Viability of DNA for Archival Storage

Devin Leake
VP of R&D

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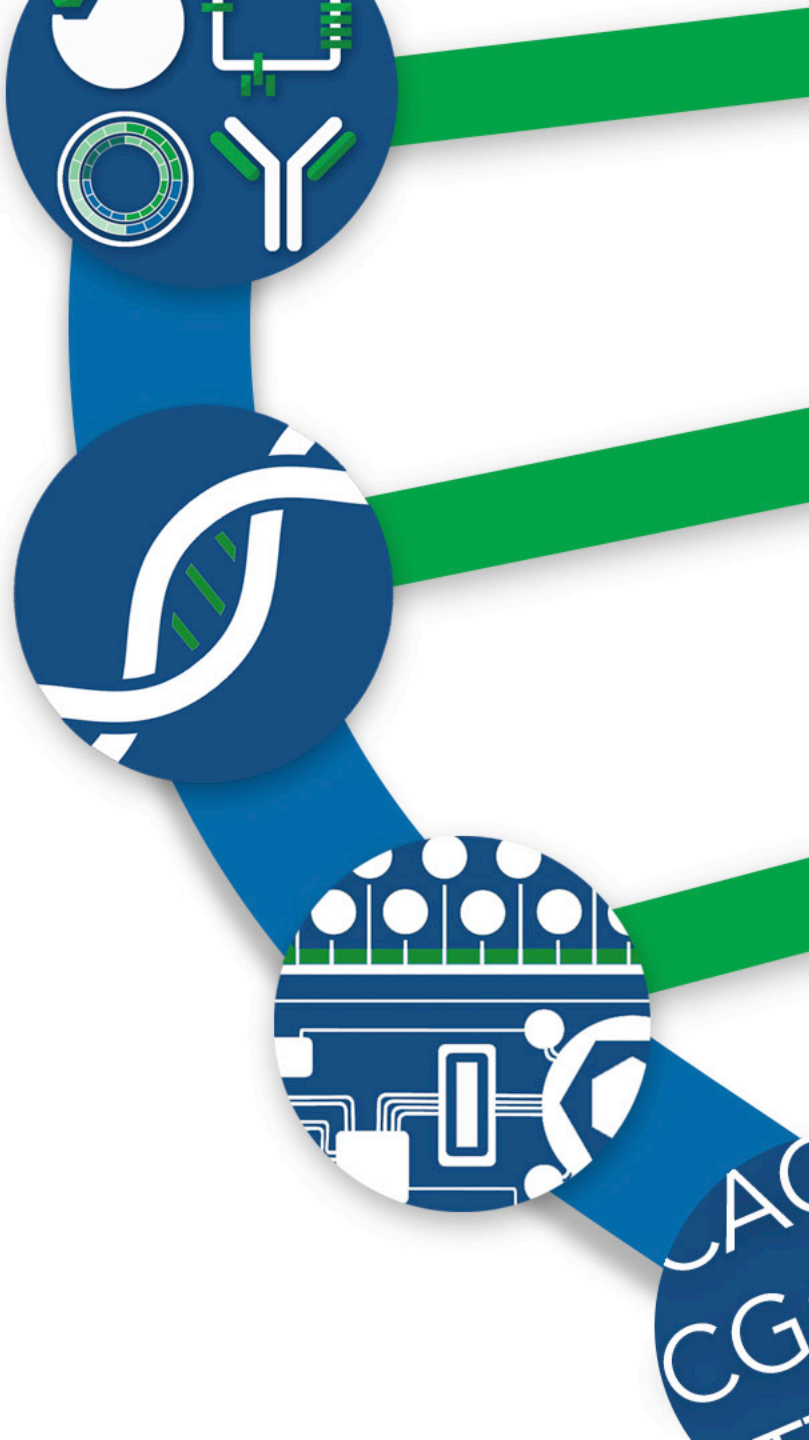
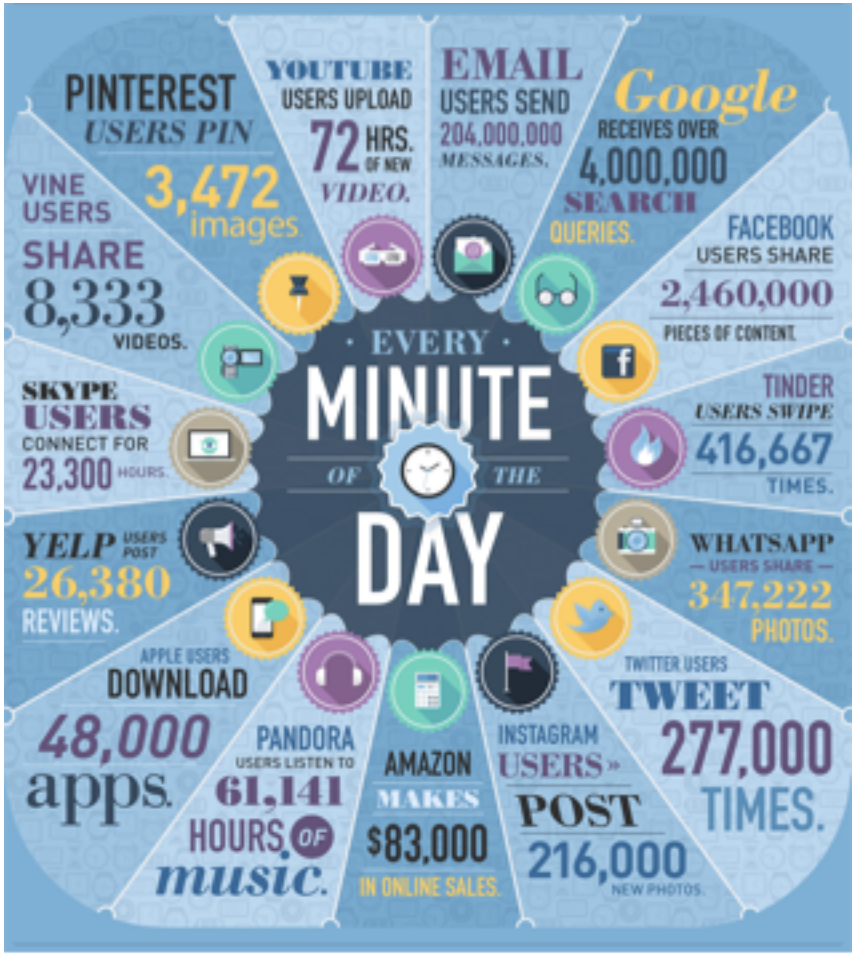


