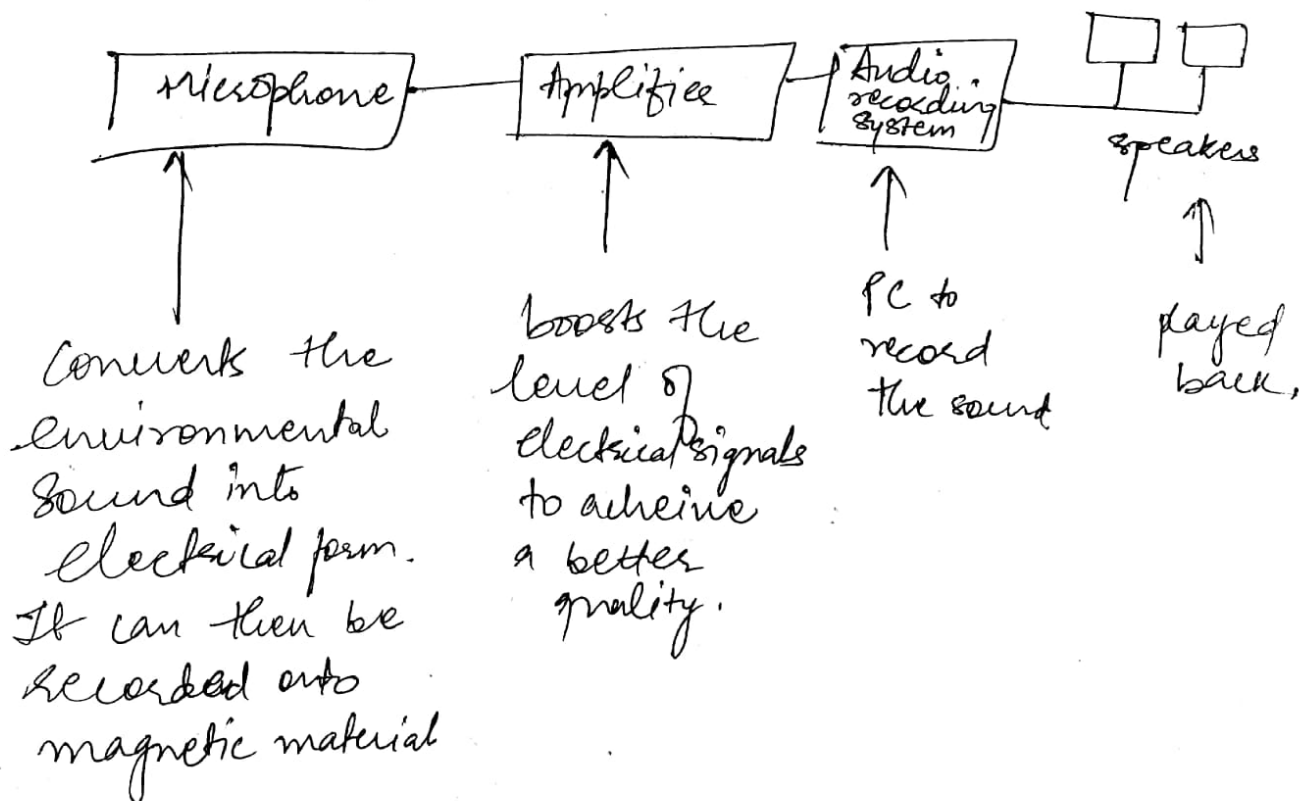


①

- Nature of sound waves

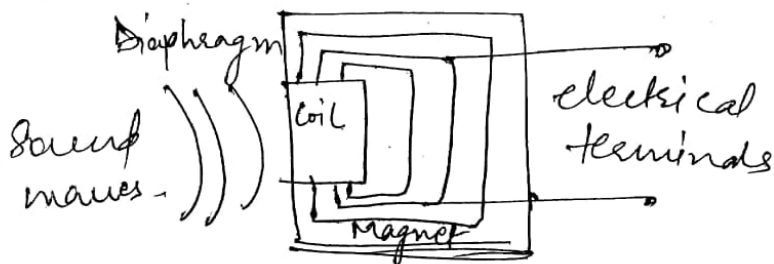
↳ rarefaction (rough / -ve peak " " " )

