Decentralized Data Interoperability Network Unlocking A.I. for Healthcare

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1. Executive Summary

The Prism Protocol is a decentralized data interoperability platform based on the sharing economy, powered by blockchain technology and a cryptographic token. The Prism blockchain infrastructure allows data to flow in a seamless, secured, transparent and yet private manner. Prism provides an open market place for the service providers of the healthcare industry centered around self-collected medical data.

The Prism Protocol backbone is built on the 3.0 generation of blockchain technology. It uses the flexibility, modularity and scalability of the NULS blockchain to create a cutting-edge platform which is secure, customizable, highly scalable and HIPAA compliant.

Prism is pro-active in the data generation process, and relies on self-collected Real-World Data (RWD). It integrates with and assists in the distribution of IoT devices to empower individuals on data collection. Finally, Prism provides open access for developers to design new features and applications, such as A.I. as a Service, to integrate its market place.

The Prism Protocol ecosystem consists of 3 distinct groups:

- **Data contributors -** generate and have full ownership of their RWD. This group is constituted mainly of individuals empowered with our range of IoT devices.
- **Service providers -** use the platform as a customer base. This group contains A.I. as a Service, medical professionals, and telemedicine portals. Their purpose is to generate revenue by providing a use case for the RWD collected by the contributors.
- **Data consumers -** use RWD to improve the overall healthcare system. This group consists of pharmaceutical groups, insurers, researchers and NGOs.

The Prism Token (PSX) has a double utility. It is used as a decentralized cryptographic means of payment within the Prism Protocol network, allowing transactions to be seamless and secured. It is also the foundation of our Proof of Credit consensus validation protocol. The Prism consensus validation protocol was designed to converge towards a mathematical scarcity of PSX. The gate keepers gain the right to work for the network by showing a Proof of Stake, and receive PSX as part of the block reward function.

Prism aims to give back to everyone pro-active control over their healthcare journey. The use of RWD will open the gate to the era of preventative healthcare and fuel the new generation of A.I. healthcare algorithms. Ultimately, Prism will allow a more equitable allocation of resources by including those currently excluded from the traditional healthcare system, while better distributing the profit of this industry.

Anthony Munoz Cifuentes, Founder and CEO

2. Current environment and perspective

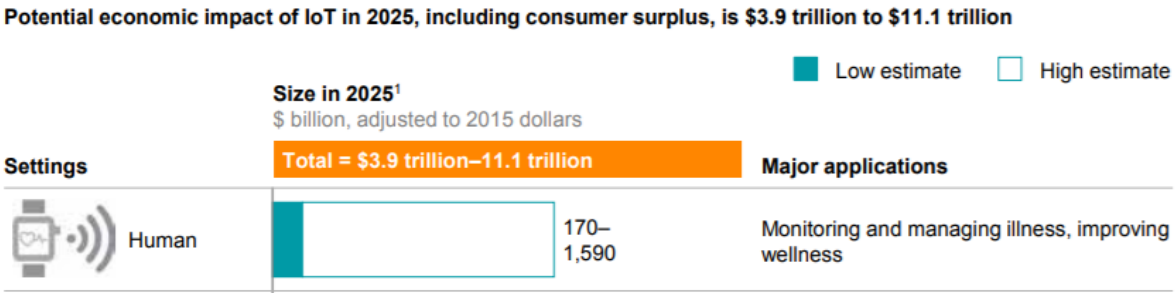
2.1 Market

Prism is operating across different fast-growing markets: big data, blockchain, healthtech, A.I. and IoT. These markets are poised to become some of the most dynamic and critical of the next decades. Before understanding how and why Prism will capture value via its protocol, let's consider an overview of the pie itself.

2.1.1 IoT

According to McKinsey[1], interoperability among IoT systems could capture up to $4 trillion per year in potential economic impact by 2025. This represents 40% of the value generated by the use of IoT, out of a total potential impact of $11.1 trillion.

The medical IoT market could itself grow up to $1.6 trillion per year by 2025.

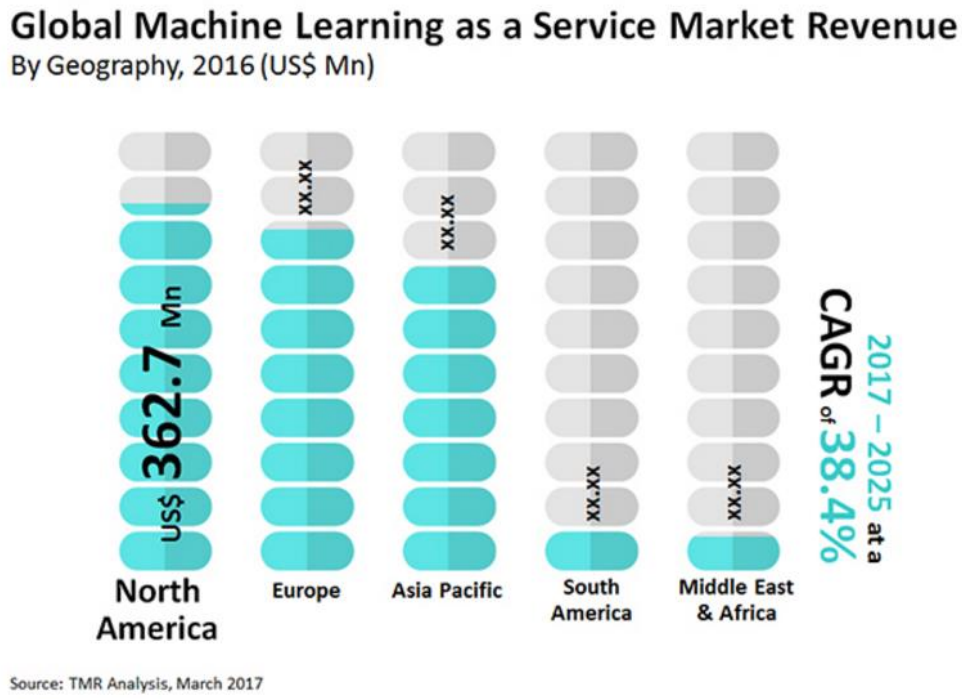


IoT has potential for transformative change in human health. Using connected devices to continuously monitor patients as they live their lives—particularly those with chronic conditions such as diabetes—the Internet of Things can improve patient adherence to prescribed therapies, avoid hospitalizations (and post-hospitalization complications), and improve the quality of life for hundreds of millions of patients. This could have an economic impact of $170 billion to $1.6 trillion per year by 2025. Use of IoT systems could enable societal benefits worth more than $500 billion per year, based on the improved health of users and reduced cost of care for patients with chronic diseases.

[1] https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

2.1.2 A.I. as a Service

The growing demand for A.I. as a Service in the form of Application Programming Interface (API), Software Development Kit (SDK) and the growing number of innovative startups, are some of the major factors which are expected to drive the A.I. as a Service market. Furthermore, the increasing need for intelligent business applications and a growing demand for A.I. service integrators are together expected to provide growth opportunities in this market.



Machine Learning as a Service for Healthcare market

According to markets and markets[2], the A.I. as a Service market value is expected to grow from $1.5 Billion in 2018 to $11 Billion by 2023.

