
The DeBio Network Litepaper

The Anonymous-First Platform for Medical and Bioinformatics Data

Introduction To DeBio Network

DeBio (pronounced dɪˈbiːo)

The DeBio Network is a decentralized anonymous-first platform for medical and bioinformatics data specializing in genetics testing.

Genetics testing has experienced explosive growth in recent years due to its applications in identifying diseases and health risks — as well as a rising interest in ancestral tracing. But with this increase in growth has also come an increase in ethical concerns regarding an individual's right to autonomy, privacy, and confidentiality.

Discussion

Genetic testing is a promising technology that may give an assessment of an individual's inherent risk for disease and disability. Genetically determined risk predictions can be used to design treatments on the basis of genetic and non-genetic factors — and even cure or eliminate some diseases entirely via gene-editing technologies.

But the predictive nature inherent in genetic testing also makes it liable for misuse. Individuals have been [denied health care, insurance, and employment](#) based on knowable genetic dispositions. This misuse is generally referred to as “genetic discrimination.”

Addressing Genetic Discrimination

In response to ongoing genetic discrimination, [GINA \(the Genetic Information Nondiscrimination Act, 2008\)](#) was passed in the US to prevent group health and Medicare supplemental plans (excluding long-term care plans, life, and disability insurance) from using genetic information to discriminate against individuals for insurance purposes.

[GINA Title II, 2009](#), followed up to prohibit the use of genetic information in making employment decisions. But it only applies to employers with 15 or more employees. Furthermore, these laws are based on older testing technology, limited in scope, and only apply in America. They are unable to provide the broad span of privacy protection required of the ever-evolving space genetics testing has become.

The basic systemic ethical problem with genetic testing solutions today is that they are centralized. An individual permanently loses their autonomy once they provide their genetic material to a third party testing service, increasing the risk of their [genetic data being used against them](#).

Genetic discrimination can have severe and permanent consequences on an individual's livelihood and socio-economic freedom. The [World Health Organization has acknowledged](#) the damage that released genetic data can cause to an individual and his or her relatives.

Government Agencies Access to Genetic Data

Law enforcement agencies have even started exploiting third-party consumer genomics services to trace suspects by finding their distant genetic relatives. This means that your genetic data can be traced back to you via a distant relative's genetic test results even with the simplest of [basic demographic data](#) known about you, such as your age and state.

Because genetic data is not unique to you but rather unique to your family tree, by using a centralized bioinformatics service, you may unknowingly not only put your own privacy at risk, but also the privacy of your near-relatives. To date, most [Americans of European descent](#) can already be identified through the DNA of distant relatives they may not even be aware exist.

Solutions for the Genetic Testing Market and its Users

DeBio eliminates risks of genetic discrimination by leveraging blockchain technology and high-level encryption to protect identity — while allowing users to access the benefits of genetic testing.

Individuals who use DeBio's anonymous bioinformatics services are not required to provide any demographic data. Their identity is not accessible by any testing labs. And any other data they may provide is fully encrypted and inaccessible by third parties without their permission.

To further increase privacy and anonymity, DeBio processes all genetic testing payments using cryptocurrencies so that even financial transactions in relation to genetic testing are nearly untraceable to the users.

Consumers' Increasing Data Privacy Concerns

Today's consumers are voicing concerns about entering a dystopian reality where they lose control over their identity. Fewer people today trust that governments, corporations — and any other third parties — have their best interests in mind in regards to their unalienable rights to privacy.

While [87% of consumers](#) today believe that data privacy is a human right, data breaches such as the Equifax Data Breach in 2017 and Cambridge Analytica in 2018 continue to plague innocent individuals. Frustration from privacy scandals has increased the demand for regulations, such as the [GDPR](#) (General Data Protection Regulation) and [CCPA](#) (California Consumer Privacy Act). But these regulations, while educational to the consumer, are punitive after privacy has been compromised and potential damage may have already been done.

Holes in Current Health Data Privacy Protections

HIPAA (the Health Insurance Portability and Accountability Act) is a federal US law designed to prevent disclosure of sensitive patient health information (PHI). Like other health information, to be protected by HIPAA, genetic data must first meet the [definition of protected health information \(PHI\)](#). But even PHI (including genetic data) can be released [without a patient's consent for treatment, payment, or health care operations reasons \(TPO\)](#).

For example, under HIPAA, genetic data can be shared freely amongst doctors and other providers for treatment purposes, with insurance companies for payment purposes, and within some internal operations of the health care entity itself. PHI can also be disclosed if required by state or other law. In the US, [state laws may vary](#), causing confusion in the space.

It's also important to note that HIPAA only applies to healthcare organizations it considers a ["covered entity" or a "business associate."](#) It has no power over companies that collect genetic data online like [23andMe](#) and genealogy websites such as [Ancestry.com](#).

DeBio feels that the global attempts to protect genetic data, along with other personally identifying data, fail in eliminating risk to the users. The possibility of our personal information and genetic data being misused is a serious concern.

Coincidentally, this increasing demand for consumer privacy solutions just happens to be growing in parallel with the popularity of genetics testing.