## - Elements of Audio Systems



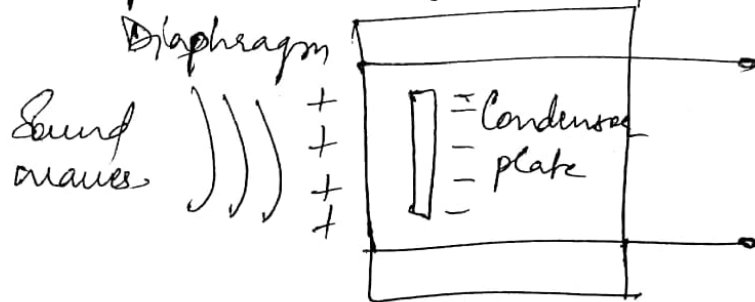
## - Types of Microphones

↳ Dynamic Mic: moving coil mic consists of thin metallic diaphragm & an attached coil of wire. A magnet produces a magnetic field & surrounds the coil.



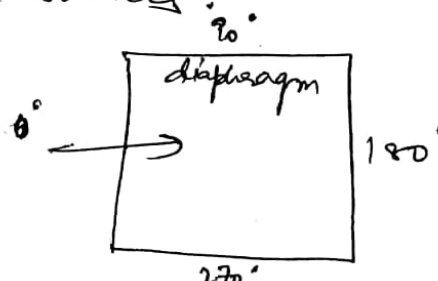
- relatively inexpensive
- resistant to moisture
- ideal for onstage use.

↳ Condenser Mic: diaphragm is actually a plate of capacitor. The incident sound on the diaphragm moves the plate  $\therefore$  changing the capacitance & generating a voltage.



- Karaoke mics.
- popular choice in live & recording studios.

↳ Omnidirectional: Equally sensitive to sounds coming from all directions. Record sound coming from multiple sources.



Q.

↳ Bi-directional : is sensitive to sounds coming from 2 directions : front & rear.

↳ Unidirectional : used to record sound from single source. Similar to bidirectional mic but on the rear side it has a resistive material like foam or cloth near the diaphragm. The mic doesn't respond to any sound coming from the rear.

- MIDI (Musical Instrument Digital Interface)

↳ protocol for connecting synthesizers to each other or to digital computers.

↳ nature of info exchanged is music.

↳ tells the synthesizer, when to start & stop playing a specific note.

↳ technical & administrative issues related to MIDI handled by MMA (MIDI manufacturers Association).

## ↳ MIDI specification

↳ ① H/w: uses special 5 conductor cables to connect the synthesiser ports.

↳ cable is specially grounded & shielded to ensure efficient data transmission.

↳ data is carried thru cable on pins 1 & 3.

↳ pin 2 is shielded & connected to common.

↳ pins 4 & 5 are unused.

↳ ② Messages: constitute an entire music description language in binary form.

↳ designed for keyboards.

↳ select  $\subseteq$  instrument to play, mix & panning sound & controlling various aspects of electronic musical instruments.

↳ ③ File format: MIDI files are extremely compact as compared to WAV files.

↳ MIDI file doesn't contain the sampled audio data, it contains only the instructions needed by a synthesiser to play the sounds.

↳ instructs the synthesiser  $\subseteq$  sounds to use,  $\subseteq$  notes to play & how loud to play.

↳ ability to easily edit the music.

(3)

## MIDI Messages

↳ each msg consists of 2 or 3 bytes:  
 first is status byte containing the  
 func'n or operation to be performed &  
 channel no. to be affected.

↳ other two bytes are called data bytes  
 & they provide additional parameters  
 on how to perform the indicated operation.

Channel Msgs.

↓  
 apply to a specific  
 channel & the channel  
 no. is included in the  
 status byte for these  
 msgs.

