Compos CZ 2023

Hard Disk Drives (1984 to 2062)

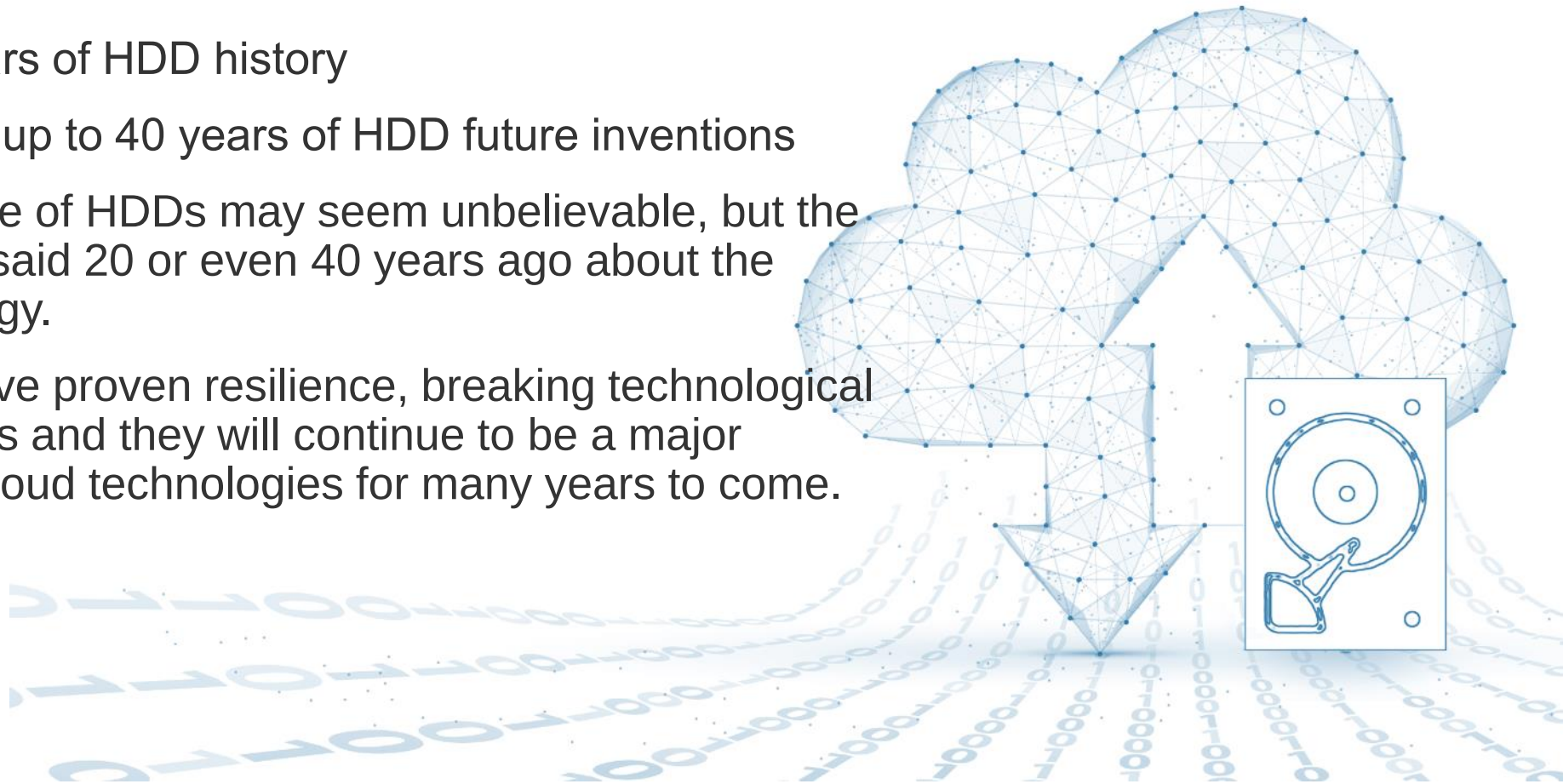
TOSHIBA

Toshiba Electronics Europe GmbH

4Q2023

Abstract

- The recent release of the Toshiba MG10 20TB Hard Drive has been a milestone within the HDD technology evolution, so we are taking this opportunity to
    - look back at 40 years of HDD history
    - dare to extrapolate up to 40 years of HDD future inventions
- This outlook for the future of HDDs may seem unbelievable, but the same would have been said 20 or even 40 years ago about the current state of technology.
- Ultimately, our HDDs have proven resilience, breaking technological boundaries over decades and they will continue to be a major contributor to resilient cloud technologies for many years to come.



2022 – 20 Terra Byte = 2.000.000.000.000 Byte

20 Million Songs/Pictures

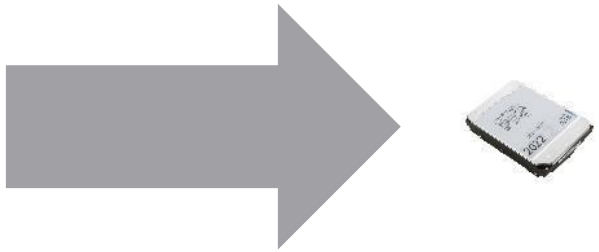
2002 – 20 Giga Byte = 2.000.000.000 Byte

