TraneAi: Decentralized Network for Artificial Intelligence at Scale

trane.ai

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ABSTRACT

Large amounts of training data are required to improve the accuracy of artificial intelligence and expand the capacity of what AI-systems can see, say and comprehend, thus expanding the pool of applied use cases for AI. Through an open, decentralized network that includes companies that supply data and individuals who label data, an economy is created around the need to prepare data for AI-training. The open source protocol that facilitates this training is called TPAI (Transaction Protocol for Artificial Intelligence). The incentive-based economy that drives the use of this protocol lives on the blockchain and functions with a native token called a TPAI token. TraneAi is the first platform to tap into this economy and utilize TPAI. TraneAi gives people across the globe who don't have a background in data science the opportunity to participate in AI innovation. Anyone can use TPAI to engage Crowd-miners to label/annotate, train, store and distribute data. The TraneAi platform demonstrates how TPAI creates a value-based ecosystem on the blockchain.

TPAI functions as a layer on top of an innovative AI system that uses machine learning to verify proofs and transactions across the network. This sits on top of a proven, decentralized, blockchain-based storage network powered by IPFS storage infrastructure. Such an open system liberates the raw material of artificial intelligence — "data" — from a single point of control giving it both permanence and community governance.

The demand for AI-focused services and data is growing at a rapid pace. This paper details how the TPAI enables a high-value-creation ecosystem as follows:

(a) Introduces the TPAI token and ecosystem

(b) Overviews the TPAI token components in detail

(c) Introduces a first-of-its-kind AI-based proof-of-performance process which allows proving of work quality on the network

(d) Formalizes mining incentives

(e) Outlines the demand for ai-data and services across all industries

(f) Illustrates use cases and how the token protocol will be used in the implementation case

EXECUTIVE SUMMARY

Forrester Research projects the artificial intelligence market will blossom to $1.2tn (Global GDP annual growth rate of 3.5%) by 2020[1], and will drive change in almost every aspect of our existence from how countries operate, companies operate and people navigate their daily lives.

AI innovation is not without challenges. AI must be trained, and like a human, that process includes integrating new data with previous learnings. Preparing data sets for AI training is currently a costly and time-consuming process, and as a result it slows down progress and hinders product development.

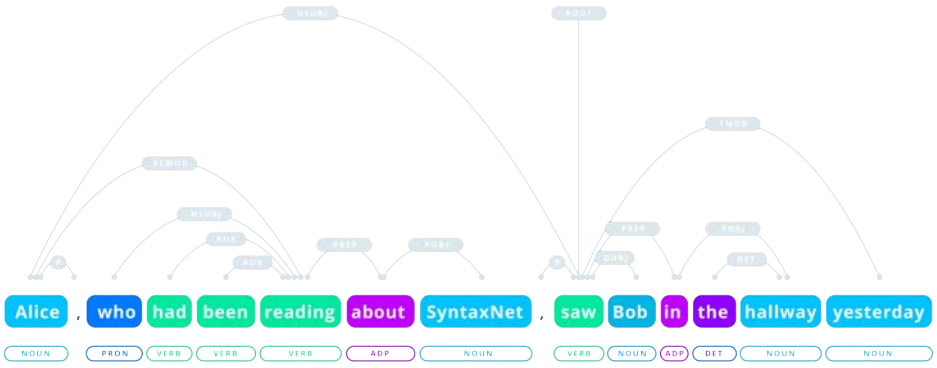
Our vision is an ecosystem of companies and individuals that cooperate to accelerate AI innovation through an open, decentralized network, built on blockchain technology that provides smart contracts and secure data storage. We have streamlined the training process by utilizing crowds to quickly and cost-effectively prepare data, which eliminates a major bottleneck. TraneAi is a platform that unites crowds and companies in a more efficient and effective methodology for AI-training in the following manner:

- TraneAi is the platform upon which companies and crowds collaborate.
- Companies planning to develop AI-powered products supply their data to TraneAi.
- TraneAi disseminates that data to the crowd for labeling through a simple process that any layperson can use.
- TraneAi has developed a protocol for the streamlining of the training process, called TPAI (Transaction Protocol for Artificial Intelligence), which we have made open source so that anyone in the ecosystem can develop on it and contribute to the enhancement of the ecosystem.
- An AI agent audits the data sets created by the crowd and awards tokens, called TPAI tokens, for highly-qualified, useful data.
- TPAI tokens can in turn be used by holders to procure products and services, such as custom chatbots.

[1] https://www.techemergence.com/valuing-the-artificial-intelligence-market-graphs-and-predictions

The Challenge of AI

Like humans, what the AI understands is based on the data it is familiar with; like humans, the more quality data the system has, the better the system operates. Today, AI systems depend on supervised learning. Properly labeled data is prepared containing examples of anticipated user inputs alongside desired outputs. Code iterates through advanced algorithm-based computations producing a model of possible outcomes based on the labeled data. This is called training. The better the data, the better the outputs. Data scientists and topical experts review the output created from the training process (called a model) and update labels or include new labeled data to incrementally improve it's accuracy. For a computer to see, having the ability to recognize general objects requires millions of images to be labeled and trained. One of the most popular cases of this is ImageNet[2]. For a computer to comprehend a user's sentence, given the different ways people express their ideas, the volume of labeled data that is required is even greater.[3]



Part of speech processing example

Training data remains the greatest challenge given it is prohibitively expensive, time-consuming and often requires a specialist or scientist to train. Further, to apply this data requires an understanding of deep neural networks, complex algorithms and access to powerful hardware. We realized the we can solve the inherent problem of qualifying large sets of data by crowd-sourcing, yielding rapid results and improving the accuracy and performance of an AI system.

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[2] http://www.image-net.org

[3] https://research.googleblog.com/2016/05/announcing-syntaxnet-worlds-most.html

A Decentralized Solution

TraneAi brings crowds and companies together to build AI powered systems. TPAI serves as a protocol to govern how companies and crowds exchange valued services. Any user can help with supervised learning of AI with our user-friendly, simple interface that prompts users with binary, Yes/No questions. Enlisting thousands of answers to the same question renders more accurate models quickly. Users earn TPAI tokens when they label data, and holders of TPAI tokens can exchange them to develop their own AI systems or other apps

.

