How can Lightspeed's sound panel solutions possibly break down acoustic barriers in the classroom?

News flash: there is no magic.

There is no audio solution that "throws" sound. There is no solution that "overcomes the laws of physics." Yet there is a breakthrough audio solution that provides access to comfortably audible and intelligible speech for every child in the classroom. And does so with ease of installation, no steep learning curve for teachers, or complex speaker placement or management of finicky, outdated FM systems.

"Hearing is the primary channel for learning. The more children hear, the better they learn."

—Dr. Mark Ross,

University of Connecticut

Audibility vs intelligibility: what's the difference and does it matter?

Think of audibility as loudness and intelligibility as clarity. If you want to hear something, you may turn up the volume to make it louder. If you want to understand what you are hearing, adequate volume or loudness alone just doesn't cut it. Have you ever been blasted with instructions from the cockpit on an airplane? Very loud, and completely unintelligible.

Fact: hearing (audibility) does not equal understanding (intelligibility).

Increasing audibility in the classroom is a no brainer. Four traditional cone speakers strategically placed will easily fill the room with sound. Use two cone speakers and turn up the volume a little more and audibility will be satisfactory. This is a fine solution if all you care about is making sure media related audio is being heard. But what about speech intelligibility cues from teachers and peers?

A teacher's voice can generally be heard just fine at almost any point in the classroom through a traditional cone speaker system. The problem lies in providing adequate intelligibility. Audibility is essentially static, meaning that once you set the volume it won't vary significantly as you move about the room. It is measurable and predictable. However, Intelligibility is dynamic. Teachers move around the room, and may turn to face the interactive whiteboard, for example (reducing visual cues as well). Student generated noise levels change dramatically in an active classroom. Other factors impacting speech intelligibility include projector noise, HVAC noise, and traffic noise and are pervasive in modern classrooms.

No compromises required: providing great speech intelligibility is attainable.

Inadequate intelligibility has been a compromise that educators have been forced to accept given the limitations of traditional cone speakers. Unfortunately it is this crucial factor that is at the heart of auditory learning. Thanks to advances in sound panel technology, educators no longer have to make this compromise in their efforts to increase speech intelligibility in the classroom.

"If you want to understand what you are hearing, adequate volume or loudness alone just doesn't cut it."

No compromises? Get real. There is always a trade-off.

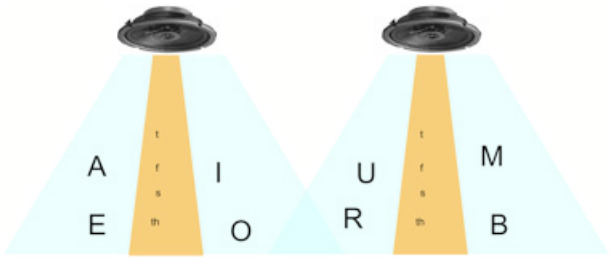
So true. A Lightspeed sound panel is designed to maximize access to learning by improving voice audibility and speech intelligibility for every student within the confines of a classroom. No compromise there. But what do you give up? Bass - but only the very deep bass that is found in some media sources. That is why we combine our sound panel with a traditional cone speaker in multimedia applications.

Lightspeed sound panels produce frequencies down to about 120 Hz, which is the bottom of the male voice spectrum. When it comes to vocal frequencies, panel solutions do not have low frequency limitations. This means that plenty of bass is available for providing vocal power from the teacher, as well as for many media applications in the classroom.

Why are lightspeed sound panels superior in achieving intelligibility?

Audibility is generally found in the lower frequencies (such as vowel sounds and vocal fundamental sounds). These sounds are easy to project. Intelligibility is found in the higher, soft consonant frequencies. You cannot make "t" or "s" loud no matter how hard you try. Consider whispering – which generally relies on the soft consonant sounds — you cannot make a whisper loud.

Cone Speaker: Audibility vs. Intelligibility:
Cone speakers create excellent audibility throughout the classroom. By their nature, the lower frequency sounds have a relatively wide dispersion pattern. However, as you see from the diagram below, the dispersion of high frequency soft consonant sounds is relatively narrow. In fact, in some cases, once you get out from underneath the direct path of a cone speaker, intelligibility starts to degrade as you begin hearing less and less of those high frequencies.



