Audio Studio Orientation
Audio Fundamentals

Fayetteville Public Library

What is an Audio Engineer?

- An audio engineer helps with recordings or a live performances using technical skills and equipment
  - Recording Studio (Recording, Mixing, Mastering)
  - Video Games (Foley, Sound Design, ADR)
  - Film (On-set audio)
  - Post Audio (Foley, Sound Design, ADR)
  - Broadcasting
  - Live Sound
  - System Engineer

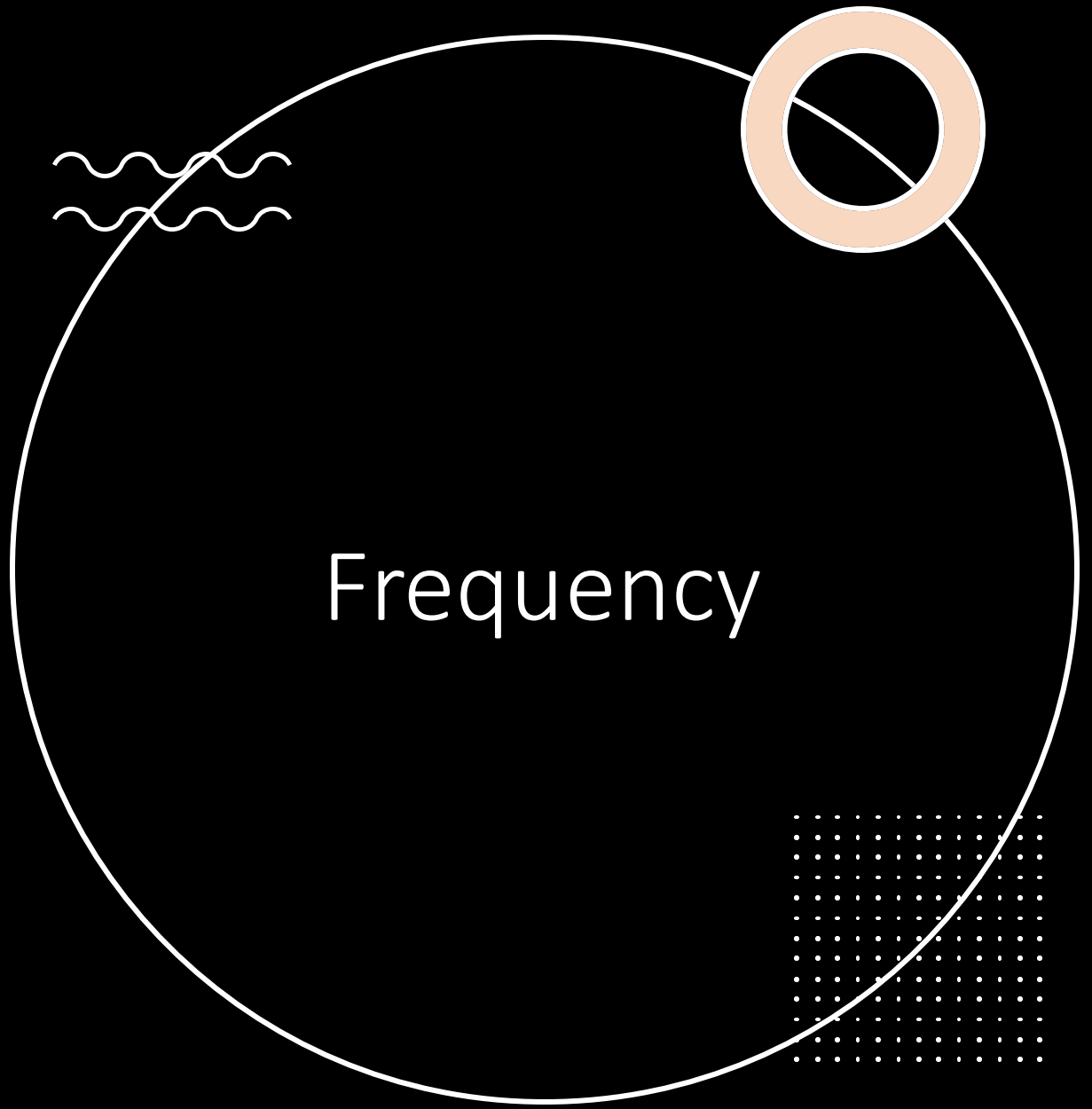
Analog Audio Theory

Frequency, Wavelength, Amplitude, Phase, Fletcher Munson Curve, Sound Pressure, Decibels, Levels

What is Sound?

