

# THP 350: Sound Design

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These notes are not endorsed by the lecturers, and I have modified them (often significantly) after lectures. They are nowhere near accurate representations of what was actually lectured, and in particular, all errors are almost surely mine.

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# 1 Sound System Overview & Signal Flow

## 1.1 What is a sound system?

The sound system is the selection and configuration of the loudspeakers, microphones, equipment, and specification of connections between all the elements. The sound system is designed uniquely for every production, based on and influenced by:

- Text of the play
- Director/choreographer’s vision
- Venue
  - Layout
  - Acoustics
- Scenic design
  - What sounds make sense given the scene being seen?
- Conventions and audience expectations
  - Doing something different or unique is allowed, but it should be a thought-through choice
- Available Inventory
- Constraints from other departments

Every sound system will have the same basic structure:

- (i) Sound source(s)
  - Mics
  - Keyboards
  - Synths
  - Guitars
  - DI Boxes
    - Takes an error-prone signal and makes it stronger, clearer, and protected from interference
    - Converts from an unbalanced signal to a balanced signal
  - Computers
  - CD Players
  - Etc.
- (ii) Mixer (“console,” “desk,” “board”)
  - Pre-amp (“head amp”) is the first step of this stage
- (iii) Power amplifiers (“amps”)

- (iv) Loudspeakers
- (v) Audience/performer's ears

There are some common variations on this system:

- Combo amps: Items ii-iv are combined in one place
- Active/powered loudspeaker: A loudspeaker with an amplifier built-in
  - Might have a power cable, indicator light, screen, etc.

## 1.2 Signal Levels and Amplification

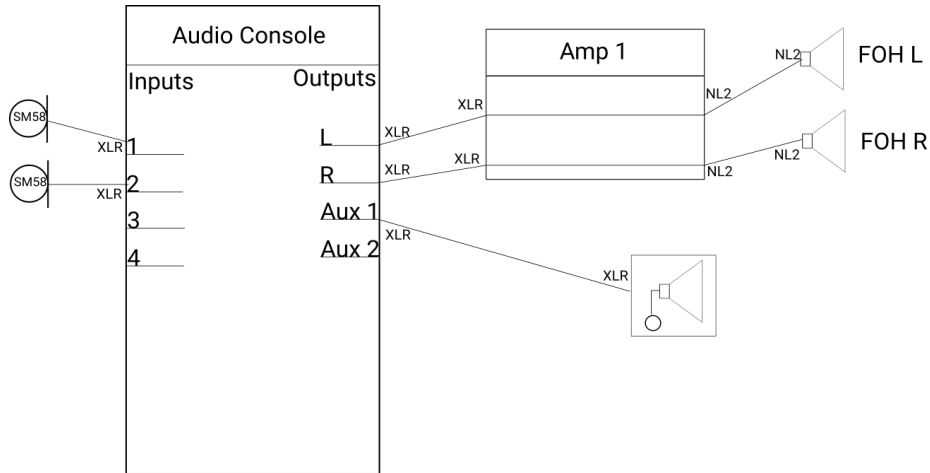
Another “narrative” of a sound system is that of a quiet sound becoming a much larger/louder sound. Each step in the system is a way to step up the signal level from the quietest to the loudest.

There are basically three signal levels:

- (i) Mic/Instrument Level
  - Level of the signal coming directly from a mic/input
  - Approx. 2-20 mV
- (ii) Line Level
  - Level of the signal coming from the console after pre-amplification (or the gain stage)
  - Approx. 2-20 V
- (iii) Speaker Level
  - Level of the signal coming to the speakers after power amplification
  - Approx. 10-50 V

## 2 Engineering Overview

### 2.1 A Basic Layout Diagram



### 2.2 Review

#### 2.2.1 Sound Systems Design Fundamentals

There are two goals in sound system design:

- (i) Reasonable choices in terms of imaging
  - Imaging — the idea that we can create a third, imaginary sound using two different speakers. The illusion of stereo
- (ii) Even coverage for every audience member
  - This can often be improved using fill speakers for the first few rows

#### 2.2.2 Dispersion

Sound varies based on your position relative to a loudspeaker in 2 ways:

- (i) Distance from a loudspeaker
  - The farther you are from a speaker, the quieter the sound is
- (ii) Axial position relative to speaker (ie. angle from the center axis)
  - The farther off-axis you go, the quieter the sound is, and the more you lose higher frequencies

## 2.3 Types of Connectors

### (i) XLR Microphone Cable



In audio, we use 3-pin XLRs (one pin is positive, one is negative, one is ground). One cool thing about XLR connectors is that they usually lock.

### (ii) 1/4" Instrument Cable



1/4" cables can either be balanced or unbalanced. Balanced cables have three conductors (tip, ring, sleeve, or TRS, for +, -, and ground, respectively), and unbalanced cables have two conductors (tip and sleeve, or TS, for + and -, respectively).

### (iii) 1/4" Speaker Cable

These look basically the same, but they're thicker (different gauge, can be used to pass more voltage).

### (iv) SpeakOn Cable (NL2, NL4, NL8)



Thick balanced cables that can lock. They carry more voltage than 1/4" cables.

(v) Bare Wire Speaker Cable

Balanced or unbalanced, no connector, it's just the wires straight. Usually used in situations where there's no movement or chance of tripping.

(vi) RCA Cable



Low-voltage unbalanced cable.

(vii) 1/8" to dual XLR adapter (aka "iPod Cable")



## 2.4 Audio Channels and Common Configurations

Common audio channel configurations:

- Mono (one output to one speaker)
- Dual mono (same signal to both speakers, or totally different signals to each, like two different mono signals)
- Stereo (signal shared across two speakers—panning is possible)
- 5.1, 7.1, etc. (usually just for film—we sometimes replicate similar things in theatre, but industry film standards don't really work for us)



## **3 Design of Sound Systems II: Imagining**

### **3.1 Imaging in Horizontal and Vertical Planes**

### **3.2 Delay Times and Haas Effect**

## 4 Design of Sound Systems III: Sub-Systems

### 4.1 Phase, Phasing, Polarity

### 4.2 Surrounds, Subwoofers, Sub-Systems, and Unconventional Stagings