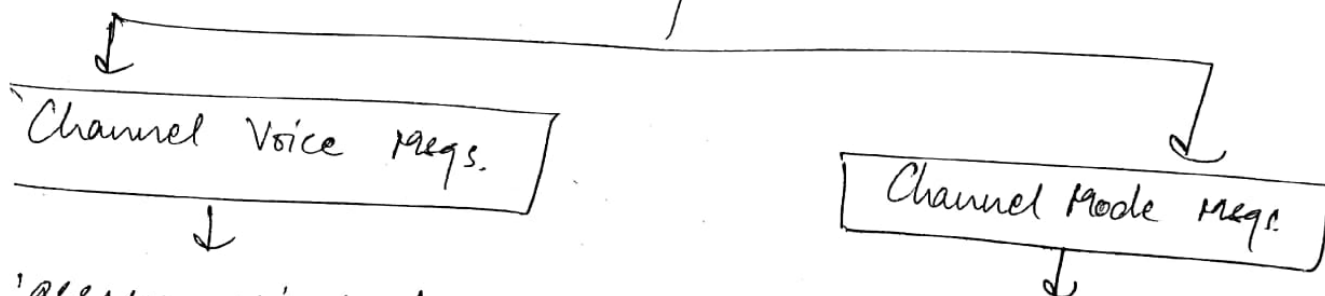
System Msgs

↓  
 not channel  
 specific, they affect  
 the system as a  
 whole & no channel  
 no. is indicated in  
 their status bit.

Status Byte	Data Bytes	
	Data Byte 1	Data Byte 2
channel no. & func'n	Additional parameters	→

MIDI Ch.

## ↳ Channel msgs



↳ carry musical data.  
When key is pressed on a MIDI keyboard instrument or MIDI controller, keyboard sends a note on msg on any one of the 16 logical channels. When key is released, note off msg is sent. Polyphonic key pressure used to control some aspects of sound.

Effect the way a synthesizer responds to MIDI data.

121 → reset all controllers

122 → enable/disable local control.

124-127 → select b/w omni mode on or off & to select b/w mono mode or poly mode of operation.

## ↳ System msgs

↳ System common msgs: intended for all receivers in the system: song select, song pos'n pointer.

↳ System real time msgs: Synchronize all of MIDI clock based equipment on a system: start, continue, stop msgs.

↳ System exclusive msgs: to send data such as patch parameters or sample data b/w MIDI devices.

(4.)

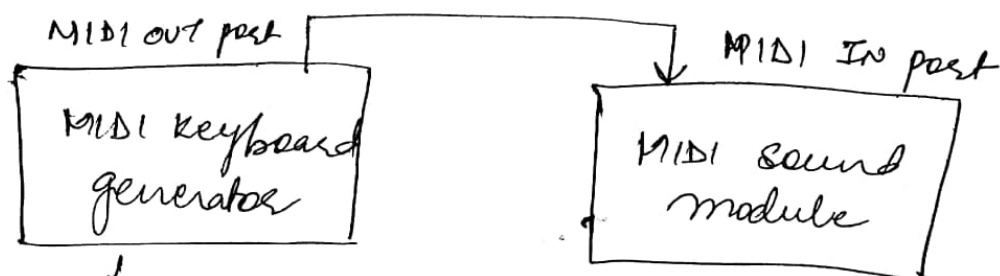
## MIDI Connections

↳ MIDI interface has 3 connectors IN, OUT & THRU.

↳ MIDI controller is an instrument & is played as an instrument like keyboard & translates the performance into a MIDI data stream in real time.

