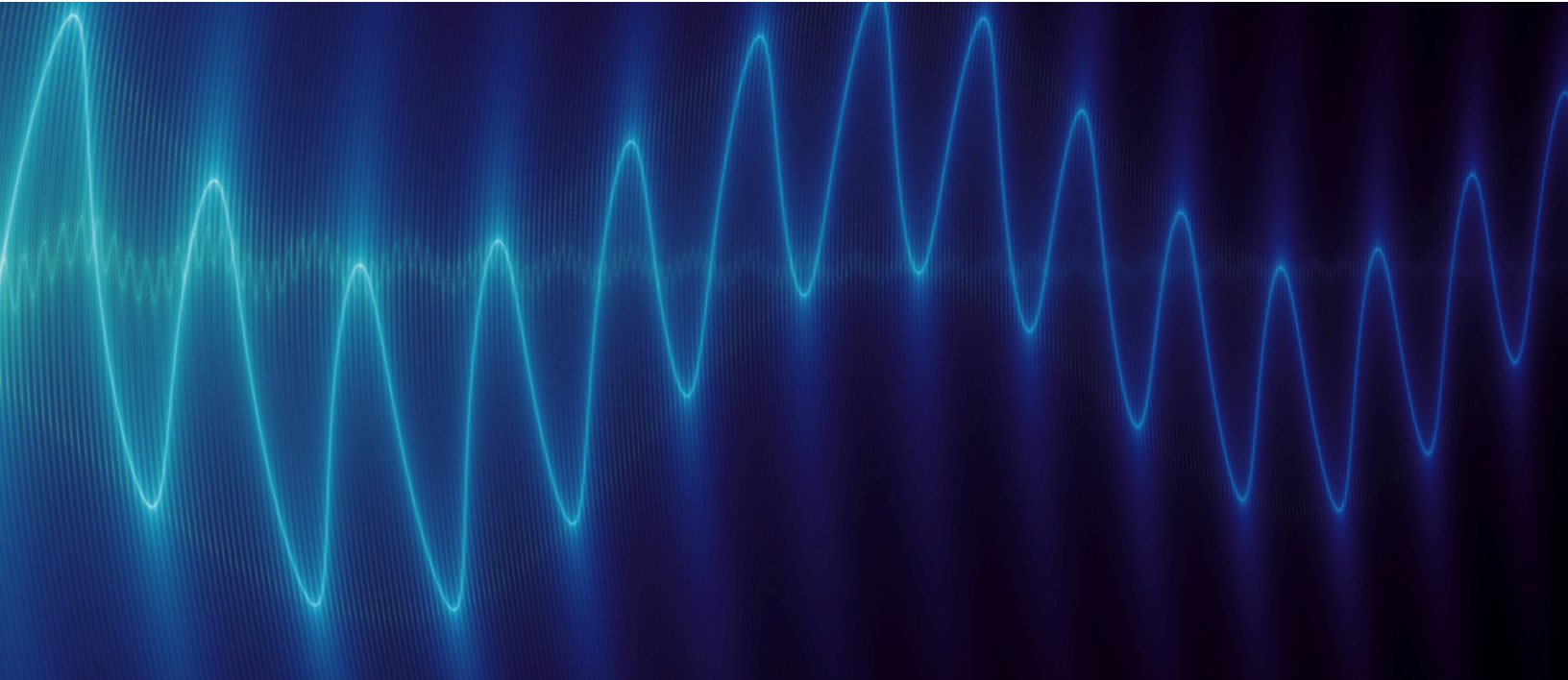


ClearOne[®]



White Paper

EFFECTIVE AUDIO FOR VIDEO CONFERENCING

January 2013

S. Ann Earon, Ph.D.
President, Telemanagement Resources International Inc.

©2013 ClearOne Inc. All rights reserved. No part of this document may be reproduced in any form or by any means without written permission from ClearOne Inc. Printed in the United States of America. ClearOne reserves specific privileges. Information in this document is subject to change without notice.