There is a growing need for storage



Content created by DOMO, "Data Never Sleeps"

- According to the IDC (International Data Corporation)
  - 1.8 zettabytes was generated in 2011
  - By 2020, 40 zettabytes will be generate (or 40 Trillion GB)

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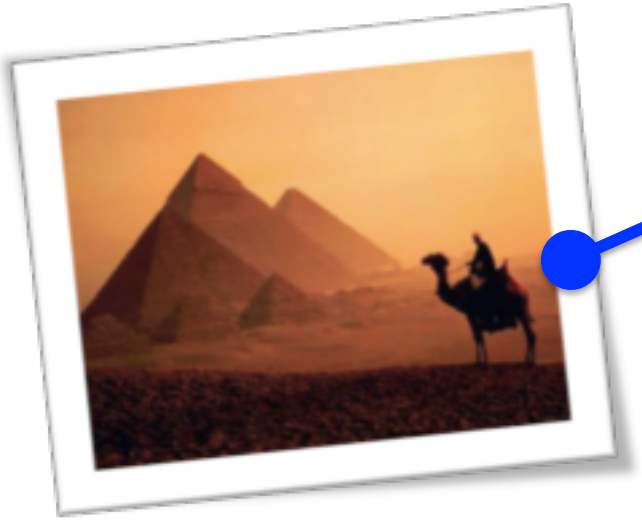
Types of storage based on needs