20 Thousand Songs/Pictures

1984 – 20 Mega Byte = 2.000.000 Byte

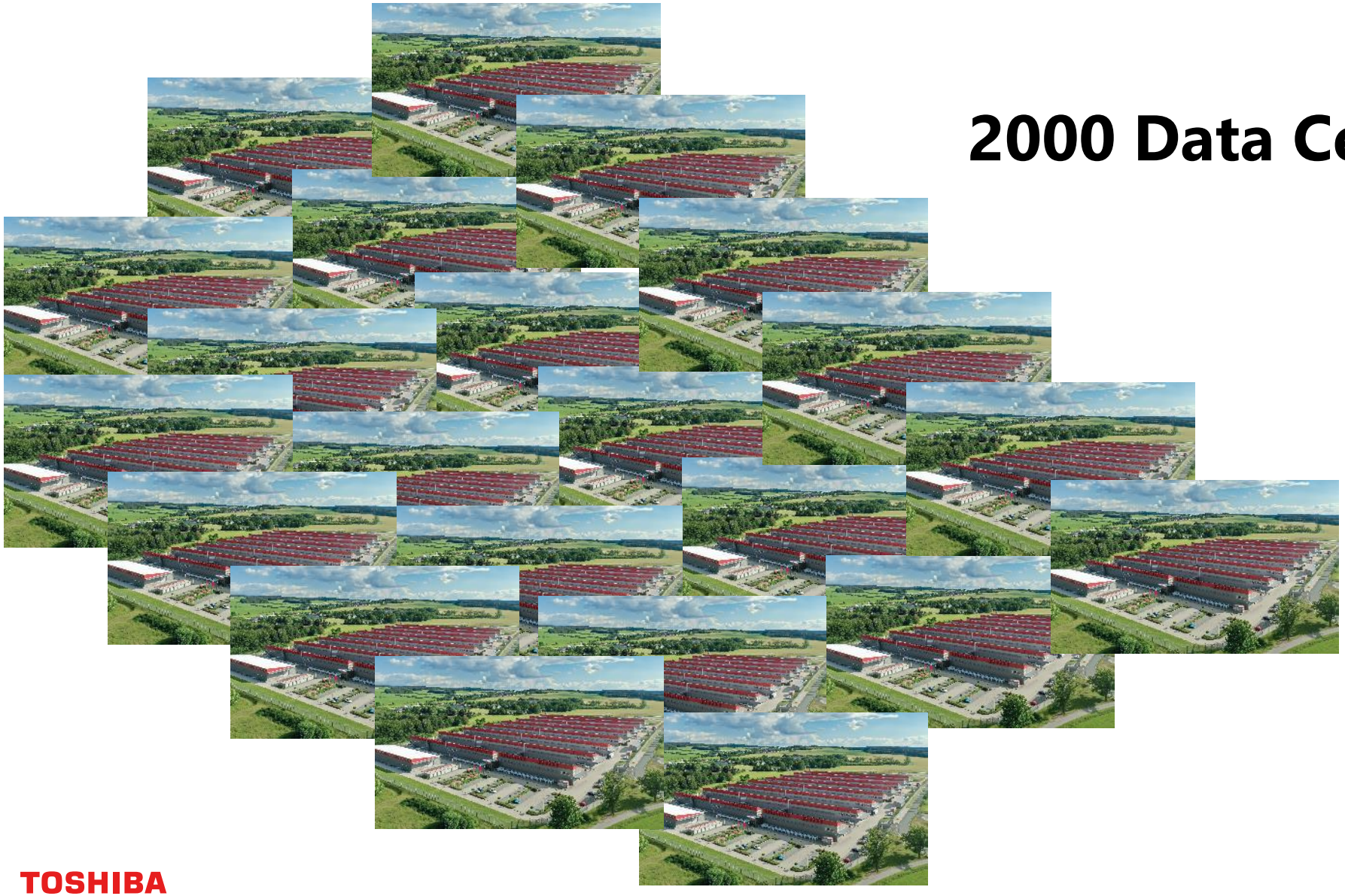
20 Songs/Pictures

2042 – 20 Peta Byte = 2.000.000.000.000.000 Byte

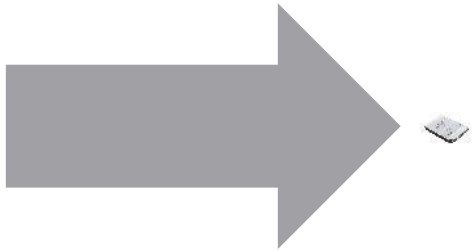


2062 – 20 Exa Byte = 2.000.000.000.000.000.000 Byte

2092 – 20 Zetta Byte = 2.000.000.000.000.000.000.000.000 Byte



2000 Data Center Halls



1984–20MB 2002-20GB 2022-20TB 2042-20PB 2062-20EB

Alternative Approaches for Data Storage in Experimental Stage

- **Quartz crystal**

  Encoding by laser on nanostructured material

  Extremely robust

  Quartz of size of a coin can hold 360 TB of data
  (source: https://en.wikipedia.org/wiki/5D_optical_data_storage)

  → 20PB = 60 coins

  Data readable even with a usual microscope

© Adobe Stock

Cold Storage only !!

- **DNA**

  4 molecules: Adenine (A), Guanine (G), Cytosine (C), Thymine (T)

