Digital Music Demystified.

An Introduction to Digital Music Playback

Marc Saltzman, TAVES 2012

About me

- “Geek speak to street speak”
- Musician turned techie


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An Introduction to Digital Music Playback

What we'll cover:

- What's digital audio
- Understanding compression, lossless audio
- Brief history of MP3 revolution
- The Apple decade: iEverything
- Digital audio today
- Digital audio tomorrow

What is digital audio?

- Digital audio refers to technology that records, stores and/or reproduces sound by encoding an audio signal in digital form, represented as numerical values (i.e. data), instead of analog form.
- With analog recordings, sound waves are recorded to the record or tape via physical grooves or magnetic impulses.

Digital versus analog

* Analog recordings degrade each time they're played (record pops, tape hiss), lack of portability, usually "linear" media
* But warm, live sound

Digital Sound: Pros

- On disc or all-digital (non-physical) media, can be easily and perfectly duplicated; it's more portable, playable on number of devices; multiple options to acquire music (without leaving the house); and clear sound

Digital Sound: Cons

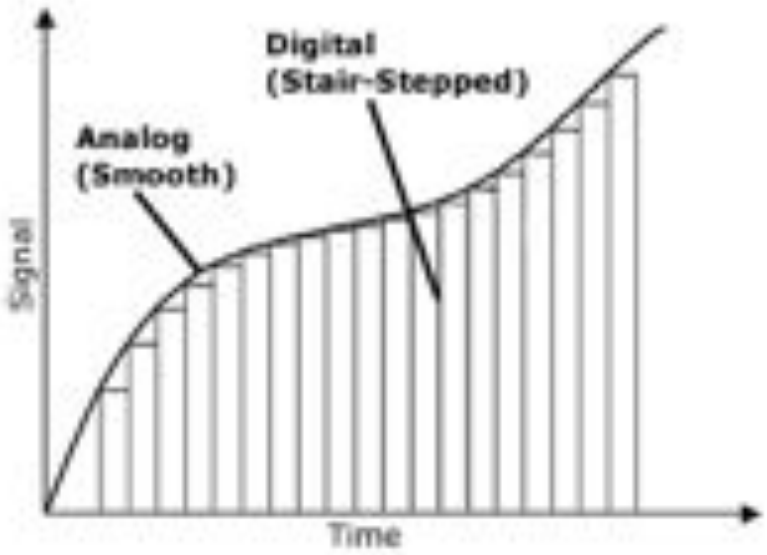
- But quality can vary greatly between digital tracks
- Many audiophiles believe digital recordings sound sterile, lack warmth of analog
- Easily duplication and sharing of digital, non-physical media encourages piracy