We are building the TPAI *ecosystem*, which is the first open AI-training network built on the blockchain. The first use case of this ecosystem is for labeling data for the AI systems that power chatbots, computer vision systems, neural networks and natural language understanding applications. Users will earn tokens to label data. Customers will use tokens to have their community labeled datasets modeled and served for usage in their own AI powered apps. Companies will use tokens to have their custom datasets trained by high powered GPU machines. Users providing that computing power will earn tokens.

For this ecosystem to reach its full potential, we must build up baseline datasets scaling to over 1 billion images and conversation examples. This will help the networks core system which makes predictions based on what it sees and reads. One billion, based on the experiences of companies like Google with their machine vision database of 1 billion+ data points, is a size that is meaningful and useful for a large set of systems and applications which can be used at the commercial and enterprise level.

To demonstrate the potential of the TPAI ecosystem, we are using TraneAi as the reference implementation to showcase all of the core usages of TPAI.

Audited by AI

A qualified dataset with over 1 billion items is too large for humans to check every word or image of to ensure it is labeled correctly. Hence, TPAI uses an autonomous AI-powered verification mechanism called *"proof-of-performance"* to audit data quality. This quality assurance process occurs through a decentralized network with no need for central management or trusted parties to verify datasets.

Mission

We believe that by building our solution for crowdsourced AI training data on the blockchain, we can realize the full potential of AI by making AI training faster, less-expensive and more accurate. This will unlock innovation in the AI space.

The Token

TPAI (**Transaction Protocol for Artificial Intelligence**) serves as a protocol that governs how participants exchange services for training data, and the TPAI token is a utility token that creates an economy around labeled data. Using TPAI tokens, companies engage ecosystem miners to train, store and distribute data. Miners collect TPAI, which can be used to procure products and services within the economy, or be converted to crytpocurrency or cash.

Other platforms and workflows can leverage the TPAI ecosystem through an open SDK/API that enables them to create user experiences or access network capabilities using tokens.

The Token Launch

A crowdsale of TPAI tokens will commence following a pre-sale period and will have a target raise of $50m. Funds from the sale will be used by TraneAi to build the first AI-training platform on the blockchain which uses AI-powered auditing for proof-of-performance, as well as, to provide tokens for ecosystem participants to trade for valued services.

Objectives

- Raise $50 million through a token crowdsale, for the development of the TPAI ecosystem and TraneAi as the reference platform for TPAI.
- Build a 1 billion item data set by end of Jan 2019

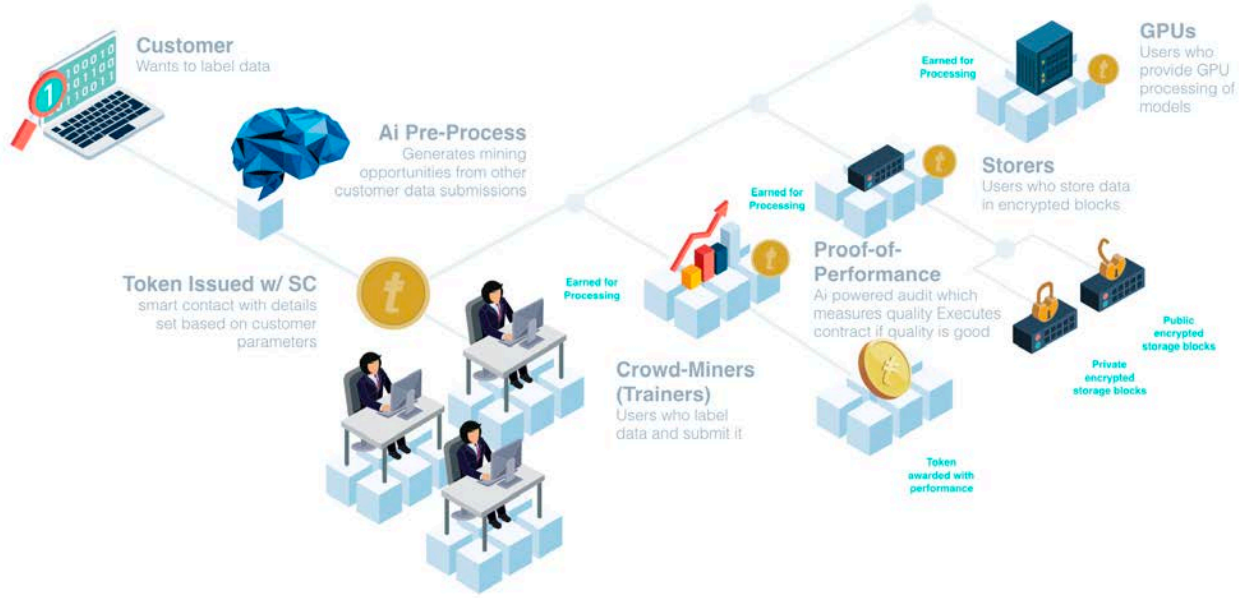
Traction

TraneAi is a working platform with a pipeline of interested companies. TraneAi has already created the beta version of the product that allows users to register, submit data and train/label data. TraneAi has enlisted Crane, a company which uses AI to build commercial software, as

our first proof-of-concept case. Crane has leveraged the crowd-mining process to as an input to its customer projects and is selling apps built by AI for an average price of $100K.

The TraneAi Workflow

TraneAi is the first implementation of TPAI which will showcase its core usages. On the TraneAi platform, customers use TPAI tokens to access GPU resources, algorithm-based instances of AI and data labeling services. Crowd-miners earn tokens by responding to binary, Yes/No questions which improve the quality of the dataset used in an AI system.



How TPAI tokens are used in TraneAi

The core components of the initial TPAI ecosystem include:

TPAI
is an ecosystem for AI innovation

TPAI tokens
are the utility tokens of the AI ecosystem

TraneAi
is the reference implementation for TPAI

Customers
use token to create "smart contracts" for services

Proof-of-performance
is an AI agent which tests and grades labeled data quality

Storage-miners
provide storage for private and public datasets via encrypted IPFS

Crowd-miners
label AI data issued by customers

Processing-miners
provide GPU computing resources to process and train labeled data into models

The TPAI Token

The TPAI token (Transaction Protocol for Artificial Intelligence) creates a market out of training data. The value the token represents is directly reflective in usages such as CraneAi. Crane is an AI that rapidly develops software. To achieve such compressed timelines, Crane relies on the performance of contributions from users labeling datasets to train AI. Crane is a revenue-generating business that serves as a proof of concept implementation for TraneAi and showcases the impact of Crowd-miners on AI innovation.