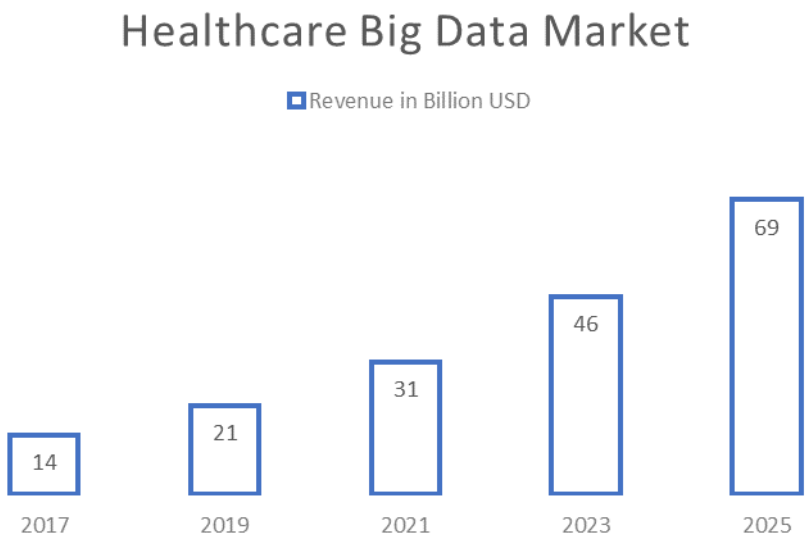
2.1.3 Big Data

Health data has been growing at unprecedented rates, driven by falling storage costs, the emergence of cloud storage, growing regulatory mandates and the increasing number of government initiatives aimed at promoting the adoption of healthcare information systems. The increasing adoption of wearable devices, at-home testing services and mobile health applications, are empowering patients to proactively manage their health and further contributing to the pool of personal data. The availability of large volumes of health information has paved the way for massive advances in clinical research, the development of precision medicine and clinical decision support tools, faster drug discovery and a more

[2] https://www.marketsandmarkets.com/PressReleases/artificial-intelligence-ai-as-a-service.asp

detailed view of population health. Combined these advances offer a wealth of opportunities for chronic disease management.

According to BIS research[3], the global big data in healthcare market was estimated to be worth $14 billion in 2017, and is expected to grow over $69 billion by 2025, driven by a growing adoption of cloud storage and analytics, large scale government initiatives to promote data driven innovation, and a growing consumer demand for wearables and mobile health applications.



Prism is at the center of this highly interdependent environment, by connecting the different markets through a Decentralized Data Exchange Network. A.I. as a Service requires data to run, and data requires IoT for its collection. By integrating IoT devices and connecting data contributors, data users, and service providers, the Prism Protocol will increase the total value of these markets, while capturing revenue on a Sharing Economy basis.

Let's now review the potential for the application of such technologies to healthcare.

2.2 Curative Healthcare challenges

Our medicine has never been as advanced as it is today. We are capable of performing robotic surgery, cellular therapy, DNA sequencing and even genetic engineering. There are virtually no limits to what humankind can achieve to improve its life conditions and expectancy. Nevertheless, those progresses are actually concealing a surprising paradigm - our

[3] https://bisresearch.com/industry-report/global-big-data-in-healthcare-market-2025.html

healthcare system is at the exact same stage as it was during the Stone Age: it is mainly based on curative care.

In most of the cases, the triggering point to start the healing process is the visibility of the disease. We wait until someone's health has degraded enough for symptoms to appear, revealing the presence of the illness. The reason for this is that most of the population do not want to deal with healthcare while they *feel* healthy. It is only after they start to *feel* sick that they interact with the various resources available for curative healthcare, be it self-medication, doctor consultation or even hospitalization.

The issue with a feeling-based way of dealing with healthcare, based on symptoms, is that it creates a time lag between the start of the disease, and the start of the cure. This delay of action can lead to huge complications, in terms of both health and cost of treatment. The WHO reports that a cancer detected at late stage is up to 4 times more expensive to treat[4] than if detected earlier. This fact is particularly frustrating knowing that the CDC[5] published that 80% of deaths from cardio-vascular diseases are due to preventable factors, like cholesterol-related issues or diabetes.

Knowing the limits of our curative medicine, there is more and more incentive to shift towards a preventative-based healthcare system. Nevertheless, in making this shift there are many challenges which need to be overcome.

2.3 Preventative Healthcare challenges

Most of the different players in the healthcare system, from medical professionals, to pharmaceutical groups, insurers, and particularly governments, agree on the value of and potential for preventative healthcare. And yet, despite this agreement, no defined or coordinated action has emerged. There are many obstacles along the path to a prevention-based healthcare system, the major one being the cost of data collection, the quality of it, its availability and finally, its ownership.

There is a quasi-monopoly from healthcare organizations over the data collection process. There are 3 main reasons for this:

- They possess the devices capable of collecting medical grade data.
- They have the infrastructure and knowledge to ensure proper collection.
- They are the ones who interpret the data to reveal diagnostics.

These axioms have produced and maintained the current status quo in the development of preventative healthcare.

[4] http://www.who.int/news-room/detail/03-02-2017-early-cancer-diagnosis-saves-lives-cuts-treatment-costs
[5] https://www.cbsnews.com/news/cdc-200000-heart-disease-deaths-could-be-prevented-each-year/

2.3.1 Cost issues

To be effective, prevention needs to be practiced on a massive scale. Its cost, however, if performed by medical practitioners, is high, and by its very essence, it will yield no monetary value most of the time. This is the reason leading insurers[6] to be reluctant to develop it. Insurers want to minimize the interactions between physicians and individuals, as long as they have to pay for it. A prevention system relying on a massive increase of the interactions between patients and doctors is a non-sense for insurers.

2.3.2 Quality issues

There is paradoxically a systemic quality issue with a medical-centric data collection process. As previously stated, most of the population will interact with doctors only when they already feel unwell. This means that most of the collected data comes from sick people, a bias which devalues such data for prevention purposes.

Another issue is the punctuality of this system. It is based on analyzing a single data point representing a snapshot of someone's health at a given point. As detailed as this snapshot may be, it is by essence incomplete. It will generally fail to provide any hint on the process that led to the current state, the very thing that needs to be analyzed in order to develop preventative tools. It is only by identifying common patterns among a huge sample that researchers will be able to develop appropriate answers. The punctuality issue is also damaging for the follow up phase, making it difficult for researchers to evaluate the effectiveness of their solution in the long term.

2.3.3 Availability issues

The absence of globally accepted data sharing platforms among the healthcare system makes it difficult to transfer data to the appropriate organizations. Data users are often different from data collectors, making it even more difficult. The inefficiency of this system is particularly visible in data storage, with most of it decaying in hospital archives.

2.3.4 Ownership issues

Most of the time, collectors take for granted that they have the ownership over the data they collected, even if it comes from third parties that *paid* for its collection. This paradigm disincentivizes individuals to have their data used, as they will not be the primary beneficiaries of its assetization.

[6] http://www.marottaonmoney.com/why-are-insurance-companies-reluctant-to-cover-preventive-care/

2.4 Government policies

There have been and are many government initiatives aimed at incentivizing preventative healthcare, with many tools encouraging this shift, such as financial subsidiaries, insurance policies, or favorable regulations.

We identified two major programs favorable to the adoption of Prism.

2.4.1 Obamacare

One of Obamacare's biggest sources of criticism is that it aims to force insurers to pay for preventative health care. By offering the government a solution to undertake mass-scale, low cost preventative medical data collection, Prism can help this policy to achieve better adoption.

Indeed, Prism aims to reduce the number of interactions between patients and doctors, not increase them, such as the current version of Obamacare.

2.4.2 China 2030

The Chinese government plans to have all of its major health indices matching those of western developed countries by 2030. By encouraging preventative healthcare, and developing health awareness leading to healthier habits, initiatives such as Prism will be key for the successful implementation of China 2030.

3. Healthcare digital revolution

3.1 Artificial Intelligence

Human doctors use, without noticing it, an algorithm-based reasoning to give diagnostics. A.I. is using the same technique, with an accuracy and rapidity that will never be attainable by humans.

A.I. supremacy is already visible in some use cases. Google has developed an algorithm capable of detecting cardiovascular diseases thanks to a retina scan, with a higher accuracy than an experienced doctor[7].

A.I. can process and analyze tremendous amounts of data at the same time, and can self-improve via Machine Learning algorithms. The combination of A.I./M.L. will lead to an era of previously unwitnessed progress. But the biggest challenge for A.I. is not the engine conception, it is the fuel. A.I. algorithms, as well designed as they can be, are powerless without data to make them run.

