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The International Electrotechnical Commission Standard for exponent prefixes in IT

Mike McCorkle

Fuji Photo Film U.S.A., Inc

2629 Sunnyside Circle, Palm Harbor FL 34684-4160

Phone: +1-727-773-2800, FAX: +1-914-789-8530

E-mail: mike_mccorkle@fujifilm.com

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The difference between decimal and binary counting systems results in different interpretation of capacity and transfer rate between storage hardware specifications and software programs.

Kilo, mega and giga prefixes, from the International System of Units (SI), the modern metric system, designate one thousand (1000), one million (1 000 000) and one billion (1 000 000 000) respectively. Yet a kilobyte, as computers calculate, is 1024 bytes, a megabyte is 1 048 576 bytes and a gigabyte is 1 073 741 824 bytes.

This discrepancy stems from the need to write electronic information in binary code, using only two digits, ones and zeros, while the metric system is based on 10 digits. To describe large numbers of bytes, programmers [incorrectly*] used the closest approximate metric prefixes available at the time. In 2000, the International Electrotechnical Commission (IEC), which writes international standards for electronic technologies, adopted new prefixes to more accurately express the values of quantities used in Information Technology.

With significant input from the National Institute of Standards and Technology, the IEC adopted kibi (Ki), mebi (Mi), gibi (Gi), tebi (Ti), pebi (Pi) and exbi (Ei) to represent exponentially increasing binary multiples. A kibibyte, equals 2 to the 10th power, or 1024 bytes. Likewise, a mebibyte equals 2 to the 20th power, or 1 048 576 bytes. The new prefixes for binary, which parallel the metric prefixes, will better express electronic information.

SI prefixes should still be used in computing just as they are used in other fields and one megabyte (1 MB) should mean exactly 1 000 000 bytes or one million bytes. Alternatively, programmers can choose to use the IEC one mebibyte (1 MiB), which means exactly 1 048 576 bytes. Etcetera!

*Programmers have been incorrectly using the SI prefixes developed by the International Conference on Weights and Measures; these are based on powers of 10, whereas quantities in computer science and IT generally use the binary system. The IEC adopted prefixes for binary multiples in International Standard IEC 60027-2, Letter Symbols to be used in electrical technology – Part 2: Telecommunications and electronics. Though the IEC standard is not part of the SI, these IEC prefixes should be used in the indicated fields to avoid the erroneous practice of applying an SI prefix incorrectly for computer calculations.

For data storage products, according to IEC standard 60027-2 (2nd edition), when prefixes are used to express a storage capacity the bit (b) and the byte (B) may be combined with SI prefixes [as is common practice today].

Using the new IEC prefixes for binary multiples is also correct, providing the storage capacity is correctly expressed by the binary multiple.

References: International Electrotechnical Commission, IEC 60027-2 and National Institute of Standards and Technology, NIST SP330.

System Prefixes

SI Metric Prefix	Symbol	Decimal Multiplication Factor	Exponent
deka	da	10	10^{1}
hecto	h	100	10^{2}
kilo	k	1 000	10^{3}
mega	M	1 000 000	10^{6}
giga	G	1 000 000 000	10^{9}
tera	T	1 000 000 000 000	10^{12}
peta	P	1 000 000 000 000 000	10^{15}
exa	E	1 000 000 000 000 000 000	10^{18}
zeta	Z	1 000 000 000 000 000 000 000	10^{21}
yotta	Y	1 000 000 000 000 000 000 000 000	10^{24}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000 001	10^{-6}
nano	n	0.000 000 001	10^{-9}
pico	p	0.000 000 000 001	10^{-12}
femto	f	0.000 000 000 000 001	10^{-15}
atto	a	0.000 000 000 000 000 001	10^{-18}
zepto	z	0.000 000 000 000 000 000 001	10^{-21}
yocto	y	0.000 000 000 000 000 000 000 001	10^{-24}

IEC Binary Prefix	Symbol	Binary Multiplication Factor	Exponent	COMMENTS
kibi	Ki	1 024	2^{10}	Kilobinary
mebi	Mi	1 048 576	2^{20}	Megabinary
gibi	Gi	1 073 741 824	2^{30}	Gigabinary
tebi	Ti	1 099 511 627 776	2^{40}	Terabinary
pebi	Pi	1 125 899 906 842 624	2^{50}	Petabinary
exbi	Ei	1 152 921 504 606 846 976	2^{60}	Exabinary

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