- In physics, sound is described as a pressure wave that propagates through a medium
- Sound waves are usually described by
  - Frequency/Wavelength
  - Amplitude
  - Speed of Sound
  - Direction

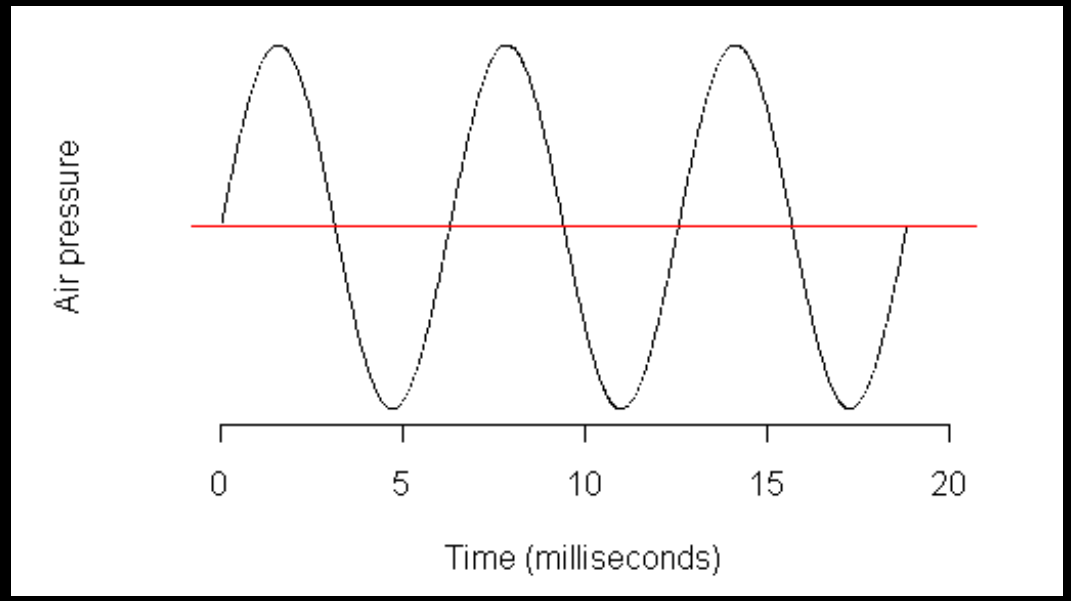
Frequency



- Frequency is described as f = 1/t
  - Frequency (f) = 1(how many times?)/t(period)(how long?)
- Units of frequency are called Hertz
- Hertz = one cycle per second
- Cycle = one complete wave
- In music, a single frequency can be described as a pitch
- Human hearing 20hz – 20khz

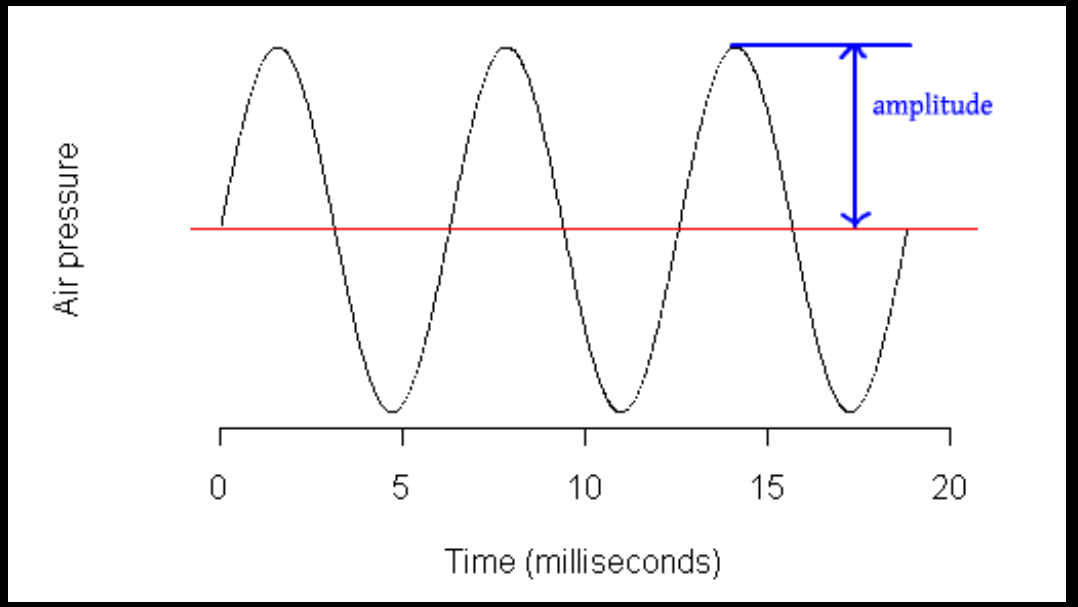
Wavelength(λ)

- Wavelength is described as λ=v/f
  - Wavelength(λ) = velocity(v) / frequency(f)
    - Just remember the distance formula d=s/t
- The distance for a full cycle of a wave



