

# Molecular **S**torage **S**ystem

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Store data in DNA



Helixworks

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# About MoSS

**MoSS**, short for Molecular Storage System is an open architecture to store digital information in DNA (Deoxyribonucleic acid). DNA is ubiquitous to life and all most all living organisms contain this molecule and has thought to exist on earth for more than 3.5 billion years.

DNA is known for its robust and resilient nature and its efficiency in carrying genetic information from generation to generation. MoSS takes advantage of these exemplary chemical properties of DNA and use it for storing digital data.

Synthesising long fragments of DNA has been an expensive endeavour and one of the primary issuing in adopting DNA as a main stream data storage medium. **MoSS is extremely cost efficient** compared to previous researches and brings down the **cost of DNA to \$0.005/byte**.

MoSS is compatible with existing robotic pipette handling platforms and the process of synthesising MoSS fragments is **end-to-end automated**. The user can embed any binary information in DNA with zero hands-on time.

Using MoSS platforms, digital data can be archived in DNA at enterprise level. **MoSS is an extremely dense medium** with **areal data density of 2.5 Petabytes/mm<sup>2</sup>**, which leads all other data storage media by an incredible margin.

Integration of cost effectiveness along with ready to deploy automation strategy, MoSS is the beginning of a **new epoch in data storage technologies**.

Helixworks Technologies (<https://helix.works>) is the **developer of MoSS**, and is in a continuous pursuit to democratise DNA.