Active Data

Backup Data

Archival Data



High storage durability

Low total cost of ownership

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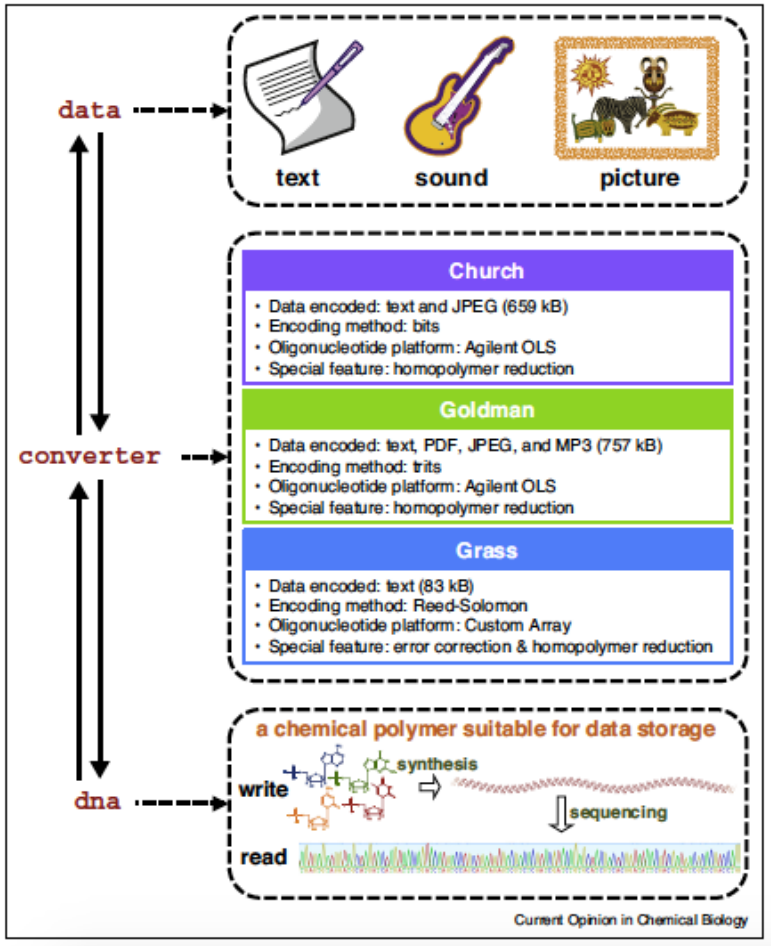
DNA as a medium for archival storage



- Viability of Reed-Solomon error-correcting codes adapted to DNA
- Limited demonstration of storage capacity (less than 1 MB)
- Utility of multiple media formats (ASCI, JPEG, PDF, MP3)

Zakeri and Lu Current Opinion in Chemical Biology 2015

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High storage durability

- Hardware can fail but storage capability cannot
- Data must be protected from modification and distributed such that data loss is minimized
- DNA has been recovered and analyzed from:
  - Wooly mammoth (20,000 years ago)
  - Neanderthal (40,000 years ago)
  - Bison (60,000 years ago)
  - Pollen samples (~500,000 years ago)

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Low total cost of ownership

- Current convention (Grass et.al. Angew. Chem. Ins. Ed. 2015) indicates 10 billion base pairs are need for each 1 GB
- Estimates suggest that a 1.5mL tube filled with DNA could hold approximately a petabyte of data (Goldman et.al. Nature 2013)

➢ Currently, **cost** of DNA writing is **too high** and synthesis **capacity** is **insufficient**