3.2 Big Data challenge

Big Data is the new ".com", a magical word. It excites investors, increases company value and implies countless possibilities. And there is a reason for this. Big Data will be for 21st century what oil was for the 20th century. The 20th century was the era of machinery and automation that required massive and cheap energy. This era was the era of energy hunting. And the principal source of energy was oil.

The 21st century is the era of information, and the source of information is data. Humans are hungrier for information than ever before. Big Data is the fuel for all of our information producing machines. These machines process raw data, not intelligible by humans, through algorithms to create information accessible to the human brain. That's what A.I. algorithms do. They take data as an input, and give information as an output.

Big Data is, however, facing two major challenges: the difficulty of collection, and the change of regulations making it more difficult to assetize.

3.2.1 Collection issues

Medical Big Data is the key for the digihealth revolution. It will unlock the development of an A.I. based preventative healthcare system. Nevertheless, as we noted, the most challenging

[7] https://www.theverge.com/2018/2/19/17027902/google-verily-ai-algorithm-eye-scan-heart-disease-cardiovascular-risk

aspect of using medical data is its collection. The current situation, characterized by a quasi-monopoly over the collection of medical data by the medical profession, is not compatible with the emergence of healthcare Big Data. The only way to allow this emergence is to empower individuals with the collection. The development of the usage of self-collected Real-Word Data (RWD) is showing the will to decentralize the data collection process. It is only by shifting from a few punctual collectors, to an entire population of continuous collectors, that Big Data will be achieved.

3.2.2 Regulation Issue

Individuals and governments are more and more aware of the importance of privacy. The time where big corporations were offering free services in exchange for ownership of users' data is over. It is now more and more difficult for third parties to monetize data without the clear consent of their legitimate owners. The EU has issued a new regulation making illegal any rogue monetization of data (GDPR), effective from May 2018. This progress of everyone's fundamental rights shows that individuals are not ready to forego their privacy for the sake of big data, even to gain access to personalized content and better information.

3.3 IoT devices

3.3.1 Decentralized collection

The emergence of IoT devices is the key factor allowing for the decentralization of healthcare, and particularly data collection. McKinsey estimates that by 2025, there will be 1.3 billion fitness monitors used worldwide[8]. There is a strong appetite for fitness monitoring from the consumer. Providing a global network to use and/or assetize self-collected RWD will improve the user experience of IoT device possessors.

Moreover, the medical industry is more and more seeking ways to collect data outside the context of randomized controlled trials (RCTs) and generated during routine clinical practice. Those Real-World Evidences (RWE) are evidences obtained from Real World Data (RWD), such as those self-collected by any IoT devices.[9] They are recognized and regulated by the Food and Drug Administration (FDA).[9]

[8] https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

[9] https://www.fda.gov/scienceresearch/specialtopics/realworldevidence/default.htm

3.3.2 Legitimate ownership

The decentralized collection of RWD not only increases the quality and availability of data, it legitimizes their assetization. Indeed, by being the collector of their own data thanks to the use of IoT devices, individuals achieve full ownership of their exploitation. It allows them free choice to have their data used as an asset in exchange for a compensation.

3.4 Blockchain

Blockchain is a technology that creates immutable and distributable data records which are shared peer to peer between networked database systems. It allows data to be transmitted between two parties while being encrypted, ensuring that only the due receiver of the data can access it. Indeed, when talking about healthcare data, it is crucial to respect a set of rules ensuring privacy, immutability, integrity and authenticity. The United States Congress enacted in 1996 the Health Insurance Portability Accountant Act (HIPAA), which enforces compliance by any system willing to store/transmit Electronic Health Records (EHR).

Storing EHR on the blockchain can be problematic for different reasons:

- Scalability issues
- HIPAA compliance
- Country regulations

Originally, blockchain was not created to store data, it was created to record transactions, which is radically different. Blockchain shows its true potential by its ability to make data interoperable. In a Bitcoin transaction the blockchain produces a data record – some Bitcon moved from one account to another. The Bitcoin blockchain is a distributed ledger recording all of those transactions.

By having a combination of locally stored data, exchanged via a blockchain network, both security of storage and efficiency/security of transaction is ensured. This is what the Prism Protocol provides.

4. Prism solution

Prism is a decentralized marketplace for medical data and preventative healthcare solutions. Various entities operate in the healthcare industry, but most of their interactions are isolated from the rest of the system. This isolation is particularly true for medical data. There is no convincing incentive to create a commonly used platform for medical data solving the collection issue. Such a platform would allow individuals to collect and have a follow-up on their medical data, and medical professionals to have more information to take the right

decision. Moreover, this platform would allow individuals to interact remotely with medical professionals. Indeed, the main reason for physical consultations is the collection of medical data. Finally, a facilitation of the circulation of medical data would open new perspectives for drug discovery, as well as A.I./M.L. based diagnostics, thanks to data analysis. Pharmaceutical and clinical trial groups are already buying medical data for such reasons[10]. Nevertheless, the collection process, done by third parties, makes data expensive. Prism aims at being a commonly used platform fulfilling all of those different needs, at a greatly reduced sum cost.

Building a platform used to exchange Electronic Health Records (EHR) requires a respect for a set of rules and restrictions enforced by the mandates of the Health Insurance Portability and Accountability Act of 1996 (HIPAA). The act is divided into three main parts, the Privacy Rule, the Security Rule, and the Cloud Computing Guidelines. The next section of this paper will investigate the relevant and critical elements when implementing a HIPAA compliant data exchange network.

4.1 HIPAA Regulation and Compliance Guidelines

4.1.1 Privacy Rule

The Prism Protocol must comply with the Privacy Rule due to its ability to transmit private health information. Applicability of the privacy rule is summarized as, «The Privacy Rule. . . (applies) to health plans, health care clearinghouses, and to any healthcare provider who transmits health information in electronic form»[11].

Any third party acting on the behalf of those agent, as service providers, also falls under the HIPAA regulation. These agents are termed Business Associates (BA), and are defined as «An entity who… (performs) or assists in performance of a function or activity involving the use or disclosure of individually identifiable health information»[11].

The HIPAA introduces two other critical notions. The Private Health Information (PHI or ePHI), defined as «all individually identifiable health information held or transmitted by a covered entity or its business associate, in any form or media, whether electronic, paper, or oral»[11]. The second is the notion of De-Identified health information, defined as «Health information that does not identify an individual and with respect to which there is no reasonable basis to believe that the information can be used to identify an individual is not individually identifiable health information»[11].

The restrictions of use of de-Identified data are summarized by the following, «There are no restrictions on the use or disclosure of de-identified health information. De-identified health

[10] https://www.propublica.org/article/big-data-big-pharma-big-money
[11] https://privacyruleandresearch.nih.gov/pr_06.asp

information neither identifies nor provides a reasonable basis to identify an individual»[12] The limit between identifiable data to de-identifiable data is defined as any information that may restrict the possible number of individuals a collection of information is associated with to less than 0.04% of the total US population.

Based on the current regulation, it is authorized for any BA such as Prism to transmit any set of data falling under the de-identified data definition.

4.1.2 Security Rule and Cloud Computing Guidelines

The HIPAA specifies that any agent engaging the services of a Cloud Service Provide (CSP) to create receive, maintain, or transmit ePHI (such as to process and/or store ePHI), on its behalf, makes the CSP a business associate under HIPAA. This is true even if the CSP processes or stores only encrypted ePHI and lacks an encryption key for the data. Lacking an encryption key does not exempt a CSP from business associate status and obligations under the HIPAA Rules. As a result, the covered entity (or business associate) and the CSP must enter into a HIPAA-compliant business associate agreement (BAA), and the CSP is both contractually liable for meeting the terms of the BAA and directly liable for compliance with the applicable requirements of the HIPAA Rules.

Using blockchain to encrypt and transmit data will reduce the risk of breach compared to the use of a standard CSP. This allows the creation of blockchain based data exchange platforms such as Prism, complying with the HIPAA regulation.

4.1.3 Data Storage

Storing EHR or RWD on the blockchain can be problematic for several reasons. The gas cost to store and access the data limits the potential of a blockchain based storage of massive set of data.

