to isolate it in three-dimensional space (the microphones eliminate the spatial reference) and they do not (often) know what is making the noise (in this example the double-outside doorway to the building). The far-end participant brain will devote more and more conscious observation and thought energy to trying to work these elements out, in an attempt to isolate and finally "ignore" the unwanted sound. We have already stated that they cannot ever do this, however, due to the electronic separation between the locations, so they are left with an impossible task that takes up more and more thought energy, thereby eroding the perceived quality of the spoken communication over time. Frustration and exasperation will quickly set in, and the communication flow will quickly fall apart. This, then, is one reason why we must pay even greater attention to the acoustic (and visual) issues for any presentation space that will be connected via conference to another. Minor, seemingly insignificant anomalies we have often ignored in the local environment will become major, significant impediments to smooth communication with people at the far-end of any connection. In short, we must always ask ourselves, "What does this look like and sound like to the people at the far-end?"

In order to guarantee that the final conference environment will have a solid foundation we begin with the construction of the walls, floors and ceilings for videoconference spaces.

Conference room walls should be built from "slab to slab." That is, no gaps from floor concrete to the next floor concrete, using resilient mountings. The thickness of the gypsum board should be 5/8" or thicker (one layer of 5/8" and one layer of ½" bonded together would be ideal) on the inside of the room, with ½" thick appropriate for the outside of the walls. There should always be a difference in thickness between the material used on the inner versus the outer walls. The difference in material thickness subdues vibrational coupling between the two layers. A good overall wall thickness is 6", and it is recommended that “offset stud” construction be used (a 6” (typical) header and footer with 3.5” verticals attached in an alternating pattern- one toward the outside of the footer, the next toward the inside and so on). Fiberglass dense batting or mineral rock wool, 4”-6” thick (equivalent R-11 to R-13), should be placed in the wall space. The thickness of the batting is not critical. The critical aspect is that it must be loosely placed in the wall space, not compacted to fit. The resultant wall will have excellent acoustic isolation from the outside world. More significant acoustic isolation can be achieved by placing an additional “barrier” layer within the wall space. Typically this barrier will be made of a dense polymer material, about 1/16” thick, and the improvement regarding loss of sound transmitted through the wall will be roughly a factor of 10. These materials are available from a variety of manufacturers.

Windows: Windows usually present the equivalent of an acoustic nightmare (as well as altering the way a camera renders colors and brightness) as they not only transmit room sound, but also allow unwanted outside noise to intrude on the conference space. In the event that windows cannot be avoided it becomes essential that window treatment of some sort be used. This treatment should be selected to best match interior look and feel while providing a high level of both sound and light block. Typically, a heavy weight drape (24 ounce or better) of deep fullness (not less than 6” fullness on not less than 8” centers per fold) is preferred. In all cases the use of sheer draperies or standard vertical or horizontal blinds should be avoided, due to their inherent inefficiency in blocking sound and light and the fine lines they create within the camera field of view.

Ceiling tiles: These should be of high quality acoustic type, also 1” thick compressed dense-core fiberglass. An added benefit of this particular ceiling tile is that it works well with the indirect lighting as specified elsewhere in this document. To reduce any extraneous noise from either leaving or entering the room via the ceiling space, the ceiling tiles should be completely blanketed from the plenum side, with a minimum of 6” thick unfaced dense fiberglass batting or mineral rock wool, (R-15 to R-19 equivalent). To make entry and exit from the ceiling space easier, this blanket does not need to rest on the ceiling tiles, but may be suspended above it. (Hint: Most “acoustic tiles” used in typical construction provide little or no acoustic control, they merely “look” right and are cheap)

Air Conditioning: It is critical that all air-handler equipment (i.e.: blowers, heat exchangers, solenoid valves, etc.) be located outside the physical meeting room space. This will prevent the noise burden associated with such equipment from impacting the participants of any meetings held in that room. The location of air handling equipment within the ceiling space of a conference room often renders that room unusable for video or audio-only conferencing.