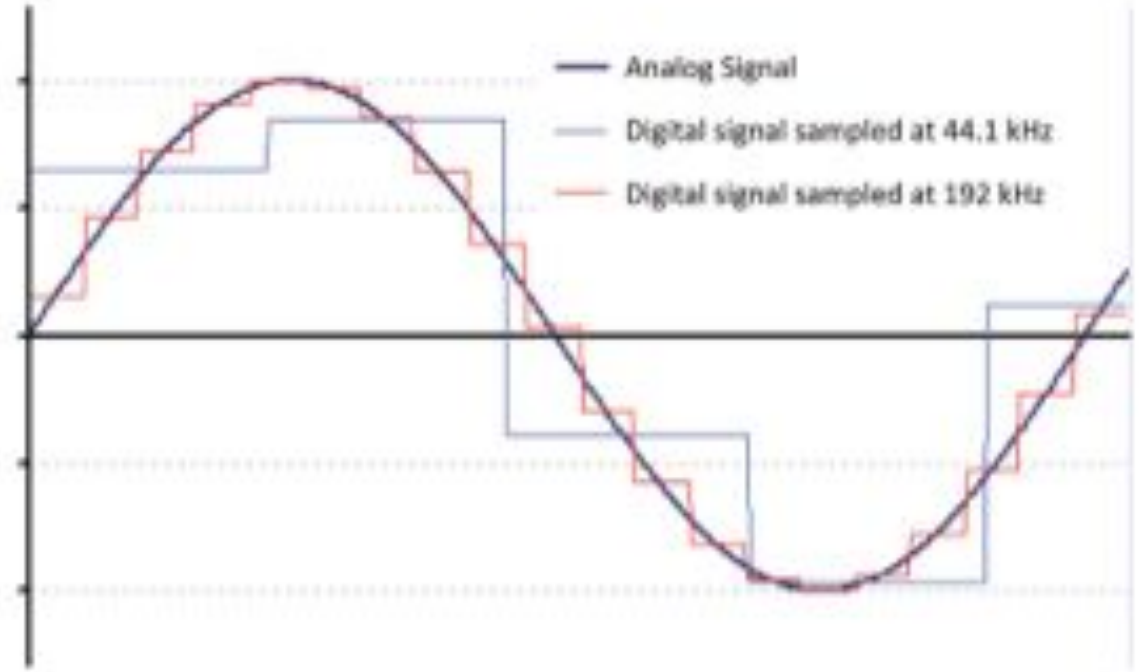
How digital recordings are made

- Unlike analog recordings, where the recording device captures a constant sound, digital recording captures a series of samples taken from the sound being recorded.
- Just like a movie camera captures series of still pictures to make it look like motion, digital recording takes a series of "pictures," or samples of the incoming sound.

Called “Sample rate”

- The higher the number, the better
- CD, for example, has 44.1 kHz (44,000 times a second), but can find higher for digital-only tracks (e.g. 96 kHz)





This diagram illustrates the difference between an analog signal and digital signals sampled at two different sampling rates.

- Photo credit: Canada HiFi Magazine (April 2012; George de Sa)

Bits, Bit rate

- **Bits**: Units of information contained in the digital file; the higher the bits the better. A standard CD has 16-bit sound, but higher bit sizes can be found online.
- **Bit rate**: Measurement of amount of bits played per second (kilobits); the amount of sound info presented to the listener every second (e.g. 64 Kbps, 128 Kbps, 320 Kbps)

Digital music formats (high level)

- Most digital music is in the form of PCM (Pulse Code Modulation) or LPCM (Linear PCM) audio data
- File formats were created, such as .WAV, .MP3, .AIFF
- Three main types of digital audio: uncompressed, lossless compressed and lossy compressed.

Digital audio formats

- **Uncompressed**: Identical to original digital music file. Two most popular formats are WAV (Waveform Audio File Format), developed by Microsoft, and AIFF (Audio Interchange File Format), developed by Apple. Players can access PCM music data and "metadata" info (album art, artist, song, etc.).

- **Lossless Compressed**: Somewhat shrinks PCM data down to files by removing only redundant data. Popular lossless formats ("codecs") include FLAC (Free Lossless Audio Codec), ALAC (Apple Lossless Audio Codec) and some WMA (Windows Media Audio) files. Maintains quality of the original uncompressed file.

- **Lossy Compressed**: Most popular kind of digital audio. Compressed, or shrunk, down to very small files by removing some of the PCM music data. Not hi-fidelity audio but usually ok for average listener. Most popular formats: MP3, AAC and WMA (lossy).

Digital music explosion

- Revolutionized music industry: Good and Bad
- Since late ‘90s, first on PCs
- MPEG-2 Audio Layer III (“MP3”) paved the way
- 1/11 or 1/12 of CD; 128 kbps standard
- 150 songs per CD-R
- Faster Internet, Napster, MySpace, BitTorrent
- MP3 players, smartphones

- **December, 1996: “Marc’s Web Watch” with Alan Cross on 102.1 The Edge**

- “The latest and best sounding music files on the Web now are called MP3s or MPEG Audio (version 3) which compresses music into smaller downloads but somewhat preserves the CD quality of the tracks. Once it’s on your computer you can listen to these tunes, put them on a tape for your Walkman or car or burn them on a CD yourself if you’ve got one of those recordable CD-ROM drives.”

Floodgates opened….

MP3s @ turn of the century

Pros:

- Can fit hundreds or thousands of songs in your pocket; storage increasing for hard drives and players
- Don't have to leave your home to acquire music
- Can't choose what you want to hear
- Easy to search, organize tracks
- Free, no DRM

Cons:

- Sound quality inferior, but not many noticed (novel, PC speakers)
- No one cared about SACD and DVD-Audio
- Needed to be somewhat technical to rip, download and share music
- No legitimate way to buy music
- Competing audio standards

iPod and iTunes (2001), iTunes Store (2003)

iTunes changed the game

- Apple legitimized digital music
- 99-cent tracks
- Huge selection
- “Full circle” solution
- iTunes became no. 1 music vendor in the U.S. by spring of 2008, and then no. 1 in the world by early 2010.
- iPod>iPhone>iPad

Apple iOS devices

- Digital music migrated from computers to portable players

Digital music migrates to media room

Speaker docks

The Perfect Storm

- Digital audio loses physicality (CDs, tapes)
- Proliferation of computers; High-speed Internet debuts
- Cost of memory drops; inexpensive and smaller players
- Apple makes it easy to pay for individual tracks (iTunes)

