InPhase TECHNOLOGIES

What is Holographic Storage?

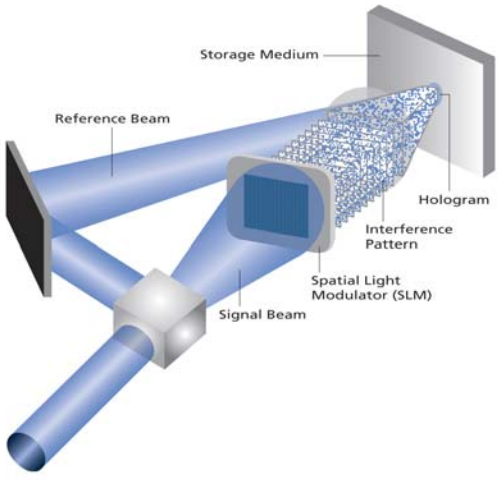
Holography breaks through the density limits of conventional storage by going beyond recording only on the surface, to recording through the full depth of the medium.

Unlike other technologies that record one data bit at a time, holography allows a million bits of data to be written and read in parallel with a single flash of light. This enables transfer rates significantly higher than current optical storage devices.

Combining high storage densities, fast transfer rates, with durable, reliable, low cost media, make holography poised to become a compelling choice for next-generation storage and content distribution needs.

In addition, the flexibility of the technology allows for the development of a wide variety of holographic storage products that range from handheld devices for consumers to storage products for the enterprise. Imagine 2GB of data on a postage stamp, 20 GB on a credit card, or 200 GB on a disk.

How is data recorded?

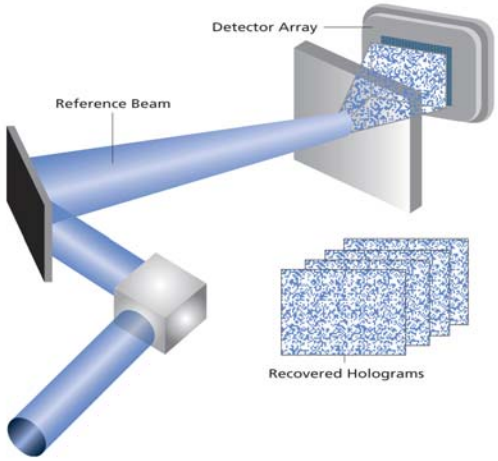


Light from a single laser beam is split into two beams, the signal beam (which carries the data) and the reference beam. The hologram is formed where these two beams intersect in the recording medium.

The process for encoding data onto the signal beam is accomplished by a device called a spatial light modulator (SLM). The SLM translates the electronic data of 0's and 1's into an optical "checkerboard" pattern of light and dark pixels. The data is arranged in an array or page of around a million bits. The exact number of bits is determined by the pixel count of the SLM.

At the point of intersection of the reference beam and the data carrying signal beam, the hologram is recorded in the light sensitive storage medium. A chemical reaction occurs in the medium when the bright elements of the signal beam intersect the reference beam, causing the hologram stored. By varying the reference beam angle, wavelength, or media position many different holograms can be recorded in the same volume of material.

How is data read?



In order to read the data, the reference beam deflects off the hologram thus reconstructing the stored information. This hologram is then projected onto a detector that reads the data in parallel. This parallel read out of data provides holography with its fast transfer rates.

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What about the storage media?

The major challenge to implementing holographic storage has been the development of a suitable storage medium. The scientists at Bell Labs worked on media and systems for seven years, and developed the solution that eluded other research teams. Inphase Technologies, a spin-off of Bell Labs is now taking it to market.

The *Tapestry* ™ storage medium satisfies the many stringent criteria for a viable storage material including high dynamic range, high photosensitivity, dimensional stability, optical clarity, manufacturability, nondestructive readout, thickness, and environmental and thermal stability.

In addition to developing a new class of materials, InPhase Technologies also developed the *ZeroWave* ™ manufacturing processes, which enables the cost effective fabrication of optically flat media. This makes the media price competitive for mass consumption.

How have the problems with holography been solved?

Problem: No suitable recording media existed.
Solutions: InPhase technologies invented *Tapestry* ™, a high performance, proprietary material with demonstrated high-density storage capabilities.

Inphase Technologies invented a flat media manufacturing process *ZeroWave* ™ that allows inexpensive substrates to be used in a process similar to the way DVD are created.

Problem: Recording methods were complex, difficult to implement and achieved limited densities.
Solution: Inphase Technologies invented new multiplexing recording methods that enable a simple, compact storage system.

Problem: The operational temperature range was limited.
Solution: InPhase developed a compensation scheme that allows a wide range of operating temperatures.

Problem: Lasers were costly and unreliable.
Solution: DVD recording technologies require the availability of high quality, price competitive lasers. InPhase Technologies is leveraging the availability of red and blue lasers used in other high volume products.

Problem: Detectors were costly and had poor performance.
Solution: CMOS active pixel sensor arrays used in digital cameras are of high quality and are readily available.

Problem: Spatial Light Modulators had slow frame rates and poor optical contrast.
Solution: Commercially available digital micromirrors, and ferroelectric modulators used in digital TVs and projectors satisfy the requirements.

What applications are good fits?

Holographic storage allows you to carry more information in the palm of your hand than computer professionals have on their servers.

Professional video applications are migrating to the digital world. Imagine being able to record, edit, distribute, and archive on the same medium.

The unique ability of storing data through out the depth of the media greatly reduces the threat of piracy. In addition, holographic watermarks can be used to check the authenticity of the media, making this technology extremely important for film and game distribution.

Your entire medical history on a credit card? Having unalterable data with long archival life is critical.

Security and surveillance is on everyone's mind. Whether it be transaction logging at an ATM, or face recognition systems in airports, the random access and data matching ability of holographic storage makes speedy recovery of archived information possible.