The air vents should be of open construction to eliminate “wind noise” while the system is running. These vents are normally specified as “low-velocity” diffusers. The number of air vents within the room should be sufficient that the temperature of the room is consistent throughout the space. All HVAC ducts and diffusers should be over-sized for the general application in the space, with minimum 2’ diameter insulated flexible ducts and noise dampening matching 2’ diffusers generally best. All ducts should be installed with gradual bends and curves rather than rigid 90-degree corners. This will minimize "thunder" sounds as the initial air pushes through the ductwork and into the room.

There should be a thermostat to control this specific room system independently of the rest of the building, and that control should be located within the room, not in the hallway.

Important: Allow an additional 5000 Btu cooling capacity for a standard "roll-about" single monitor VC system with extended in-room peripherals (PC, document camera, scan converter, etc.) and a minimum of 10,000 Btu for a dual display multi-media presentation system with plasma or large screen displays. For the comfort of the end-user, the room must accommodate these heat loads with minimal temperature rise.

Colors: Wall colors within the field of view of the camera have a significant impact on the *far-end perception* of the room video quality. Certain specific colors are better suited to video rooms than others. The electronics and software of the videoconferencing system "builds" the images at the far-end from a gray/blue reference image. When there is a minimal difference between the room background and the reference image color, the codec has an "easier" time turning the image into numbers, with the result being that the far-end will "see" a much higher quality video presentation. In general, light gray with just a touch of blue seems to work best. For rooms that have marginal lighting, slightly darker colors are quite useful.

In keeping with these color recommendations, the acoustic panels (discussed elsewhere in this document) should be ordered in light colors such as silver-gray, quartz, or champagne for panels within the camera field of view. For esthetics, however, panels may be alternated in color.

Furniture/Layouts *general information*: As we have already noted, the rooms should be slightly on the large side for the typical number of attendees. The placement of furniture should present a natural rapport with the videoconference system, but shouldn't preclude the local interaction of the conference participants. Doorways used for access to the space should usually be within the view of one of the camera presets to prevent the perception from the far-end that people could come into their meeting unseen. Doorways should not, however, be in constant direct view of the camera system, as this may cause unwanted distractions and movement of people in the picture field.

Any tables within the conference environment should have a light top surface. Glossy tops should be avoided, as should strong colors or any bold wood grain. If you are required to work with glossy or saturate color surfaces, then proper lighting can help reduce (but not necessarily eliminate) ill effects caused by these surfaces. The best table surface color is a flat satin finish, neutral gray. In cases where the worst possible surfaces are present, then the proper surface color effect can also be achieved by using a table covering, put in place only when the room is being used for videoconferencing. This will, however, create problems related to the use of access ports in the tables or movement of end-user items across the surface.

Acoustics- additional general elements related *to the interior finish details* for the space: The acoustic design goal for any “conference” enabled room in terms of ambient noise level is at least NC-30 (**N**oise**C**riteria_30). This level of specification dictates a very quiet space (somewhere around 40-dBSPL-A ambient noise level), and a room built to the description elsewhere in this document will usually fall between NC-30 and NC-35. The actual NC value is not critical, only that the room is built with the intent and care required to achieve the low noise rating. Typically, a site evaluation and audio room analysis with a calibrated meter is required to certify the noise performance of a given space. The quieter the room is, the easier it is to hear others in the same room as well as be heard by others who are participating via conference connection to a far-end location (or locations).

Almost every conference room of medium-to-large size (larger than 12’x15’) requires some level of acoustic treatments to provide good speech rendering to other conference sites. The quality differences lie in the areas of intelligibility and consistency of loudness as presented to the far-end. While it may be possible for people at the far-end to “hear” the sounds coming to them from your space / systems, it may be less possible to clearly distinguish all of the vowels, consonants, inflections and nuances that comprise actual human speech communication. (We all know that it is not simply what you say but “how you say it” – i.e. – the inflections and intonations – that make the difference in perceived meaning in human communications).