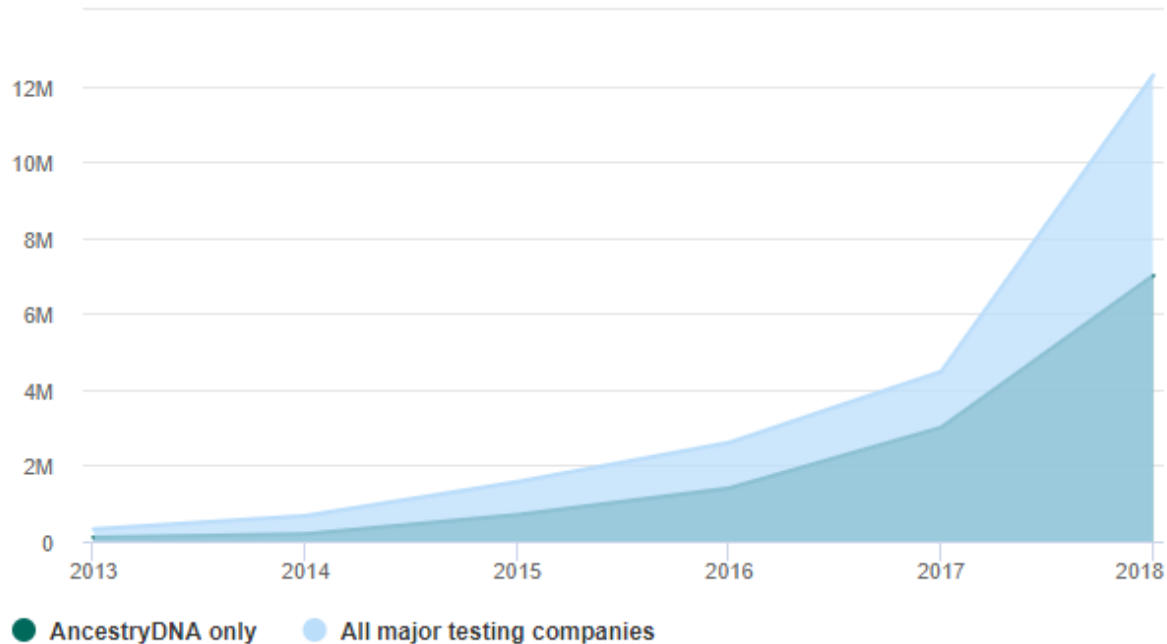
Consumer Market Review and Forecast

Consumer demand for genetics testing has exploded over recent years. Fueled by mounting concerns over genetic disorders and cancer, fascination with genetics genealogy, and the availability of take-home DNA testing kits, data has shown that the consumer genetics testing market grew thirty-six times between 2013 and 2018.

Up, up, and away



Total number of people tested by consumer genetics companies, in millions.



ISOGG, Leah Larkin, company reports

Graph by [Antonio Regalado](#) from [MIT Technology Review](#)

In [2016, a market review by Grand View Research](#) predicted that the genetic testing market would reach 10B USD by 2022. Yet as 2020 rolled in, the [market value of genetic testing had already exceeded 10B](#) — beating that prediction by two years.

The use cases for genetic testing has expanded as well to include a myriad of applications from diagnosing genetic disorders, carrier testing for hereditary disorders, predictive testing for genetic variants, prenatal screening, pharmacogenetics to predict drug reactions, transplantation testing for genetic matches, and an increased personal interest in genealogy, to name a few.

Emerging Asia Pacific Market

While North America is currently the dominating market in genetic testing, due to an increase in healthcare expenditures and rising populations in nations like China and India, [genetic testing in the Asian Pacific market](#) is expected to emerge as the fastest growing regional market in the world.

Based in Singapore, DeBio's decentralized solution for anonymous genetic testing is situated in the heart of the Asia Pacific region. The DeBio Network is perfectly poised to offer genetic testing with consumer privacy solutions in the midst of its hottest emerging market.

As the genetic testing market revenue is expected to hit [31B within the next 6 years](#), DeBio is presently situated to capitalize on our expertise in cutting-edge blockchain technology, bioinformatics, and our strong belief in the inalienable right of privacy for individuals.

DeBio's Core Values

The DeBio Network adheres to core principles which include:

1. The Right of Privacy for Individuals

DeBio is a decentralized, anonymous-first, consumer oriented protocol aligned with the growing belief that the right of data privacy and autonomy over personal information is a basic human inalienable right.

2. The Right for Individuals to Take Preemptive Measures on Their Health

While genetic testing is a relatively new technology, the implications for its use is groundbreaking. For the first time in history, humans have the possibility of taking a heretofore impossible preemptive measure towards improving personal health and longevity.

3. Technological Innovation and the Right of Individuals to Participate Anonymously

While we acknowledge the scientific and technological innovation that made genetic testing possible, we insist that further effort is necessary to empower labs of all sizes to be able to collaborate on analyzing genetic and medical data **anonymously** to offer improved joint biomedical products.