Prism implementation is based on storing data off-chain, using HIPAA compliant CSP and local user devices. Our protocol creates a meta data index, stored on the blockchain, guiding requests to data contributors having generated data of the requested type.

The usage of self-collected RWD tends towards an off-chain based storage due to the size and frequency of samples. Prism, by relying primarily on self-collected RWD via integrated IoT devices, is creating a realistic platform. The Prism Protocol will not suffer from exponential storage cost due to its dual off-chain/in-chain storage design, while being able to scale and process a high number of requests.

[12] https://www.hhs.gov/hipaa/for-professionals/privacy/special-topics/de-identification/index.html

4.2 Ecosystem

4.2.1 Users

Users are at the center of the Prism platform. In this section, the tasks, interactions, and experiences of those individuals using the platform are listed and discussed.

Data collection and upload

Users are responsible for collecting their own data, and uploading it to the platform. They will do so using our range of certified and integrated IoT medical grade devices. There are two ways in which the data can be retrieved by the Prism app:

- The device directly talks to the Prism app, and is automatically visible in its interface.
- The device has its own application and the Prism app needs to retrieve the data from this application

Data management

Users will have the ability to view, manipulate, create charts from and view trends within their data via their own Graphic User Interface (GUI).

They will also be required to provide information about their profile: age, gender, size, weight, allergies or disease record. The more information the better the user experience will be.

They will be offered the ability to authorize monetization of their data. Such authorization can be punctual (Users will need to accept each and every time) or automatic for given periods of time.

Payment solutions

Transactions within the Prism platform **always** use PSX as a medium of value. Nevertheless, restraining the usage of the platform to the Users willing to use cryptocurrency would be damaging to the development of Prism's customer base. This is why we are designing our solution with every user in mind, including those willing to have a full fiat interface.

The Prism app offers a free PSX wallet. It also handles fiat payment solutions - credit card, WePay, Alipay. The fiat/crypto liquidity will be provided by accredited third parties (brokers). Prism will allow the UX/UI to be either full fiat, full crypto, or a combination of both. We believe that during the first stage, the majority of users will want to have a fiat interface.

Telemedicine

Prism will integrate existing telemedicine portals and create its own. Prism users will be able to request from medical practitioners' diagnostics based on their data. Such diagnostics will be consultative, as the data will be acquired in non-controlled environments. In time such diagnostics will increasingly be issued by A.I. as a Service algorithms.

Such interaction will be subject to the transfer of

- Funds, be it crypto only, or fiat + crypto, from Users to the diagnostic giver for services provided.
- Data, from Users to diagnostic givers, via temporary Read Only, or Read/Write access to their data

Data monetization

Users will be offered the ability to monetize their data according to various triggering points:

- A Data Purchase Order (DPO), in which case users will be offered the opportunity to provide data should they meet the requirements of the DPO. Such monetization will be anonymous: the buyers' identity does not have to be revealed, and the monetization will not be the result of a past interaction between the two parties. Such interactions will result in a temporary Read Only access offered to the data buyer.
- Clinical Trial (CT), in which case users will provide a continuous stream of data following the completion of required task(s) (taking a drug, doing exercise) depending on the CT requirements. Such interactions will include temporary Read Only, or even Read/Write access offered to the data buyer.

A data monetization event will always trigger the transfer of PSX and data within the Prism Protocol.

4.2.2 Service Providers

Parties willing to provide services to Users, based on the data Users collect, will be compensated in PSX, or in their choice of fiat via the service of a payment facilitator.

Medical professionals

Users will be able to have their data reviewed by medical professionals to receive diagnostics. Such interactions will be included in their Electronic Health Record (EHR). Service providers will receive temporary Read/Write access to the EHR of the User.

A.I. as a Service developers

Prism provides an OpenAPI and SDK for AIaaS developers. The Prism Decentralized Market Place provides them an access to a wide database of Users, empowered with high quality medical grade data to fuel their algorithms.

4.2.3 Data users

Data marketplace

The Prism Decentralized Market Place allows data to flow between data contributors and data users.

The pharmaceutical industry is the main medical data user and buyer. The reasons why they acquire data are discussed later in this paper (see 8.1). The Prism Market Place allows them to access data efficiently through a dedicated portal.

Data users will be able to purchase data in two ways:

- Directly through the marketplace using PSX
- Indirectly via third parties, such as brokers, using fiat

Prism is currently holding NDA discussions with major pharmaceutical groups willing to integrate with our Market Place to diversify their data acquisition channels. It is expected that MoU's resulting from these discussions will be finalized before end 2018.

4.2.4 Facilitators

The Prism Decentralized Market Place creates the opportunity for agents to facilitate transactions. Such agents, or brokers, will allow companies and individuals to access the Prism services without having to directly buy or sell PSX.

These transactions will be secured by smart contracts and thereby rendered "trustless".

4.2.5 Network keepers

To ensure decentralization, a blockchain needs to design an incentive consensus validation protocol. Keeping a network safe requires to spend time and resource, and won't be done without a proper compensation.

The innovative Proof of Credit (PoC) validation protocol designed by NULS will be used in Prism V1 of main net. It allows validators to earn PSX in exchange for keeping the network safe.

5. Business model

5.1 Go-to-Market

Prism is the first ever medical data exchange platform that is proactive on the data generation process. This is the main competitive advantage of Prism: instead of relying on third parties to acquire data, we empower individuals to do it by themselves.

Medical data are expensive due to their utility and scarcity. While the utility is well explained in this paper, the scarcity is mainly due to the fact that collection is executed only by a small number of entities, mostly medical professionals. One of the key strategies of Prism is to change that, by both integrating IoT devices in the data collection process and by facilitating their distribution.

The measures taken by Prism to empower individuals in their data collection process are discussed below.

5.1.1 IoT device integration

Prism is providing OpenAPI and SDK to allow the integration of IoT devices into the Prism network. A dedicated entity will define a set of properties with which devices must comply to be integrated: The Prism Certification.

Integration with Prism offers device makers the benefit of providing their customers a broader user experience. Instead of collecting data for personal consumption only, by integrating with Prism their customers will be able to use their data on a vast network, allowing them access to expanded features and experiences that device producers could not provide on their own.

The Prism Certificate will be a brand enhancement tool. Our vision is for Prism to become a standardized protocol for medical data exchange in South East Asia. A device certified as "Prism Compliant" will not only have access to a widely used network which enhances the experience of the device owner, but will brand it as one compliant with a widely and well-regarded standard of quality.

First use case - Nano optical-spectrometer

The prime device integrated in the Prism Protocol is the first ever Nano optical-spectrometer. An optical spectrometer is an instrument used to measure properties of light over a specific portion of the electromagnetic spectrum, typically used in spectroscopic analysis to identify materials. It reveals the composition of a sample by decrypting the

spectrum of the light reflecting from the analyzed material. For many decades this technology has been widely used by laboratories and medical professionals to undertake the analysis of medical samples (spectroscopic analysis[13]).

The current technology is only accessible to medical professionals due to the price, size, complexity and fragility of the equipment required to undertake it. Our partners have patented an innovative manufacturing process which allows the manufacture of a spectrometer at the size of a coin, with a level of accuracy at the same standard as a $30k laboratory machines, while being in the hundred USD price range.

Listed below are the specifications and applications of the spectrometer:

- **Small -** Professional laboratory reagent-based tests in hand-held device.
- **IoT -** All result transmitted to smartphone.
- **Rapid -** Test time within minutes.
- **Versatile -** Health monitoring and food safety inspection. Hundreds of test items based on urine, blood, biological and food safety test strips or reagents.
- **Easy -** Finishing all the test procedures and wirelessly sending the results to smart phone with one-touch.
- **Accurate -** ±0.1% accuracy, 100 x better than current handheld device.
- **Smart -** Intelligent health profile management with smart phone APPs. Linked to expert system on the cloud for advanced diagnostic suggestions.