Crowd-miners are incentivized to earn tokens by assisting in the crowd-mining of labeling datasets, while other users also earn tokens by storing those datasets across the blockchain. With a myriad of application usages, the TPAI token will pave the way to a new market where the value of the TPAI is determined by the market forces of demand and supply of public and privately labeled datasets.

As the quality of these datasets improve, the demand for them will grow, increasing the value similar to any other open market mechanism.

The TPAI ecosystem will function on the blockchain without any central control or authority. TPAI handles the entire lifecycle of data — labeling, auditing, storage, training, hosting and serving.

We believe the ecosystem will become the central marketplace for data that can be used to dramatically improve the performance of an AI system or application.

How Crowd-miners earn TPAI tokens

THE PROBLEM

Building an artificial intelligence system or application has its challenges. Powered by both code and data, the quality of data is the greatest hurdle to success. Although AI technologies have existed for decades it's data, the raw material of AI, that realizes its potential[4]. In the typical approach there is a dependency chain of experts, data scientists, annotation manuals and a breakdown of the features to be identified using the AI system. It becomes increasingly inefficient and expensive to maintain that system. Further, due to the associated cost and limited participating human experts, bias occurs which impacts quality.

Once it's running there are instances where AI systems still produce low confidence predictions for things it doesn't understand. This continuous process of analyzing and updating the dataset, called Active Learning, does improve accuracy but remains a challenge requiring those same costly experts, additional computational power and a lot of time.

There are well-trained datasets available on the internet, however they are very broad and too generalized, making it difficult to achieve the custom requirements of the AI system being built. For example, in the case of Crane, an AI that develops software, there were specific cases where open datasets simply didn't reflect the training needs. This might have forced the Crane development team to invest in producing labeled data by hand over several weeks with advanced experts, which would have been very costly and time-consuming.

[4] https://twitter.com/AndrewYNg/status/883464017280454657?ref_src=twsrc%5Etfw&ref_url=https%3A%2F%2Fexplosion.ai%2Fblog%2Fprodigy-annotation-tool-active-learning

THE SOLUTION

AI systems produce a wide variety of products and services, from self-driving cars and virtual agents to chatbots. AI systems can create new opportunities in any industry. Quality labeled data is critical in those applications both for the creators as well as the users. From experience of the CraneAi team, it is clear that developing quality data sets quickly and cost-effectively has a tremendous impact on the development traction and revenue of a company that uses AI to create products or offer services.

The TPAI (Transaction Protocol for Artificial Intelligence) Token creates a market for quality labeled data. The market invites Crowd-miners to earn tokens by improving data quality through annotating and labeling data. This labeled data is stored with either public or private access, giving Storage-miners the ability to earn tokens for storing the data. Processing-miners earn tokens by delivering predictions based on inputs. Customers access these application capabilities using TPAI.

Spend TPAI Tokens	Earn TPAI Tokens
Crowd Labeling/Annotating data	Training data
Data/Model storage	Storing data
AI Predictions	Providing GPU computing resources
GPU Computing Resources	

The variety of opportunities available will create active market participation on all sides of the marketplace. With the growing need for active learning and specific datasets, the market for quality labeled data will continue to see rapid growth. With customers and miners having the ability to set their offer/demand prices or accept current offers, the network guarantees miners are rewarded by the customers when providing the service of labeling, storing or processing data sets and data models.

THE PRODUCT

Data Training (mining) and TPAI Smart Contracts

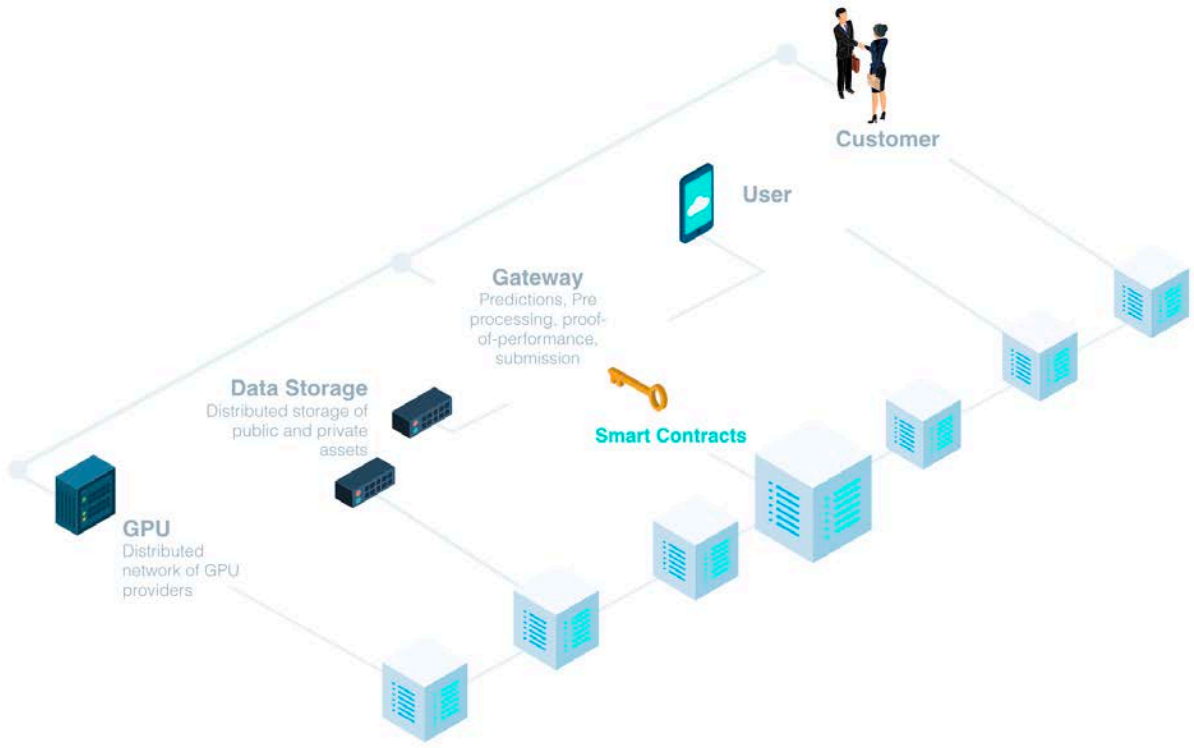
The core of the TPAI ecosystem is a crowd-mining network of at least 2 billion entries of labeled data along with corresponding AI trained models on the blockchain. This system will be independent of any centralization or control.