Concept of The DeBio Network

A Physical-To-Digital Bridge for Anonymous Testing

For anonymity, users of DeBio Network only need to take two DNA samples via the buccal swab method or take samples of oral cells with cotton swabs. Then the user accesses our genetic testing marketplace to select our wide range of products and laboratory recommendations. The user then sends their sample to the laboratory within an envelope that is identifiable only by their public key void of any personally identifiable information.

The results (e.g, test and genome) are then encrypted with the user's public key and stored on decentralized storage. This allows users to maintain full control over their encrypted data—only their private keys can decrypt these results, and only through user control may the results be reused by another lab.

The DeBio Network team is also planning to expand this “physical-to-digital bridge” concept to use cases outside of the genetic testing market—which may include lab testing for diseases & other electronic medical record data or personal health information.

Sovereign Lab Collaboration To Offer Joint Products Integrating Services From Several Labs

After the user chooses a service and sends the DNA sample to a sovereign lab, the lab will be notified. When the sample arrives, the lab will begin sequencing the physical samples, and/or any requested biomarker tests.

The lab then encrypts the results (e.g, test and genome) with the user's public key and uploads them to decentralized storage. Only the user's private keys can decrypt these results, and only through user control may the results be reused by another lab.

The goal of having sovereign labs is to increase the availability of products and enable joint products by integrating services from several labs. This also allows DeBio to scale because labs do not need to be centralized allowing for multiple standalone genetics facilities to participate.

DeBio Bioinformatics Use Cases

Regarding Bioinformatics, DeBio's services are not limited to genetics testing alone. Non-genetic testing use cases include anonymous medical testing and privacy-first document digitization.

Our services include but are not limited to:

1. Decentralized Genetics

Decentralized genetics allow users to sequence their genome and retrieve their test results **anonymously**.

2. Electronic Medical Records

DeBio provides services to secure electronic medical records and PHI (personal health information) for use by medical organizations only with the user's consent to protect their privacy. These medical records can even contain large data such as MRIs, radiology images, etc.

KYC and EMR (electronic medical records) are by default delinked from each other within the platform architecture. This means that the patient's identity is not attached to his or her records. Patients are also able to share their EMR data with hospitals while retaining full control over which data to reveal or receive. Individual doctors can even also participate in the decentralized EMR system to diagnose solutions for particular patients.

3. Biomedical Testing

DeBio enables at-home medical testing so that patients do not need to visit a physical facility.

4. COVID-19 Testing

DeBio empowers labs and hospitals of all sizes to provide at-home testing for SARS-CoV2. The same platform can be utilized to provide testing for other diseases. All tests are anonymous-first.

DeBio Payment Mechanism

DeBio supports two payment models: Trustless/Decentralized Payments or traditional Enterprise/Consortium Model. This enables users who aren't savvy with decentralized payments to still be able to participate in our platform.

Trustless/Decentralized Payments

Trustless/Decentralized payments all occur via a Blockchain token model. Consumers can onboard with their preferred cryptocurrency token, or use a fiat-to-crypto bridge to submit their payment. Smart contracts then hold the consumer's tokens in escrow until the lab returns the valid data. Only then does the smart contract trigger the fund disbursement from escrow into the lab's account.

Enterprise/Consortium Model

This model uses a traditional payment option:

Consumer funds are held in escrow by a local payment gateway or bank until the lab provides valid data (report and genome) into decentralized storage. The smart contract then triggers the fund disbursement into the lab's accounts.

Note that this still maintains the anonymity of the genomic data, since:

- Payment gateway/bank **does** have access to consumer KYC but **does not** have access to genomic data or reports
 - Labs **do not** have access to consumer KYC, although it **does** have access to anonymized genomic data.
-

Technical Architecture

“The DeBio Network believes that the future of blockchain lies in the specialization of technology use cases as well as interoperability. The unique demands of the bioinformatics and biomedical ecosystems, the decision-making governance required to ensure proper and transparent data handling, in conjunction with the one-of-a-kind business models we provide, require a fresh, alternative architecture.” — Pandu Sastrowardoyo, Initiator of the DeBio Network.

Technologies

The DeBio Network infrastructure is optimized for user anonymity. Other than safeguarding the user's sovereignty from the business logic perspective, the DeBio Network leverages the most recent and innovative technologies available, including but not limited to:

- Substrate
- Kilt
- The Octopus Network
- The InterPlanetary File System (IPFS)

Substrate

Substrate, the framework behind the Polkadot token, enables developers to build purposeful blockchains. The DeBio Network team chose Substrate to make use of the security features provided by the relay chains of the Polkadot ecosystem. Beyond enabling the DeBio Network to [connect parachains to the existing Polkadot relay chain](#), DeBio Network's parachains will also benefit from the security provided by the relay chain.

Kilt

KILT Protocol provides a solution that prevents data or identifiable User behavior from being recorded or concentrated in one entity. Built on the principles of “Privacy by Design,” [KILT is an open-source blockchain protocol that issues claim-based verifiable, revocable, and anonymous credentials](#).

KILT allows users to claim arbitrary attributes about themselves, have them attested by trusted entities (Attesters), and then store these claims as self-sovereign Credentials in the form of hashes on the blockchain.