As good audio practice dictates, the treated surfaces should be comprised of at least two non-parallel walls, and as the VCS hardware is a potential source of distracting fan noises, the walls to be treated should include the wall immediately behind the VCS hardware (whenever this hardware is within the conference room proper). To help prevent meeting audio from leaking into adjoining hallways or offices, the walls along those areas should also be treated.

The area of the walls to be covered is as follows: Approximately 50% of the wall area needs to be covered with acoustic panels. Recommended type: Armstrong “soundsoak” 1” thick compressed, dense-core fiberglass, fabric covered, or equivalent, with a SABIN (**s**ound **ab**sorption **in**dex) value of .9 average. This specification is also sometimes referred to as NRC (**n**oise **r**eduction **c**oefficient). If reduction of sound passing through is required, then an additional “barrier” layer is laminated to the dense-core material, usually 3/8” thick fiber compression board. The barrier layer is placed against the existing wall material, then the acoustic absorption panels are placed on the interior-room side of that. The barrier panels will have a SABIN of .9, but will also have an additional specification of STC (**s**ound **t**ransmission **c**oefficient) of 20. STC is a measure of the amount of reduction in loudness to sound passing through the material. Having an STC rating of 20 means there is a factor of 10 reduction in the amount of sound passing through that material. A high quality conference room wall usually has a STC of 60 or more (less than 1/1000 of the sound in the room leaks through the wall).

Lighting- *general information*: The brightness of the lighting in a videoconference room plays an important role on the far-end view of the participants in the meeting. When there is low to moderate amounts of light (20-35fc or **f**oot-**c**andles) (typical office lighting), the distance range of "in focus" objects (depth-of-field) would usually be only 2 or 3 feet (nearest in-focus to furthest in-focus). With bright light (70fc or more) the range of in-focus objects increases, and can more than double. The far-end will then see more people in sharp focus, and the codec will have an easier time encoding the image. *This increased light level must be handled very carefully*. Increased levels of standard direct lighting (florescent or incandescent) have the undesirable effect of being "harsh" to the local participants. Aside from the significant "drop shadows" cast by direct-down lighting, there are physical effects on room occupants. The harshness of the lighting will cause undue visual fatigue and increased stress on end-user participants.

The very best lighting should be in-the-majority "indirect" (80-85% of the available light) for videoconferencing, with the remaining 15-20% evenly distributed as "direct" light. The indirect light will help to minimize shadows on the faces of the participants, and to make the room more comfortable local participants to view the "far-end" on the local monitor. The direct light can be used to create backlight separation between foreground and background objects or surfaces. There should be not less than 55fc and [ideally] as much as 75fc of light (770lux) on the faces of the participants/ in the facial field as viewed by the camera in the conference space. The light should be completely even across the field of measure (seated = 48" AFF and standing = 50-70" AFF) and of one consistent color temperature.

To best enable these requirements, indirect fluorescent lighting is most often recommended. This type of lighting works by using the upper walls and ceiling as diffuse reflectors for the light. The usual recommended color temperature for these is 3000-3800 degrees Kelvin. If there is a significant quantity of outdoor light entering the room, then the lamps should be above 5500 degrees Kelvin.

Light fixtures- types: Indirect lighting fixtures are available from a number of manufacturers. They are generally 3 tube - 8" oval indirect up-lights, though they may take the form of chandelier style pendant lights, wall sconces / cove lights and/or flush mounted specialized troughs. Many manufacturers work very closely with contractors and lighting designers to ensure the correct light levels and shadow-free zones are designed into any room, but especially when the room is used for videoconference. Lamps are available for these fixtures in a variety of specified color temperatures from manufacturers such as Sylvania, GE, and Phillips. Indirect fixtures are available in a number of different designs or "looks" and can be purchased in a configuration that will compliment (and not detract from) the interior design or "look" for the space.

The actual fixture quantity and layout recommendations are generated either by the local Architectural Design firm or by submitting a complete floorplan, including reflected ceiling, walls, and furniture placement, to fixture vendors. They will analyze the plans and return a finished lighting layout to the customer, detailing the number of fixtures, placement and required wiring. ***Remember- The use of traditional meeting room downcans***, even those that have color corrected light sources / lamps, for any lighting in the field of view for VC that will or may include the actual human faces, **is to be <u>avoided</u> <u>at</u> <u>all</u> <u>costs</u>**. These will result in extremely uneven fields or pools of light and heavy, unnatural shadows on the faces of the participants.