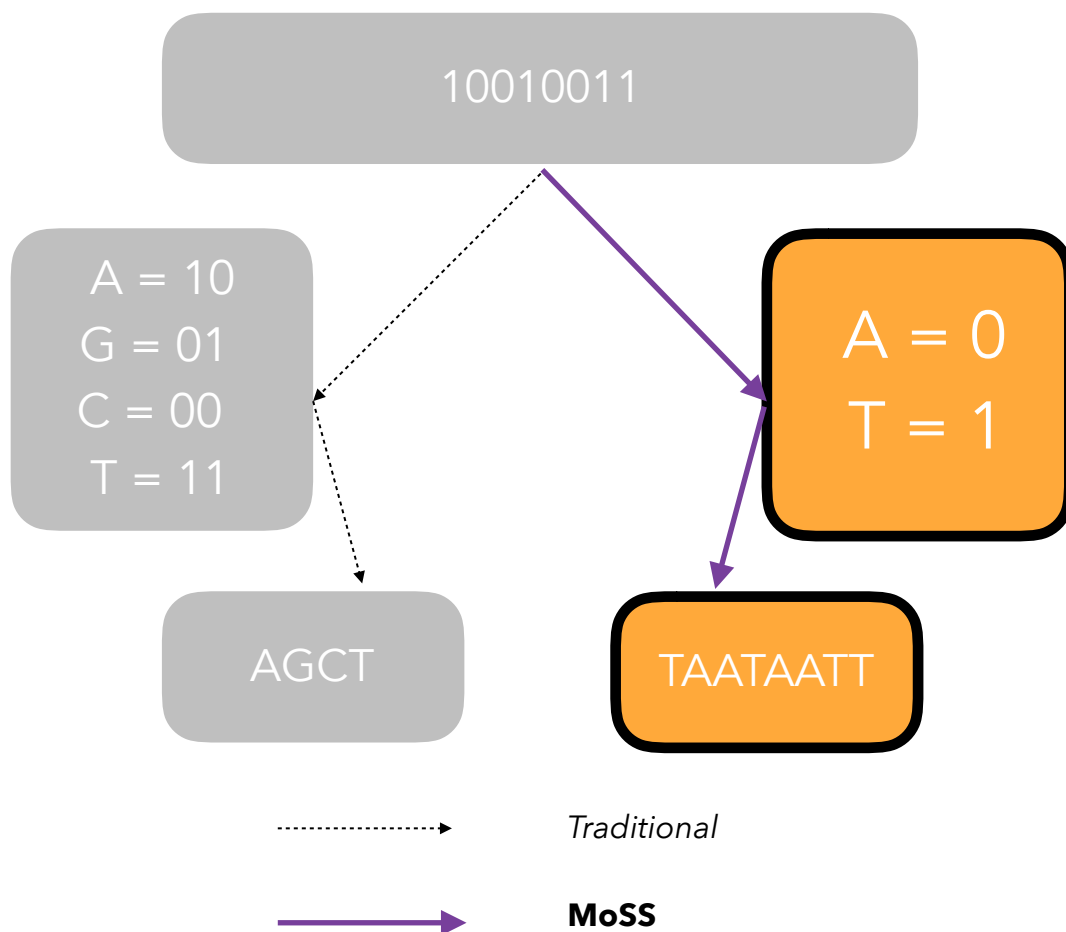
**MoSS is Open Source.**

## Tech Insight

Storing information in DNA was a research endeavour since several decades and most of the conducted previous research has focussed on **utilising the 4 bases in DNA** - Adenine, Guanine, Cytosine and Thymine (**A, G, C and T**) to be **used as a base-4 numeral system** and **compress** as much as data possible into it by algorithms.

**MoSS** shatters this approach by using **only 2 bases in DNA for data storage** (A and T for data), **the other 2 bases are used for extension and stabilising DNA** (G and C for stability).

A visualisation of traditional approach versus MoSS for representing a binary number



**MoSS is relaxed on compression and is true-to-binary format.** The strategy of using only two bases (A and T for data storage) brings down the number of combinations to a base-2 system. This leads to a smaller number of overall possible combinations and operational blocks.

**Guanine and Cytosine rich regions** would exist at the **terminals of MoSS blocks** that aid in maintaining stability and help in extension of MoSS fragments. Please refer tech documentation for a deeper insight on the MoSS technology.

## MoSS (DNA) vs Competition

A tabular comparison between MoSS versus traditional data archival medium is shown below. **MoSS is the worlds first DNA data archival platform** developed by Helixworks Technologies to bring DNA as a front runner in data archival medium at an enterprise level.

Criterion	MoSS	Magnetic tapes
Write speed	1 bit/s	100 Megabytes/s
Read speed	100 bits/s	250 Megabytes/s
Write cost	0.5 ¢/byte	1 ¢/Gigabyte
Read cost	1 ¢/10 Kilobyte	(Read and write included)
Cost per Gigabyte	\$ 500,000	1 ¢
Copies per run	100 billion (PCR)	1
Cost per copy	0.0005 ¢	1 ¢
Replication cost (100 billion copies)	\$ 100 (PCR)	-does not compute-
Areal density	2.5 Petabits/mm <sup>2</sup>	0.1 Gigabits/mm <sup>2</sup>
Maintenance volume	1 cm <sup>3</sup> /Zettabyte	1 cm <sup>3</sup> /100 Megabyte
Maintenance requirement	Minuscule metallic shielding and cold storage	EM shielding (Unavoidable random bit decay)

As emphasised in the above table, the **read and write speeds are relatively extremely slow** with regards to MoSS which would likely improve with time. **MoSS shines in being extremely robust and being easily replicable with low cost.** The maintenance cost of MoSS is extremely low as it would require refrigeration and shielding in the range of cubic millimetres.

MoSS would also **bring down the sequencing cost** as it uses a binary approach for data storage and sequencing of **only the bit-bases (A and T)** would reveal all the encoded information.

## MoSS partners

As an open source system, the MoSS platform moves forward by the collective efforts of its partners working hand-in-hand to cater the industry requirements.

MoSS would be standardised along the traditional data archival medium with planned revisions published via ([openmoss.org](https://openmoss.org)). The MoSS platform is open for all to use, replicate, modify and reproduce for non-commercial/research purposes. Any commercial endeavours by a third-party (non MoSS partners) originating or evolved from the MoSS platform should be notified to the MoSS partners prior to commercialisation.

**MoSS founder and C<sup>3</sup> partner (Chemistry, Community & Commercialisation) - Helixworks Technologies, Ireland.**



**Helixworks**

<https://helix.works>

**MoSS hardware partner - OpenTrons, USA.**



<https://opentrons.com>

Updates of the MoSS initiative can be followed at [openmoss.org](https://openmoss.org) and reach Helixworks Technologies via [info@helix.works](mailto:info@helix.works) for queries and information on all things DNA.