Other ways to acquire digital music

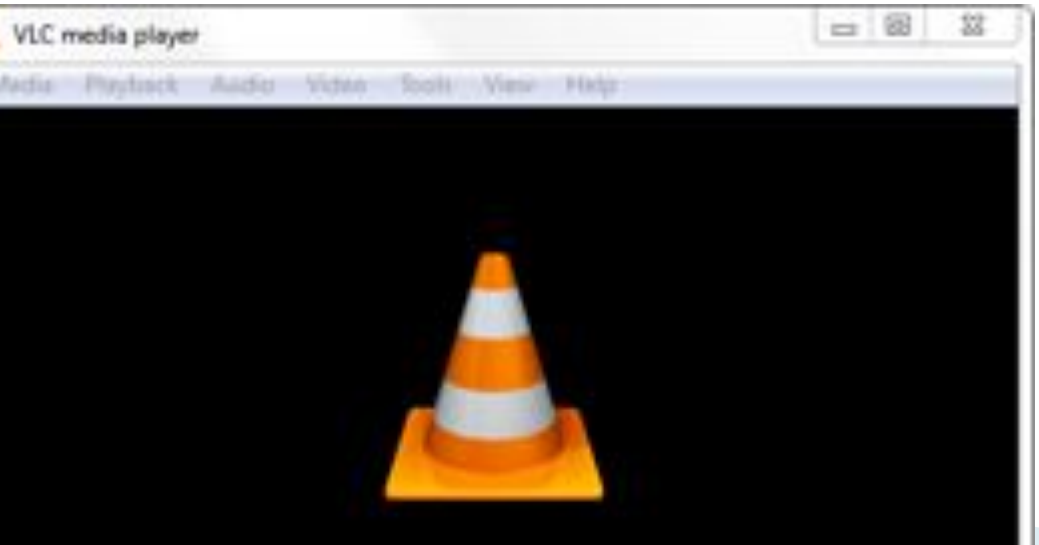
- **Along with online stores like iTunes**:

- CD ripping (legit)
- Pirated tracks on websites, Newsgroups, FTP, P2P services, BitTorrent technology
- Hard drive parties (lossless audio exchange)
- Streaming music

Recording industry finding other revenue streams

- Concert ticket sales, meet and greets
- Publishing, radio play, movies, games
- Merchandise (t-shirts, DVDs) , ringtones
- Advertisements, product placement

Lossless audio playback on PCs



Trend today: Wireless streaming

- AirPlay, Bluetooth, Wi-Fi, DLNA, WiDi

Wireless streaming in car, too

Another trend: Cloud storage

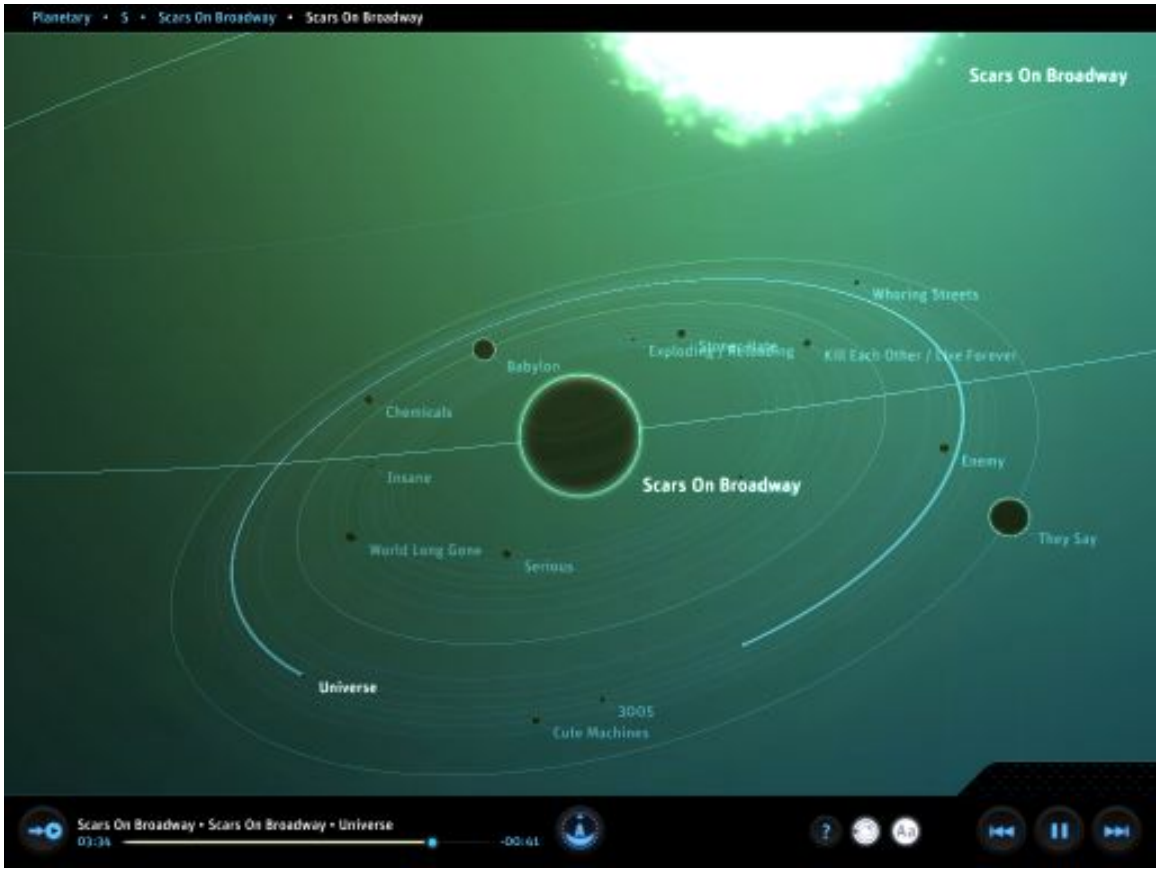
- All your music: anywhere, anytime on any device
- Some free services, but often limited by capacity (e.g. 5GB)
- iTunes in the Cloud