White Paper
Effective Audio for Video Conferencing

ClearOne Rev 1.0 - January 2013

Effective Audio For Video Conferencing

Table of Contents

Introduction	1
Audio Communications	1
Audio Endpoint Equipment	1
Audio Is The Foundation	2
Achieving Audio Quality	3

Introduction

Most business users are familiar with audio & video conferencing and have experienced both technologies in a variety of situations. But, many users forget that these technologies are only as good as the audio foundation. Audio quality can be impacted by the type of device used to participate in the calls (i.e. using hands-free devices like speakerphones or cell phones versus using non-hands free devices like telephone handsets). Too often microphones are not properly placed to hear those talking and users attempt to use a variety of audio devices, including cell phones, to connect someone into a video call. Voice quality in a video conference is impacted by the acoustics of at least two rooms – the caller and the listener. The purpose of this paper is to address what needs to be done with audio to make it effective in all situations so users can clearly hear everyone involved in audio and video conferencing calls.

Audio Communications

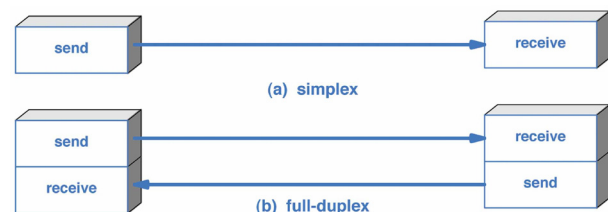
Audio, that is voice, is almost always deemed the most critical portion of any conference. Without audio, the meeting loses nearly all value. A variety of equipment might be involved to hold an audio conferencing call or add audio into a video call, including telephone handsets, speakerphones for use by small groups, installed audio systems, microphones, mixers, and controllers to initialize and manage the call speakers.

The quality of the voice transmission line is crucial to the success of an audio conference. A regular (analog) dial-up telephone line is often all that is needed to conduct a successful audio conference. But users should be wary of individuals calling into an audio or video call on their cell phone. Both the quality of the line they are on and

their location (driving in a car with a noisy truck passing them, near construction sites, etc.) can negatively impact the overall quality of the call. While many people use their telephone systems for three-way conference calls, and sometimes to even link multiple sites, a multipoint conference, of more than three sites, often requires an audio or video bridge to link sites together. A number of telephone and bridging service companies offer multipoint audio, data and video conferencing services. Calls can be established through an operator or on a dial-up basis. Keep in mind the call is only as good as the audio foundation. A noisy, hands-free conferencing connection can negatively impact the entire call, whereas video can sometimes be forgiven when lacking certain quality.

Audio Endpoint Equipment

Today, most audio conferencing endpoint products (speakers, microphones, and audio mixing controls) are full-duplex systems, providing the same kind of interaction one gets from the telephone, with important improvements.



Differences in simplex and full-duplex audio

Users can interrupt one another at any time, speaking and hearing simultaneously (known as a full-duplex call), and both users can be heard simultaneously without echo (call feedback often caused by speaker/microphone placement). Communication seems as natural as being with the person in the same room.

A properly chosen and configured full-duplex conferencing endpoint will ensure that high-quality audio is captured at

the endpoint even when the room is reverberant or contains noise sources like a projector, HVAC noise, outside traffic, etc. Audio conferencing endpoints can be categorized as personal conferencing devices, tabletop conference speakerphones, and professionally-installed conferencing systems. Personal conferencing devices include one or more microphones, a speaker, and signal processors. They are designed to be used by a small group of people (one to four). Tabletop conference phones have a built-in speaker that can produce a higher sound output volume than the personal conferencing products, and they may also support expansion of the microphone pickup area through the use of expansion microphones or attachment of conference phones. Professionally installed audio systems offered today support arrays of microphones that can be placed around a large conference table to handle large groups of participants. The microphones used by professionally installed systems are generally permanently installed in the conference table or on the ceiling. There are also wireless microphone systems that are designed to use with professionally installed audio conferencing systems.

