



The Digital Age



The Digital Age

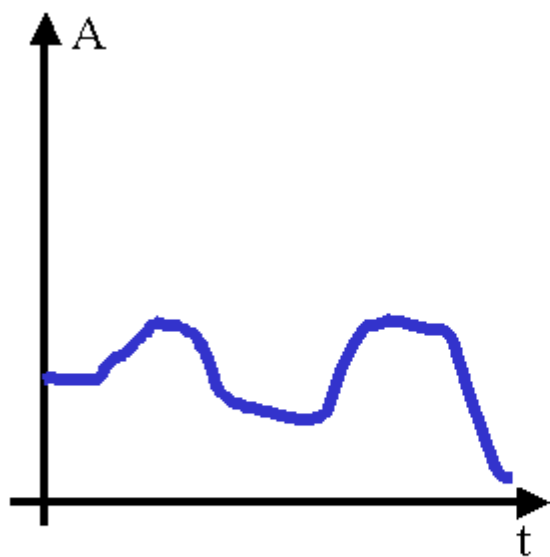
What is digital?



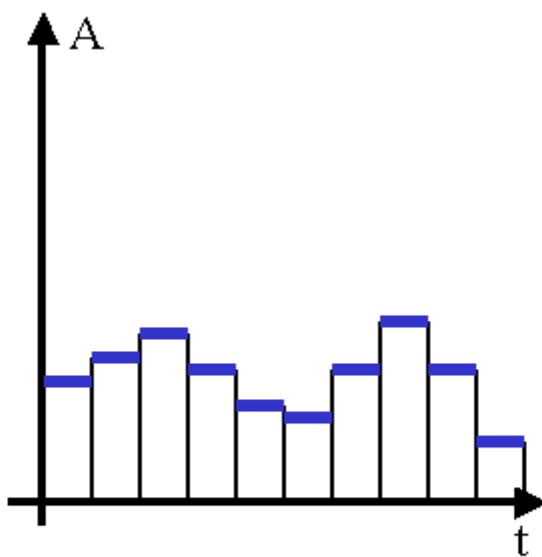
The Digital Age

What is digital?

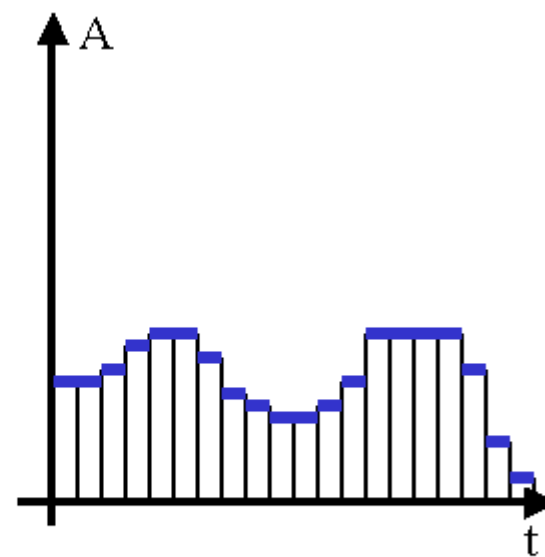
- the signal of sound is converted into a stream of discrete numbers, representing the changes in air pressure over time



**Analog signal –
continuously varying**



**Digital signal – large
time divisions**



**Digital signal – small
time divisions**



What are the advantages of digital recording?



What are the advantages of digital recording?

- The recording does not degrade over time: As long as the numbers can be read, you will always get exactly the same wave.
- Groups of numbers can often be compressed by finding patterns in them, thus saving storage space.

