B&W Bowers & Wilkins

Positioning speakers for home theatre

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Before reading this section, please read the articles **Positioning speakers for 2-channel stereo** and **Dealing with room acoustics** first. The problems discussed also apply to Home Theatre installations. Setting up a successful Home Theatre installation is a confusing business, especially for the newcomer. Conflicting advice from different quarters increases the confusion and there are often constraints on the users, imposed by domestic arrangements, which prevent them following any of the "ideal" scenarios suggested. Because the audio part of the installation is tied to where you want the screen, your flexibility in speaker placement in order to avoid some of the room acoustic problems may be limited. To a certain extent though, the presence of a visual image on the screen takes your attention away from some of them. Difficulties can arise, however, when you want to use the same system for both Home Theatre and audio-only. The confusion is often associated with advice given for the older Dolby Pro-Logic® based formats compared to the newer 5.1 formats, such as Dolby Digital® and DTS®. Pro-Logic® offered essentially 4 separate channels of information – left, centre, right and surround. Because of the desire of many users not to have a number of large speakers in the room, the low bass from all the channels could be routed to a separate subwoofer. In fact the Lucasfilm Home THX® enhancement to Pro-Logic® made the use of a subwoofer mandatory and it handled all the bass below 80Hz. Home THX® also added further processing to the surround channel – so called de-correlation – which offered an approximation to two separate surround channels for left and right. Dolby Digital® uses 5 discrete channels of information for left front, centre, right front, right surround and left surround, plus an extra channel (the .1 in 5.1) for low frequency effects (LFE), normally fed to a subwoofer. Dolby EX® adds a further centre rear channel and 7.1 systems are on the horizon.

Surround speakers

To reproduce the surround information, the original Home THX® system introduced the concept of dipole surround speakers ("ordinary" speakers are monopole). In a full-size cinema, the surround information is reproduced by a number of monopole speakers placed along the side and rear walls of the auditorium, to give an enveloping sound field. However, because of the spread of speakers, all producing the same signal, there is little in the way of precise localisation and sound tracks were produced recognising this to be the case. Dipole surround speakers, when placed to left and right of and in line with the listeners, produce a similar enveloping sound field with just two speakers in the room. The reason they can do this is because dipoles produce a figure of eight dispersion pattern. Sound is projected strongly along an axis in two opposing directions and in opposite polarity. At 90º to this axis, the equal and opposite signals cancel and you have what is known as a null plane. If this null plane points at the listeners, with the strong signal axis aligned along the side walls, the listener hears little direct sound, only that which has been reflected off room surfaces. It is therefore difficult to locate the speakers aurally. When listening to many movies using dipole surround speakers compared to conventional monopole speakers, one might hear a smoother transition of sounds panning from front to rear – aeroplanes flying overhead for example. Also, the fact that the surround sound field is more diffuse makes the system easier to balance for a wider spread of listeners. The tendency for the sound to collapse to the nearer speaker is largely avoided. But dipoles do have their disadvantages. They do not work so well if the listeners sit close to the rear wall, as the rapid reflections off the rear wall tend to make the speakers easier to localise aurally and you lose the whole point of having dipoles in the first place. There are also some listeners who are disturbed by the out of phase signals from the front and back of the dipole, hearing the same uneasy ethereal effect that one gets from a stereo pair of speakers wired out of phase. When Dolby® introduced their Digital 5.1 format (using the processing algorithm known as AC-3®), they suggested an ideal for the type of speakers used. The separation of the surround information into two discrete channels now offered much more scope for steering and positioning sound sources to the side and behind the listeners, and the recommendation was to have 5 identical speakers for left, centre and right front, left and right surround. More than that, the requirement was for all 5 speakers to be full range, as the subwoofer channel (the .1 in 5.1) was intended only to reproduce special low frequency effects (hence the term LFE channel). This recognised that positional information can extend to very low frequencies, contrary to the popular, but only approximately correct opinion that low frequencies are so omnidirectional that you cannot tell where they come from. So, where does that leave dipole surround speakers, and those users who don't want to have a multitude of large speakers in their room? Lucasfilm® has adapted its Home THX® specification to the newer formats and still

recommends dipole or other diffuse speaker designs for surround use. There are still movies around where the surround information assumes this type of presentation, and aurally misleading results can sometimes be obtained if monopole speakers aimed directly at the listeners are used in the surround positions. It is also true that, even with monopole speakers, the imaging to the sides and rear is not as precise as at the front. Phantom images between the speakers are fairly easy to create with sustained tones, but fricative or percussive sounds (plosive sounds in speech, bangs, clicks and pops) can tend to localise more at the speakers, especially if the listener's head is turned to the side. It is also difficult to get an ideal level balance between front and surround speakers for more than one row of listeners. But there is little doubt that more and more 5.1 recordings are being made using monopole speakers for surround, with some attempt at imaging to the sides and rear. When the industry begins to embrace 7.1 formats more widely, it is likely that diffuse speakers will be used less and less for surround applications. Monopole speakers can be positioned to give a more diffuse sound field if required, by a combination of siting them higher than normal – say 60cm (2 ft) or so above ear height - and angling them away from the central listening area. We therefore think the better long-term strategy is to buy monopoles in anticipation of the higher resolution systems and, if preferred, place them for now to give a more diffuse sound field as described above. There is no industry standard for the angular position of surround speakers relative to the screen. Dipoles, as stated above, should be placed in line with the listeners, to direct the null plane at them. You should not generally place dipoles behind the listeners, although it may be the best thing to do if the listeners sit close to the rear wall. Dipoles should also be mounted higher then ear height, with a minimum 60cm (2 ft) recommended. With monopoles, the angle from the screen at which the speakers are placed during recording varies from programme to programme, but it is usually between 110 and 130 degrees round from front dead centre. It is no surprise therefore that we recommend you get as close the average angle of 120 degrees as possible. The geometry of the room will determine whether the speakers end up on the side or rear walls.