We believe this approach is the right method to enable Crowd-miners, Storage-miners and Processing-miners to be rewarded for the value they offer to the ecosystem. We will require Customers to use tokens in order to crowd-train their proprietary data. Their proprietary data will not be publicly available. We will also require customers who want to recognize/predict objects in their apps (using public or privately served models) to use tokens. This economy is enabled by TPAI tokens, a utility token that allows services to be exchanged between and among the various Miners and Customers.

The components necessary to create this ecosystem are:

- Data storage component
- Gateway data submission component
- Smart Contract for mining component
- Pre-processor component
- Proof-of-performance component
- Data access / usage component
- Smart Contract for data usage component
- GPU Access / usage component
- Smart Contract for GPU usage component

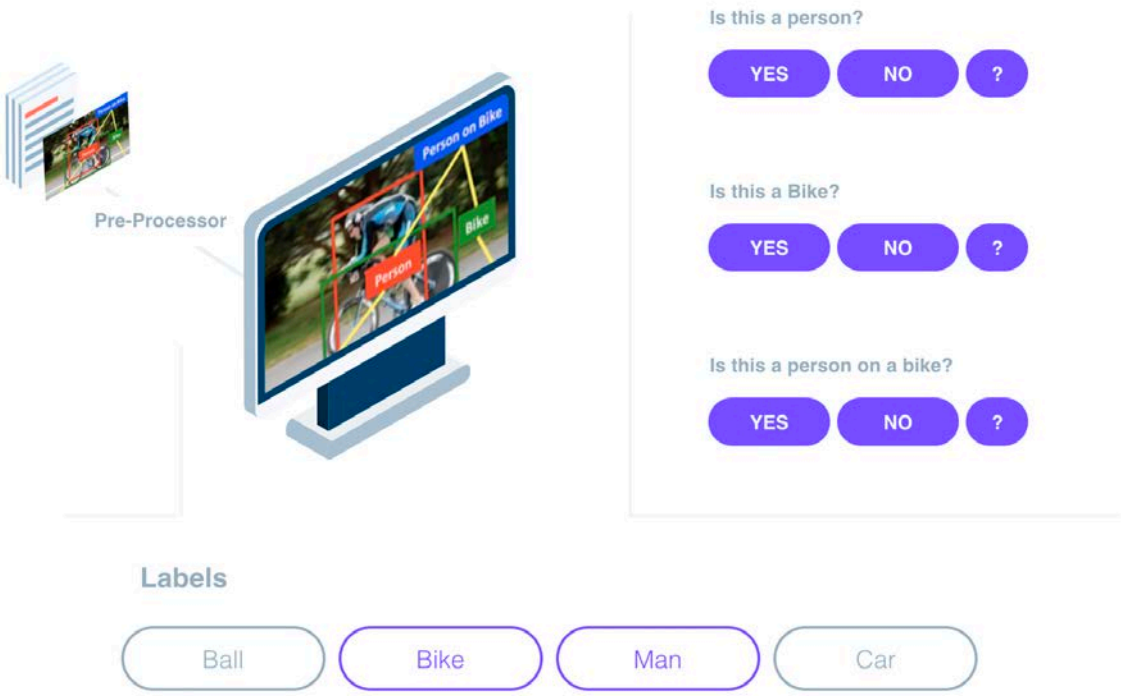
The TraneAi application is the initial access to this ecosystem where customers and users can post orders which are subsequently aggregated into order books. TraneAi's interface will provide an automated way to easily distribute large volume submissions. Within this application, every Miner and Customer will be identified by a wallet address.



Simplified diagram of the general architecture of the ecosystem

Pre-Process

To train new data, all incoming submissions will go through the Pre-Process which prepares the data for training. We take a complex concept, identify single label requirements and translate those into several versions of simple binary questions. The interactions for Crowd-miners are simple, focused and easily answered without requiring any special expertise. By offering variations of the same simple question, we allow large numbers of Crowd-miners to give input quickly, leading to greater accuracy and a tighter feedback loop within the active learning process administered by the AI system.