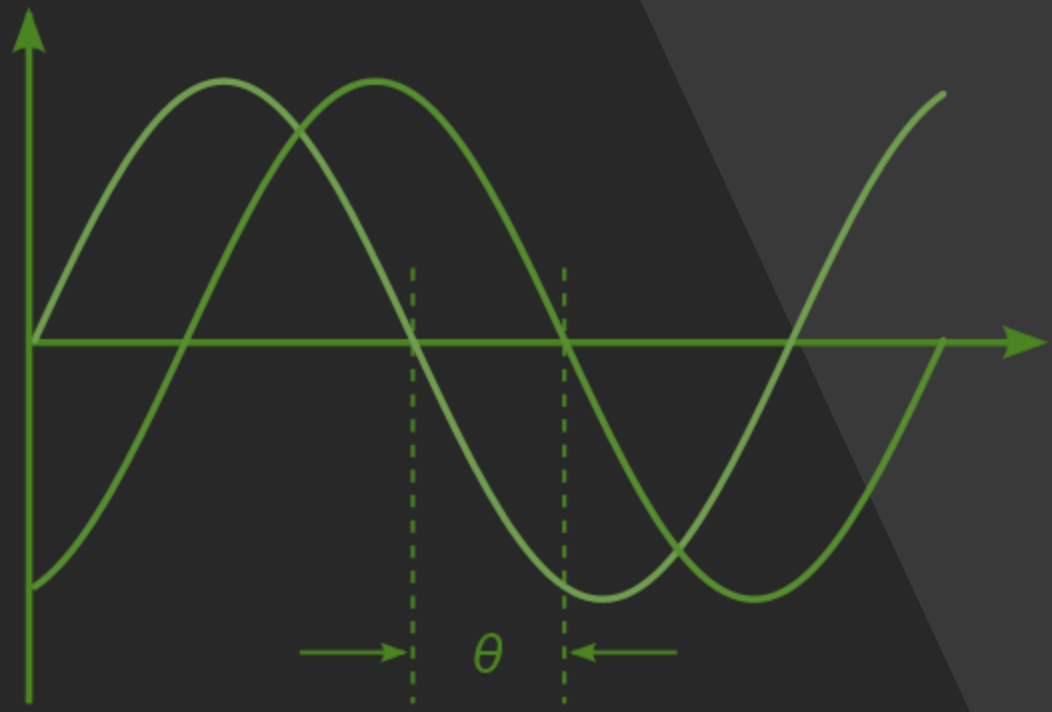
Amplitude

- Can be described as loudness
- Measured in decibels (dB)



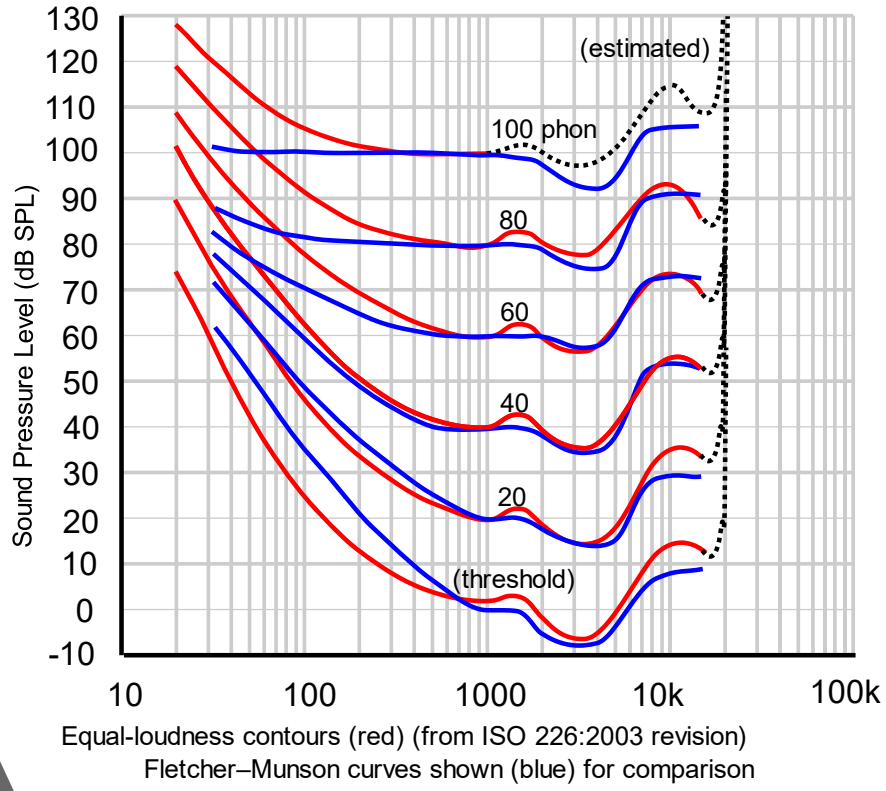
Phase Shift

- Phase shift is the difference between two periodic signals
- Phase is measured by angular units such as radians or degrees, audio engineers usually degrees
- Two signals that are the same will null each other out at 180 degree