The electronics that support full-duplex audio systems process audio signals to separate the signal that originates from a local person speaking into a microphone from the sound coming from a far end talker that is played through the local speakers and is subsequently coupled into the local microphone. This is called Acoustic Echo Cancellation (AEC). Professionally installed audio systems may also include an additional technology called feedback cancellation. A feedback canceller may be required when a presenter needs his/her voice amplified into a local conference space so listeners, who may be in the same large room or auditorium, can still clearly hear the presenter's voice. Amplification of the local presenter's voice in the local room may result in a high-pitched squealing sound called feedback if there is positive gain

between the microphone and the speaker. ClearOne's Dynamic Automatic Resonance Eliminator (DARE) feedback eliminator uses proprietary adaptive algorithms that have evolved from ClearOne's years of experience and expertise in echo cancellation technology. These algorithms eliminate feedback by rapidly identifying a feedback node and then placing a narrow-band filter at that frequency without the need for additional feedback elimination equipment.



Professionally installed systems for large venues require custom configuration

For a very large auditorium, a professionally installed system may also need to include a time delay function that delays the local presenter's voice by a programmable amount. This allows an installer to guarantee that a listener at the back of a large auditorium does not hear the presenter's amplified voice (which is transmitted at the speed of electrical signals through the audio systems) followed by a delayed version of the presenter's live voice (which takes longer to reach that person due to the fact that the acoustic sound travels more slowly than the electronically captured version of the presenter's voice).

Audio Is The Foundation

Humans can tolerate visual interference – a grainy image, untrue colors, and jerky images. But, the audio must be high-quality in order for listeners to perceive the words. Decades of research have shown how specific types of signal degradation affect perception. This research has

been used to produce telecommunications networks that are optimized for transmission of high quality human speech.

One study, conducted by TRI, had 100 participants view video and evaluate the quality of the image as they thought the bandwidth of the video was being altered. In reality, the bandwidth allotted to audio was changed. The participants perceived the video improving as the audio improved, even though no changes were made to the video quality.

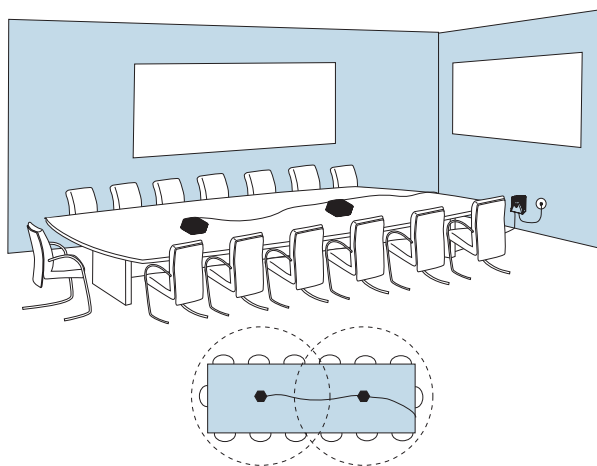
Audio must be high quality in order for people to perceive the words. Speech can tolerate some clipping or the loss of an occasional syllable, but time lag is intolerable to listeners during conversation. When the range in the voice is muffled and speaker identity and intelligibility are affected, calls are no longer understandable. All these factors make audio quality an extremely important component of a video conference. Lowered speech intelligibility will inevitably obscure natural communication, take focus away from important aspects of the meeting, and cause fatigue.

The way audio is handled in a video call can also be an issue. The quality of speech transmitted over a local area network (LAN) or wide area network (WAN) can be impacted by the way audio packets are handled. Compression and decompression of audio is a standard part of a video conferencing system, and can be a source of reduction in audio quality. Complete loss of some audio packets during transmission over the public Internet may also occur. As a result, the audio signal may suffer in quality and delay. In some instances, to optimize audio in a video conference, a full duplex voice telephone circuit is used to carry the audio portion of the conference. The independent channel can also be helpful for troubleshooting if participants have

difficulty with the LAN or collaboration applications during a meeting. As an alternative, a company can pay a service provider with Quality of Service (QoS) technologies like Multiprotocol Label Switching (MPLS) and Differentiated Services or DiffServ, which allow audio and video data to be transmitted with a guaranteed level of quality.

