Sound Recording, Transmission, and Playback Methods

MUS 201: MUSIC HISTORY II, DR. DAVID SHAW

1) **ANALOG**
   a) **Media**
      i) Vinyl
      ii) Magnetic Tape
         (1) Cassette
         (2) Reel to Reel
         (3) 8-Track Cassette
         (4) Video Tape
         (5) Video Tape's audio track
      iii) Film (audio track)
      iv) FM/AM broadcasts
   b) **Process**
      i) Recording
         (1) A microphone changes vibrations in the air into a similar pattern of varying voltage on a wire
         (2) This voltage pattern gets "etched" into one of the above mediums
      ii) Playback
         (1) The "etched" pattern is converted into a similar pattern of varying voltage on a wire
         (2) The voltage pulls and pushes the electromagnet in a speaker to move air molecules, which we will hear as sound
   c) **Pros**
      i) Most people already own analog playback hardware
      ii) Portions of a corrupted recording can usually be recovered
      iii) Society is accustomed to the sound of the older analog formats
   d) **Cons**
      i) The sound quality is degraded during each playback
      ii) Copying analog audio usually takes the same amount of time as the length of the recording
      iii) Due to the physical limitations of analog formats, its sound quality is less than perfect (i.e., it doesn't match the range of our hearing)

2) **DIGITAL**
   a) **Media**
      i) CD (Compact Disc)
      ii) MD (Mini Disc)
      iii) DAT (Digital Audio Tape)
      iv) ADAT (Alesis Digital Audio Tape)

v) MP3 (MPEG3 – Motion Picture Experts Group)

vi) DVD (Digital Versatile Disc)

vii) Computer Recording

viii) Telecommunications

ix) Morse code

b) **Process**

i) Recording

(1) A Microphone changes vibrations in the air into a similar pattern of varying voltage on a wire

(2) This voltage pattern gets digitized, or sampled, by an Analog to Digital Converter (A/D or ADC) into discrete (separate) numbers

(a) Sampling Frequency

(i) For professional audio quality, one second of sound is broken into 44,100 equally-spaced samplings

(ii) The highest sounds we want to hear need to be sampled as they vibrate back AND forth, therefore, the Sampling Frequency must be at least twice this value (i.e., desired frequencies up to 20,000 cycles per second need to be sampled at least at 40,000 times per second

(iii) Lowering the Sampling Frequency will lower the highest frequencies recorded

(b) Bit Depth/Resolution

(i) The range of numbers needed to represent the vertical position of the voltage's sampled waveshape is from 0 to 65,536 in a 16-bit system

(ii) Digital devices need 16 bits (binary digits) to represent numbers up to 65,536 (i.e., binary 0000000000000000 = decimal 0, binary 0000000000000001 = decimal 1, 0000000000000010 = 2, 0000000000000011 = 3,… 1111111111111111 = 65,536)

(iii) Lowering the Bit Depth adds noise to your recording

ii) Playback

(1) The numbers are converted back into a continuous and varying voltage by a Digital to Analog Converter (D/A or DAC)

(2) The voltage pulls and pushes the electromagnet in a speaker to move air molecules, which we will hear as sound

c) **Pros**

i) Digital numbers can be played back infinitely without degrading sound quality

ii) Digital sound quality is close to perfect (i.e., what gets recorded is what plays back)

iii) Copying digital audio can take a much shorter time than the length of the recording

iv) Sound that is represented by numbers can be complexly manipulated by mathematical formulas to inexpensively and creatively change the sound

v) Digital systems are generally more compact than analog systems

d) **Cons**

i) Large amounts of memory are required to store digital audio samples

ii) When digital systems fail, often all the data is lost

iii) Society is not accustomed to hearing clean, high frequencies represented in their recordings