Highlights

Data Storage & Data Creation

Physical Storage Sales are Down

Both HDD and SSD Sales Have Declined Through 2022

Western Digital and Seagate have revealed that physical storage sales are down, and they have little confidence that the situation will improve anytime soon. WD CEO David Goeckeler has little faith that the company will achieve its sales revenue projections of $3.6-3.8B for the final quarter of 2022. Meanwhile Seagate has revised its revenue projections from $2.5B to $2.1B for the most recent quarter.

Data Storage Power Analysis

Metrics Can Guide Data Storage Oriented Public Policy

In every economic era in history, infrastructure has played a critical role. For a digital economy, data storage is the infrastructure. The amount of data produced every year, from regular people's pictures and videos to companies' crucial operations files, grows at an astonishing rate. Huawei GIV predicts that, by 2030, humanity will enter the YB data era. In order to have a competitive economy, capable data storage is a must.

As Data Creation Grows, Data Storage Growth Falters

Companies are Retaining Less and Less Data

Companies are saving less and less data each year. Only 2% of data created in 2020 was retained into 2021. But is this a good or a bad thing? There is plenty of data that does not need to be held onto, but there also is older data that holds unlocked value for corporations. Unfortunately, holding onto this older data can be expensive, especially when it is not used optimally, or at all. Thus corporations need to improve their data analysis initiatives and look for clear ROI opportunities in order to maximize profits.

Reimagining the Multi-cloud

Maximizing Data Value While Minimizing Friction

Over the last ten years, the total amount of global data has grown exponentially. THe distribution of this data geographically is not uniform however; data has a tendency to cluster around other data. Whether that clustering takes the form of data sources or data centers, there are economic advantages to connecting to large data sources and data centers, much like there are economic advantages for firms to locate near other firms in similar and/or complimentary industries (ex. Silicon Valley, the Detroit Auto Industry, Los Angeles Film Industry). Unfortunately, this *data gravity* leads to bottlenecks from endpoints to data centers, much like traffic jams in cities. Dave Mosley (CEO of Seagate) breaks down these problems and offers solutions moving forward. He offers the following five steps to curb data costs:

1. Use predictive third-party tools that help anticipate and measure the costs of cloud resources for every deployment decision—each time.
2. Evaluate deployment criteria (performance, availability data mobility, API, user network bandwidth, etc.) prior to deploying applications.
3. Monitor characteristics once applications are up and running.
4. For investment, prioritize tools in addition to training.
5. Automate security and protection.

The organizations that enact these practices reduced their cloud storage costs by 36%.

He suggests you make the multi-cloud your own and “transform it into a space where your data isn’t locked in and siloed to the point that you lose control over its security, resiliency and value.”

Storage Technologies- Hard Drives, Cloud Storage, SSDs, and… DNA

Storage technology has evolved from CDs and floppy disks to hard drives, cloud storage, and solid-state drives. The amount of data being produced is well outpacing storage capacity. Right now, at least 2.5 quintillion bytes of data is added each day. Another technology exists for data storage, with extraordinary capacity- DNA data storage. DNA has been used as a storage medium for at least a decade.

DNA data is encoded into DNA nucleotide bases (A, C, G, T) and stored. These strands are then converted to binary digits when needed. DNA storage comprises three processes: coding the data, synthesizing and storing it, and decoding it. The DNA carrying information can be frozen in solution, stored as droplets, or stored on silicon chips.

Researchers say that all the data in the world right now can fit into a shoebox using DNA data storage. One cubic inch of dried DNA could contain 11.2 exabytes of data, nearly 2 billion times the capacity of a 5.7 gigabyte DVD, and enough room to store the contents of multiple enterprise data centers packed with hard drives. We will generate 33 zettabytes of data by 2025—that's 3.3 followed by 22 zeroes. DNA storage can fit that into a ping-pong ball, with room to spare.

