**Lesson 5 – Signal Flow and Patch Bay**

* You must know your signal flow patch bay inside out
* Where signal is coming from 🡪 Singer in booth with mic
* Where is signal going 🡪 In the speakers

PATCH BAY TYPES

* Can be divided into 3 categories
  + Open (de-normalled)
  + Full-Normalled
  + Half Normalled (Parallel)
* BASIC PATCH BAY CONFIGURATIONS
  + Allows you to patch in audio signals in studio from central point and send to other gear
    - Like; mixer
    - Multi-track recorder
    - Effects processor
* Keeps cabling all neat and tidy
* Majority includes two rows of connectors
  + RCA
  + ¼ inch
* Modular patch bays
  + Each group of 4 forms 1 module
    - You can change config by jumpers or rotating the modules
* Half-normalled
  + All terminals are interconnected
  + Used to split up and send one audio signal to several devices
* Most popular ways to config patch bay

AUDIO SIGNAL

* Represents of sound waves in different forms
* An electrical voltage
  + Can be magnetic when recorded onto analog tape
* Can be manipulated, stored, transmitted and reproduced in ways a sound wave can’t
* Mics convert sound into electrical audio signal
* Headphones convert electrical audio signal into sound
* Electric energy flows through circuit as voltage
* Opposition to voltage is impedance
* Impedance measured in ohms
* In PA – the lower the impedance of a circuit the better

SIGNAL FLOW

* Describes path an audio signal will take from the source to speaker or recording device
* Frequent in studio where signal flow is long and complex
* Electrical signal passes through many sections of analog console, external equipment and rooms

**Lesson 5 – MRT**

**SYNCHRONIZATION USING SMPTE TIMECODE**

* Basic function of synchronization is to control one or more slave machine so their speed and positions are accurate to the master machine
* Synchronization is divided into 2 basic systems
  + Project/electronic music production facilities
  + Larger audio/video production and post-production facilities
* Serves multiple purposes to achieve lock with a high degree of accuracy

**SMPTE OFFSET TIMES**

* Instead of inserting 11 mins of empty bars into a midi track
  + Just insert an offset start time of 11 mins
* Useful when syncing devices to an analog or videotape source that doesn’t start @ 0
* Pre-roll gives transports ample time to start playback and sync master time code source
* Wise to start production at offset time of 01:00:00:00
  + This minimizes possibilities of synchronizer getting confused

**DISTRIBUTED OF SMPTE SIGNALS**

* Only connection required between the master machine and synchronizer is LTC time code track
* Routed directly from machine to machine or patched through audio switching system via…
  + Balanced, shielded cables
  + Unbalanced cables
  + Combo of both

**TIMECODE LEVELS**

* One problem = crosstalk
  + Happens when high level signal leaks into adjacent signal paths or analog tape tracks

**MIDI REAL-TIME MESSAGES**

* Midi has built in protocol for syncing all tempo and timing elements of each attached device to the master
  + operated by transmitting real-time messages to devices through standard midi cables, usb and internal CPU paths
* Midi real-time msg consist of 4 basic types that are each 1 byte in length
  + Timing clock
  + Start
  + Stop
  + Continue

**MIDI TIMECODE**

* Developed to allow virtual production environments to easily translate timecode into time-stamped msgs that can be sent through midi cables
* Enables SMPTE –based timecode to be sent through midi chain to devices capable of syncing and executing MTC commands
* Chain midi cables from the master to the appropriate saves within system
* Only one master can exist in an MTC system
  + Any number of slaves can be assigned
* Has become the most commonly used way to lock together devices

**MIDI TIMECODE CONTROL STRUCTURE**

* MIDI timecode format divided into 2 parts…
  + Timecode
  + MIDI cueing
* Timecode capabilities of MTC allow devices to be synced, locked or triggered to SMPTE timecode
* MIDI cueing is a format that informs midi devices that an upcoming event has to be performed at a specific time
  + Load
  + Play
  + Stop
  + Punch in/Punch out
* MIDI timecode made up of 3 message types
  + Quarter-frame messages
    - Transmitted only while system is running in real or variable speed time
  + Full messages
    - Used to encode complete timecode address within a single message
  + MIDI cueing messages
    - Designed to address individual devices or programs within a system

**SMPTE/MTC CONVERSION**

* Used to read incoming SMPTE timecode and convert it to MIDI timecode and vise-versa

**DIGITAL AUDIO’S NEED FOR A STABLE TIMING REFERENCE**

* Digital system generally achieves syncing lock by adjusting playback sample rate
* Sources program speed should vary as little as possible to prevent degradation in digital signal’s quality

**MASTER/SLAVE RELATIONSHIP**

* Only one master, and there can be several slaves

**AUDIO RECORDERS**

* Easier to set analog devices as the master especially is slave device is a DAW
* When starting new session…
  + Stripe highest track on a clean rll og tape then reproduce code can be routed to SMPTE input on midi interface