Fletcher-Munson Curve

- Indicate the ear's sensitivity to different frequencies at various levels
- Lower levels = more midrange
- Higher levels = more treble and bass



Equal-loudness contours (red) (from ISO 226:2003 revision)
Fletcher–Munson curves shown (blue) for comparison

Decibels

- Relative unit, not absolute
- Logarithmic
- Easier to work with

Environmental Noise	*dBA*
Jet engine at 100’	140
Pain Begins	*125*
Pneumatic chipper at ear	120
Chain saw at 3’	110
Power mower	107
Subway train at 200’	95
Walkman on 5/10	94
Level at which sustained exposure may result in hearing loss	*80-90*
City Traffic	85
Telephone dial tone	80
Chamber music, in a small auditorium	75-85
Vacuum cleaner	75
Normal conversation	60-70
Business Office	60-65
Household refrigerator	55
Suburban area at night	40
Whisper	25
Quiet natural area with no wind	20
Threshold of hearing	0

Levels

- Mic - Mic level is the voltage of signal generated by a microphone. This is the lowest, or weakest, level signal of the four and requires a preamplifier to bring it up to line level.

- Instrument - Instrument level signals fall between mic level (lower) and line level (higher) signals. These signals refer to any level put out by an instrument, commonly from an electric guitar or bass. A preamplifier is required to bring the signal up to line level.

- Line - Line level signals are the highest-level signals before amplification. This is the type of signal that typically flows through your recording system after the preamplifier stage and before the amplifier that powers your speakers.