Users can then submit their Credentials with applications and services that use KILT Credentials and trust the corresponding Attesters. These applications or services Verify the Credentials of the User by comparing the hash of the Credentials to the hash on-chain.

Because the Attestor is not involved in the Verification process, the behavior of the User remains unknown to the Attestor. In addition, when showing the Credentials to the Verifier, the Claimer can hide any data that is unnecessary for the service, allowing the Claimer full

autonomy over their data. Finally, because the hash cannot be transformed back to the data originally submitted in the user Claim, any hacking efforts by malicious actors are rendered futile.

Octopus Network

The Octopus Network will be used for connecting to public networks, more specifically, to public exchanges. [The Octopus Network is an appchain built on NEAR Protocol](#). Both the [design and development of the NEAR platform](#) are guided by a handful of key principles that solve problems inherent in both centralized and decentralized systems. Those key principles are usability, simplicity, scalability, and sustained decentralization.

The InterPlanetary File System (IPFS)

IPFS is a protocol made for fully decentralized, peer-to-peer data sharing and storage. IPFS uses a content addressing system by hashing the content. Every piece of content that uses [the IPFS protocol has a content identifier, or CID, that is its hash](#). The hash is unique to the content that it came from.

Ocean Protocol

The DeBio Network team is currently researching the feasibility of Ocean Protocol. Ocean Protocol is built for the consumption of data assets in a secure, privacy-preserving fashion. [Ocean's Compute-to-Data](#) features provide a means to share one's data while preserving privacy because the data itself never leaves the premises of the owner. Ocean Protocol resolves the tradeoff between the benefits of using private data, and the risks of exposing it.

Ocean Protocol has also developed an open-source data marketplace called Ocean Market. Ocean Market is forkable. The DeBio Network Team is researching its potential for use because it's in line with our goals to create a data marketplace for biomedical and genetics research.

Hashicorp Vault

[HashiCorp Vault is a secrets' management tool](#) designed to control access to sensitive credentials and data. DeBio chose Vault because of its security and accessibility. HashiCorp Vault can store sensitive environment variables, database credentials, API keys, and more, giving users control over who has access and who does not. Hashicorp Vault already provides a unified instance to store a multitude of secrets in various Platforms.

ERC20 Smart Contracts

Our main payment option is Escrow. ERC20 Smart Contracts will be used to transact stable coins meant to be used as in-app currencies to purchase services.

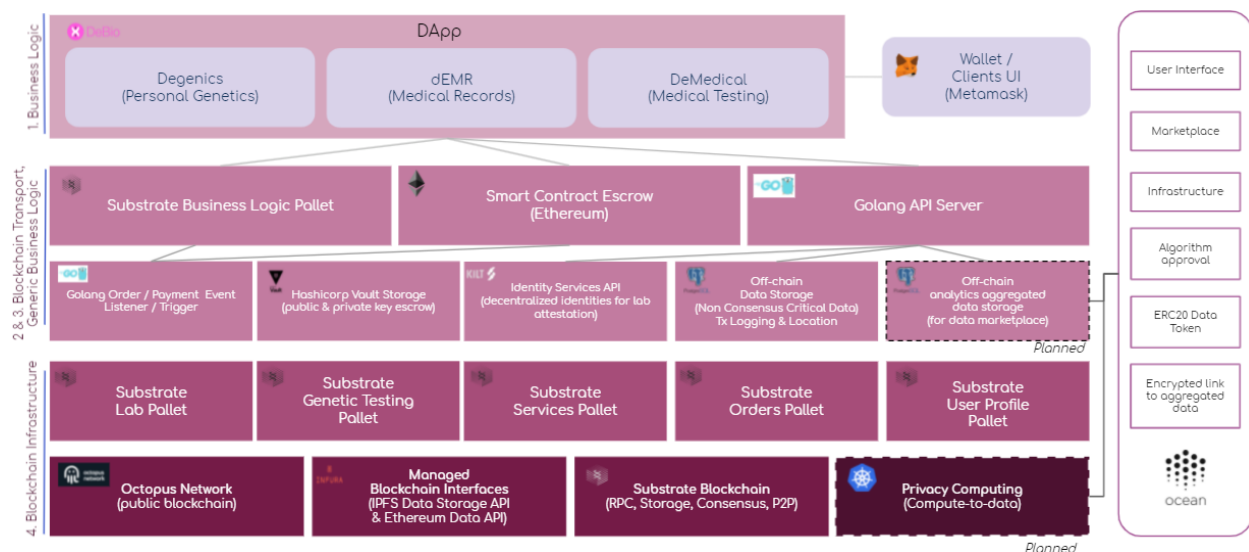
Golang APIs and Workers

The Golang API is mainly used for non-consensus critical data that is used by the dApp such as lists of countries, regions, and city codes. Data that are non-consensus will not be stored in the blockchain, rather it will be stored inside a PostgreSQL Database instance.

Golang Worker, is a service built intentionally to listen and confirm payments from the Ethereum Network — more specifically the Escrow smart contract. After receiving a confirmed payment notification, the payment confirmation is then published through the Substrate pallets.