**SOFTWARE APPLICATIONS**

* In general, midi sequencer will be programmed to act as a slave device
* Digital sequencer can easily chase a master MIDI time code source and lock to a point within production with ease

**DIGITAL AUDIO WORKSTATIONS**

* Computer-based DAW set to act as either master or slave
* Workstation can be set to..
  + Chase master timecode
  + Generate timecode
  + Vise-versa

**ROUTING TIMECODE TO AND FROM COMPUTER**

* Best to have DAW generate master code for system
* Use audio interface or multiple MIDI interface that includes software for generating timecode
* Select interfaces sync driver as your sync sources for all slave applications

**AMPLIFICATION**

* By introducing small varying signal at input onto tubes grid – a larger electrical signal can use to regulate flow of electrons between plate and cathode
* AMPLIFIER SATURATION:
  + Results when input signal is so large that DC output signal is large enough to produce required output signal
* CLIPPING:
  + Overdriving an amp will cause mild to severe waveform distortion effect
* Best way to avoid distortions to be aware of various amp and device gain stages throughout studios signal chain

**OPERATIONAL AMP**

* A stable high gain, high bandwidth amp
  + Has high input impedance
  + Has low output impedance

**PREAMPLIFIERS**

* Found at input section of a console
* Used in a wide range of applications
  + Boosting mics signal to line level
  + Providing variable gain for various signal types
  + Isolating input signal paths and equalization

**EQUALIZERS**

* A frequency discriminating amplifier
* Achieved through use of resistor/capacitor networks located in op-amps negative feedback loop..
  + To boost (AMPLIFY) certain frequencies
  + To cut (ATTENUATE) certain frequencies

**SUMMING AMPLIFIERS**

* Active combining amp
* Designed to combine any number of discrete inputs to a single output signal bus while providing high degree of isolation between them

**DISTRIBUTION AMPLIFIERS**

* Used to provide signals current power being delivered to one or more loads

**POWER AMPLIFIERS**

* Used to boost audio output to a level that can drive 1 or more loudspeaker at their rated vol. levels

**VOLTAGE AND DIGITALLY CONTROLLED AMPLIFIERS**

* VCA – VOLTAGE CONTROLLED AMPLIFIER
  + Overall output gain is a function of an external DC Voltage applied to devices control input

**THE RECORDING PROCESS**

* Recording session generally involves…
  + Recording
  + Overdubbing
  + Mixdown

**RECORDING**

* Involves process of capturing live or sequenced instruments onto a recorded medium
* You can record all instruments at once – live
* Live musicians or electronic musicians can be used
* Vocals and instruments can be recorded separately or together
* Resulting foundation tracks are called basic, rhythm or beds

**OVERDUBBING**

* Instruments that were not recorded at time of recording can be added at a later time

**MIXDOWN**

* When all musical parts have been recorded you can then start to play with the levels – emphasizing certain instruments in volume

**UNDERSTANDING CONCEPT OF “THE MIXING SURFACE”**

* Most important concept to know is the signal chain / signal flow
* Signal flow travels down the strip – generally…
  + Input
  + Sends
  + EQ
  + Monitor
  + Output
  + routing
* CHANNEL INPUT
  + Serves as pre-amp section to optimize signal gain levels
  + Mic trims – capable of boosting signal
  + Line trim – can be varied in gain
* INSERT POINT
  + Used to send strips line level to external processing
  + Use TRS connectors
* AUXILIARY SEND SECTION
  + Used to route and mix signals from one or more input strips to effects output sends
* EQUALIZATION
  + Most common form of signal processing
  + Compensates for deficiencies in sound shaping
* DYNAMIC SECTION
  + Allows individual signals to be dynamically processed more easily
    - Compression, limiting and expansion
* MONITOR SECTION
  + Provides control over each input
* CHANNEL FADER
  + Each input contains associated channel fader and pan pot
  + This section includes solo/mute
* OUTPUT SECTION
  + Signals can be inserted onto or routed off of this bus at multiple points
* CHANNEL ASSIGNMENT
  + Located at the top of the channel strip
* GROUPING
  + Mixing system allows any number of inputs channels to be organized into groups
* MONITOR LEVEL SECTION
  + Controls levels for control room levels, studio levels, headphone levels and talkback
* PATCH BAY
  + Panel found on large consoles
  + Contains accessible jacks that corresponds various input and outputs
  + 4 types of configurations
    - Open
    - Half-normaled
    - Normaled
    - Parallel
* METERING
  + Where the level of signals strengths at an input and output are measured

**POWER-AND GROUND-RELATED ISSUES**

* Balanced Power
  + Reduces line noise
* Power Conditioning
  + Can be broken into 3 topics
    - Voltage regulation
    - Eliminating power interruptions
    - Keeping the lines quiet

**MIXING AND BALANCING BASICS**

* Process of combining audio using traditional tools
  + Relative level
  + Spatial positioning
  + Equalization
  + Dynamic processing
  + Effects processing