Advantages of DNA Data Storage:

- Capacity- The main advantage of DNA storage over other storage mediums is storage density. Data stored remotely on the cloud of NAS is still stored in big servers and datacenters which can be as large as football stadiums and cost billions of dollars to build and maintain. DNA data storage stores massive amounts of data in a very compact space. One gram of DNA can store 215 petabytes of data. A petabyte is 1,024 terabytes. So, one gram of DNA can store approximately 220,160 terabytes. A one-terabyte hard disk drive weighs approximately 400 grams. So, to store the equivalent amount of data one gram of DNA keeps, you need more than 88 million grams of hard drives.

- Durability- The digital storage equipment available have today is far from durable. They are all prone to decay and degradation. Digital decay is the gradual decomposition of data stored on a computer, affecting millions of people every year. DNA has a half-life of 521 years. When stored in an optimum environment, data stored in DNA can be available for hundreds of years. DNA encapsulated with a salt remains stable for decades at room temperature and should last much longer in a datacenter.
- Replicability- Because of the degradation of data, data in data centers have to be copied and transferred onto other hardware after periods of time to preserve the information stored. Data stored in DNA can easily be replicated. One method scientists have tested is to insert the DNA with stored information into a bacterium. This bacterium then reproduces bacteria with the same information stored in the first DNA without any errors or loss.
- DNA can be used to store data without the use of electricity. Energy costs are among the highest overheads for most data centers today.

> "One of the great properties of DNA is that you don't need any energy to store it. You keep it cold, dry and dark, and it lasts for a very long time. We know that because we routinely sequence woolly mammoth DNA that is kept by chance in those sorts of conditions," said Cambridge scientist Ewan Birney.

Disadvantages:

- Cost, cost, cost- The techniques and machinery currently required to take a digital photograph and turn it into a DNA strand is several times more expensive than comparable, completely digital technologies. The GAO estimates the current price tag of writing and reading DNA-based data at $3,500 per megabyte, which is “millions of times more than silicon-based storage.”
- Some of these challenges are social. Some people worry about using a biological molecule, and indeed the molecule that makes us who we are, to store Facebook messages.
- Technical challenges that relate to the unique ways in which data is written to DNA strands. if even small errors creep into the transcription of data onto a DNA helix, this can easily make the whole data set unreadable.
- Data stored in DNA has to be decoded into binary, which is very time-consuming.

DNA data storage is in use today by companies who want to preserve extensive archives of information that do not need to be accessed regularly such as movies that must be preserved for decades. Those archival backup copies represent a substantial share of the storage market.

To Be Or Not To Be…

In a Stable, Recoverable Format 10 Millennia From Now?

Like most good ideas, almost a decade ago, over beer in a pub in Hamburg, two Cambridge scientists brainstormed alternatives to using expensive hard disks and magnetic tapes for data storage. Their solution, scrawled on some napkins, was to use DNA. And, for this experiment, they selected the entire collection of Shakespeare's 154 sonnets, a portion of audio of Martin Luther King, Jr's "I have a dream" speech, and the research paper that first described the double helical nature of DNA written by Francis Crick and James Watson. Written in DNA, one of Shakespeare's sonnets weighs 0.3 millionths of a millionth of a gram. One gram of DNA could hold as much information as more than a million CDs.

Nick Goldman and Ewan Birney knew that DNA was an incredibly efficient and compact way to store information, and set about devising a way to turn the molecules into digital memory: capable of encoding the 1s and 0s used to store words, images, music and video on computers. "We wrote on napkins and sketched out details, and realized we could probably do this," said Goldman. The scientists developed a code that used the four molecular letters or "bases" of genetic material – known as G, T, C and A – to store information.

Digital files store data as strings of 1s and 0s. The Cambridge team's code turns every block of eight numbers in a digital code into five letters of DNA. For example, the eight-digit binary code for the letter "T" becomes TAGAT. To store words, the scientists simply run the strands of five DNA letters together. So the first word in "Thou art more lovely and more temperate" from Shakespeare's sonnet 18, becomes TAGATGTGTACAGACTACGC.