Technical Architecture Layers

Our technical architecture consists of four layers, the main blockchain infrastructure, the transport and generic business logic layer, and lastly the top-level business logic layer.



DeBio Proposed Technical Architecture

Layer 1: The Blockchain Infrastructure

For our main blockchain infrastructure, we will be using Octopus Network, Substrate, and IPFS.

Layer 2 & 3: The Transport and Generic Business Logic Layer

The second and third layer contains our transport and generic business logic. This layer is responsible for serving data from the blockchain infrastructure to the users directly.

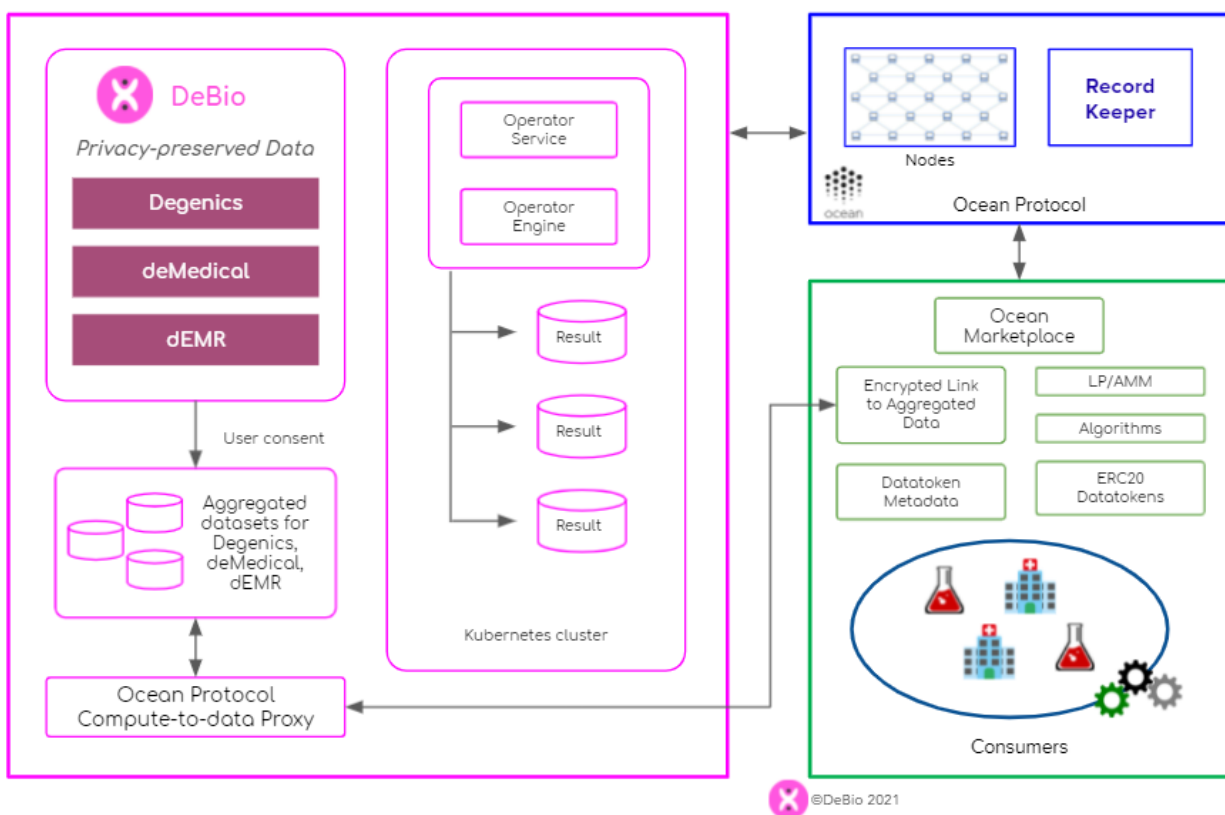
The Substrate blockchains in the first layer are accessed through the second and third layers. Each pallet contains the base business logic for interactions with our blockchain, thus the users will trigger this business logic from a higher level, more specifically, from the dApp itself.

Layer 4: The Top-Level Business Logic Layer

The fourth layer will be the dApp and Metamask. All transactions with the DeBio Network will be available for Metamask users only for the time being.

Privacy Computing

As one of the primary tenants of the DeBio Network is privacy, DeBio will implement privacy computing concepts within our systems. [Privacy computing concepts support privacy preservation with high concurrency and efficiency even for a massive number of users.](#) Privacy computing will later be performed on many types of lab results including services from Degenics, deMedical, and dEMR.



Once users give consent, their aggregated datasets, whether for degenics, deMedical, or dEMR can be sold for in the Ocean Protocol through the Compute-to-data proxy.

The idea behind using Ocean Protocol Compute-to-data is to let data stay on premise yet allow 3rd parties to run specific compute jobs on it to get useful analytics results like averaging or building an AI model.