Download a song or album.

It appears on all your devices.

Music apps popular, too

Music apps, cont'd



Streaming audio services

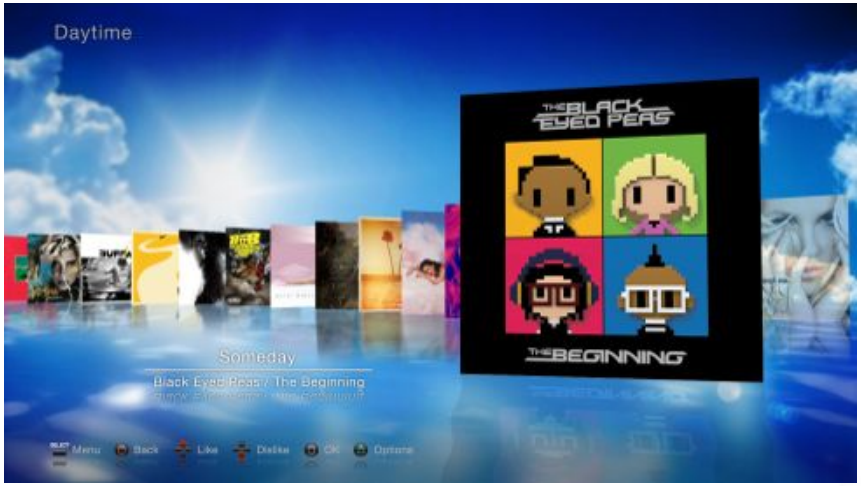
- Trend towards on-demand music (like other media)
- Streaming instead of downloading; one flat fee per month for 15M tracks
- Computer desktops, social networks, TVs, mobile players (smartphones)

Streaming music not high-quality

- Again, we're trading quality for convenience, price
- "All you can eat" buffet model versus per-track "a la carte" – but no ownership
- Subscription-based, cloud synchronization
- Extra features (favourites, thumbs up/down, playlists, social media)

Streaming music services, cont'd

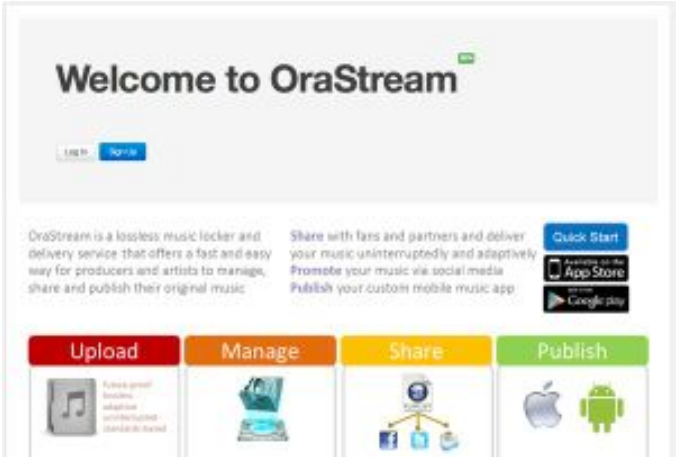
- British Phonographic Industry: "Ownership is the old model of music consumption"



Don’t forget YouTube

YouTube

Is the future lossless streaming?



Private cloud media streaming, too

- Combination of services and owned content, accessed anywhere, wirelessly

Thank you!

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Q & Eh?