To test the procedure, they emailed the DNA code to Agilent Technologies, a biotech company. The company waived the cost of DNA synthesis and returned tiny test tubes with specks of DNA that encoded all the information. At first, the researchers thought the test tubes were empty. To make sure the DNA stored the information correctly, they sequenced the DNA and ran their cipher backward. All the files were 100 percent intact and accurate. DNA has several advantages: It's very dense; it's three-dimensional rather than two-dimensional (like a hard disk); and it's incredibly stable. Birney and Goldman successfully stored two thousand million bytes of data in a single gram of DNA, and say that data should still be able to be accessed 10 millennia from now.

DNA Data Storage Alliance

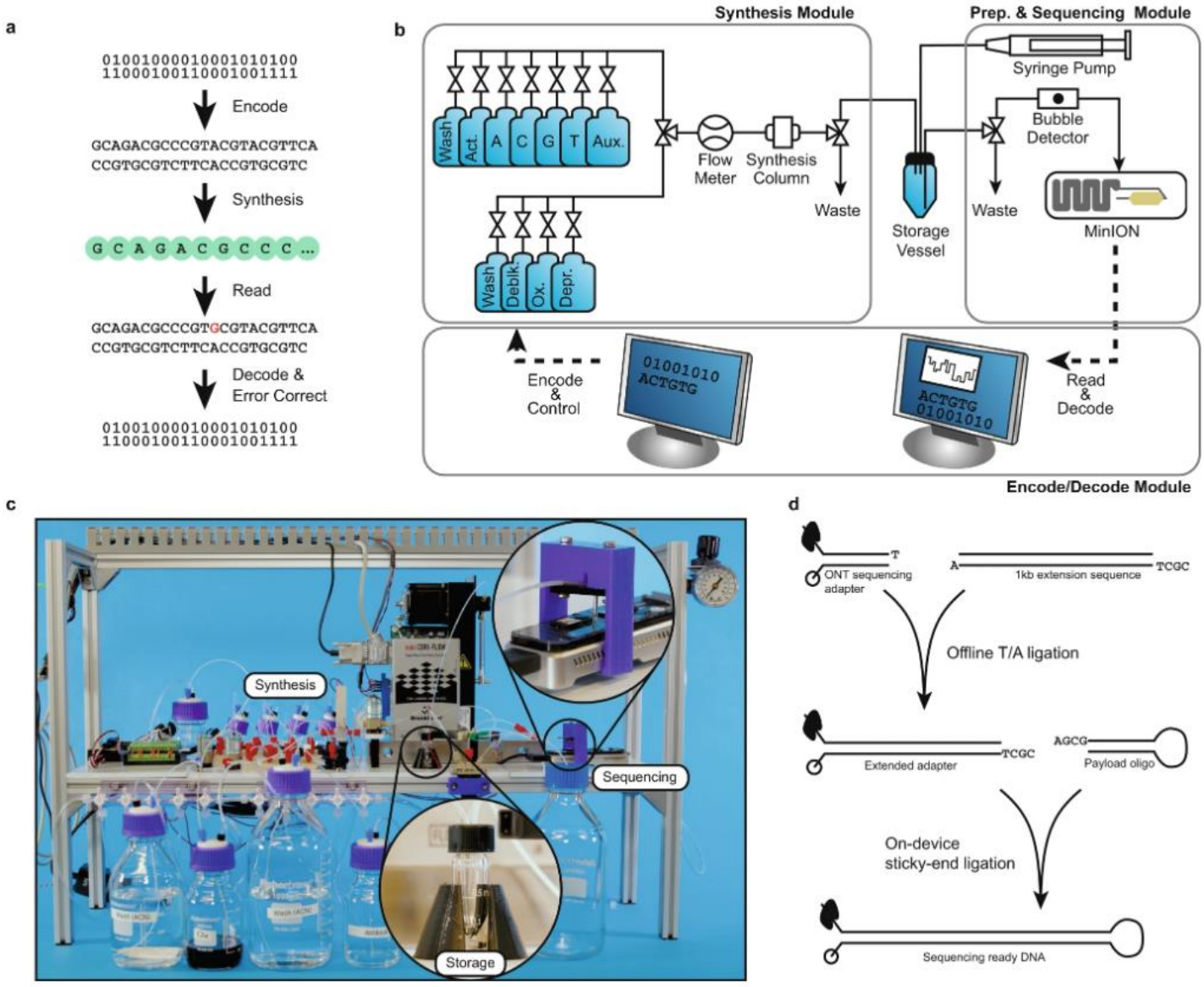
DNA Data Storage Alliance, formed in 2020 by Illumina, Inc., Microsoft, Twist Bioscience Corporation, and Western Digital to create and promote an interoperable storage ecosystem based on DNA as a data storage medium now has 50 members. The Alliance includes 11 public companies, 14 private companies, 2 consultancies, 2 venture capital firms, 17 universities, 5 research non-profits and 1 foundation. The 2021 SNIA Storage Developer Conference featured An Introduction to DNA Data Storage, an Alliance whitepaper.