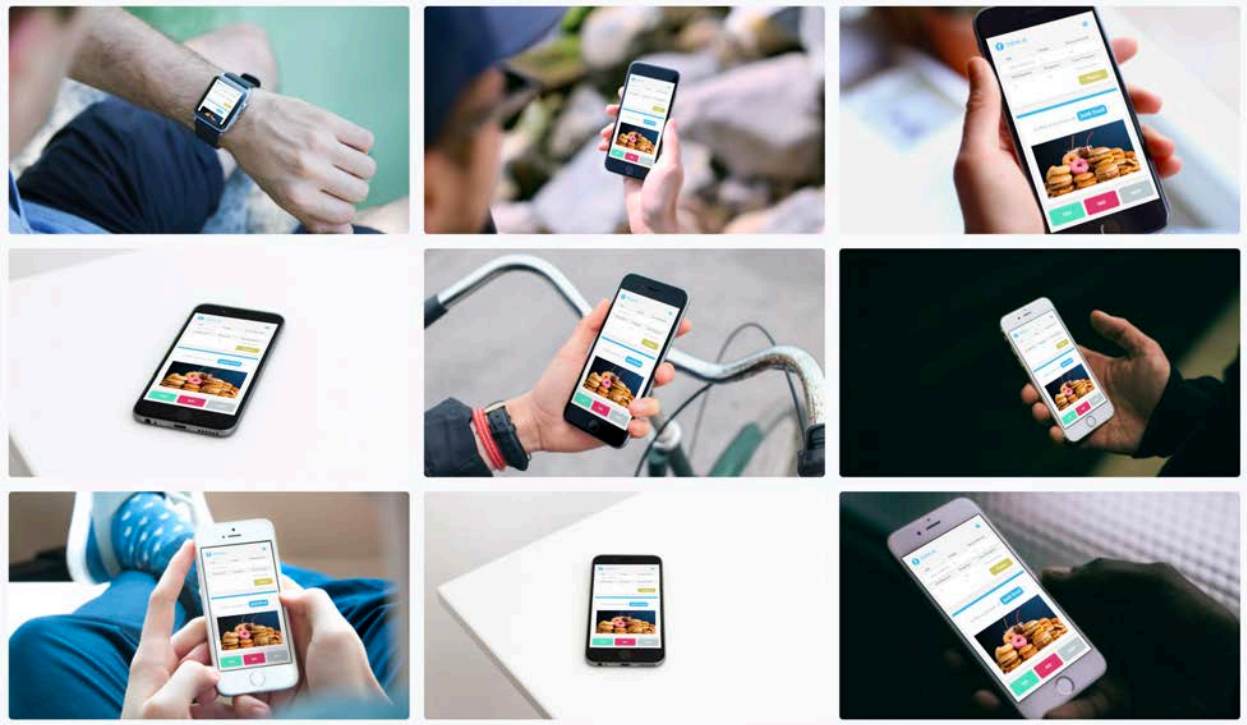
Submission Pre-processor

Crowd-Mining

Crowd-miners will receive binary questions that are simple to answer as pictured below. Each submission batch of questions will receive a TPAI token bounty attached to it with an additional value the miners can earn by mining that entire submission batch.

Initially mined results are only honored if they originate from the TraneAi application . The application provides a graphical user interface configured for the network. The application formats the origination data, generated questions and response data to appear in a way that is easy to use, simplifying the mining process.

During the mining process the application self-trains a neural network model based on the answers provided. Those answers are used to improve the experience quality for the miner, removing duplicate questions. Redundancies, especially in cases where the machine is sure the answer (higher confidence predictions) are skipped and automatically answered by the machine with the reward still given to the miner. The mining bounty is essentially optimized for quality labor.



Crowd-mining via TraneAi answering binary questions

To participate, Crowd-miners simply navigate to the customers application and:

- Enter their wallet address
- Review the various mining opportunities and select one
- Click start
- As a sequence of questions appears, one at a time:

    Click yes (or swipe right on mobile) to indicate the question is correct, or

    Click no (or swipe left on mobile) to indicate the question is not correct, or

    Click Don't Know (or swipe vertically on mobile) if the answer is not clear

To further ensure the quality of both labeled data and transactions across the ecosystem, our proof-of-performance AI will monitor the quality of data and confirm the efficacy of a Crowd-miner's submission. Additionally, we will provide a mining application to ensure the mining is being executed by humans and not machines intermediating on humans behalf.

Submission

Anyone with a TPAI token balance and wallet address will be able to create a new submission batch with a TPAI token bounty attached to it. In the TraneAi implementation, users who only have local fiat can simply use a credit card which will turn that fiat to TPAI tokens for use on the system (exchange rates apply).

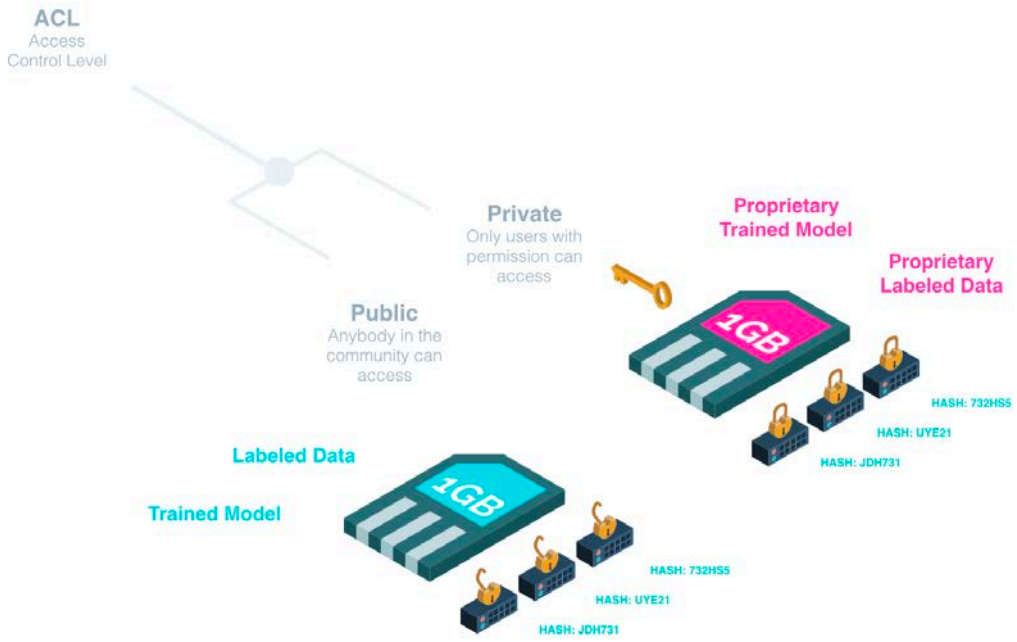
The creator of this submission batch, called the Customer, can decide how many TPAI tokens they are willing to provide to have that submission hosted, labeled or trained. A smart contract for mining will be issued and a small fee will be charged; a percentage of that fee will be dedicated to the upkeep of the system.

Additional opportunities for participants in the TPIA ecosystem are available through the blockchain and smart contract system. Participants can access public data and previously trained user-owned models, for example, someone can submit a trained data model that is really good at detecting celebrity faces. By making that model available on the network a participates can earn TPAI tokens each time others make predictions using that model. The smart contract system will ensure each party will earn their fair share of TPAI tokens for the data they mined or the data or models they share.

Data Sharing and Access

Public data can be accessed by any users with TPAI tokens, proprietary data access is limited to its owners. Contents of proprietary data are secured as they are stored on the blockchain, as illustrated below.

In order to ensure storage resources are available, TraneAi will initially deploy a distributed storage network built on top of the TPAI. TraneAi will look to resource partners to help expand the storage footprint incentivizing Storage-miners with TPAI. All the data on the storage network will be permission-based using access control.