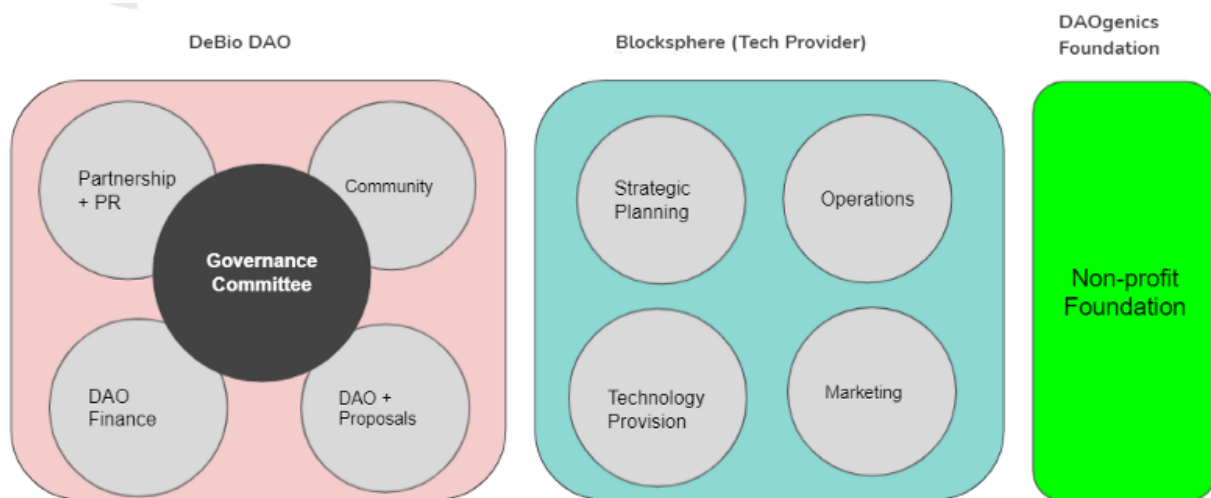
It is meant to be useful for data sharing in science or technology contexts. It's also meant to be useful for selling private data, while preserving privacy. The private data isn't directly sold; rather, specific access to it is sold, access "for compute eyes only" rather than human eyes.

Tokenomics

Before we can discuss the tokenomics of The DeBio Network, we must first discuss the proposed DeBio decentralized autonomous organization (DeBio DAO).

The Decentralized Autonomous Organization

The DeBio DAO will be an organization run by its users. The DeBio DAO is basically the platform of the technology. [Blocksphere](#) is the provider of this technology while DAOgenics is the attester for the labs joining the organization.

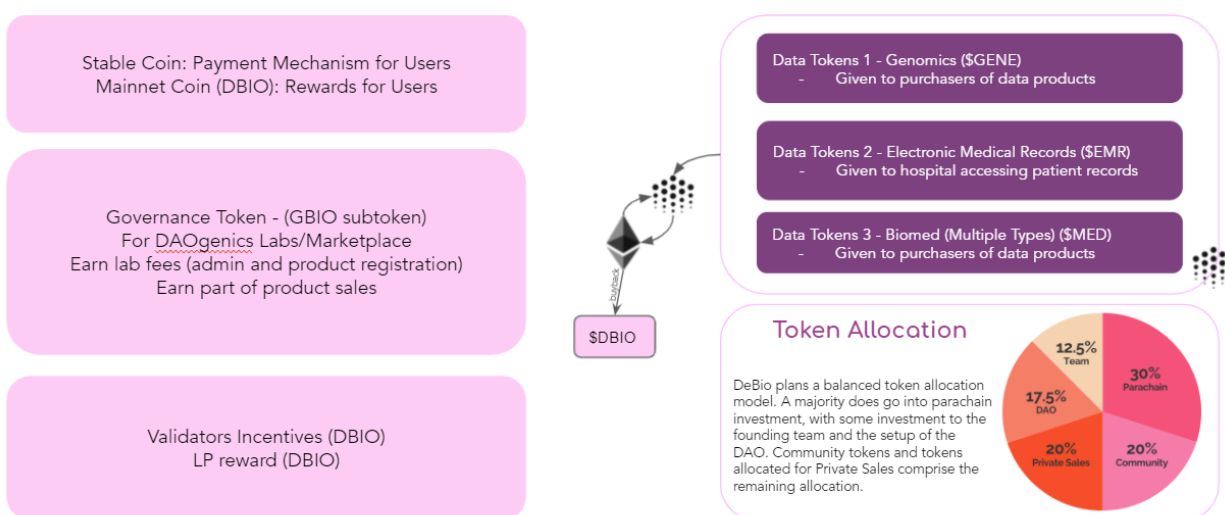


The purpose of having a DAO is to enable a system that both allows the users to vote and executes the results of the vote. While it is possible to create a decentralized system where the results of the vote are executed manually, this can ultimately become a point of weakness. Thus, it's important for the system to execute the results of the vote to create a truly decentralized system.

While the governance committee will be able to vote on the decentralized organization, the committee will not be too technical. We don't expect the committee to be blockchain experts.

So, most of the time the technology provider (Blocksphere) will provide the lead. Although, the governance committee can veto the technology provider's decision if they don't see fit.