Room preparation conclusion: When we follow these guidelines we dramatically improve the odds for success in the final deployment of live bi-directional conference based human communication. An added benefit is that this approach also dramatically enhances the effectiveness of the room as it operates for more traditional meeting and presentation. The environment is more comfortable and less dependent on specialized electronics for "fixing" space deficiencies.

AV Elements in Videoconferencing: Once the space is prepared we are able to move to the level of integration of the various audio/visual tools within the environment. We are often well served to divide this area into discussions of the audio, video, and control.

Audio Input: The *primary* input device for the audio portion of any conference system is the microphone, common to many applications. We turn now to a short discussion of how these operate within a VC environment, where things like "critical distance" are often pushed to the limit or violated entirely.

Sound travels in a room subject to what is known as "the Inverse Square Law". This means the volume heard at a microphone drops by a factor of four every time the distance doubles (it drops by 6dB). This is considered along with another important element in room audio design - the concept of "critical distance", defined as the distance where the loudness of the room background noise plus reverberation is less than one tenth of the loudness of voices getting to a particular microphone. *For example*, let us work with a room having an ambient noise level of approximately 60 dBSPL. A person speaking in a normal voice is 72 dBSPL at about 2 feet distance. At 4 feet, the loudness drops to approximately 66 dBSPL. This is the already further than the critical distance criteria allows given the ambient noise level. At 8 feet distance, a normal speaking voice is approximately 60 dBSPL and the voice energy and the room background noise are about equal, making it difficult to distinguish words from "noise". Given the physics involved we know, then, that for VC room / "send" audio systems to work correctly the room noise level must be below 40-45dBSPL at the microphones at all times. This gives us some measure by which we can begin to plan the microphone array within a space, including selection based on pickup pattern, sensitivity, noise rejection and signal-to-noise in relation to the ambient noise floor or level within the space. *The good news?* A room designed and built as described earlier in this report will provide an acoustic space where any properly configured and installed audio system can operate with very good results.

Perhaps the most difficult area for any room designer / system planner is in the area of actual microphone placement within the space. Given the fact that many people view the conference table space as sacred (to be used for papers, laptops, coffee cups and other end-user items) there is often a great deal of pressure to place the local microphones on the ceiling instead of on the table surface. ***This approach must be taken with great caution.*** We have already seen the dramatic impact of changes in the distance from the people (their mouths) to the microphone and ceiling systems generally place microphones further away from the participant mouths, not closer. Critical distance calculations may therefore [often] eliminate this approach due to this fact alone. Additionally, the ceiling surface is generally one of the noisiest areas of the room. Proximity to HVAC ducts and vents, attachment of tiles and runners to building members that are prone to vibration and shaking and proximity to noise from other spaces migrating through the plenum make this area perhaps one of the least desirable for placement of microphones. This doesn't, however, keep many people from looking at this broad open surface as the best way to "get the mics off the table".

If this option is chosen the system planner must take pains to select the components with great care from a manufacturer that specializes in this type of audio voice reinforcement. They must be skilled in live audio and capable of installing the components to extremely tight tolerances and, in all cases, the system provider must meticulously inform the end-users of the potential downside risks of this approach. In any event, simply mounting a typical standard "table-top" microphone to the ceiling tiles and/or implementing this solution in an ambient noise environment of 45dBA-SPL or greater will all but *guarantee costly failure*, and no amount of post-mic electronic processing will "fix" the mistakes.