Digital Audio Theory

Sample Rate

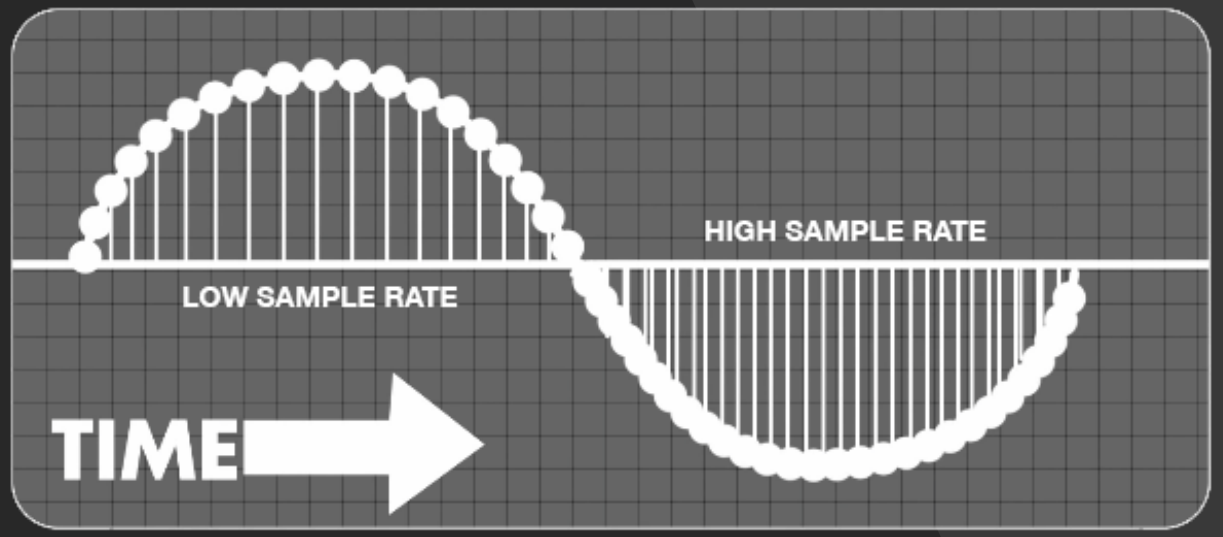
Bit Depth

Buffer Size

Latency

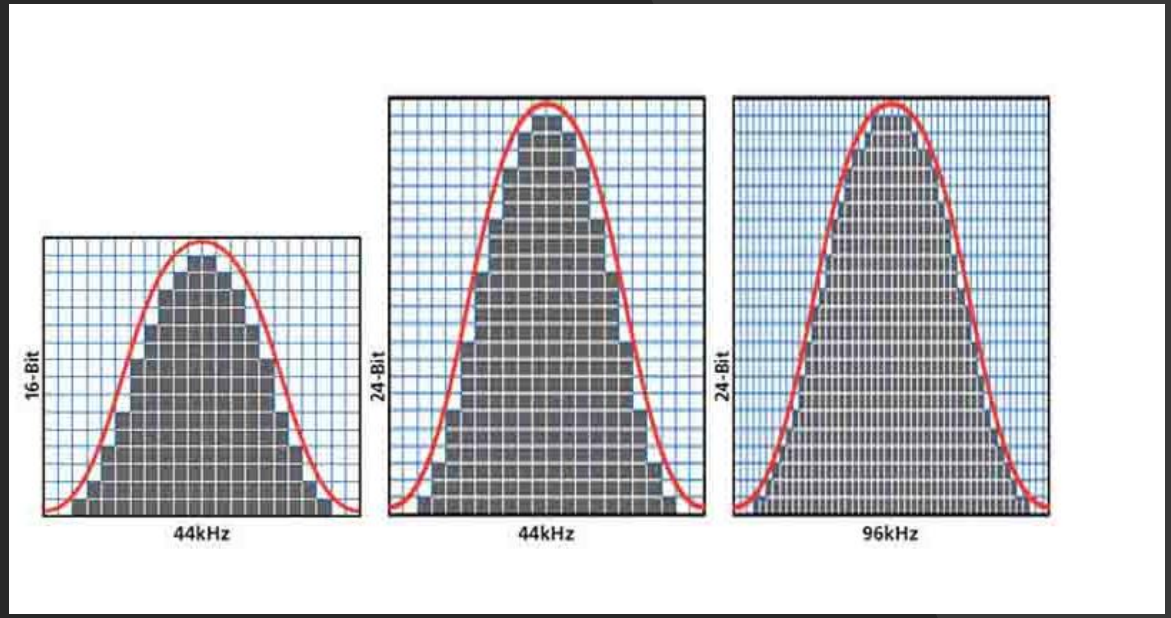
Sample Rate

- Samples per second
- AD -> turns continuous waveform in discrete waveform
- Nyquist Theorem - in order to reproduce a signal, it should be periodically sampled at a rate that is 2X the highest frequency you wish to record.



Bit Depth

- Bit Depth relates to the SNR and the dynamic range
- The more bits, the lower the noise floor and the more dynamic range you have
- $2^{\wedge n}$ = Possible integers values per sample
- $20\log(2^{\wedge n})$ = dynamic range

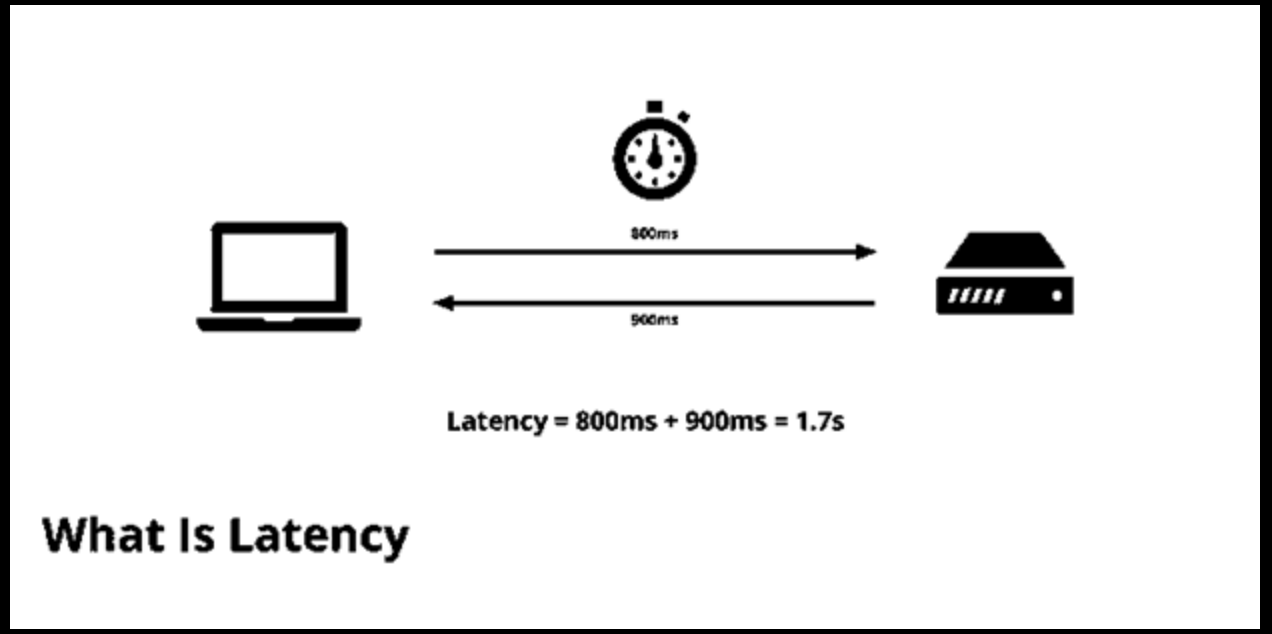


Buffer Size

- The amount of time it takes your computer to process audio
- Stores chunks of data in RAM before processing
- Buffer Size determines latency and CPU load
- Low Buffer = Low Latency, High CPU usage
- High Buffer = High Latency, Low CPU usage

Latency

- The amount of time the AD/DA process takes
- Will cause delay in foldback/headphones while tracking



