



designers of electronic media

**An article for IPS Planetarian "Sound Advice"
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“Help Me...I’m Surrounded, Part 1”

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Stereo... 4-channel...5.1...Dolby Pro Logic.... 10.2...Spatial Sound...7.1...Atmos...I have had opportunities since 1985 to either design most types (formats) of planetarium and exhibit audio systems or to compose and design soundtracks for these systems.

There is some confusion as to what these systems really are, what they sound like, and how you produce for them.

Why use surround sound?

To fly sounds around the room? No. Most importantly to create space between audio objects. The more sound elements you jam into two stereo channels, the more confused the sound elements become and the less separated or less distinct. A side effect of this “spatialization” is that you can also place sounds in spatial locations in the room that mimic where they would be heard from in the real world. This is known as “imaging”.

So...rather than only hearing evening crickets or crowd conversation from two speakers, in surround you would hear these spread out from all direction...more like heard in the real world. By spreading these out, you create space or “air” between these and they become more clearly heard.

In music, a cool surround sound hi-def audio format is SACD. Many SACD discs are now coming out and these often feature 5.1 remixes of the studio recordings. Listen to the stereo CD version of Dark Side of the Moon and then the 5.1 SACD of the same songs. Stunning.¹

Localization.

With all dome video you can place (localize) the voices of on screen characters at where the characters appear on the screen rather than all the voices coming from one or two speakers. Let’s face it...when you hear three voices they don’t all come from the same point in the room. Michael Daut (E&S show producer) states, “when used dramatically, musical instruments or voices can pan through the 360° space to track objects on screen, and sound effects in the soundtrack can enhance the “off-screen” space behind the audience to intensify earthquakes, volcanic eruptions, severe weather, or even the business of a city at work. Surround sound is a vital tool that can powerfully orient the audience inside of the experience, completing the illusion of immersion. After all, the sense of immersion is the uniqueness and power of fulldome.”

What do I need for surround sound?

This following table shows that the necessary parts of the audio “chain” for the most popular surround sound arrangements. There are basically four sections in an audio system.

1. If possible you should add SACD capability to you system. SACD is 64x the resolution of a CD. Some Blu-ray players will also decode SACD and DVD-A hi-res audio files but not all will. These players must connect to your system via analog because HDMI does not have enough bandwidth.

	Audio Channels (tape, hard drive, computer file, video server, etc)	Processor Inputs and Outputs	Amplifier Channels (Minimum)	Speakers	Channel Names
Stereo	2	2-4*	2	2-4	L-R front, L-R rear
5.1	6	6-8*	6	5+ Subwoofer(s)	L-R-C-Sub- Ls-Rs
7.1	8	8-10*	8	7+ Subwoofer(s)	L-R-C-Sub-Ls-Rs- Lss-Rss

Note the * and ** in the table. More about these in a minute.

Stereo. First, a look at stereo 2-channel audio in a dome with unidirectional seating. If your show audio is stereo this is what you have. Of course you have two main speakers in the front of the audience but you might have two more in the rear. This helps fill the seating area with sound but isn't really surround sound...the audio is stereo in four speakers. Your front and rear speakers might be on the same amplifier channels which makes the volume level the same in all four speakers. It helps to have the rear speakers on a separate amplifier so you can reduce the rear sound level. This keeps the audience focus to the front of the dome. And you might have a subwoofer with "crossover" and a separate amplifier (or this subwoofer might be a self powered unit with a built in crossover).

But now let's take those four speakers and work a little magic.

Adding 5.1. Lets add a "center channel" speaker and a subwoofer. Then add enough amplifier channels to have each speaker on it's own amplifier channel. Then add an audio processor with at least 6 outputs (L-R-C-Sub-Ls-Rs) and at least 6 inputs (see my Sound Advice from Spring 2014 for details). If the show audio is in 5.1, you've got it! If not, you can program your audio processor to route stereo audio channels to all the speakers. This at least fills the room with sound.

7.1. Time to bust a myth. I have designed many 7.1 systems. 7.1 is not a better format than 5.1, it is just a different format. If the show has been produced in 7.1, you will benefit from the extra two channels. If not, you probably won't. However, with the proper audio processor you might be able to route some of the Ls-and Rs audio from a 5.1 soundtrack to the side speakers just for "fill". But you need to be careful that you do not ruin the stereo and rear imaging the show producer created in their mix. If you are producing your own soundtracks you can create some great effects with the 7.1 channels but most of the shows you purchase won't have 7.1 audio.

3D Audio. In recent years two object based 3D immersive formats have surfaced. One from Fraunhofer Institute (as well licensed by Barco and Shure) and the other Dolby Atmos. These formats have many advantages over 5.1 and 7.1 Atmos is already installed in over 700 cinemas as an international standard and is Dolby's new generation surround sound. The consumer version is being built into home theater receivers at the time of this writing and most films are now mixed in Atmos. I am sure there is a theater near you where you can experience Atmos. New Blu-ray movies have Atmos, 7.1, 5.1 and Stereo mixes all on one disc. The Fraunhofer 3D sound Format (Spatial Sound Wave) (based on wave field syntheses) deals with sound objects on individual locations in the dome and a enlarged sweet spot area. This sound objects are free in placing and moving freely through the dome with an open interface to digital audio workstation (DAW) and external hard and software.



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Next Issue.

More surround sound formats including 3D audio and interviews with producers as to how they use the formats. We answer questions such as “How do I create a surround sound track” and “How do I convert my old shows with stereo audio to surround”.

On another note, Mark Peterson, Jeff Merkel, Charlie Morrow and I are conducting an immersive audio workshop at Imersa Thursday Feb 26th. Should be neat-o.

Reader Question for This Issue: Q: What is peak power? A: Meaningless. Peak is a number made up by speaker manufacturers who just multiply their RMS rating x4 to get this number which is only used for marketing. Audio professionals never use “peak power” ratings as they are not a measurable number. What matters is matching the RMS power a speaker can handle with the RMS power an amplifier can deliver. The amplifier should be rated at 1.5 or 2 times what is needed to generate the SPL (loudness) you want. Why? See my earlier articles about this in the Autumn 2014 issue. You DO keep you back issues, don't you ☺

Send your questions to me at jeffb@bowentechnovation.com