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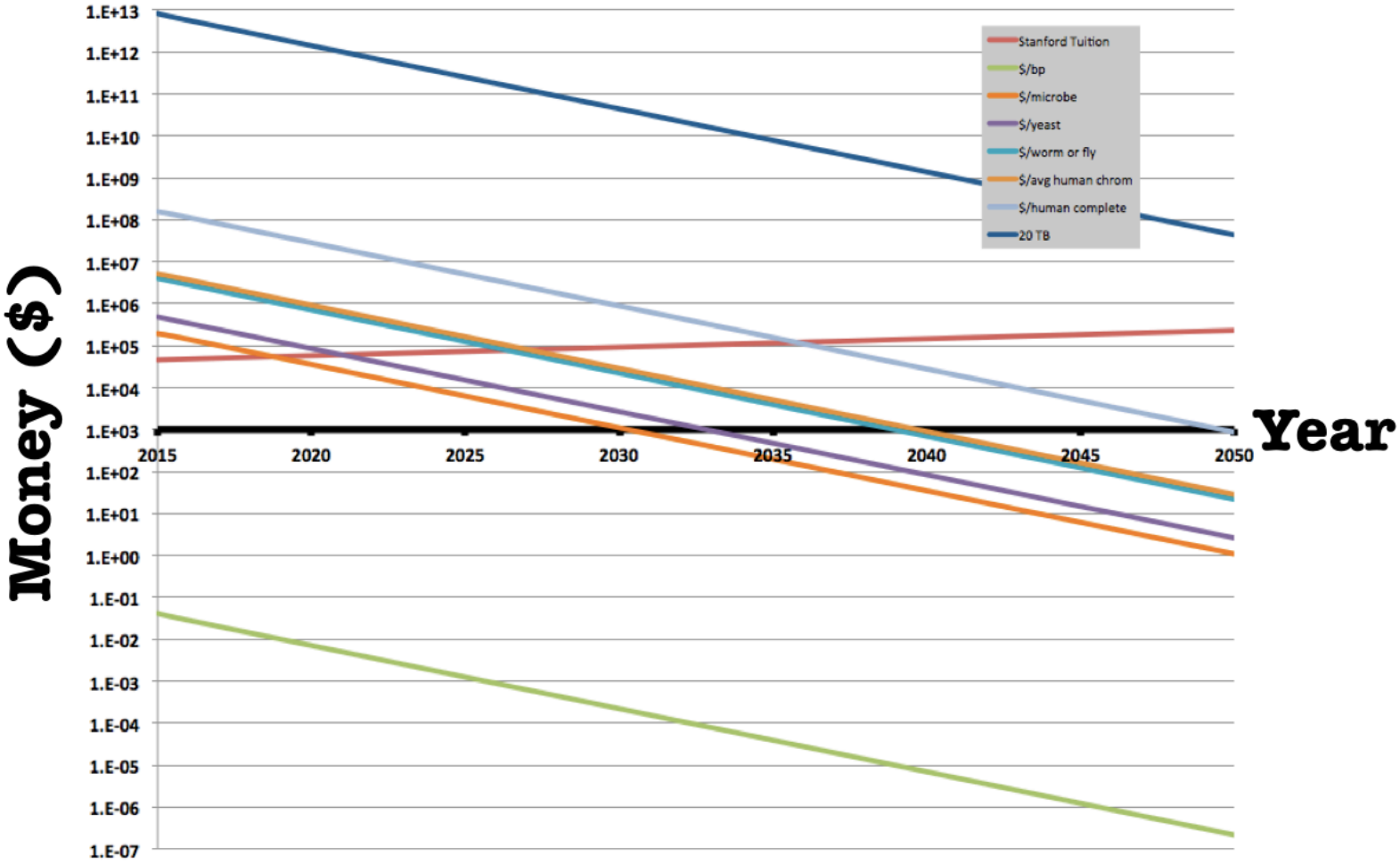
DNA synthesis cost and scale



Courtesy of Drew Endy, Gen9/Stanford 2015

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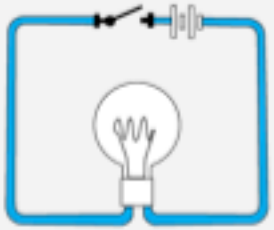
Massive divergence in capacity

