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## How Much Information Is There in the World?

*Think you're overloaded with information? Not even close.*

A study appearing on Feb. 10 in Science Express, an electronic journal that provides select Science articles ahead of print, calculates the world's total technological capacity -- how much information humankind is able to store, communicate and compute.

"We live in a world where economies, political freedom and cultural growth increasingly depend on our technological capabilities," said lead author Martin Hilbert of the USC Annenberg School for Communication & Journalism. "This is the first time-series study to quantify humankind's ability to handle information."

So how much information is there in the world? How much has it grown?

Prepare for some big numbers:

\* Looking at both digital memory and analog devices, the researchers calculate that humankind is able to store at least 295 exabytes of information. (Yes, that's a number with 20 zeroes in it.)

\* Put another way, if a single star is a bit of information, that's a galaxy of information for every person in the world. That's 315 times the number of grains of sand in the world. But it's still less than one percent of the information that is stored in all the DNA molecules of a human being.

\* 2002 could be considered the beginning of the digital age, the first year worldwide digital storage capacity overtook total analog capacity. As of 2007, almost 94 percent of our memory is in digital form.

\* In 2007, humankind successfully sent 1.9 zettabytes of information through broadcast technology such as

televisions and GPS. That's equivalent to every person in the world reading 174 newspapers every day.

\* On two-way communications technology, such as cell phones, humankind shared 65 exabytes of information through telecommunications in 2007, the equivalent of every person in the world communicating the contents of six newspapers every day.

\* In 2007, all the general-purpose computers in the world computed  $6.4 \times 10^{18}$  instructions per second, in the same general order of magnitude as the number of nerve impulses executed by a single human brain. Doing these instructions by hand would take 2,200 times the period since the Big Bang.

\* From 1986 to 2007, the period of time examined in the study, worldwide computing capacity grew 58 percent a year, ten times faster than the United States' GDP.

Telecommunications grew 28 percent annually, and storage capacity grew 23 percent a year.

"These numbers are impressive, but still miniscule compared to the order of magnitude at which nature handles information" Hilbert said. "Compared to nature, we are but humble apprentices. However, while the natural world is mind-boggling in its size, it remains fairly constant. In contrast, the world's technological information processing capacities are growing at exponential rates."

Priscila Lopez of the Open University of Catalonia was co-author of the study.

**Source:** Martin Hilbert and Priscila López. The World's Technological Capacity to Store, Communicate, and Compute Information. Science, 10 February 2011 DOI: 10.1126/science.1200970