The spectrometer is capable of analyzing a wide range of markers, using lab-based reagent procedures. Below the list of markers measured on urine, with the related diagnostics:

[13] https://link.springer.com/chapter/10.1007/978-3-7091-6840-0_9

Measure	Diagnostic
Protein Occult Blood Nitrite Leukocyte Specific Gravity pH	Kidney, Urethra
Glucose Asco. Acid Ketones	Diabetes, Metabolism
Bilirubin Urobilinoger	Liver, Gall bladder

By using the same testing protocol as professional laboratories, we ensure that our results are medical grade. Empowering individuals with such a device will be a major step towards the path to a preventative based healthcare system. It will allow patients with chronic diseases, such as diabetes, to collect their data effortlessly and independently. Users will be able to perform regular check-ups, based on historical data, remotely from, and at a fraction of the cost of, traditional medical facilities, significantly reducing the risk of not being diagnosed with serious diseases before they reach advanced stages.

Preventative healthcare will not kill cancer. It will allow individuals to detect it at less critical stages, where cure is easier, less expensive, and less invasive. At the same time, being given a visual interface of their health condition normally hidden to them before the appearance of symptoms, will create health consciousness, and improve lifestyle habits. It will be a virtuous circle, where individuals self-monitor their health markers and act before the situation becomes problematic.

Our team members, together with our partner's team, had the opportunity to present the Nano spectrometer at the Consumer Electronic Show (CES) at Las Vegas in January 2018. The integration will be completed for the release of the alpha version of the platform mid-2019.

The Nano spectrometer is only the first of a long list of IoT devices to be integrated into the Prism Protocol, some of them being already the subject of advanced discussions with their developers/owners. Regular updates of the integrated devices will be forthcoming, with at least three being available by the release date of the alpha version of the platform.

5.1.2 Distribution channels

Having available integrated IoT devices is already a major step towards the empowerment of individuals, but we believe it is not sufficient. Prism aims to accelerate the transition towards a preventative based healthcare system by proactively facilitating the distribution of IoT devices.

Prism is securing partnerships with major players who have interests in the transition to preventative healthcare. Those players include governments, public organizations, corporate healthcare programs, NGOs and above all, health insurers.

Health insurers have been skeptical towards the adoption of a preventative based healthcare system due to the cost of its application. Prevention requires by essence to be used massively, while rarely showing results. Insurers aim at reducing the interactions with medical professionals, not increasing them. A system relying on medical professionals, due to the incapability of individuals to collect medical data by themselves, is not in their financial interest.

The impact on health insurers of a cost-efficient preventative healthcare system would nevertheless be tremendous, not only as a powerful marketing concept capable of attracting new customers, but as a means of producing healthier (and therefore more profitable) customers. A healthier client is a client which remains a center of profit, and not a center of cost. Health insurers are constantly seeking ways to incentivize their clients to adopt healthier life styles in order to reduce the clients' risk of suffering from severe illnesses and the insurers' exposure to the resultant costs of treatment[14] . This win-win equilibrium will be made possible thanks to the adoption of cost-efficient preventative measures, such as self-collection of RWD via the use of IoT devices.

Prism is in discussion with major insurers to implement new policies which will directly provide to individuals devices such as the Nano spectrometer. Prism is currently under due diligence by selected insurers to allow them to assess the potential economic and marketing impact on their businesses of integrating the Prism Platform. Importantly, Prism policies and protocols will never include pre-screening of clients by insurers, nor continuous monitoring in order for them to adjust clients' premiums based on their health condition. Prism users, and only Prism users, will have access to their data, unless they choose to share it for diagnostic or monetization purpose.

[14] https://www.forbes.com/sites/parmyolson/2014/06/19/wearable-tech-health-insurance/#622262118bd5

In this regard regular updates will document our advancements and secured partnerships.

5.1.3 Data interoperability platform

Prism empowers its users with integrated IoT devices to facilitate the orderly collection of medical grade health data. The Prism Protocol has been created to serve as the base layer allowing the interconnection of the healthcare ecosystem, centered around medical data.

How can this data be used?

Prism is an OpenAPI and SDK platform, allowing different entities to create portals and applications using medical data. Growing adoption among users will increase the incentive for corporations to integrate the Prism Protocol, thus increasing the utility of the platform, generating a virtuous circle.

5.2 Revenue generation & use cases

Prism revenue generation is based on the sharing economy model. The sharing economy is a peer-to-peer ecosystem allowing buyer and seller of goods and assets to trade thanks to a commonly used platform. The main examples are Airbnb for the house market, or Uber for the private driver transportation market. By improving the global utility of its community, Prism generates a surplus of added value. Part of this surplus is redirected by smart contract to sustain the cost of maintenance and development of Prism's peer-to-peer platform in order to keep serving its community. The advantage of such model is that it is directly correlated to the utility generated by its services.

For this purpose, no solution, as good as it may be, is sustainable without being self-sufficient. Prism's economic model has been structured to sustain not only its maintenance cost, but also to provide sufficient revenue to maintain investment in its development to retain relevance in the ever-changing high technology industry. Prism‘s model aims specifically to avoid the mistakes of the past by corporations who took advantage of their leading position to over tax a service, reducing the utility of its community.

Below are listed the different use cases embodied in the Prism platform. The potential creation of new additional usages prevents an exhaustive list at this pre-release stage.

5.2.1 Telemedicine

The first and most obvious function of a healthcare platform is that of providing services which facilitate the functioning of and improvements in healthcare. The Prism Protocol aims at integrating major telemedicine portals, allowing users not only to interact with doctors remotely, but also to provide them with accurate medical data.

Prism's OpenAPI and SDK architecture will allow third parties to develop A.I. as a Service

diagnostic algorithms. It is evident today that A.I. algorithms, already capable of giving diagnostics with a higher accuracy than a doctor in some fields[15], will play an ever-growing role in healthcare.

5.2.2 Data purchase

Prism will allow users to monetize their data to corporations willing to openly purchase it for the transparent goals of improving healthcare. The data transfer can be anonymous, depending on the type of request from the data buyer, and will always remain the clear decision of the user sharing his/her data. The vast majority of the compensation will be transferred to the PSX wallet of the user.

The previous transactions might be triggered by massive Data Purchase Orders (DPO). DPOs are issued by pharmaceutical groups for the purpose of obtaining data pertinent to a particular condition, such as diabetes or cholesterol levels, for statistical analysis. Such DPOs may require data to be shared anonymously, and passively (data contributor simply provides access to their historical data, without being asked to generate specific new data).

Other types of interactions exist, that are more direct and require an active participation of the data contributor. This is the case for Clinical Trial (CT), or medical follow up, in order for drug makers, or medical professionals, to see the long-term impact of their prescriptions.

5.2.3 Personal health management

The Prism App provides advanced features/applications which users will be able to unlock on a freemium model basis. Such features will include (but not be restricted to) advanced graphic user interface, proprietary data reading algorithms, and enhanced interconnectivity.

5.3 Roadmap

The Prism Protocol development commenced in 2017 with the incorporation of the parent company in Singapore. By the end of 2017, the first device MoU had been signed (with the developers of the integrated Nano Optical Spectrometer), and the first round of seed capital secured.

2018 marked the progress of discussions and negotiations with the various players of our ecosystems, including insurers, pharmaceutical groups and device makers. The Prism token model was designed and formalized, and the Prism white paper published. Token sales

[15] https://www.theverge.com/2018/2/19/17027902/google-verily-ai-algorithm-eye-scan-heart-disease-cardiovascular-risk

commenced in mid-2018 as initial first seed round investments from various institutional investors. Blockchain developer NULS became a Prism technical supporter and investor in July 2018, when Prism was introduced live on stage as NULS' first investment and partner during the main NULS main net release ceremony in Beijing.

By the end of 2018, Prism expects to have signed an MoU with at least one data user (pharmaceutical group in priority) and one insurer for device distribution and to have advanced the integration of other devices into Prism's certified range of devices.

Prism's Token Generation Event (TGE) is planned for early 2019. PSX will be directly listed on major exchanges within a week of the closure of the TGE.