Members of the Alliance include: 21e8; Ansa Biotechnologies, AOE I, LLC; Battelle; Bioecho Life Sciences; Biomemory; Boise State University; Cache DNA, CATALOG, Center for Applied NanoBioscience & Medicine at the University of Arizona; Centrillion Technologies; Cinémathèque Suisse; Claude Nobs Foundation (Montreux Jazz Digital Project); Dell Technologies; Digital Preservation Coalition; DNAli Data Technologies; DNA Script; Eindhoven University of Technology, EPFL (École Polytechnique Fédérale de Lausanne) – Cultural Heritage & Innovation Center (Montreux Jazz Digital Project); ETH Zurich - The Swiss Federal Institute of Technology in Zurich, Switzerland; EureKARE; Fitzpatrick Institute for Photonics at Duke University; FUJIFILM Recording Media U.S.A., Inc., George Church Lab at Harvard University; Gupta Lab at Dhirubhai Ambani Institute of Information and Communication Technology (DA-IICT); Hyperion Research; I3S laboratory - Université Côte d'Azur and French National Centre for Scientific Research (CNRS); Illumina, Inc.; Imagene; Imec; Iridia; KIOXIA Lab for Intelligent Storage and Computing at Oklahoma State University; Los Alamos National Laboratory; Microsoft; MilliporeSigma; Molecular Assemblies; Molecular Information Systems Lab at the University of Washington; OligoArchive at Imperial College; PFU America, Inc., a Fujitsu company; Reichman University and Technion, Yakhini Group; Quantitative Scientific Solutions (QS-2); Quantum; Seagate Technology; Spectra Logic; Semiconductor Research Corporation (SRC); Stanford Compression Forum; Technical University of Munich (TUM); Technion - Israel Institute of Technology; Twist Bioscience; University of Marburg; Western Digital Corporation

Over [350 grants worth $517M] have been awarded to support research on DNA data storage during the period, 2016- 2021. Of these, 33% of the grants were awarded to support the research related to projects on DNA data storage, were / are being managed by NCI, followed by those managed by NIA (11%), NINDS (9%) and NIDDK (6%).

Over 900 patents have been filed / granted related to DNA data storage, since 2001

More than 50% of these patents were filed / granted in North America, followed by Europe (39%). Patents related to DNA data storage were also filed by academic institutes, such as Massachusetts Institute of Technology, Harvard University and University of Arkansas. [Roots Analysis] [DNA Data Storage Market, 2021-2035 report] provides an analysis of the market, market trends, and global forecasts.



Upcoming Conferences

October 5-6	Evolve, Vegas
October 5-6	Cyber Security and Cloud Expo, Atlanta, GA
October 5-6	Digital Transformation Expo, USA, Santa Clara, CA
October 6-7	Big Data & AI Toronto
October 7-10	Gartner IT Symposium/Xpo EMEA, Barcelona
October 10-12	ISC Security Congress, Las Vegas
October 11-12	Edge Computing World, Santa Clara, CA
October 11-13	Google Cloud Next, Virtual
October 12-14	Microsoft Ignite, Virtual
October 17-19	Authenticate 2022, Seattle
October 17-20	NAB Show New York, NYC
October 17-20	Gartner IT Symposium/Xpo, Orlando
October 17-20	Oracle OpenWorld/JaveOne, Las Vegas
October 18-20	OCP Summit, San Jose, CA
October 19-20	NAB Show New York 2022, NYC
October 24-27	ICS Cybersecurity Conference, Hybrid/Virtual
October 31-Nov 1	CompTIA EMEA Member/Partner, London
October 31-Nov 2	Gartner IT Symposium/Xpo Japan, Tokyo
November 1-3	NetApp INSIGHT 2022, Virtual
November 7-9	Acronis #Cyberfit Summit 2022, Miami, FL
November 7-10	VMWare Explore Europe, Barcelona
November 9-11	IT Nation Connect, Orlando, FL