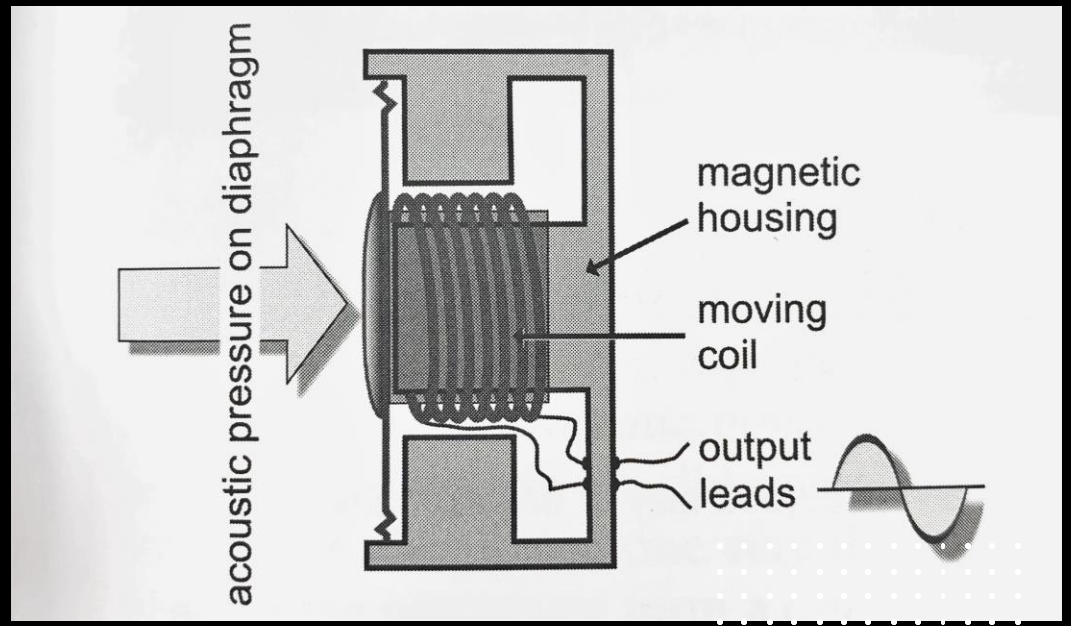
Microphones

- Microphones are transducers which convert sound energy into analogous electrical signals

- Dynamic
- Ribbon
- Condenser

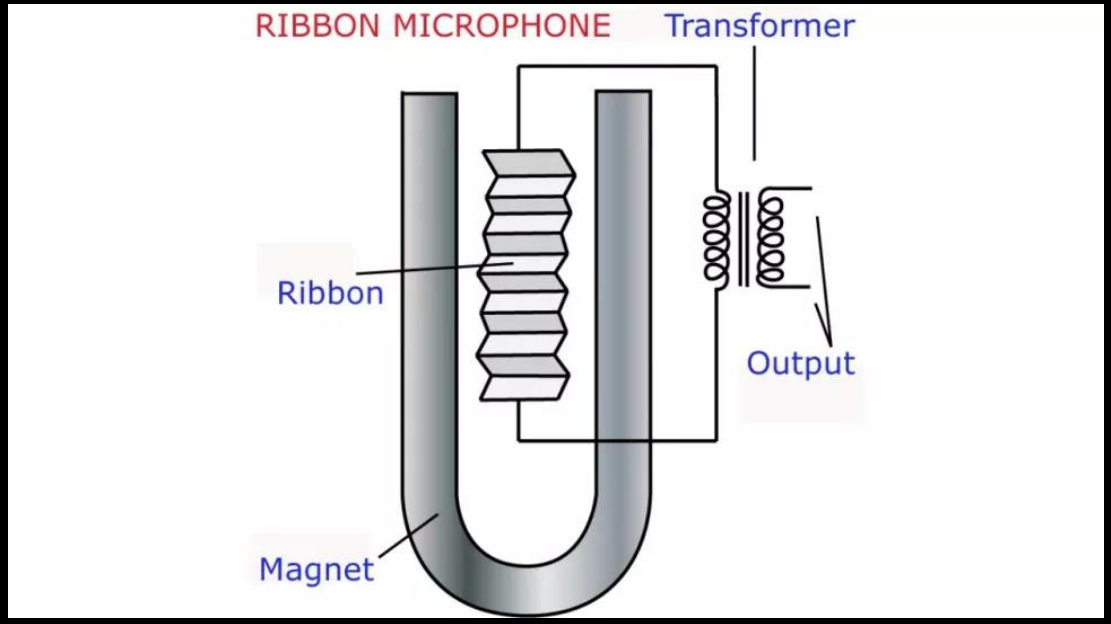
Dynamic

- A diaphragm is attached to a wrapped core of wire, which is suspended around a magnet
- Moving a coil around a magnet creates a voltage
- This is known as electromagnetic induction