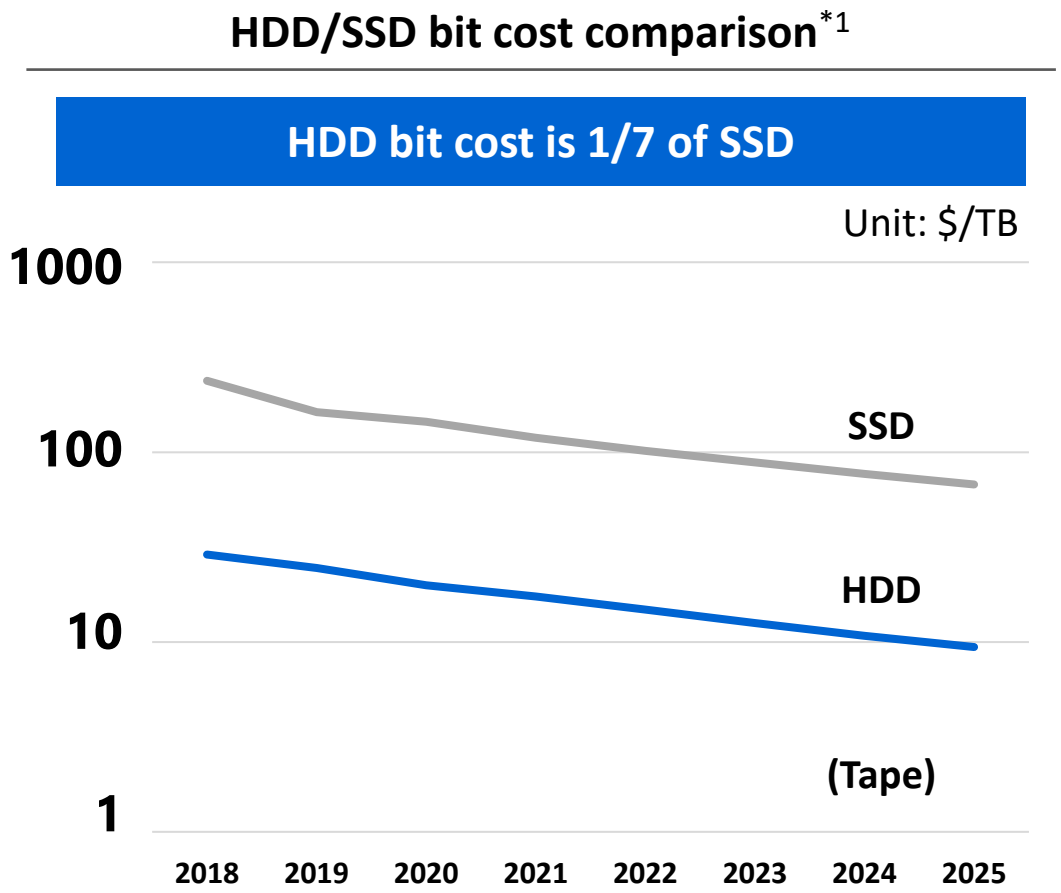
  Binary code translated into code of DNA base pairs: A-T and C-G (corresponding to „0“ and „1“)

  Stable, durable, cheap, always readable in the future

  Giant storage capacity: >200 Petabyte per 1g of synthetic DNA (source: https://en.wikipedia.org/wiki/DNA_digital_data_storage)

  → 20EB = 100g of DNA

HDD vs. Solid State Memory based Storage Components



*1 Source：Techno System Research Co., Ltd. HDD/SSD Market Trend(Annual) Dec. 2021