Audio Output: Speakers: We are well served to remember that human-to-human conference communication is just that. *People talking with people is the application*. This is not TV and it is not the Movies. For human communication we do not really care about deafening thundering roar of Surround Sound sub-bass speakers for accurate reproduction of jet aircraft engines. We are interested in reproducing the human voice. The tone, intonation, pitch and level of anyone speaking to us from the far-end should sound as close as possible to the sound they would make if they were actually speaking with us right there in our own room. We are well served, then, to touch base on a couple of simple basic elements of the speaker technology we deploy in our own room. These basics fall into these subcategories:

- *direction*
- *power*
- *range / frequency response*

Direction: As human beings, we feel most comfortable when the voice we hear appears to come from the same direction as the image of that person. This tells us that traditional presentation system reliance on ceiling speakers alone is not an ideal practice when the system is used for videoconferencing. In many small and medium sized systems, front firing speakers alone can provide proper direction and adequate coverage. In larger rooms (greater than 12'x15') we will probably need to work with both front firing and side or top fill speakers in order to maintain proper coverage at nominal power levels. In that case we need to take advantage of the HAAS Effect. This is basically stated as the interpretation of the human brain of sound direction when the same sound arrives at the ear from two or more directions within a certain time period. We attribute the direction of the sound to the direction from which the sound is *first perceived*, even if it is mixed with that same sound arriving from a completely different direction, as long as the two (or more) appearances of the sound at our ear (our brain) are within 14ms of one another. Sound travels faster electronically than it travels through the open air, this means that we may need to add audio delay to the side firing or ceiling speaker arrays in order to keep the primary *perceived* source as the front of room / front firing speakers.

Power: Power is a function of loudspeaker efficiency and total available system power. Most speakers operate in a range of power that is broader than the range they operate in without distortion. For the purpose of conference communication, we are only interested in sound that has little or no distortion (speakers operating in their range of zero distortion). Sound that is accurately reproduced (with no distortion) will most accurately represent the voice of the people from the far-end (our primary goal). Accurate reproduction will also aid the echo-cancellation circuitry in the system, minimizing the amount of echo that our system sends back to the people at the far end (thereby increasing perceived ease of intelligibility and understanding). In short, speaker power should be matched to overall audio subsystem power and the speakers should provide adequate coverage and should present approx. 70-75dB-SPL at the local site with the system operating at nominal power utilization before distortion.

Range – Frequency Response: The human ear is able to hear sounds in a very wide range of frequencies (tones as low as 70Hz and as high as 12,000Hz or more). The human voice is able to produce sounds in a much narrower range (only 100Hz to about 8000Hz). Most human spoken communication occurs, however, in a range that is only 150Hz to about 5000Hz. *This means that we need the speakers to operate with ideal performance in a fairly narrow range for human voice (as opposed to speakers used for music where we often see ranges of 20Hz-20,000Hz).* We must also be cautious of the crossover characteristics of the speakers we select. Many coaxial and paraxial speakers have their crossover within the middle audio frequencies, thereby inducing potential distortion within the spoken frequency range, creating anomalies within the system that damage voice clarity and hinder proper echo control.

Video: Display: As a general "rule of thumb", any display that is used in a videoconferencing environment should be sized for the number of attendees, the physical distances involved, and the type of material presented on-screen. The screen size should allow for clear and easy viewing at the various distances experienced within the room. A measure of screen size required, often applied to projection technology, is "no closer than 1.5 and no further than 7 times the diagonal measure" in order to properly view the images. When evaluating monitor technology, no one should *have* to sit closer than 2 times the screen diagonal measure, nor any further than 8 times that measure.

Direct viewed "tube" type displays (monitors) and Plasma displays (now available up to 60" diagonal) are almost always sharpest and brightest in a videoconferencing environment, with “retro-projector cabinet” displays (looks like large screen TVs) next, and “front-screen” projectors last. Glare and uncontrolled ambient room lighting adversely affect the quality of the image most with “front-screen” projectors, and will have the least adverse affect with “direct view tubes or screens”. There are a very limited number of models of the “retro-projector cabinets” and even fewer “front-screen” projectors that have sufficient brightness and [especially] contrast to be useful in a properly lit videoconference room.