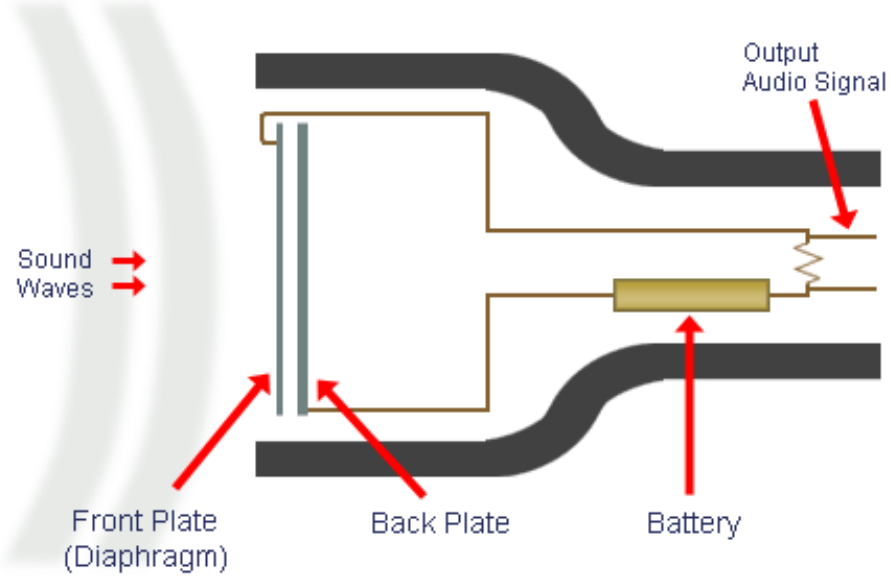
Ribbon

- A metal ribbon is suspended between a magnet
- When the ribbon moves between the magnets it creates a voltage
- Also uses electromagnetic induction



Condenser

- One small, movable diaphragm and one fixed backplate
- These two plates create a capacitor
- When the distance between the two plates move, it creates a change in capacitance
- Uses the electrostatic principle
- Needs phantom power

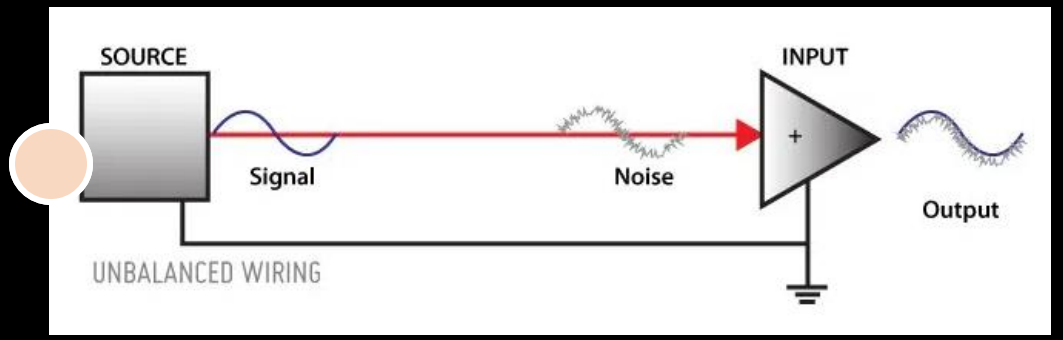


Cable Types

Balanced vs Unbalanced

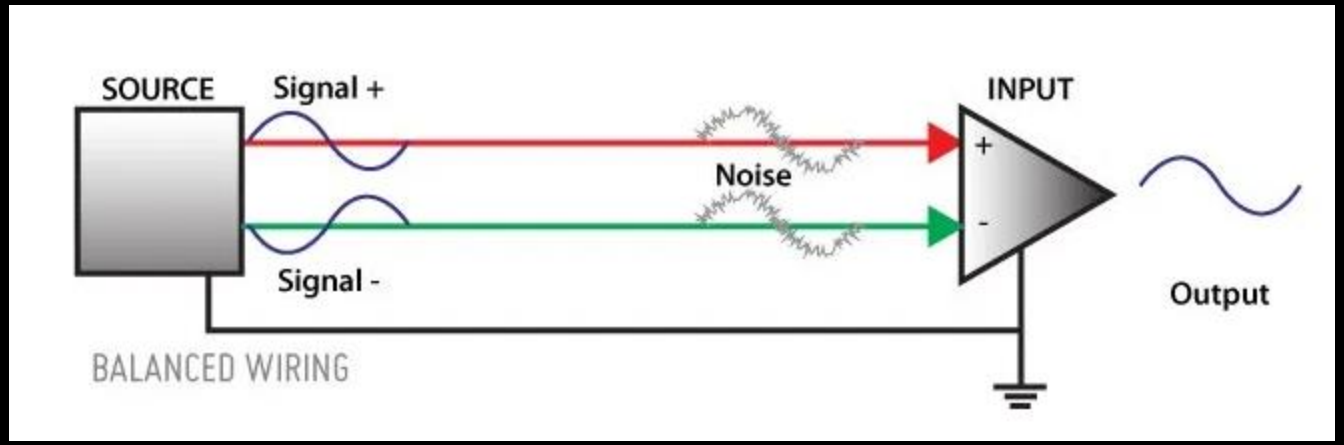
Unbalanced Cable

- Has two connections, one for signal and the other for ground
- Types of unbalanced cables
  - TS (tip – sleeve)
  - RCA
- Susceptible to noise