Manufacturing Capacity 2022:

- Total Enterprise-HDD Capacity shipped
- **1021 Exabytes** (Mio TB) in 88 Mio Units
-
- Total Enterprise-SSD Capacity shipped:
- **175 Exabytes** in 66 Mio Units

85% HDD

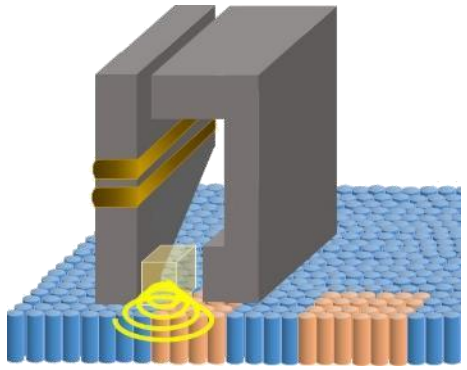
- Total (Enterprise and Client)
  - HDD: **1227 EB** in 172 Mio Units
  - SSD: **386 EB** in 449 Mio Units

76% HDD

Source: TEE research & TEE estimates, Gartner 4Q22 Update

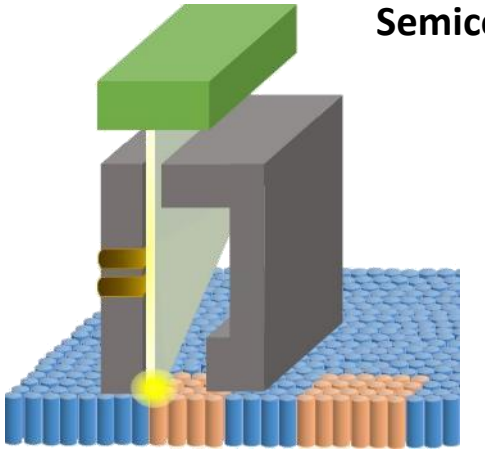
Actual Technologies for Capacity Increase (This Decade)