Prism's alpha version of main net is planned for release by mid-2019, one semester after the TGE. Technical implementation commenced in mid-2018.

The initial targeted markets for the Prism platform are China and South East Asia, with a focus on Thailand and Singapore.

6. Technical Infrastructure

6.1 Based on NULS Architecture

Prism is an application built on top of the NULS blockchain protocol. NULS is a blockchain that architecturally enables extendibility using smart contracts, modules and sub-chains. It separates its features into customizable modules such as smart contracts, the multichain system, cross-chain consensus and other operating mechanisms.

Prism is an independent and customized sub-chain of the NULS ecosystem. It benefits from the functionalities of the main-chain, while being tailor made to serve its purpose. By using the underlying protocols and infrastructure of NULS, Prism will be developed and deployed faster. Prism's development team works closely with the NULS team, giving Prism access to their experiences and resources. Prism's lead developer, Rui Zhao, is one of the core developers of the NULS infrastructure.

6.2 Modular

Prism will inherit its modular architecture from NULS. At the same time, Prism will create its own Business Modules and Function Modules, such as Account Module, Ledger Module, Network Module, Consensus Module, Data Module, Storage Module and Security Module.

6.3 Proof of Credit (PoC) Consensus

Prism will apply the NULS Proof of Credit protocol which is the first of its kind. It works like Proof of Stake where a certain number of tokens will need to be locked before a user can run a node on the network. When users wish to stop running a node, they can immediately unlock their tokens.

A credit coefficient exists for each account in the system. Credit ratings are between -1 and 1 and are automatically calculated based on the behavior of the node using the credit rating algorithm. To ensure balance and fairness in the entire Prism system, the consensus reward is computed based on the amount of staked coins and the node credit submitted by all consensus nodes.

6.3.1 Yellow Card

When a user generates a block during an internet disconnection, computer crash or when experiencing network issues, this will not be considered as a violation of the network's rules. However, because such an event will affect the entire system, a warning will be given and the tokens will be frozen for a period (e.g. 72 hours). The credit ratio will also be downgraded.

6.3.2 Red Card

In the case of hostile attacks, double spend attacks, attempts at forking the system or deliberately trying to attack the system, the Prism network will be able to detect and protect from vulnerabilities and exploits. Any hostile nodes will have their tokens frozen for a longer period (e.g. 1 month) and their credit ratio will be downgraded again meaning they are no longer able to meet the minimum amount to participate in the network.

6.3.3 Consensus reward formula

The consensus reward formula is shown below:

$$coinbase = fee + 5000000 * rnc * \frac{bti}{spy} * \frac{cmc * \max(0, cr)}{\sum_{1}^{rnc} cmc * \max(0, cr)}$$

fee = Fee for this block.
rnc = Round Node Counting.
bti = Block Time in Second.
spy = Second Per Year.

cmc = Consensus Mortgage Count
cr = Credit Ratio

6.4 Data

6.4.1 Account Center

Prism will be based on accounts. When a user creates an account, he will receive two keys, one a private key, the other a public key. Prism will apply the same elliptic curve encryption as Bitcoin. It will take more than 1 billion years to decode even if using super power computer.

The private key will be owned only by users. It will be used for the signature of all contents. This private key will be stored only in the user's computer, with the possibility of generating a safer hard copy. Without a private key, a user cannot create, update, delete or access his data, nor grant any access to others.

6.4.2 Encryption

Prism requires extremely high levels of security for data. The data needs to be secured during their transmission and storage phases, regardless of being on-chain or off-chain. All data are encrypted with complex algorithms and integrity verification to avoid modification and leakage.

6.4.3 Storage Mode & Architecture

The data within the Prism platform will be stored in two parts: local storage (off-chain), and on-chain.

The personal medical grade data of each individual will be stored locally (off-chain). The benefits will be multiple:

- After the algorithm is updated it will be quicker to synchronize and re-encrypt. This is critical, as it will secure the updates of the algorithm, while giving to the user the control of the algorithm to encrypt his own data, stored locally.
- The compliance to the legislation of each country. In some countries, it's mandatory to keep personal health data inside of the country, even it's encrypted. PRISM wants to be a global platform, so it needs to comply with each country's legislation.
- Users retain full control over their own data. Once the data is on-chain, it is duplicated and distributed to each node, which means everyone gets a copy of the user's data. In the case where the user wishes to delete his data, it will require all nodes to execute the transaction.

- The blockchain will remain light and efficient, making data access requests extremely fast to execute. A low latency network allows small pieces of off-chain data to be loaded within a split second. Having all data on-chain will result in huge storage requirement and transmission inefficiencies.

Users' general information will be stored on-chain with metadata. Prism's blockchain will consolidate all metadata, providing on-chain indexations to execute in an efficient way all data access requests.

Data will be organized with JSON format.

6.4.4 Privacy

While storing data directly on a blockchain works well, it suffers from two key shortcomings – confidentiality and scalability.

~~In~~ terms of confidentiality, the content of every stream item is visible to every node on the chain, and this is not necessarily a desirable outcome. In many cases a piece of data should only be visible to a certain subset of nodes, even if other nodes are needed to help with its ordering, timestamping and notarization. Privacy is a relatively easy problem to solve, by encrypting information before it is embedded in a transaction. The decryption key for each piece of data is only shared with those participants who are meant to see it. Key delivery can be performed on-chain using some off-chain mechanism. Any node lacking the key to decrypt an item will see nothing more than binary gibberish.

Every record of user data is fully controlled by the user himself with encryption. Users can decide with whom they want to share as well as the way of sharing, including:

- Share to specific user;
- Share to all;
- Cancel sharing;
- Sharing according to certain conditions;
- More ways of sharing to be introduced in the future;

6.5 Client

Prism provides for different clients to interact with its network according to different roles.

6.5.1 Node Wallet

Node wallet is mainly used by miners, who receive benefits by providing stable and efficient super nodes. Through node wallet, miners will easily monitor their profit or the traffic of Prism network. Node wallets will be available for MacOS, Windows and Linux.

6.5.2 Application Client

Application client is mainly designed for individuals as personal users, they could top up their account with FIAT, PSX transfer, manage their data, interact with telemedicine, and other business transactions in the future. Application client includes for both Android and iPhone terminals.

6.5.3 Business Client

Business client-is designed mainly for brokers, A.I. developers and telemedicine, who will have the ability to develop their own business through the Prism network.

6.6 Integration

6.6.1 OpenAPI

Thanks to the OpenAPI of Prism, entities can easily integrate into the Prism network. All OpenAPI will be RESTful style, supplying with JSON-RPC, and data will be exchanged with JSON. JSON-RPC is installed for every client, and commenced with the launching of that client. Any users will be able to close an account temporarily or forever.

Prism will also provide a developer website, where users will find the whole OpenAPI documentation and related examples for reference.

6.6.2 SDK

Beside OpenAPI, Prism will provide SDK of several languages, to facilitate business integrations and reduce development efforts. SDK is a higher layer package for OpenAPI that

eases the integration to the Prism Network, Those SDK will be available for Java, Go, Python, NodeJS and .NET.

7. Token utility

Prism Token is a utility token providing a double utility. It will be used as a cryptographic means of payment within the Prism ecosystem, allowing transactions to be seamless and secured. It is also at the center of Prism's consensus validation protocol, providing incentives for agents to secure the network, thus ensuring decentralization.

Designing a proper token model is key when undertaking a utility token crowd sale. As well as the key points an investor needs to consider when assessing a traditional venture, such as the project, the team, or the market, Initial Coin Offerings (ICOs) require consideration of the token model. A stock imparts ownership of a venture, ensuring a link between the success of the company and the profit of an investor. That is not necessarily true for all tokens, especially those which aim not to be securities, such as utility tokens.

The relationships involved in the theoretical pricing of a given utility token are explained in 7.1 below, and how the Prism Tokens' design and application conforms to this theory is demonstrated in the following Section 7.2.