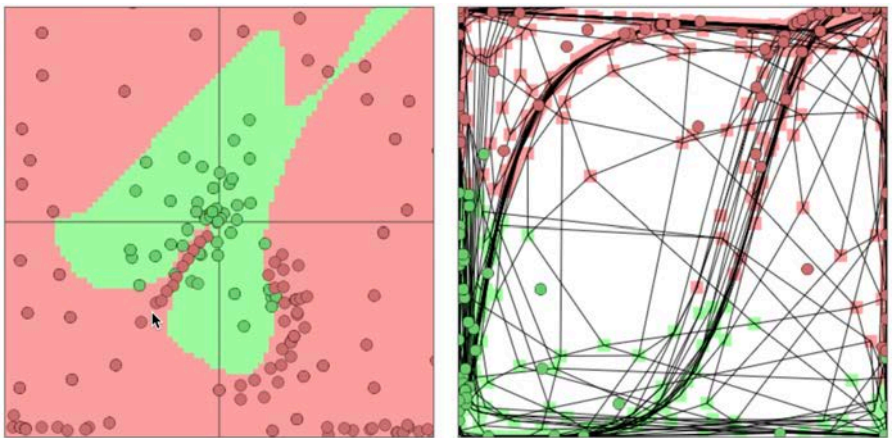


Data access component

Bounty and TPAI Token Rewards

The neural network is powered by a model created in real-time based on the answers provided by Crowd-miners. The model measures the accuracy, speed and redundancy of answers. Quality answers enable the model to optimize the sequence of questions and remove questions if possible. The model can also self-answer based on other responses from the Crowd-miners during that session. When the neural network can self-answer other questions in the sequence with confidence scores above 0.9, the Crowd-miners will be rewarded a quality bonus. This bonus replaces the rewards they would have received for answering additional questions, effectively incentivizing Crowd-miners to product quality responses.

Fundamentally a Crowd-miner's performance can enhances the active learning process, causing the machine to assist the miner in mining quality labels faster. Ultimately this becomes additional value for the Customer who used TPAI tokens to submit batches of data for labeling and training.



Crowd-mined votes provide accuracy based on consensus

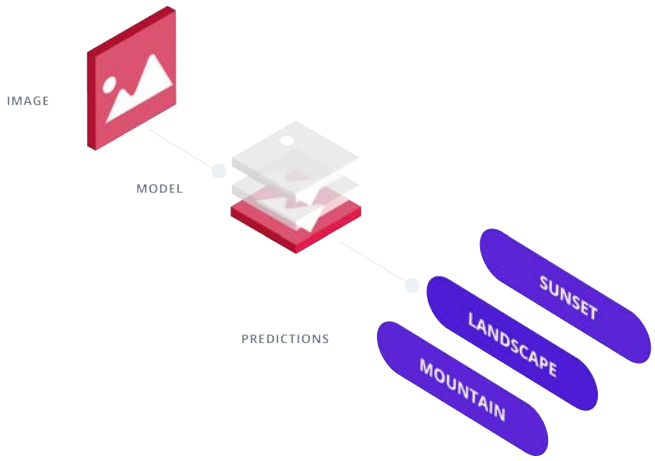
Public Data Usage

After the necessary answers are submitted though the TraneAi application, labeled data is qualified through the proof-of-performance component, rejecting patterns of fraud and abuse. Upon successfully finding proof in quality, the labeled data will be stored in a decentralized manner where Storage-miners will earn TPAI tokens for storing encrypted shards of these publicly-available datasets. This storage will be managed using the IPFS protocol.

Accessing labeled data will be done through API calls where an open source SDK requires a wallet address containing TPIA Tokens. These users can download data sets through the SDK and TPAI will be automatically deducted directly from the requesting wallet.

Storing labeled data directly on the network allows for frictionless production of a model. A model is a processing block that converts data inputs (e.g. sentences, sounds, images) to predictions (e.g. concepts, intents, bounding regions, outcomes). When an input is run through a model it will return predictions based on what the model understands that input to be. For example, a sentence model with the input 'Hello' will return an intent with the label `greeting.' The process of training models requires an immense amount of computing power. Large models can often take several weeks without the proper resources. Users with TPAI tokens can tap into high performance GPU resources and use the industry standard tools and frameworks like Tensorflow, Torch, Caffe, and Keras to train their data into models. GPU resource providers, called Processing-miners, can earn TPAI tokens by providing access to the TPAI infrastructure.

When launching the token to ensure resource availability TraneAi will acquire powerful Nvidia DX-1 machines and place them on the network similar to Paperspace on the blockchain[5]. Processing-miners who run models for training can host them or have them hosted by the network. The originator of each model will earn tokens whenever other users with TPAI use those models by making predictions with them.



How models are used to make predictions

Making these trained models available on the public network allow Customers with TPAI tokens to use them make predictions. The request is generated via the Software Development Toolkit (SDK) that is connected to their wallet. TPAI tokens will be removed from a Customer wallet when the SDK makes the request. The SDK requires the Customer to provide a data input along with the address to the model(s) against which they want to make predictions.

Proprietary/Private Data Usage

In some cases users will want to tap the value of the network with proprietary data that they want to have labeled, modeled, stored and served, while preventing others to have access to it. In these cases, a Customer indicates that they want a data submission to be private when they issue it; and additional TPAI tokens will be required to do so. Private data, models and annotations/labels on the network will be encrypted and distributed as shards to Storage-miners, who will then earn TPAI tokens for providing storage resources.