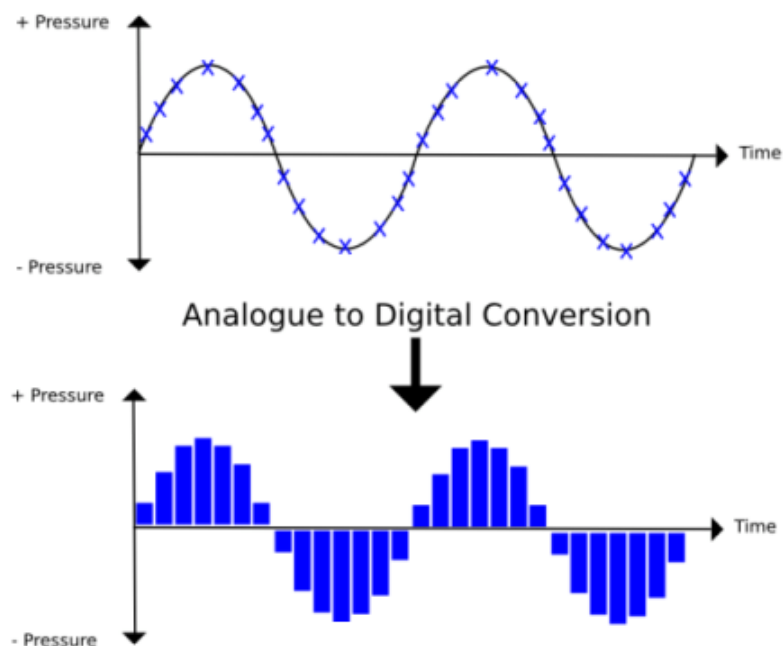


The Process

- Analog signal transmitted from the microphone to an analog-to-digital converter (ADC).
- The ADC converts this signal to a series of *binary numbers*. The quantity of numbers produced per second is called the sample rate.
- These numbers are stored onto recording media such as magnetic tape or hard drive or optical drive.
- To play back, the sequence of numbers is transmitted from storage into a digital-to-analog converter (DAC), which converts the numbers back to an analog signal to be transmitted to the loudspeakers.



ADC

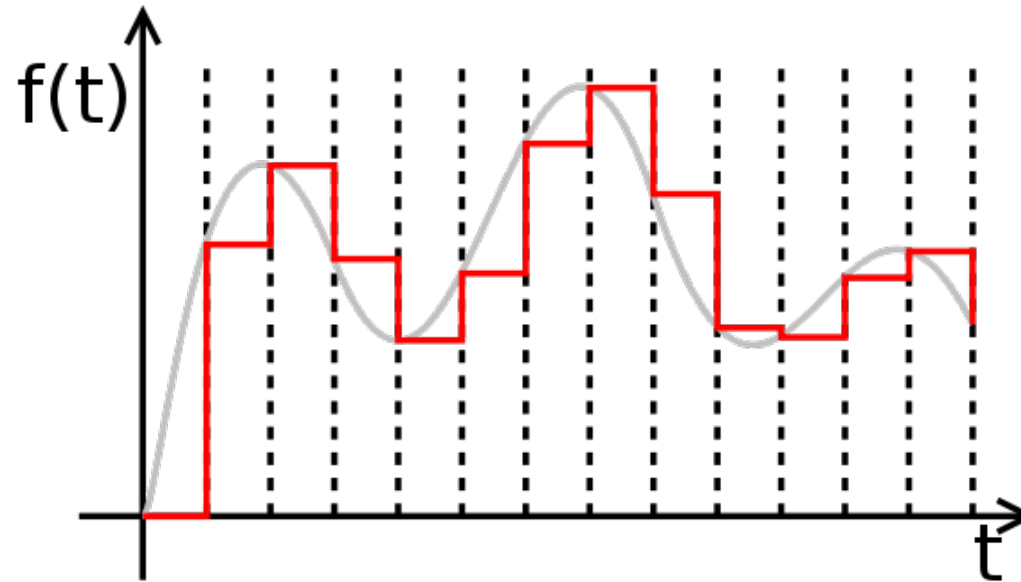


- Word size *or* Resolution *or* Bit depth
 - How many bits will be used to represent the signal level?
 - (Introduction to the binary system)
- Sample rate
 - How often will the level of the signal be read?