The Token Model



The DeBio Network team intends to release six tokens:

- Mainnet Transaction Rewards & Validator Token (\$DBIO)
- The Governance Token (\$GBIO)
- The Genomics Data Token (\$GENE, via Ocean Protocol)
- The Biomed Data Token (\$MED, via Ocean Protocol)
- The Electronic Medical Records Data Token (\$EMR, via Ocean Protocol)

The method of token distribution will be announced at a later date.

Mainnet Coin (\$DAI, etc)

The Mainnet coin will be backed by a stable coin. We decided to use a stable coin because the Mainnet coin is intended to be used for transactional purposes, or for fees for work being done by the corresponding labs. We are intending to use DAI as our stable coin.

Governance Token (\$GBIO)

Governance tokens are intentionally made for the labs. Because The DeBio Network is essentially a decentralized organization, the labs would need a token to be used for voting in the DAOgenics marketplace. The Governance Token can also serve as a method for lab onboarding.

The Data Tokens (Genomics, Biomed, Electrical Medical Record)

These tokens are used as a method of transaction in the data marketplace. The DeBio Network team intends to research Ocean Protocol as an alternative for this token.

Validator & Transaction Rewards (\$DBIO)

The Validator Token is used to incentivize the node owners to validate transactions and protect the dApp from unauthorized users. The intended incentives provided for validators are LP rewards and Governance tokens.

Our Team

The DeBio Network team consists of blockchain and bioinformatics experts who are renowned in their field.

Pandu Sastrowardoyo (Ideator)

Ms. Pandu Sastrowardoyo, Initiator of DeBio. *IT & Blockchain consultant and business leader. Former environmental engineer with bioinformatics course certificates and microbiology experience. Ex-IBMer, cofounder of multiple Blockchain organizations, as seen in Forbes, CNBC, CNN, Deutsche Welle, Forkast News, and many others.

Ibnu Gamal Alhadid (Bioinformatics Advisor)

Mr. Ibnu Gamal Alhadid, Bioinformatics Advisor for DeBio. Biologist, fitness professional, and wellness enthusiast. Experienced in network marketing, business development, and sales throughout a wide range of industries. Coordinates the DeBio Network Advisors.

Dr. Agus Mutamakin, M.Sc (Bioinformatics Advisor)

Dr. Mutamakin has 15 years of medical information technology experience as the Chief Information Officer at the National Referral Hospital and as a Health Information Systems Consultant. He is also involved in the Data and Information Compartment of the Indonesian Hospital Association and a member of the Health Informatics Technical Committee of the Indonesian National Standard. He has also been invited as a guest lecturer in several master's degree programs in Hospital Management in Indonesia.

Dr. Hendy Wijaya, M.Biomed (Bioinformatics Advisor)

Dr. Wijaya is a researcher specializing in biochemistry, nutrition, and metabolic diseases. He has researched aging, nutrition, metabolic diseases, and genetics. He regularly lectures and

teaches biochemistry and physiology on one of the campuses in Indonesia and is a research consultant for a food supplement company.

Dr. Karlia Meitha, Ph.D (Bioinformatics Advisor)

Dr. Meitha is a researcher adept in the field of molecular biology. She has an interest in genome editing and small RNA applications in the pursuit of sustaining life. She regularly writes in the field of plant physiology and molecules. Currently, Dr. Meitha leads a biotechnology master program aiming to create a generation of biotechnology experts who engage in creative thinking.

Dr.rer.Nat Marselina Irasonia Tan (Bioinformatics Advisor)

Dr. Tan is a researcher specializing in cell and molecular biology, particularly in the biomedical sciences. She has research experience in the fields of cancer biology, immunology, and whole-genome sequencing. She is currently active as a lecturer and regularly lectures about immunology, cell biology, cancer biology, animal development, and tissue engineering.

Dr. Popi Septiani, Ph.D (Bioinformatics Advisor)

Dr. Septiani is a specialist researcher in the field of genomics and bioinformatics. She has extensive experience in genomic data analysis and transcriptomics in the field of medical and agricultural sciences. She has worked in the field of biotechnology for an agricultural science company. She is currently active as a lecturer on subjects regarding molecular genetics and bioinformatics on Indonesia's campuses.