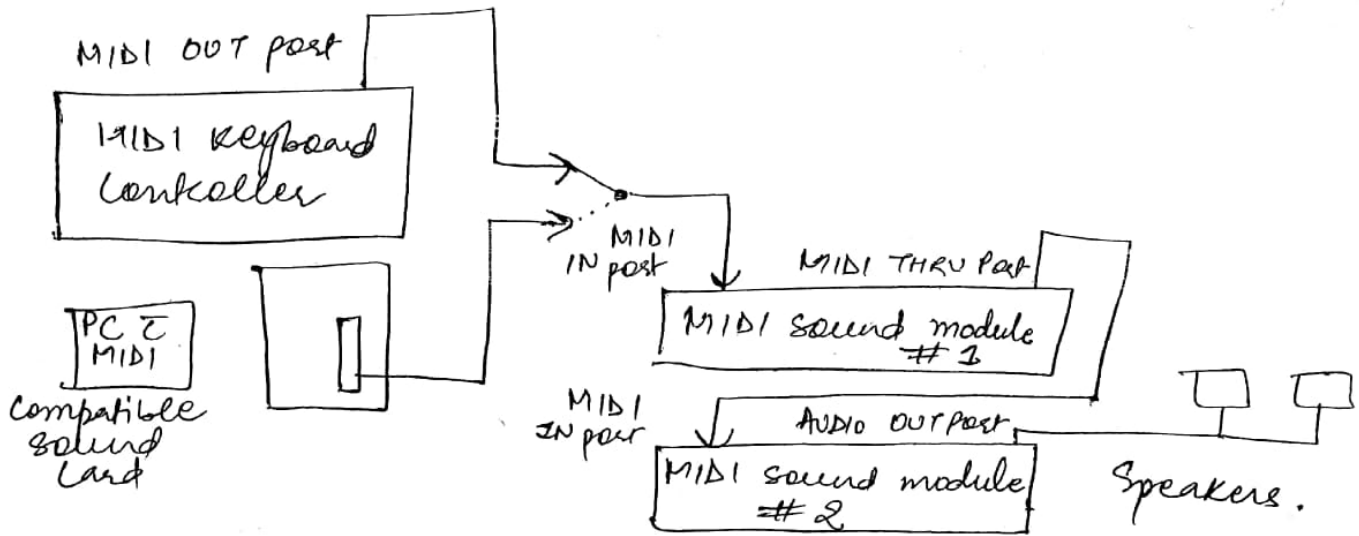
↳ MIDI sequencer is a device & allows MIDI data to flow from MIDI controller / sequencer & is transmitted via the device's MIDI out connector.

↳ MIDI sound generator receives MIDI msgs at its MIDI IN connector.



includes both  
Keyboard controller  
& MIDI sound  
module functions.  
Internal link b/w  
keyboard & sound  
module & may be  
enabled or disabled  
by setting the local  
control func'n on or  
off resp.

~



IC based MIDI system.

↳ PC is equipped with an internal MIDI interface card & sends MIDI data to an external MIDI synthesizer (can play multiple sounds).

↳ MIDI chain describes a series of one-way communications in a MIDI setup. The MIDI out port of one device is connected to the MIDI in port of a second.

→ Soundcard (ppt).



## Audio file formats

(6)

### ① WAV (Waveform Audio)

Is defined by Microsoft for use with Windows

Is used for uncompressed 8, 12 & 16 bit audio files.

Is can also be edited & manipulated & relative ease using spw.

Is can be used for intermediary storage type for saving songs from cassette tapes.

### ② AIFF (Audio Interchange File format)

Is to facilitate data transfer b/w spw programs of diff. vendors.

Is used for storing audio data on PCs.

Is most commonly used on Apple Mac syst.

Is is uncompressed,  $\therefore$  files tend to be much larger than files that use lossless or lossy compression formats.

MP3

### ③ WMA (Windows Media Audio)

- ↳ proprietary compressed audio file format used by Microsoft.
- ↳ almost always encapsulated in an ASF (Advanced Systems Format)
- ↳ file extension may be 'wma' or 'asf' <sup>(audio only)</sup>
- ↳ can be played using Windows Media Player, Winamp or other media players.

### ④ Ogg Vorbis

- ↳ free & open audio compression project from Xiph.org Foundation.
- ↳ uses modified discrete cosine transform for converting the sound data from time to frequency domain & back.
- ↳ produces better quality of audio & smaller file size than other formats under comparable circumstances.