7.1 Theoretical Pricing

7.1.1 Network value, Monetary Mass and Velocity

The vast majority of the currently operating and incoming projects are based on imperfect token econometric models. They assert that the success of their solution will lead to an increase of the transactions on their network, leading to a higher demand for their token. This could make sense knowing that the value of the network will indeed increase. We have the following relationship:

$$(1)\ Network\ Value = P \times Q$$

where:

$$P = Price\ index\ of\ the\ goods\ and\ services\ available\ on\ the\ network$$
$$Q = Number\ of\ Transactions$$

An understanding of the interaction between the network value and the available monetary mass is required. If there is a positive linear relationship between the two, then indeed the rise of the value of the network *must* result in a higher available monetary mass, everything else remaining the same. This leads to the introduction of the concept of velocity. The

velocity is the rapidity of a medium of payment. It refers to how fast money passes from one holder to the next. In other words, it is the number of times one unit of money is spent to buy goods and services per unit of time, usually one year. For instance, the US dollar has a velocity of 5.5, down from 10.5 before the financial crisis.[16]

Understanding this concept requires the introduction of the concept of equation of exchange[17]:

$$(2)\ M \times V = P \times Q$$

where:

$$M = Available\ Monetary\ Mass$$
$$V = Velocity$$

This equation shows that an increase of the value of a network will not necessarily lead to an increase of the available monetary mass (M). This can be shown with a quick example. Consider a given ecosystem composed of a monetary mass worth 100 units, a network value of 1,000 units, implying a velocity of 10. An increase of the transaction of 20% leads to a network value of 1,200 units. To respect the equation of exchange something has to change on the other side. It can be resolved by a velocity of 12, meaning that the speed of money increased, filling the increasing need for money in the network. Another way to see the equation of exchange is the following:

$$(2.1)\ M = \frac{P \times Q}{V}$$

This shows more clearly the negative relationship between the velocity and the monetary mass. A proper utility token model will be a model addressing the "velocity problem"[18]. A new way, therefore to define the available monetary mass on a tokenized ecosystem is:

$$(3)\ M = \Omega(1 - \alpha)\mathrm{T}$$

where:

$$\Omega = Total\ supply\ of\ Token$$
$$\alpha = Number\ of\ Token\ not\ available\ to\ the\ network$$
$$T = Token\ price$$

It is clear that the total number of tokens available for the network times their value will give the available monetary mass to power the network. A new term α, corresponding to the number of tokens not available for the network, is introduced at this point. This variable can be interpreted as tokens locked for vesting, reserves and stacked tokens. A clear relationship is visible between M and α where the higher the number of tokens not available for the

[16] https://fred.stlouisfed.org/series/M1V
[17] https://en.wikipedia.org/wiki/Equation_of_exchange
[18] https://multicoin.capital/2017/12/08/understanding-token-velocity/

network, the higher the token price, for a given monetary mass. Replacing M by its value in (2.1) results in the following:

$$(4)\ \Omega(1-\alpha)\mathrm{T} = \frac{P \times Q}{V}$$

A simple way to strengthen the hypothesis of an unchanged velocity after an increase of α is to imagine an agent of the network deciding to keep every token he receives. With time this will cause a token scarcity, creating an increase of its value for a given demand due to the reduced offer. It is unlikely that the network, composed as it is of individuals spread around the world, who do not know each other, will change its patterns of money spending and increase its velocity because one of its agents is changing his pattern. Individuals won't even know that someone is actually "stacking" tokens. They will note that suddenly it is harder to get tokens, and token sellers will take this opportunity to increase their price, resulting in a higher token price.

How to positively influence the value of α (ie. ways to incentivize individuals to stack their tokens) is discussed below.

7.1.2 Consensus incentivizing scarcity

Proof of Stake (PoS) is a type of algorithm by which a cryptocurrency blockchain network aims to achieve distributed consensus. In PoS-based cryptocurrencies, the creator of the next block is chosen via various combinations of random selection and wealth or age (i.e., the stake). In contrast, the algorithm of proof-of-work-based cryptocurrencies such as Bitcoin uses mining; that is, the solving of computationally intensive puzzles to validate transactions and create new blocks.[19]

When an agent of the network is chosen to validate a transaction, he is rewarded with tokens for servicing the network. A PoS model can be compared to a taxi license: individuals need to pay to obtain the right to work for the network and be rewarded.

It is evident therefore that a PoS token model incentivizes individuals to stack tokens, and therefore tends to increase α, and by this M. The likelihood of an individual to stack tokens and work for the network will depend on how beneficial it is. Indeed, in a Decentralized Autonomous Organization (DAO) which is not based on trust, the only way to have individuals powering the network is to incentivize them enough so that they see an interest in doing so.

[19] https://en.wikipedia.org/wiki/Proof-of-stake

A simple way to generate money to reward the validators is to apply transaction fees to a network. It is quite fair that the users of a network reward the agents whose efforts allow the network to be trusted. Therefore, the larger the size of the network, the higher will be the amount of money to be shared between the validators.

The cost to maintain the network must also be considered. If this cost is higher that the potential benefits, no one will see its interest in maintaining the network.

The last point that needs to be considered is the perception of the future value of the network by the agents. Stacking tokens leads to a stable income directly correlated to the value of the network. While at a given time it may not be considered financially worth maintaining a network because of its small size, future growth needs to be considered. All of those points imply the following relationship:

$$(5)\ \sum_{i=0}^{k} \frac{(P_i Q_i)\lambda - C_i}{(1+r)^i} = nST$$

where:

$i = 1\ unit\ of\ time$
$k = Maturity\ of\ the\ project$
$P_i = Price\ index\ of\ the\ goods\ and\ services\ available\ on\ the\ network\ at\ time\ i$
$Q_i = Number\ of\ transactions\ at\ time\ i$
$\lambda = Transaction\ cost\ in\ percentage$
$C_i = Cost\ of\ maintaining\ the\ network\ at\ time\ i$
$r = Discount\ rate, perceived\ risks\ of\ the\ future\ cash\ flows$
$n = Number\ of\ agents\ maintaining\ the\ network$
$S = Number\ of\ tokens\ to\ be\ stacked\ to\ be\ elligible\ to\ maintain\ the\ network\ (PoS)$

This relationship illustrates the fact that individuals value future cash flows at a lower price than present cash flows, and that this discount factor increases with time and risk/uncertainty. The left side of the equation is the Net Present Value (NPV) of the revenue generated by maintaining the network over a period k. We can simplify (5) by writing:

$$(5.1)\ \sum_{i=0}^{k} \frac{(P_i Q_i)\lambda - C_i}{(1+r)^i} = NPV_i^k$$

$$(5.2)\ NPV_i^k = nST$$

nST represents the value of the tokens which are stacked to maintain the network. Equation (5.2) stands that this amount must be equal to the benefit of stacking those tokens over a period k. If the two differs for too long, it will create arbitration opportunities.

Equation (5.2) also gives a new definition to the token value T:

$$(5.3)\ T = \frac{NPV_i^k}{nS}$$

The value of the token is equal to the value of maintaining the network divided by the number of tokens stacked for its maintenance. An increase of NPV_i^k will lead to an increase of either the token price or the number of stackers. Equation (5.3) also gives us a new definition of the number of stackers:

$$(5.4)\ nS = \frac{NPV_i^k}{T}$$

If the number of stackers increases, it means that more people wants to maintain the network because it has become more profitable, so they will buy tokens and stack them, removing them from the ecosystem, thereby increasing α. As demonstrated in (4), an increase in α, with a constant velocity, *must* lead to a rise of the token price. Therefore, an increase of NPV_i^k can only lead to an increase of the token price for a given velocity.