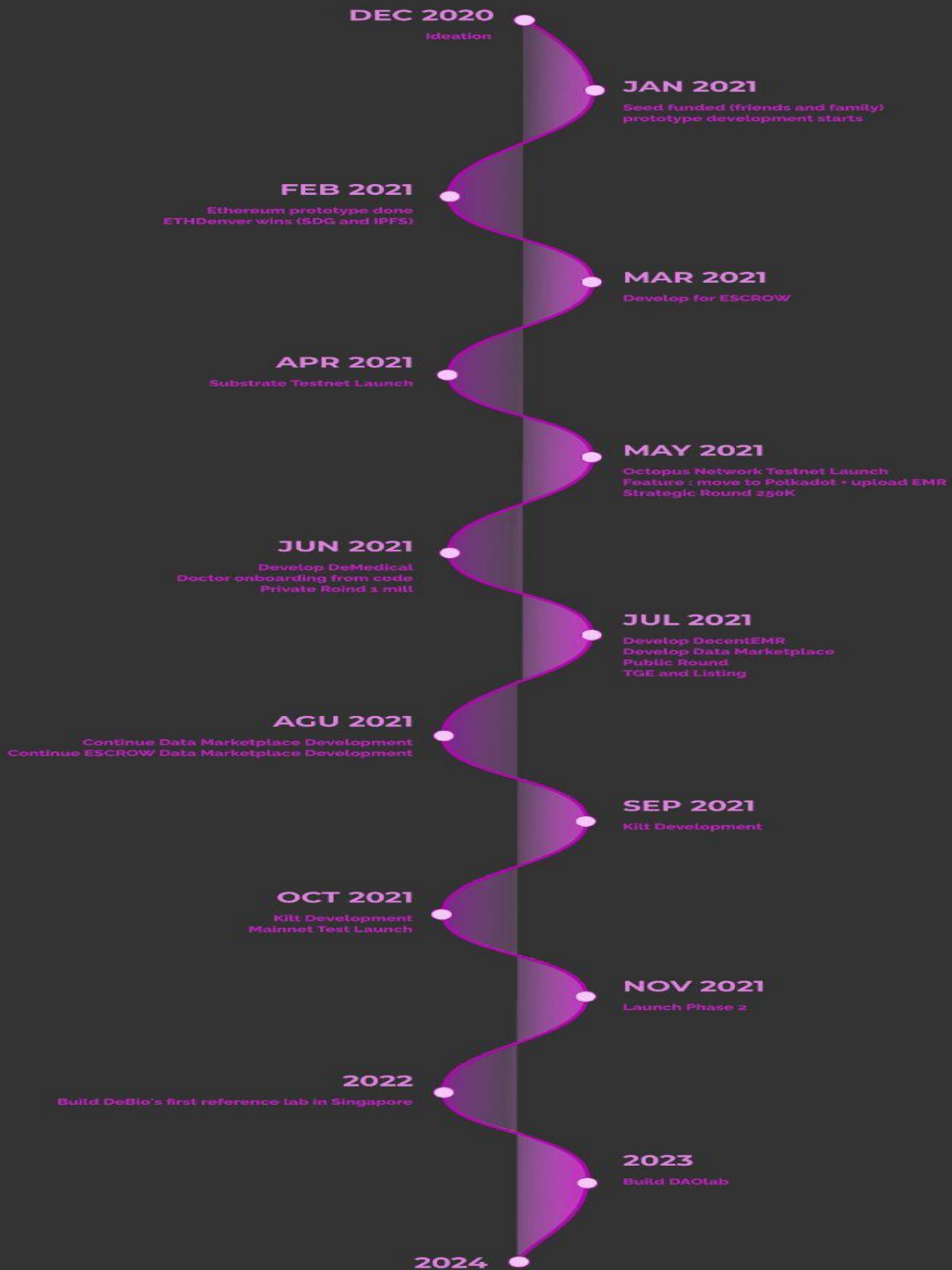
Dr. Theza Pellondo'u, Sp.KF (Bioinformatics Advisor)

Dr. Pellondo'u has knowledge and experience in the field of medical forensics, medicolegal, and bioethics. He has helped solve several criminal cases, doctor-patient disputes, and ethical problems in both the fields of medicine and education. Dr. Pellondo'u was the Chairman of the Ethics and Legal Committee in a private hospital in Jakarta. He is currently active as the Head of Department and lecturer in forensic medicine and medicolegal, and bioethics at a private medical faculty in Jakarta. He also practices as a forensic and medicolegal specialist in the same city.

Roadmap



Roadmap



December 2020

Original inception

January 2021

First seed fund by friends and family

Prototype development starts

February 2021

Ethereum prototype is done

The DeBio Network wins Hackathon at ETHDenver (as “Degenics” before rebranding to DeBio)

March 2021

Develop for ESCROW

April 2021

Develop for ESCROW

Substrate Testnet Launch

May 2021

Octopus Network Testnet Launch

Feature: move to Polkadot + upload EMR

Strategic Round 250K

June 2021

Develop DeMedical

Doctor onboarding from code

Private Round 1 mill

July 2021

Develop DecentEMR

Develop Data Marketplace

Public Round

TGE and Listing

August 2021

Continue Data Marketplace Development

Continue ESCROW Data Marketplace Development

September 2021

Kilt Development

October 2021

Kilt Development

Mainnet Test Launch

November 2021

Launch Phase 2

2022

Build DeBio's first reference lab in Singapore

2023

Build DAOlab

Contact Us

We here at the DeBio Network fully understand the concern for user anonymity. Some people might say that our [DNA is the most private thing we have](#), and we take that very seriously.

If you are interested you can contact us through these channels:

- [Telegram DeBio Channel](#) (Semi-anonymous, registering for Telegram requires phone number)

- [DeBio Discord Server](#) (Semi-anonymous, registering for Discord requires email)

We also have a company website [here](#). To try out our app you can click this [link](#).