Balanced Cable

- Has three connections, two for signal(hot and cold) and one for ground
- Hot and cold cable send the same signal but 180 degrees out of phase
- Not as susceptible to interference

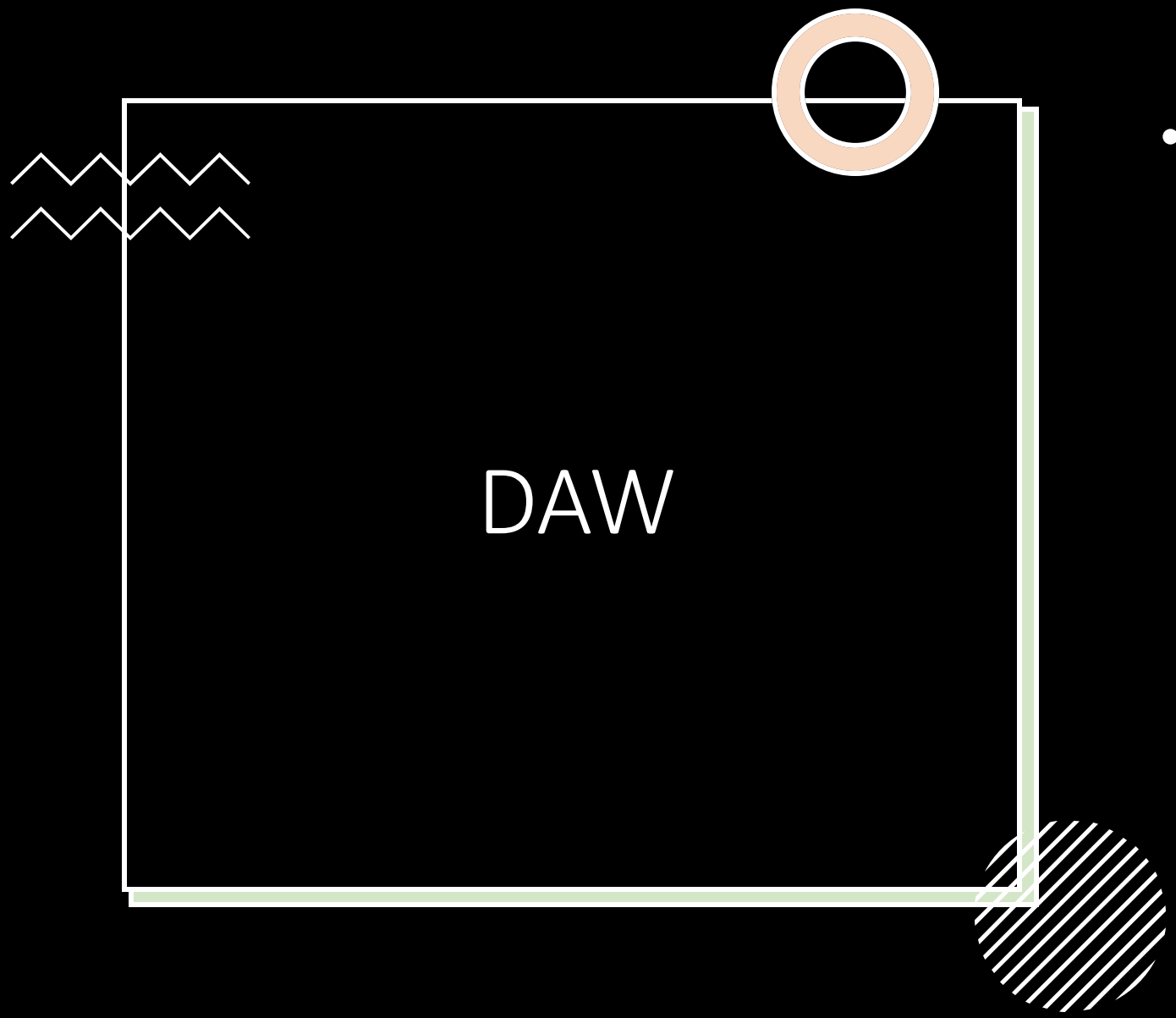


Digital File Types

Lossless vs Lossy

Lossless – Data compression with no information loss

Lossy – Data compression with removing information



- Digital Audio Workstation
  - Pro Tools
  - Logic
  - Reason
  - Ableton
  - Cubase
  - Studio One
  - Etc…