- ↳ audio player systems ?
- ↳ audio recording system } ppt

## MPEG-1 Audio.

(6)

↳ Compression algo for digital audio.

↳ 3 layers or 3 levels

- ↳ Layer 1 : basic mode
- ↳ Layer 2 : ~~proposed~~
- ↳ Layer 3 : } increasing levels of complexities.

### ↳ MPEG-1 Audio Layer I (MP1)

↳ describes the least sophisticated method that requires relatively high data rates of abt 192 kbps/channel.

↳ compression ratio is 4:1 & quality is same as digital audio cassette.

### ↳ MPEG-1 Audio Layer II (MP2)

↳ bit rate is about 128 kbps/channel.

↳ compression ratio ranges from 6:1 to 8:1.

↳ quality is same as that of digital audio broadcasting.

### ↳ MPEG-1 Audio Layer III (MP3)

↳ MP3 layer III data reduction algorithm is widely used to compress files prior to electronic distribution.

↳ lossy.

↳ analyses the audio in the freq. domain

↳ identifies <sup>masked</sup> sounds. Masked sounds are removed.

MP3

↳ MP3 encoder first converts the i/p audio from the temporal domain to the frequency domain using DFT. after  $\hookrightarrow$  a psycho-acoustic block identifies & removes the masked audio components.

↳ remaining data is sent to a quantizer & coding block for code word generation.

↳ Run length packing adds even checking codes before storing the compressed data as an MP3 file.

↳ ID3 tag :

↳ format for storing textual metadata for MP3 files such as title, artist, album, track no., etc..

## MPEG-2 AUDIO.

↳ designed for appl's ranging from digital HDTV television transmission to Internet downloading.

↳ uses lower sampling frequencies

↳ better sound quality.

↳ backward compatible to MPEG-1 (MPEG-2 BC)

↳ MPEG-2 AAC (advanced audio coding format) codes stereo or multichannel sound at 64 Kbps / channel.

### ↳ MPEG-2 BC

↳ multichannel sound to support for 5 full bandwidth channels & one low frequency channel (5.1 channel).

↳ can be read & decoded by MPEG-1 decoder.

↳ has standard 3-layer str of MPEG-1.

↳ while decoding, MPEG-1 decoder will combine all multichannels into two stereo channels.

↳ MPEG-2 AAC.

↳ not backward compatible to MPEG-1.

↳ improved BTd.

↳ high quality audio at 64 kbps/channel.

↳ support for 48 main audio channels,  
16 low frequency effects (LFE) channels  
2 16-multi-signal channels.

↳ implements 3 diff. coder complexity &  
performance schemes called profiles.

↳ Main Profile: improves upon the  
LC to backward prediction

↳ Low Complexity: simplest & uses  
least processing & memory  
resources.

↳ Scalable Sampling Rate: provides  
for scalable decoder.

↳ Successor of MP3, with same quality  
audio to larger compression factors.

## MPEG-4 Part 3 (Audio)

(8)

- ↳ third part of ISO/IEC MPEG-4 international standard.
- ↳ specifies audio coding methods.
- ↳ 3 codecs:
  - ↳ (1) Low Complexity Advanced Audio Coding (LC-AAC)
  - ↳ (2) High Efficiency Advanced Audio Coding (HE-AAC or aacPlus)
    - ↳ lossy data scheme
    - ↳ based on MPEG-4 Combines AAC, Spectral Band Replication (SBR) & Parametric Stereo (PS).
    - ↳ can operate at very low bitrates & good for Internet radio streaming.
  - ↳ (3) Scalable Sample Rate Advanced Audio Coding (AAC-SSR)
    - ↳ introduced by Sony.
    - ↳ audio signal is split into four bands using a four band polyphase quadrature filter bank.
    - ↳ these are further split to size of 32 or 16 samples.

↳ high freq. are encoded using short block to enhance temporal resolution, low frequencies can be encoded using ~~the~~ high spectral resolution.

↳ file extensions

↳ \*.m4a is the file extension attached to the names of files using MPEG 4 audio std.

↳ popularized by Apple