Cone Speaker Audio Dispersion

This narrow dispersion pattern is due to the cone moving very fast to produce high frequencies. As the cone moves faster and faster, only the center of the cone is able to keep up and the dispersion of those frequencies starts to narrow to a "beam" at the highest frequencies. When this happens, there are actually gaps in intelligibility throughout a room, despite what would otherwise seem to be a perfect dispersion of audibility.

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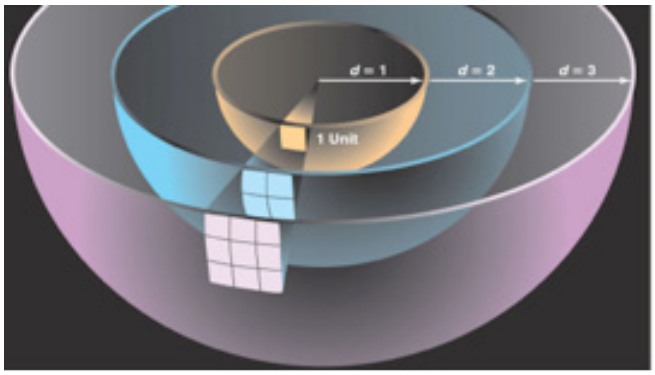
Lightspeed Sound Panels: Audibility vs. Intelligibility:
Lightspeed sound panels also deliver excellent audibility throughout the classroom. But what is amazing is that it maintains that distribution at the high frequencies, producing both sufficient audibility and excellent intelligibility throughout the room without having to crank up the volume. It just doesn't have the same "beaming issues" traditional cone speakers present.

Sound Panel Audio Dispersion

Yes. Physics is still the law. Our sound panel solutions depend upon it.

The Inverse Square Law states that sound pressure level will decrease by approximately 6dB for every doubling of distance from the sound source. Translation—the farther you are from the audio source, the more degradation of sound you will experience. Makes sense right?

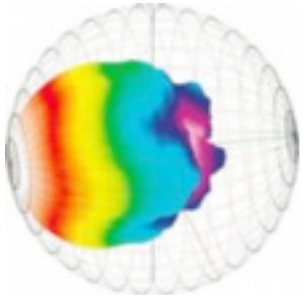


Here is the catch and here is why we have to keep our heads in the classroom and not just in the lab. The effect of the Inverse Square Law is most pronounced in an open space with no reflective surfaces and with a stationary audio source. When walls and other classroom variables such as tables, chairs, flooring surfaces, and teacher movement around the room are introduced, all bets are off. In the real world of teaching, the room characteristics impact the decrease in sound level, not the type of speaker.

"It just doesn't have the same "beaming issues" traditional cone speakers present."

Have You Ever Seen An EASE Plot Of A Speaker? Umm. Forgot Something.

An EASE plot (Enhanced Acoustic Simulator for Engineers) is a modeling tool, not a measurement tool, and has been used to depict the energy dispersion into the room as if we, the viewers, were above the ceiling of the room looking down into the room (although there are many variations possible using EASE plots). These analyses often lack two important features: First, **the sound energy produced by the teacher during direct instruction is omitted.** The teacher's own sound energy directly impacts sound levels and interacts with the energy from the speaker(s).



An example of an EASE Plot

Second, these figures and illustrations simplify a very complex interaction between the system's speaker(s), the teacher, and the acoustical properties of the room. Making general statements regarding speaker performance based on modeling software that does not contain all variables oversimplifies the complex interactions present when classroom audio systems are in use.

"Unlike classroom audio systems with traditional cone speakers Lightspeed sound panels are designed to use the reflection from the walls, ceiling and floor of a room."

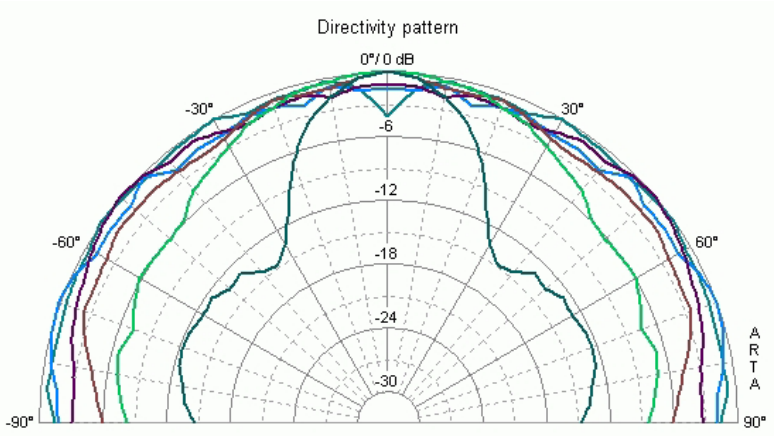
Lightspeed designs sound panels that work with the teacher and the classroom.

