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Bits, Bytes, Gigs, and Other Technology Jargon

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THE INFORMATION REVOLUTION HAS BROUGHT vocabulary into our daily lives that is often adopted and passed on without much thought. Voice technology is loaded with words we accept without much question as to origin and definition. Recording, reinforcing, storing, and transmitting vocal signals plunges us into the digital world and its computer-based language.

Computers are built with miniaturized electronic circuitry that allows electric current to flow or not flow in tiny loops. This creates binary *on-off* states (or flow–no flow states). The *off* state is represented by a zero (0) and the *on* state is represented by a one (1). The word *binary digit*, abbreviated as ***bit*** represents these two states. It is like having only one finger (digit) on the hand. We can raise the finger or not, which allows us to represent either zero or one (i.e., one positive value with respect to zero). If we try to represent values beyond zero or one, however, we need multiple hands. Electronic design can concatenate circuits that allow a huge number of independent states to occur, so that binary numbers in the form 01001011 . . . . . can be formed. With eight binary digits, for example, which would be like having eight one-finger hands, it is possible to count from zero to $2^8 = 256$. Any physical quantity (e.g., pressure, frequency, displacement) could be represented with an accuracy of 1/256, or 0.39 %. This is good enough for some measurements, but inadequate for others. Hence, binary numbers can have many more digits, often up to 64.

The ***byte*** is a unit of digital information (a number) that is represented by eight bits as described above. Historically, the byte was the number of bits used to encode a single character of text in a computer. (Consider all the alpha-numeric characters on your keyboard, including upper and lower case.) The byte is the smallest addressable unit of memory in many computer architectures. We measure the amount of memory in our digital devices in mega-bytes (millions of bytes), giga-bytes (billions of bytes), or tera-bytes (trillions of bytes). The marketing and colloquial abbreviations "megs" and "gigs" result from desires to shorten words, but they reduce clarity if the suffix bits or bytes is left off.

Misunderstandings can also occur when the *rate of transfer* of digital information between devices is confused with the *amount of storage* of digital information in a device. The industry is often responsible for the confusion by using only the letters M, G, and T. For rate of transfer, the units mega-byte per second (MB/s) or giga-byte per second (GB/s) should be used. These units also relate to internal transfer within a device. In any computational device, the basic units are the *processor* and the *memory*. The processor takes information from memory, does something to it, and stores it again. This process is executed in MB/s or GB/s. One can have small memory with large processing speed, or vice versa. Generally, the two are upgraded simultaneously.

In the digital music industry, complex sounds are converted from analog devices to digital devices, or vice versa. Microphones and loudspeakers are the common analog devices, while recorders, amplifiers, filters, and mixers are common digital devices. All of these components can add noise, distort the signal, or limit the frequency response. Thus, it is important to consider accuracy, speed, fidelity, and storage capacity throughout the entire system. Accuracy is determined by the number of bits or bytes that a processor or converter uses to represent a physical quantity (32 or 64 bits is typical today). Speed is determined by how rapidly the binary numbers can be modified and/or transferred. It can vary from only a few MB/s to several GB/s, depending on the links and proximity of the components. Fidelity is determined by how little the numerical signal is changed by added noise, distortion, or inadequate sampling in processing and transfer (44.1 kHz sampling, a signal-to-noise ratio about 90 dB, and harmonic distortion less than 1 % are common in the music industry today). Storage capability is the least challenging; it has advanced rapidly into the tera-byte (TB) range with low cost hard disk drives or solid state memory devices.