Another way to define α is the following:

$$(6)\ \alpha = \frac{nS}{\Omega}$$

Indeed, the percentage of stacked token equals the number of stacked tokens divided by the total number of tokens. Using nS value given in (5.4) in (6):

$$(6.1)\ \alpha = \frac{NPV_i^k}{\Omega \mathrm{T}}$$

Replacing α by its new value in (3) produces:

$$(7)\ M = \Omega\left(1 - \frac{NPV_i^k}{\Omega \mathrm{T}}\right)T$$

And by developing $\Omega\left(1 - \frac{NPV_i^k}{\Omega \mathrm{T}}\right)$

$$(7)\ M = \Omega \mathrm{T} - \frac{NPV_i^k}{\Omega \mathrm{T}}\Omega T$$

Producing:

$$(7)\ M = \Omega\mathrm{T} - NPV_i^k$$

And using the value of M in (7) in equation (2.1) the final relationship emerges:

$$(8)\ \Omega\mathrm{T}_i - NPV_i^k = \frac{P_i \times Q_i}{V_i}$$

Equation (8) illustrates the final point: an increase in NPV_i^k *must* lead to an increase of a token price at time i, for a given network value and velocity. This can typically be observed when a company releases good news. The statement implies an increase of the network future value, and therefore an increase of NPV_i^k. Nevertheless, the price of the goods and assets available on the network do not change for time i, neither does the number of transactions. There is no reason for the velocity to be affected either. Therefore, the only variable that can equilibrate the equation is the token price.

It has been demonstrated herein that a proper token definition such as the PoS leads to a clear relationship between the network discounted value and the token price. A token value can be divided in two: its intrinsic value and its speculation value. While the speculation value does not rely on rational behavior, the intrinsic value can be interpreted as a bottom value for the token. Any token value that is lower than the intrinsic value will lead to arbitration opportunities, which will end in a rise of the token price. Most of the currently running ecosystems have a market value mainly composed of speculation value due to the lack of incentive to hold tokens. The use of their platform does not properly create token scarcity. It converges towards a higher velocity to meet the network's need for money. The resulting high velocity allows the network to run perfectly with a very small monetary mass, regardless of its size. A key step to crypto currency adoption is the design of tokens which have a value truly linked to the success of the project they back, such as the PoS model.

7.2 Prism Token

The Prism consensus validation protocol has been designed to create mathematical scarcity. The Proof of Credit (PoC) consensus is an advanced version of PoS. While incentivizing network keepers to stack tokens, creating scarcity, it increases the network stability by giving a credit score to validators. This way, rogue agents, or inefficient network keepers, are

removed from the consensus validation protocol, ensuring that validating agents are working towards the optimum functioning of the network.

7.2.1 Medium of Value

Prism first utility is to be used as a cryptographic medium of payment within the Prism network. Every transaction is powered and secured by Prism. In this way, an increase in the network value, at constant velocity, will lead to the increase of the token price, assuming a constant speculation around the token price.

7.2.2 Block Reward

As defined in 6.3.3, Prism token is minted by network keepers as part of the block reward function. In this way, Prism consensus validation protocol converges towards a mathematical scarcity of PSX.

8. Healthcare industry advantages in adopting Prism

8.1 Pharmaceutical groups

Big Data in the healthcare and pharmaceutical industries is a host of applications ranging from drug discovery and precision medicine to clinical decision support and population health management.

According to research and markets Big Data investments in the healthcare and pharmaceutical industries will account for nearly $4.7 Billion in 2018 alone. Led by a plethora of business opportunities for healthcare providers, insurers, payers, government agencies, pharmaceutical companies and other stakeholders, these investments are further expected to grow at a CAGR of approximately 12% over the next three years[20].

Drug makers are racing to scoop up patient health records and strike deals with technology companies as big data analytics begin to unlock a trove of information about how medicines perform in the real world.

[20] https://www.researchandmarkets.com/reports/4599594/big-data-in-the-healthcare-and-pharmaceutical

Studying such real-world evidence (RWE) offers manufacturers a powerful tool to prove the value of their drugs. RWE involves collecting data outside traditional randomized clinical trials (RCT).

Half of the world's 1,800 clinical studies involving real-world or real-life data since 2006 have been started in the last three years, with a record 300 last year, according to a Reuters analysis of the U.S. National Institutes of Health's clinicaltrials.gov website. Most common areas for such studies include cancer, heart disease and respiratory disorders.

Historically, it has been difficult to fully understand how drugs work in routine clinical practice, but the rise of electronic medical records, databases of insurance claims, fitness wearables and even social media now offers a wealth of new data.

The ability to capture the experience of real-world patients, who represent a wider sample of society than the relatively narrow selection enrolled into traditional trials, is increasingly useful as medicine becomes more personalized.

Learning from the experience of millions of patients provides granularity and is especially important in a disease like cancer, where doctors want to know if there are greater benefit derived from using a certain drug in patients with highly specific tumor characteristics.

All the world's major drug companies now have departments focused on the use of real-world data across multiple diseases, and several have completed scientific studies using this information to delve into key areas addressed by their drugs. They include diabetes studies by AstraZeneca and Sanofi, joint research by Pfizer and Bristol-Myers Squibb into stroke prevention, and a Takeda Pharmaceutical project in bowel disease.

8.2 Insurers

Insurers' business model are based on the fact that the money collected from healthy individuals will more than offset that distributed to those receiving care. Prism aims at acting towards a decrease in healthcare claims for severe illnesses, thanks to continuous prevention due to the use of self-collected RWE via IoT devices.

Prism encourages individuals to become more health conscious, by empowering them with their healthcare management. Studies show that healthy habits decrease the risk of Cardio-Vascular Diseases (CVD)[21].

The main advantage for insurers is that Prism achieves increasing health consciousness and the resulting improvement in standard of health by the massive use of self-collected RWE.

[21] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2267926/#S3title

The cost of prevention is minimized by removing to a large extent the expensive patient-doctor interaction.

8.3 Governments

Governments have a social mission of guaranteeing the security, health, and happiness of their population. Government-sponsored social security programs have been created for this purpose, but funding these in current times is seriously challenged by ageing of the population, unhealthy diets, and a subsequent rise in levels of obesity[22] and other negative health issues.

Prism will help educate individuals about the benefits of preventative medical action and empower them with the tools required for their own proactivity in this regard. Prism will help patients with chronic diseases by reducing the burden of external data measurement. Finally, Prism will increase the likelihood of early diagnosis of severe illnesses, thus improving survival rates and minimizing the cost and invasiveness of treatment.

8.4 Medical corps

Prism offers an opportunity to enhance the quality of work of medical professionals by relieving them of non-medical tasks such as data entry, data searching and data collection. freeing time for them to focus on what truly matters: interacting with patients and curing them.

Since the diagnostic part of a physician's work is not the most qualitative part, an A.I.-assisted diagnostic will increase the accuracy and reduce the risk of misdiagnosis in physician's work. Misdiagnoses are responsible for 250,000 deaths per year in the US alone, making it the 3rd leading cause of death[23].

8.5 Humanitarian benefits

Prism's targeted distribution channels include NGOs in developing countries. The Prism platform, its range of accredited data collection devices, and its cost advantages over traditional medical data collection will facilitate the inclusion of many of those individuals currently excluded from the traditional healthcare system due to financial or availability reasons. In addition, and as part of Prism's Corporate Social Responsibility program, Prism is committed to invest a portion of revenue to improving preventative healthcare worldwide.

[22] https://stateofobesity.org/healthcare-costs-obesity/
[23] https://hub.jhu.edu/2016/05/03/medical-errors-third-leading-cause-of-death/

9. Conclusion

The Prism Protocol has been designed to empower individuals with their healthcare by allowing the self-collection of medical data and assigning to them its ownership.

The Prism interoperability platform allows data to flow in a seamless and secured manner. The continuous healthcare management of individuals will lead to a preventative based healthcare system, changing the current paradigm where diseases are noticed as they appear rather than detected beforehand.

The Blockchain infrastructure of Prism is powered by PSX, its native utility token. The consensus validation protocol has been designed to create mathematical scarcity over the token supply, ensuring a real purpose to hold tokens, besides the Store of Value (SoV) argument.

Finally, Prism open-source development based on OpenAPI and SDK has been designed to gather the leading players involved in the digihealth market by creating a common marketplace for data. The decentralization and digitalization of healthcare data provided by Prism will ultimately lead to a preventative based healthcare system.