Achieving Audio Quality

The goal in any video conference is for the participants to feel they are in a meeting room with good acoustics and do not feel distracted when others whisper, tap pens or rustle



Room design must be considered for optimal audio system configuration

papers. If a room is properly equipped and designed, meeting participants should not have to worry where they sit or stand in order to be heard. They should feel as if everyone is in the same room, even when communicating from a distance. Achieving quality audio is dependent on both the right equipment and the proper environment.

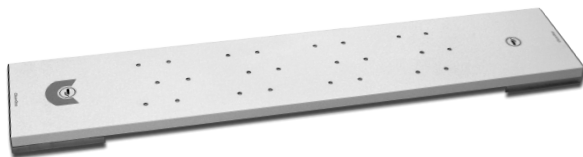
Room design is an important component for quality audio. A room with hard surfaces everywhere results in too much echo. When setting up a room for a video conference, consideration must be given to whether there are reflective

surfaces near the microphones and speakers, whether there are sources of noise coming from other equipment or SS systems, and how well the room is sound-insulated from adjoining rooms. For some rooms, a premium or installed audio system may be appropriate.

Check for symptoms of bad acoustics by clapping your hands. If it sounds like you are in an empty barrel, garage or basement, you need acoustical treatment of the room. Your goal is to achieve a sound that is relaxing and inviting. The next step is to look at your meeting room and check for hard floors, hard walls and the presence of undraped windows. Hard surfaces are part of the cause of bad acoustics. The secret to making your room better for audio or video calls is to have soft surfaces that absorb sound. Carpeting, upholstered surfaces, and draperies are examples of how to soften a room to achieve better audio. But changing a room is not always practical or desired. A professionally installed system is designed by an integrator to mitigate noise and echo while optimizing desired sound.

Acoustical wall panels will also help achieve proper sound in a room. Never let two opposing walls remain without absorption. Acoustical treatment attenuates the reflected sound and increases the usable distance between sound sources and receivers. This will increase the audio quality over a wider seating area.

Many systems today use simple microphones with little directional sensitivity. While these microphones capture



ClearOne's new Beamforming Microphone Array automatically configures to room acoustics with twenty-four microphone elements, steering its pickup pattern towards participants in the room and rejecting unwanted noise and reflections.

sound from all directions, they do not adequately suppress ambient noise. New microphones are being developed to optimize directional sensitivity. Installing the right audio equipment and treating the room will help optimize audio quality.

This process does not have to be expensive. One end user solved the audio problems in a room located in a parking garage inexpensively by hanging lined draperies on the wall. The small changes worked and resulted in acceptable audio during a video conference. Small adjustments to the room can make slight audio improvements, while solutions ranging from speakerphones to professionally-installed systems can bring the greatest improvements to conferencing sound.

Finally, there is no substitute for proper speech etiquette. Anyone speaking should use a normal speaking voice, with no need to shout or whisper, and always direct his or her voice at a microphone. The right audio system, with intelligence provided to automatically correct microphone gain without causing unnecessary pumping noise, is the approach to take for optimized audio. With intelligent systems presenters are able to stand or walk around a room without being tied to a lavalier microphone or having to directly speak into a microphone.

Awareness of what needs to be done to achieve good quality audio is the key to video conferencing success. Good audio solutions for every conferencing application – with or without video – are important to successful calls.

S. Ann Earon, Ph.D., is president of Telemangement Resources International Inc. and Founding Chairperson of IMCCA, the non-profit industry association for collaborative conferencing. She can be reached via email at annearon@aol.com.



Clearone Contacts

North America

Tel: 801-975-7200
Toll Free: 800-945-7730
Sales: 800-707-6994
Fax: 801-977-0087
sales@clearone.com

Europe & Oceania

Tel: +44 1454 616 977
global@clearone.com

Asia Pacific

Tel: +852 3590 4526
global@clearone.com

Latin America

Tel: 801-974-3621
global@clearone.com

Middle East

Tel: +852 3590 4526
global@clearone.com

Other product names may be registered trademarks of their respective owners who do not necessarily endorse ClearOne or ClearOne's products. All rights reserved.
Information in this document subject to change without notice. © 2013 ClearOne. DOC-0117-001, Revision 1.0 January 2013.