Unlike classroom audio systems with traditional cone speakers Lightspeed sound panels are designed to use the reflection from the walls, ceiling and floor of a room. Reflection is used to enhance the dispersion of intelligible audio and take advantage of the energy created by the teacher's actual voice. The result is a low volume solution that provides highly intelligible speech throughout the classroom. It's not magic. It does not create hot spots and it is not prone to feedback. It is a thoughtful, practical application within the context of the classroom realities and the laws of physics that takes down the acoustical barriers to learning.

Can I use a polar plot to measure the effectiveness of sound panels?

Ok. Maybe you have never considered asking this question, but others have so we thought we'd address it here. In the spirit of being thorough at the risk of possibly providing too much information, here it goes.

Polar plots are illustrations showing the dispersion of sound energy as a function of both frequency and angle from the sound source. They are presented as graphical hemispheres, and generally contain colored lines representing the frequencies being measured, as well as demarcations indicating the angle of incidence of measurement from the source.



An example of a polar plot

They can provide very good information if, and only if, three conditions are met: 1) We must know the distance from the source that the measurements were obtained; 2) We must have plots for the complete speech range, not just 250Hz through 4kHz. The critical phoneme, /s/, necessary for receiving speech intelligibility cues, has a center frequency of about 8kHz – this key information is missing from many polar plots; 3) **We must be aware that single mic polar plots are not appropriate for measuring sound energy dispersion from sound panels.**

In order for a single mic measurement to work, the speaker must create what is called a "spherical wave front." Traditional cone speakers emit spherical wave fronts. Lightspeed sound panels do not. Therefore, traditional polar plots will always be in error when measuring these transducers. Only multiple mic array measurements can provide energy/frequency dispersion information for Lightspeed panels. This is the only way to accurately represent what being heard in the classroom. Now you know.

"Only multiple mic array measurements can provide energy/ frequency dispersion information for Lightspeed panels."

"Think of this (sound panel technology) as the "anti-technology" technology. It's advanced, yet simple."

What makes lightspeed's sound panels work? Well, they are "exciting".

Think of this as the "anti-technology" technology. It's advanced, yet simple. So how does it work? A series of exciters directly applies sound energy to the sound panel, "exciting" the surrounding air molecules and distributing the voice signal evenly across learning spaces. Imagine a series of pebbles cast upon a pond surface. The rippling sound waves reach every inch of the area, just as they would reach every ear in class. The high frequencies (intelligibility cues) of the voice signal, so easily lost amid active classrooms, come through clearly and intelligibly.

Get the facts that the experts have collected.

Accurate information regarding available technologies is essential. "ANSI/ASA S12.60-2010/Part 1 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools" is an excellent resource regarding classroom acoustics, audio distribution systems, and the myriad of variables that must be considered in order to afford access to direct and indirect instruction to all students at all times. The document can be downloaded at http://asastore.aip.org/shop.do?pID=594.

Experience is a great teacher. The proof is in the listening.

Lightspeed sound panels have been widely adopted by schools and technology departments across the United States and Canada over the past 4 years with remarkable results. Many of these schools have replaced traditional cone speaker solutions with single panel solutions such as REDCAT and TOPCAT from Lightspeed Technologies.

We hope that your next step will be to listen to a Lightspeed classroom audio system. We offer in-classroom evaluations with no obligation. We think you will hear and understand the Lightspeed difference.

Lightspeed Advantages

- High Value and Low Cost of Ownership
- Easy-to-use Products Designed for Teachers
- Latest Technology Innovations
- Focus on Easy Classroom Integration
- Highly Responsive Service and Support
- A Passionate Commitment to Education

Established in 1990, Lightspeed Technologies is the trusted provider in classroom audio technology. Our passion is to improve the listening and learning environment for every child. We believe strengthening the connection between teachers and students is at the heart of learning.

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