MAMR
Microwave Assisted Magnetic Recording



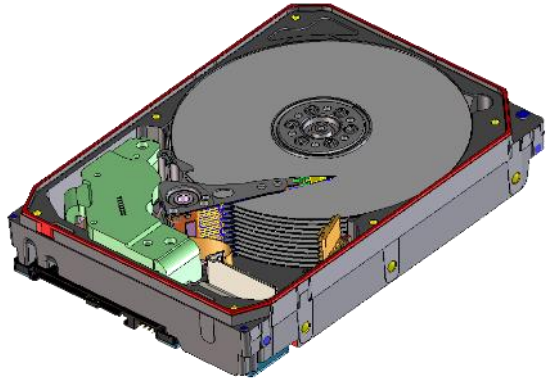
- FC-MAMR™: Massproduction
- MAS-MAMR: 30TB Prototype in 2024, Massproduction in 2025

HAMR
Heat Assisted Magnetic Recording



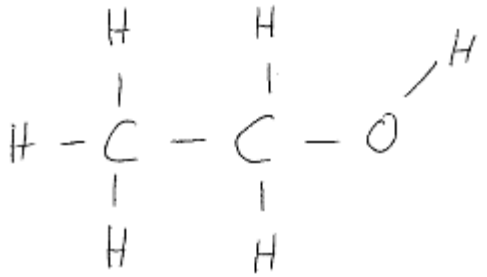
- R&D is ongoing
- Prototype in 2025

Multi stacking technology



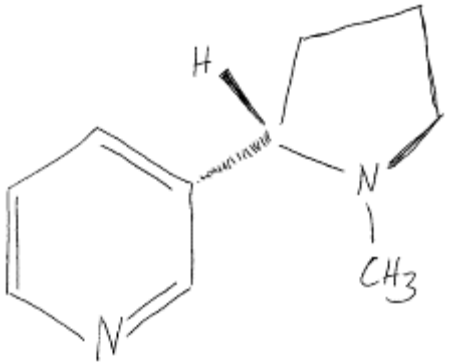
- 10-disk: Massproduction (MG10)
- 11-disk Drive under Development

TOSHIBA

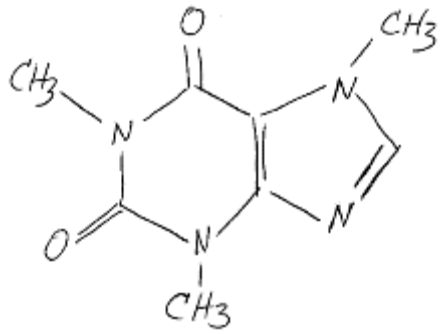


(ethanol)

Thank you. **(Coffee Break)**



(nicotine)



(caffeine)

Legal Disclaimer

The information contained herein is subject to change without notice. The information contained herein is presented only as a guide for the applications and products. No responsibility is assumed by Toshiba for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise und any patent or patent rights of Toshiba or others. Toshiba is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It's the responsibility of the buyer, when utilizing Toshiba products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such Toshiba products could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that Toshiba products are used within specified operating ranges as set forth in the most recent Toshiba product specifications. Also, please keep in mind the precautions and conditions set forth in the „Handling guide for Semiconductor devices", or the „Toshiba Semiconductor Reliability Handbook", etc.. The Toshiba products listed in this document are intended for usage in general electronic applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances etc.). These Toshiba products are neither intended nor warranted for usage in equipment that requires extraordinary high quality and/or reliability or a malfunction or failure of which my cause loss of human life or bodily injury („Unintended usage"). Unintended usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices etc... Unintended Usage of Toshiba products listed in this document shall be made at the customer's own risk. The products described in this document may include products subject to the foreign exchange and foreign trade laws. Toshiba does not take any responsibility for incidental damage (including loss of business profit, business interruption, loss of business information, and other pecuniary damage) arising out of the use or disability to use the product.