[5] https://www.paperspace.com/

Combined (Public + Proprietary) Usage

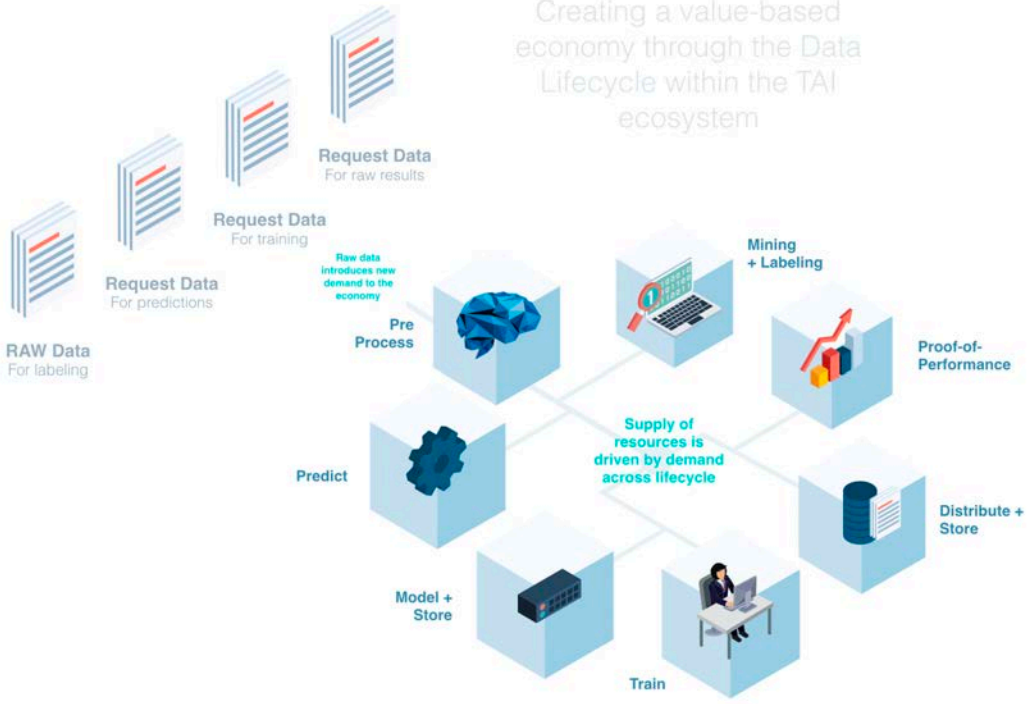
There is an interesting opportunity when Customers decide to combine public and provide data. Take the example of Kaggle, a site that promotes machine learning contests[6]. During these contests, data scientists compete to write algorithms and he prizes of these contests can be significant, sometimes as high as $2 million. Given that the algorithms require significant processing resources, the contests could run even more effectively on TraneAi by making the initial contest data publicly available and allow contest participants to access the TPAI ecosystem resources. A participant can use the wallet-connected SDK and their TPAI tokens to remotely access that *public* data and execute a *private* script to train a custom model on network GPU's, provided by Processing-miners, using the algorithm for the Kaggle contest.

The Blockchain and Value Creation

Given that data is the raw material needed to create AI, centralized ownership creates a threat in cases where single companies are controlling data, access to that data and even its quality, which leads to both risk and bias.

TraneAi enables anyone to have access to these resources . The resources that are decentralized across the network will be available to any participants who earn TPAI tokens or spend TPAI tokens. When participants contribute across the entire AI training lifecycle, labeling, storing and processing AI training data, it allows for the full realization of the potential of AI while creating a vibrant value based economy. Even so, improving the performance of AI and driving AI innovation clearly outweighs the financial benefits of TPAI tokens.

[6] https://www.kaggle.com/c/zillow-prize-1



Value based economy mapped to the data lifecycle in the TPAI data market

In summary, TraneAi works as follows:

- Crowd-miners will label data using a binary process (selecting yes/no/don't know)
- As quality is critical to value, an AI-powered proof-of-performance audit will identify abuse and bad actors, which will then be charged TPAI tokens per the smart contract
- Earlier answers will earn largest token rewards
- Later answers will earn smaller token rewards
- The minimum threshold of participating miners is set in the smart contact which can be configured directly in the TraneAi application
- Consensus will be reached once the minimal threshold of participating Crowd-miners have responded to the complete series of questions

- Tokens will be issued via the smart contracts after the consensus is reached, the new data set has been tested and the quality has been confirmed by the proof-of-performance process
- Data sets and models can be stored as public or private
- Data sets are stored on the blockchain by Storage-miners
- Processing-miners provide GPU computing power to run models and allow various participants access to public model

SMART CONTRACTS

TPAI tokens provide a full data lifecycle based on three core operations: Submit, Process and Get. These operations allow participants to access various services across the data lifecycle at a desired amount of TPAI tokens. Workflows throughout the AI training lifecycle are supported and executed on the blockchain using smart contracts. Participants can program these *smart contracts* with very specific details on Submitting, Processing and Getting data on the network.

Submit operation	Process operation	Get operation
SubmitData (submission) • INPUTS: - Type (image, text, voice) - Format (concepts, intents) - Consensus threshold min - Consensus max - Acceptance margin - Data (json only) - Labels (json) - Bid - Signing key • OUTPUTS: - Deal SubmitTrainingOrder • INPUTS: - Type (image, text, voice) - Format (concepts, intents) - Iterations - Library (TF, C) - Data (pointer) - Bid - Signing key • OUTPUTS: - Deal SubmitStorageOrder • INPUTS: - Time - Size - Bid - Signing key • OUTPUTS: - Deal	StartMachine (for training) • INPUTS: - Machine id - Data (pointer) - Bid - Signing key • OUTPUTS: - Deal PredictIntent • INPUTS: - Model Id - Data - Bid - Signing key • OUTPUTS: - Deal - NLP Data PredictConcept • INPUTS: - Model Id - Data - Bid - Signing key • OUTPUTS: - Deal - Concept Data StopMachine • INPUTS: - Machine Id - Bid - Signing key • OUTPUTS: - Deal	GetDataSet • INPUTS: - Data Id - Bid - Signing key • OUTPUTS: - Deal GetLabeledDataSet • INPUTS: - Data Id - Bid - Signing key • OUTPUTS: - Deal GetModel • INPUTS: - Model Id - Bid - Signing key • OUTPUTS: - Deal GetMachine • INPUTS: - Machine Id - Bid - Signing key • OUTPUTS: - Deal SubmitMachineOrder • INPUTS: - Duration - GPU - Memory - Bid - Signing key • OUTPUTS: - Deal

Use Case of Smart Contract Generation

A customer has 100 chat messages that were causing confusion leading to the abandonment of their chatbot. The customer wants to use TraneAi to rectify this situation, so they register and add TPAI tokens to their wallet. The customer uploads data containing the chat messages and selects a text classification template directly on the TraneAi business interface. Next the customer sets the bid price and deploys the data submission. The pre-process will generate the mining opportunities. Since in text classification cases there are typically two-three variants based on the label dictionary, a smart contract is established with 200-300 questions along with acceptance criteria.

Extendability

Smart contracts enable participants in the TPAI ecosystem to use TPAI tokens for services across the AI training lifecycle. Participants transact via smart contracts that records those transactions onto the ledger and triggers functions that are in the smart contract code. Some of the key features these smart contracts provide:

- Customers can create conditions for data labeling and annotation services, for example:
    - Custom reward strategies to incentivize miners to increase performance
    - Specific minimal thresholds for crowd activity per answer
    - Minimal percentage margin in acceptance criteria for the consensus answers
- Participants can create vendor-reseller relationships in their contracts to allow a Miner, such as a Processing-miner, to provide services as part of a broader effort

As TPAI is open source, we expect a myriad of smart contracts to develop within the TPAI ecosystem and are excited about establishing a community of smart contract developers.

