

Digital Audio- definitions of basic terms

Sample Rate and Bit Depth

In digital audio a snapshot (sample) is taken from an audio signal at specific sample rates and at specific resolutions. A normal Audio CD is recorded at a sample rate of 44100 times per second (44.1khz) at a bit depth of 16bit. Why 16bit? Because the digital process is a binary process (a process based on the factor of 2), meaning there are only two values- '0' and '1'. Each code is like a little 'yes' or 'no', and a 16 bit code might look like '0100110010100011'. Within this 16bit code there are so many variations of '1' and '0' possible that a sufficient resolution can be achieved to describe whatever the analog signal looks like at that moment.

That is, until people decided it wasn't good enough. So, in addition to 16bit, there is now also a higher resolution available- 24bit which affords a much higher resolution than 16bit because each sample is resolved in greater detail.

The sample rate of 44.1khz was selected as a worldwide standard in the 1970s because it was widely believed that this sample rate was able to capture the whole bandwidth of human hearing (20hz-20khz). But in the spirit of technical evolution, it was discovered that higher sample rates yielded an even better audible quality- especially in classical recordings where sonic detail is of great importance. So, people doubled the sample rate to 88.2khz, which is several high sample rates now in use.

But then there is another factor: 48khz sample rate, which originated in the film world. Films were shot at 24 frames per second (although there are other rates used, too), and when a digital audio format was needed for film it was decided at 48khz was the appropriate format- a multiple of 24. Today we have the following sample rates available:

44.1khz (used on CDs at 16bit depth, also available with 24bit)
48khz (standard rate for movie and video audio, 16&24bit depth)
88.2khz (sample rate for hi-resolution audio, 24bit)
96khz (sample rate for hi-resolution audio, 24bit)
192khz (for ultra high resolution, 24bit).

Common sample rates

The most common sample rate in the studio is 44.1kHz/24bit (sometimes 48kHz/24bit) and is the best choice for today's digital recording. Use higher sample rates only if you are recording in a high quality environment, with top-notch equipment and plenty of hard disk space.

Disk space

The size of an audio recording depends on its bit depth and sample rate. One minute of stereo recording at 44.1 kHz/16 bit takes 10MB of space (5MB per mono minute) while the same length of audio at 44.1kHz/24 bit takes 15Mb. So, a five minute song recorded on 10 mono tracks takes at least 250MB. It is advisable to get a large hard drive of at least 120GB storage capacity for your audio recordings.

Word Clock- the timing reference between digital devices

Digital audio is a time dependant process, meaning that it needs a timing reference in order to function. Each digital device (computer, interface, external digital processors) has its own internal clock so that a sample rate can be established. When you use more than one digital device at a time you have to synchronize their clocks by establishing ONLY one Master Clock device- otherwise you will hear pops and clicks because the clocks are not synchronized. There are different ways to establish this clock synchronization, depending what kind of digital connection you are making between the digital devices. Please read on...

Digital connections

AES/EBU

AES/EBU is used for carrying digital audio signals between various devices. It was developed by the Audio Engineering Society (AES) and the European Broadcasting Union (EBU), carries clock information alongside digital audio data and uses an XLR connector. A common format in recording studios.

S/PDIF

Sony/Phillips Digital Interface format. Uses an RCA connector and can also carry clock information along with digital audio data. Used mostly in consumer audio devices.

TOSLINK

Toshiba fiber optical version of S/PDIF. Used in consumer devices (usually for CD player outputs).

ADAT Lightpipe

A different fiber optical format than TOSLINK! Developed by ALESIS for their ADAT machines, this format has become one of the standard Pro Audio connection formats. It can carry clock information along with digital audio data.

Tascam T/DIF

A bulky multi-pin connector developed by TASCAM for their line of products. It cannot carry any clock information but has become a common format in Pro Audio setups.

BNC

The BNC (Bayonet Neill Concelman) connector is a common type of RF connector used for terminating coaxial cable. You are using BNC cables on your cable TV receiver and antenna. In digital audio, 75 Ohm BNC coax cables are used to exclusively carry clock information between different devices. No digital audio goes through BNC coax cables, only timing information.

Digital cables vs. analog cables

Despite the fact that digital audio cables sometimes use the same connectors as analog cables (XLR and RCA) they are not interchangeable. Common microphone cables are able to carry digital data but may introduce corruption to the clock information, and the same holds true for RCA analog cables. In order to guarantee a problem free digital connection it is important to use cables rated for digital transmission.

In addition to these digital audio connection methods, several other connection formats are used, including:

Firewire (IEEE 1394)- data transfer between cpu and storage devices or other cpus

USB (1.1 and 2.0)- data transfer between cpu and storage devices

RS 422- data transfer to remote control devices

Ethernet- data transfer between devices

SCSI- older multi-pin format to transfer data between devices

Please note: These descriptions are intended as a basic reference. For detailed information on these formats visit wikipedia.com.