Optical Computers

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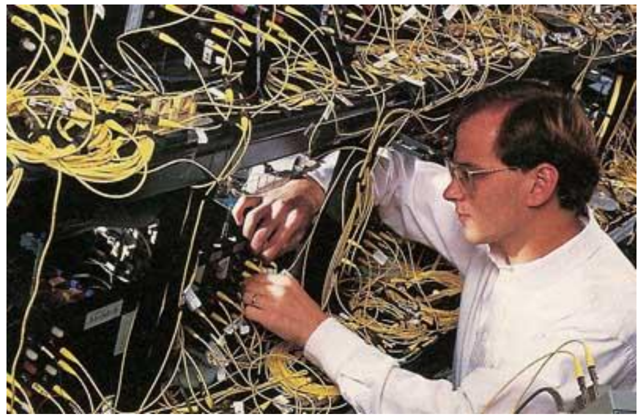
The computers we use today use transistors and semiconductors to control electricity. Computers of the future may utilize crystals and met materials to control light. Optical computers make use of light particles called photons.

NASA scientists are working to solve the need for computer speed using light travels at 186,000 miles per second. That's 982,080,000 feet per second -- or 11,784,960,000 inches. In a billionth of a second, one nanosecond, photons of light travel just a bit less than a foot, not considering resistance in air or of an optical fiber strand or thin film. Just right for doing things very quickly in microminiaturized computer chips.



Last but not least, we take a look at an optical computer. Compared to a conventional computer which uses the free electrons found in transistors to execute blazing fast calculations, the optical computer uses bound electrons in isolating crystals. The resulting digital signals are natively modulated onto a carrier light wave in the visible spectrum and no modulator or demodulator is needed, because the visible light spectrum theoretically offers 10 THz (terahertz.) of bandwidth. It is similar to performing digital computation via radio waves.

It is interesting to point out that modern (normal) electronic computers are taking on significant radio wave properties by themselves. Since the frequency of the system clocks on fast systems has passed the single gigahertz range, circuit designers must consider that any electronic signal varying at such rates will be giving off radio waves at that frequency. This means that a wire in a computer performs the dual function of a conductor of electricity and a waveguide for a gigahertz frequency radio wave.

The optical computer should be performing its computational processes with photons or polarities as opposed to the more traditional electron-based computation. Optical computing is a major branch of the study of photonics and Polari tonics. Electronics computations sometimes involve communications via photonic pathways. Popular devices of this class include FDDI interfaces. In order to send the information via photons, electronic signals are converted via lasers and the light guided down the optical fiber.

One fundamental limit for this technology has to do with size. The optical computer uses optical fibers in its microprocessor. Optical fibers on an integrated optic chip are ten times wider than the traces on an integrated electronic circuit chip. As stated before, we won't see any transistors in an optical computer. Instead, there are crystals, which have the same cross-section as the fibers, but need a length of about 1 mm and so, are immense compared to present-day transistors. Therefore, signal traveling times will be larger and the processing speed won't be that much improved. Current crystals need light with 1 GW (gig watt)/cm intensity. As a typical die-size (the size of a microchip) is about 1 cm, and some absorption takes place, this means kilowatts would be needed to power an optical chip. Keep in mind that this power is enough only for pulsed (not continuous) operation. With the near-future introduction of nanotubes, this problem could be easily solved. The biggest advantage offered by optical technologies is expected to be the synergy with existing optical telecommunication infrastructures.