November 13-18	SC22, Dallas
November 14-16	Gartner IT Symposium/Xpo India, Kochi, India
November 14-17	Titanium Converge, Austin, TX & Virtual
November 15-17	Black Hat Middle East & Africa 2022, Saudi Arabia
November 15-17	ISC East, NYC
November 16	San Diego Cybersecurity Conference, Hybrid
November 16	Threat Hunting Summit, Virtual
November 18-19	Data Strategy & Insights (Forrester Research), Virtual
November 21-22	Gartner IT Infrastructure, Operations, & Cloud, London
November 28-Dec 2	AWS re:Invent, Las Vegas
December 1-2	Digital Transformation Expo Global, London
December 5-6	Healthcare Cybersecurity Forum, Boston, MA
December 5-8	Black Hat Europe 2022, London
December 6	Security Operations Summit, Virtual
December 6-8	Gartner IT Infrastructure, Operations & Cloud, Las Vegas
December 6-9	Cisco Live, Melbourne, Australia
December 10-14	Edge 2022: International Conf on Edge Computing, Hawaii
December 10-14	Cloud 2022: International Conf Cloud Computing, Hawaii
December 12-15	Palo Alto Networks Ignite, Las Vegas
2023	
January 5-8	CES, Las Vegas & Virtual
January 18	SNIA Persistent Memory Summit, San Jose, CA
January 30-Feb 1	Cybertech Global TLV, Tel Aviv, Israel
February 6-10	Cisco Live, Amsterdam, Netherlands
February 13-14	Gartner Security & Risk Management, Mumbai, India
February 14-16	ESNA Expo, Long Beach, CA
February 14-17	ITExpo East, Fort Lauderdale, FL
February 27-28	Gartner Security & Risk Management Summit, Dubai
February 27-March 2	Mobile World Congress Barcelona
February 28-March 2	Rice University Energy HPCC Conference, Houston, TX
March 8-9	CloudExpo Europe, London
March 14-16	Gulf Information Security Expo, Dubai, UAE
March 20-22	Gartner Data & Analytics Summit, Grapevine, TX
March 20-23	GTC CPU Technology Conference, San Jose, CA

March 28-29	Gartner Security & Risk Management, Sydney, Australia
March 28-31	ISC West, Las Vegas
April 5-7	IST Information Security Expo, Tokyo, Japan
April 15-19	NABShow, Las Vegas
April 17-21	HIMMS Global Health Conference, Chicago, IL
April 19-20	CyberSec Europe, Brussels, Belgium
April 24-27	RSA Conference, San Francisco
May 22-25	Dell World, Las Vegas
June 2-6	School Transportation Network Expo East, Indianapolis, IN
June 4-8	Cisco Live, Las Vegas
June 5-7	Gartner Security & Risk Managemnt, National Harbor, MD
June 7-9	Synnex Red, White and You, Greenville, SC
June 14-16	Interop Tokyo, Chiba, Japan
June 20-22	HPE Discover, Las Vegas
June 20-22	Info Security Europe, London
July 14-19	School Transportation Network Expo, Reno, NV
August 1-3	Flash Memory Summit, Santa Clara, CA
August 5-10	Black Hat USA, Las Vegas
August 30-Sept 1	Security Expo, Sydney, Australia
September 11-13	Gartner Security & Risk Management, London
September 11-13	Global Security Exchange, Dallas, TX
September 18-20	Crowdstrike fal.con, Las Vegas
October 2-4	DattoCon, Miami, FL
October 3-4	CyberTech Europe, Rome