DAC



- clock cycle
- interpolation



Digital Recording Media

Concerns

- how to record the bits fast enough to keep up with the signal
- e.g., to record two channels of audio at 44.1 kHz sample rate with a 16 bit resolution, the recording software has to handle 1,411,200 bits per second!

Solutions

- for digital cassettes (tape), the read/write head moves as well as the tape in order to maintain a high enough speed.
- for optical media (CD/DVD) a laser is used to burn microscopic holes into the dye layer of the medium (see later).



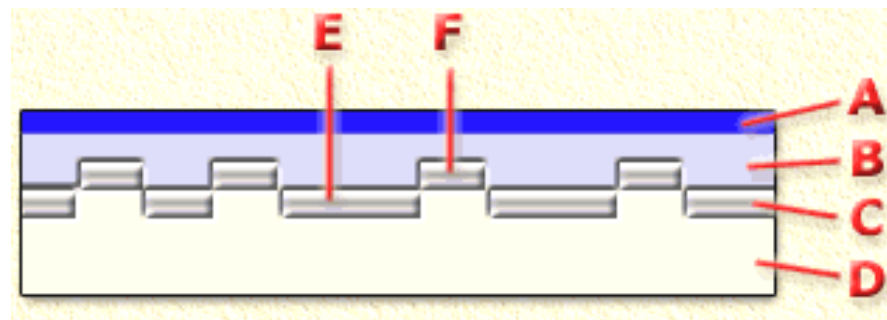
Digital Audio Tape (DAT)

- Reel-to-reel tape (1972)
- Sampling rate of 48 kHz or 44.1 kHz
- Resolution of 16 bits
- Failed in the consumer field (too expensive, too fiddly, crippled by anti-copying regulations), but popular in studios (particularly home studios) and radio stations.
- ADAT - multitrack (8 tracks), 1991 - used VHS tape.
- Still popular in professional and home studios.

Compact Discs

(developed during 70s, first commercial sale in October 1982)

- 44.1kHz sample rate
- 16-bit resolution
- 2 channels
- 74 minute duration
- *How many bits of information must a CD hold?*



<http://www.youtube.com/watch?v=eJG9GZGzMDo>

P A Siepmann
Uppingham School Music Department

<http://www.petersiepmann.net/teaching>



Benefits of digital technology and CDs



Benefits of digital technology and CDs

As described further above (ADC/CDC), a digital signal is only ever an approximation (albeit a very good one!) of the true sound wave. It should also be noted that excellent, expensive analog systems may outperform digital systems, and vice versa (in theory any system of either type may be surpassed by a better, more elaborate and costly system of the other type). However, CDs can boast...

- low levels of noise
- usually less expensive to achieve a good standard of quality with a digital system
- CDs much more resistant to minor physical degradation (though with major degradation, analog may perform better)
- inexpensive media duplication (and playback) costs
- portable storage and playback devices (analog recordings require comparatively bulky, high-quality playback equipment to capture the signal from the media as accurately as digital)
- digital error checking/correction
- digital copies are usually exact replicas, which can be duplicated indefinitely without degradation



Hard disc recording

– became popular towards the end of the 1990s due to

prices ↓ capacity ↑ size ↓ CPU speed ↑

- non-linear editing (data can be accessed randomly)
- non-destructive editing
- limited capacity
- relatively high cost of replacement drives
- reduced ruggedness of hard disk recorders as compared to tape-based systems



Personal computers in sound recording

- PCs can be used as a hard disk recorder with appropriate software
- More flexible interface to the studio engineer
- Studio-grade systems provide external hardware; less expensive software systems can use the hardware included with any modern computer.
 - Multi-channel sound cards
 - Firewire/USB devices
- Issues of: disk size, transfer rate, processor speed
- Computer also used in recording studio
 - Ease of cutting, looping, duplication of parts, effects, rearranging, etc.
 - Notator, Cubase, Logic
- Increasing processing power - increasing availability of technology to the home market.
- Instruments and effects into one box!