Building a scalable BioFab® platform

Joe Jacobson
MIT

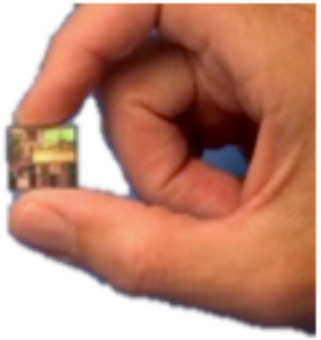
Drew Endy
Stanford

George Church
Harvard



Simple Circuit

Complex Circuit



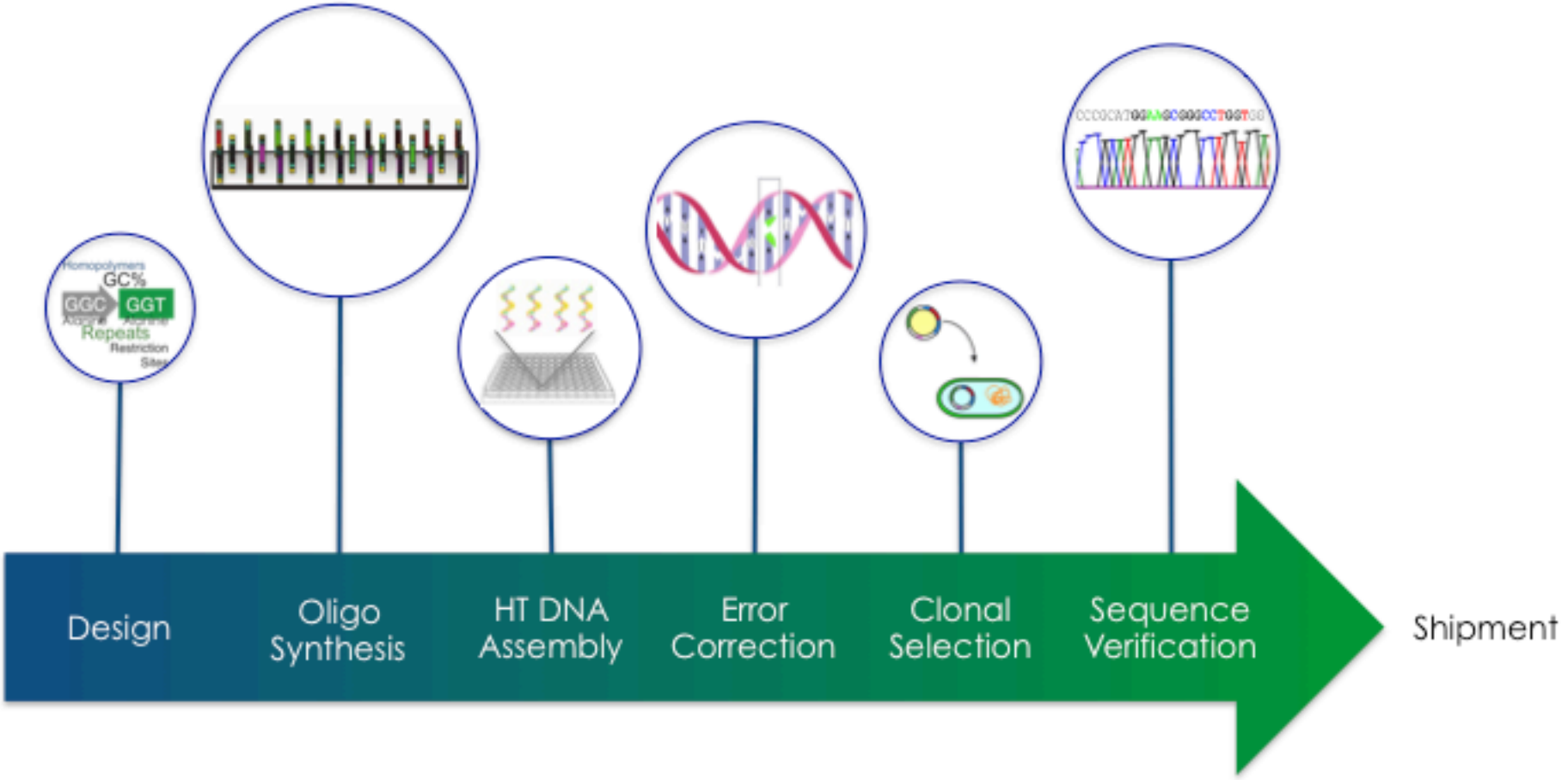
Integrated Circuit

Oligo Synthesis

Gene Synthesis

Gen9 BioFab® Chip

Gen9's BioFab® Platform



Thank You