Centre speakers

The centre speaker has to handle the bulk of the information on a movie soundtrack; virtually all the dialogue is reproduced by it and many of the on-screen effects. It is therefore important to take care with it. Don't be tempted to buy decent speakers for left and right but skimp on the centre. In a cinema, the speakers are placed behind the acoustically transparent screen and indeed, if you have such a device in your home theatre installation, that is also where you should put the centre speaker. Normally, however, one has to resort to placing the speaker either directly on top of the screen or directly below. You should choose whichever puts the speaker's tweeter closest to ear height. If the speaker is more than 10 degrees away from ear height, you should angle the speaker to point at the listeners' ears.

Front left and right speakers

There is nothing worse than to create a virtual acoustic image the size of the Serengeti, only to open your eyes, look at the screen and see a visual image the size of your back garden. When you are dealing just with audio, you can create a panorama of whatever size you want and let your imagination do the rest. When you have a screen in front of you, you should try to balance the visual and acoustic images. To that extent, you may have to put the left and right front speakers closer or further apart than you would for audio alone, depending on the size of the screen. A good rule of thumb is to place the left and right speakers around 0.5m to 1m (for those who only read imperial units, that's about 20 - 40 inches, not half to one mile) from the sides of the screen. With small screens, that just means that the panoramic angle is smaller than you might like, although the surround field tends to make it seem wider. With the widest screens, any tendency to create a "hole in the middle" effect, which might happen with 2-channel stereo, is prevented by the presence of the centre speaker. The spacing of 0.5m - 1m from the screen also means that in most cases you will be able to use non-magnetically shielded speakers for left and right (see also the article in the FAQ section How close can I place my speakers to a TV set? The optimum height for the left and right speakers depends on the height of the centre speaker, the centre of the screen and ear height. With regard to the first two parameters, the left and right speakers will ideally be somewhere between the two, erring always to be closest to ear height. Like the centre speaker, angle the left and right speakers if the tweeter height is significantly different from ear height.

Speaker size

The Dolby Digital® standard allows for those who may not want 5 large speakers in the room, and several options are available. Each of the 5 main speakers may be classified as 'full range' or 'small' in the decoder set-up routine. Classifying them as small allows the low bass to be redirected to another channel, usually either the LFE channel or the front left and right channels, if full range speakers are used in those positions. Dolby® specifies the crossover frequency as 100Hz ±20Hz and it is up to the decoder manufacturer to choose a value between these limits. Dolby Digital® based THX® decoders have the frequency set to 80Hz to maintain compatibility with the earlier Pro-Logic® based standard. Some manufacturers provide additional flexibility in choosing crossover and roll-off rates.

Voice or timbre matching

Whatever the liberties taken with the physical size of the speakers used, it is important for the sound character to be consistent throughout the installation, otherwise imaging and the perception of moving sounds can be impaired. This is especially important with regard to the three front speakers. B&W designs speakers within any given Series to have a similar sound character, apart from bass extension, which allows the user to choose from a large number of possible permutations. This is sometimes known as voice or timbre matching. Indeed, the use of drive units of similar construction (Kevlar® cone midrange and metal dome tweeter units) in several different B&W ranges allows the user to choose, for example, front speakers from a more expensive range and surround speakers from a less expensive range and still achieve very acceptable results. Users should be aware, however, that the same cabinet finishes may not be available in the different Series.

Subwoofers

If you are using the subwoofer just for LFE - in other words, none of the 5 main speakers is configured as "small", it is not that critical where you place the subwoofer. There is a slight preference for the screen end of the room, but most of the information is so low in frequency that you can get acceptable results almost anywhere. If you are configuring just the surround speakers as "small" and sending the low bass to the subwoofer, there is probably a good argument for putting the subwoofer towards the back of the room. If any of the front speakers are configured as "small", go back to the screen end. If you are using more than one subwoofer, I would be wary of putting one at the front and one at the back. It may seem like a good way of getting a good spread of sound, but the separation may cause phase cancellation at certain frequencies. Try to keep them the same distance from the listeners.

Useful links:
Dolby Laboratories Inc Home Page - http://www.dolby.com
Dolby Home Theatre - http://www.dolby.com/ht/
Dolby Digital® Surround (AC-3) - http://www.dolby.com/digital/
Lucasfilm THX® Home Page - http://www.thx.com/
DTS Home Page - http://www.dtsonline.com