



## THE GOLDMUND MEDIA ROOM SECRET: PROTEUS SOFTWARE

The room-modeling technology that makes the Goldmund Media Room possible.

Audio systems are generally designed with the goal of flat frequency response in an anechoic environment in which reflections of sound do not exist. Yet the acoustics of the room in which the system is ultimately placed always change the sound for the worse. For decades, audio system designers have tried to compensate for room problems by adjusting speaker position, adding acoustic treatment devices, and employing electronic equalizers. These measures only go part of the way toward achieving ideal audio performance.

Goldmund's Proteus technology achieves ideal and consistent performance in all Goldmund Media Rooms because the entire audio system is designed specifically for the room. Proprietary computer-based room modeling software takes into account a room's dimensions, construction, and decor. It then specifies how many and what type of speakers are needed for the room; what positions the speakers will occupy; and what electronic correction is needed for each speaker to deliver ideal performance in that particular room. The correction algorithms are loaded into the digital signal processors built into the Media Room amplifiers. Each driver—be it a woofer, a tweeter, or a subwoofer—gets its own amplifier and its own correction profile.

The result is ideal sound in any environment without the use of acoustic treatment.

### Modeling Software

The core of the Proteus technology is Goldmund's proprietary room-modeling software. Into this software program, Goldmund technicians enter numerous parameters of the room in which the system will be installed. These parameters include:

- Dimensions
- Construction materials (cinder block, drywall, etc.)
- Number of seats
- Thicknesses of seat cushions
- Total area and composition of draperies
- What type of cloth will be used to cover the speakers
- Altitude and average humidity of the room

The acoustic characteristics for all of these parameters are included in the software, as are the performance characteristics of the amplifiers, speaker drivers, and enclosures that Goldmund uses in its Media Rooms. All common construction materials (even those used in locales that do not follow European or North American construction conventions) are included in the database. Even such details as placement of screws and glue beads are considered for the acoustical effects. Every minute detail of the room's acoustics and the way its materials will interact with the sound waves emanating from the speakers is known and considered.

Conventional acoustical analysis assumes a rectangular room shape, which is a rare feature in actual homes. Proteus can calculate the acoustical effects of any room, no matter what the shape. Using a 3-D model of the room created by Goldmund's technical staff, all of the modes (or resonances) of the room are calculated.

The acoustical analysis provided by Proteus is far more detailed than traditional analysis using microphones. Traditional analysis is performed at six to eight microphone positions. Proteus, in comparison, analyzes acoustics at tens of thousands of positions in a room, which may be spaced as closely as 1mm apart. The result is a graphic diagram that shows the propagation of sound in the room at every position, at any audio frequency.

The diagram shows sound pressure level and frequency response of the audio system in each seat. Using the diagram, the Media Room technicians can choose to compensate for any sonic anomalies by altering the room construction, adding speakers, or applying correction algorithms calculated through Proteus. The effects of any such changes can be calculated using the Proteus software to evaluate their efficacy and desirability.

## Proteus calculation process

The software calculates the number of speakers that will be required to reach a maximum sound pressure level of 130 decibels in the room. This is the level Goldmund engineers have determined is essential to create lifelike sound. The maximum level is roughly equivalent to that of a jackhammer or a shotgun blast. (This should be no cause for concern, though, because when the system is playing movies or music, it will rarely be called upon to produce such extreme levels, and when it is the sonic event will likely last for only an instant.)

Next, the software determines the correct position of each speaker to the millimeter. Normally, an audio system designer will perform this task largely by instinct, and will not have the luxury of experimenting with different speaker positions. The Proteus software, in contrast, models the effects of hundreds of different possible speaker combinations and positions, then picks the best one.

The final step in the calculations is to compute a correction algorithm for each driver in the speaker system. (Although the total number of speaker drivers in a Goldmund Media Room varies according to the demands of the room, all of the systems include at least 40 drivers.) The correction algorithm compensates both for the performance characteristics of the speaker driver, and for the acoustical surroundings it will occupy.

Primary among these corrections is adjustment of driver timing. In audio, timing or phase distortion—differences in the times that treble, midrange, and bass frequencies arrive at the listener's ear—is common. In nature, however, these differences do not exist. They are thus readily identifiable to the human ear as unnatural. Adjusting the timing of each driver separately, and employing Goldmund amplifiers that are designed to reproduce an audio bandwidth 100 times greater than the ear can detect, effectively eliminates timing distortion. (See the white paper on Goldmund's Leonardo technology for more information about timing and phase, and their effects on sound reproduction.)

Many other corrections are also made to each driver through the Proteus technology. These corrections include frequency-response contouring, to ensure that all frequencies of sound are reproduced at exactly the same level. Corrections are also made for room modes, or room resonances that emphasize certain bass frequencies while damping others. The tonal balance is also adjusted to compensate for room decor that is unusually absorptive or reflective of sound.

## Using the data from Proteus

Proteus generates two types of data. First is the recommendation of speaker quantity and placement for Goldmund technicians to use in installing the Media Room system. Second is code for the digital signal processors (DSPs) that reside in each Media Room amplifier and in the Goldmund Mimesis Universal Preamplifier.

Each Media Room amplifier is dedicated to one speaker driver in the system. Each amp is fed a digital audio signal from Goldmund's Mimesis Universal Preamplifier through a coaxial cable. The digital audio signal enters the DSP, which stores the correction algorithm generated by Proteus specifically for the driver to which the amp is connected. The DSP incorporates timing, frequency response, and room compensation corrections into the audio signal. A side benefit from using DSP inside the amplifier is that speaker crossover functions are also performed at this stage—and entirely in the digital domain. Digital crossovers are more precise, efficient, and sonically transparent than analog crossover networks inside a speaker.

The resulting signal is then converted to analog through Goldmund's Alize digital-to-analog converter, amplified, and fed to the driver. Amplifiers are positioned as close as possible to their respective drivers, in order to keep speaker cables short and minimize their effect on the sound.

The components of the Media Room system are interconnected through Cat-5 networking cable, to facilitate communication among components and also to allow performance monitoring. Configuration of the amplifiers' internal DSPs is done through this cable. This cable also allows monitoring of the performance of amplifiers and speakers, warning of potential malfunctions due to overheating, and alerting Goldmund's technicians to any actual malfunctions so they can be quickly corrected.

Like the sounds of nature, the sounds from the Goldmund Media Room speakers arrive at your ear without timing or phase distortion, without frequency response anomalies, and without dynamic limitations.