Video projection for use in videoconference: Many installations make use of video projection devices. The most important thing to remember in the design of a videoconference space is that Front Projection is vastly inferior to Rear Projection. Front projection systems are less expensive and easier to implement, but the conflicting interest between the camera and the projection display make this form of display a very poor choice. Front projection setups operate best when the lighting in the room is dimmed or doused. When this is done, in order to make the image bright enough for use, the videoconference cameras can no longer operate, since they require even, bright, color-corrected light (a direct conflict between these two technologies is clear). In the event that a rear projection room cannot be set aside, retro-projection units are available from a number of manufacturers. This display type is normally available in sizes ranging from 40 to 72” diagonal measure. To enable high quality video to be displayed, while maintaining optimum lighting for interactive video meetings will require a projector of the “light-valve” or DLP class.

Regardless of the exact type of projector selected and the exact nature of “front versus rear”, there are certain essential rules for projector placement. The goal in projection is to get the image beam to aim directly into the audience eyes. In cultures in the Western Hemisphere the average distance from the floor to a seated persons eye is 4’. That becomes the target for the direct beam of the projector. Again we must emphasize that front projection should be avoided except in the most extreme cases and, if it is used at all, it must be used with an extremely bright projector (2500 lumens or greater for any space smaller than 25’x40’) and should be ceiling, not floor, mounted.

Main Camera & “Other” Inputs: There is usually a “main” or “local people” camera positioned at top-center of the inbound (far-end view) display, so that it can “see” the participants and anything necessary at the sides of the room, using pan and tilt features. If there may be individual presentations from the side or “front of audience” area of the room, an additional camera should be located at the back of the room, also mounted to allow a view of the presenters when necessary. Some cameras contain an active camera pointing system that can also be used effectively given proper care in the mounting of the camera assembly. The area immediately surrounding the camera assembly may need to be acoustically “dead” to ensure the voice tracking and pointing algorithms work correctly. This is another reason why we must pay close attention to the acoustic environment and acoustic treatment of this or any other space intended for use with this type of camera system. If local presentation is blended with VC for any event we must consider the needs of the presenter who will not be “facing” the local image or inbound image displays used by the main body of the local audience. One or two monitors (and a camera) should be mounted at the back of the "audience-end" of the room with the horizontal centerline at approximately 5' from the floor for ease of presentation interaction between the presenter and the group(s) at the far-end(s).

We are well served to remember that, with the exception of PC based information that is not in a standard composite narrowband video format, most information we wish to "show" or "view" will be translated to video, most often with some sort of camera mechanism. Document cameras, 35mm slide-to-video units, video scanners, scan conversion devices – these are all designed to take one format of source material and convert it to a standard video signal that can be digitized, shipped to the far-end(s), and converted back to composite video for display. Which devices are selected and how they are used depends entirely on the needs and goals of the end-users of the system(s) and the format of their source materials.

Room Controller: To best enable all participants the easiest use of the room for any and all presentation or conference usage, a fully integrated room controller is recommended. There are several approaches to this device. It is important that this common device control all VC elements in the room so that only one user interface must be learned by those using the facility. The common controller makes it much easier to expand and enhance the room capabilities over time by adding or upgrading the equipment as appropriate. A proper room controller can operate and coordinate the use of lighting, curtains, displays, audio devices, VCRs slide projectors, as well as all the conferencing equipment, including any network-related control that might be needed. In lieu of a complete control system, a limited functionality controller can be located at the presentation interface panel to control the switching and routing of the computer graphics, as well as configuring the overhead camera video paths.

It is strongly advised that, for every room you integrate, you devote at least 20% of your development time to this important sub-system, as it will complete the "integration" of the conference and presentation environment. And you must consider – simpler is always better. **Remember** – people do not pay for *technology*. They pay for the *benefits* that technology can bring, and the only doorway to that list of benefits is a simple, straightforward and intuitive user control. Like the other processors, this item is better addressed as the subject of a separate article, and we do not have time to do this element any true justice here.

These, then, within the broader context of "AV / Presentation Technology" discussion, are the elements that have the greatest impact on the success of any presentation space that must also operate as a videoconference communication space. The greater the attention paid to the early space and AV planning, the more technically and end-user successful the conference solution.

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