The smart contracts will follow the ERC:20 standards. We will use Ethereum gas when we make TPAI token transactions. A charge will be applied in each TPAI token transaction as ETH does; for example, if a participant earns 10 TPAI tokens from a Customer, they will likely receive approximately 9.999 TPAI.

THE TEAM

Tomer Dicturel, Co-Founder

Finance guy turned tech entrepreneur.

Tomer previously founded a variety of tech-centric ventures in addition to founding Madison Ventures, an New York investment advisory firm. Before becoming an entrepreneur, Tomer served as a Sergeant with the Israeli Defense Forces and as a security profiling officer for El-AL Airlines.

Ryan Hickman, Co-Founder

Futurist. Investor. Creator of things.

Passionately focused on building and investing in Artificial Intelligence, Ryan is an executive respected for his success in building frontier technologies. Previous ventures have focused on ad tech, streaming media influencer networks, and the Internet of Things via embedded sensors.

Jennifer Crews
Strategy

Mark Donovan
Operations

Thomas Lammers
Finance

Advisors

Adella Toulon-Foerster
Blockchain Legal

Susan Oh
Blockchain

Denmark West
Investment

Pauline Brown
Branding

Jay Taylor
Legal

Ron Quaranta
Finance Industry

Ward Stirrat
Blockchain Industry

Development Team

Ruben
Front-end Engineer

Santosh
Natural Language

Ting
Data Scientist

Esmerelda
Full-stack Engineer

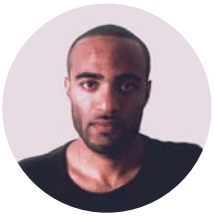
Rawshawn
Machine Learning

Matt
Full Stack Engineer

Sean
Full-stack Engineer

Kevin
Full-stack Engineer

Prinash
Computer Vision



Jordan
Front-end Designer

Viswada
Full-stack Engineer

Jennifer
Full-stack Engineer

Kalyan
Natural Language

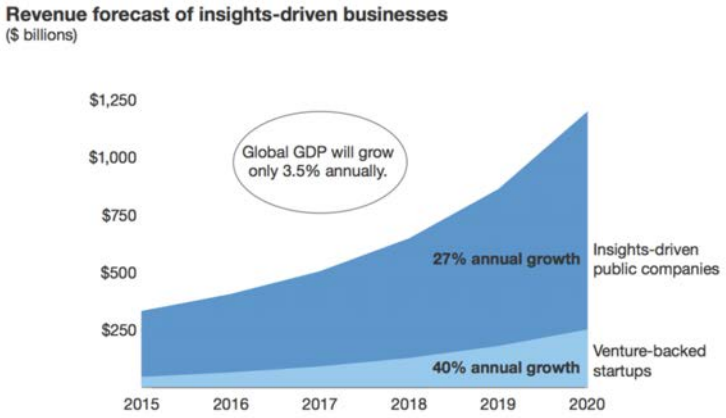
Pedro
Full-stack Engineer

THE MARKET

Artificial intelligence is a consolidation of state-of-the-art technologies which are used to develop products that work in a manner similar to human intelligence. The projected applications for AI are so numerous and varied that analysts are challenged to agree on a market size projection. However, everyone is in agreement on one point: The AI market will grow to a significant scale.

For the Chatbots market, a subset of AI innovation, predictions are that the market will grow from $703.3 million to $3,172.0 million, at a CAGR of 35.2%, from 2016 to 2021 driven by the strong need to understand consumer behavior, adoption of cloud-based technology, and the proliferating demand of intelligent customer engagement.[7] The artificial intelligence market is expected to be worth USD 16.06 Billion by 2022, growing at a CAGR of 62.9% from 2016 to 2022.[8] The graph below shows the rates of growth and the impact on GDP.[9]

FIGURE 1 Insights-Driven Businesses Will Steal $1.2 Trillion Annually By 2020



Note: The data point for public companies in 2015 is actual revenue; all other data points shown are estimates or projected figures.
Source: Economic Intelligence Unit, Morningstar, and PitchBook Data

BofA Merrill predicts the market will blossom to $153bn over the next five years with $83bn coming from robots, and $70bn from AI-based systems[10]. Demand is expected to be driven by

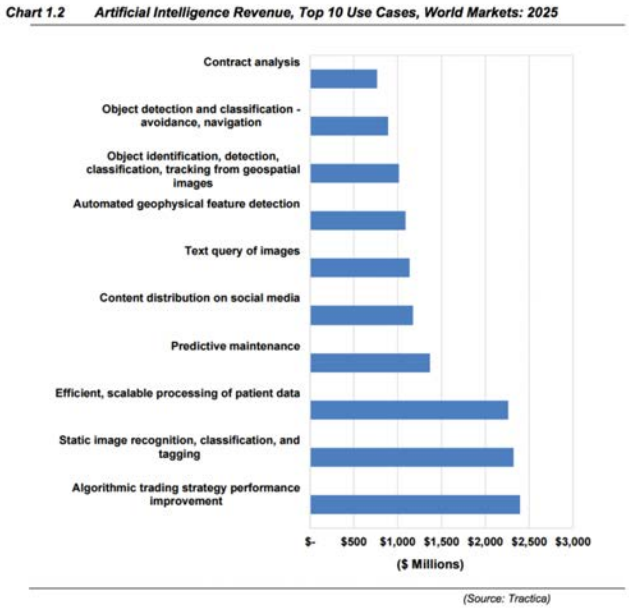
[7] http://www.reportsnreports.com/

[8] marketsandmarkets.com

[9] http://www.reuters.com/brandfeatures/venture-capital/article?id=5129

[10] https://www.techemergence.com/valuing-the-artificial-intelligence-market-graphs-and-predictions

an aging global population and a rise in wages of workers in emerging markets. Wage growth among China's factory workers, for example, has surged nine-fold since 2000. The table below projects revenue by various areas of AI and robotics applications, as featured in the Financial Times:



The Expense of AI

When the resources required to train AI - the people, storage systems and processing power - are centralized and proprietary, demand for AI systems drives up the cost of these critical services. For example, Google's vision API pricing demonstrates how valuable image data is. To detect all the base features in an image (labels, people, landmarks, logos, etc) there is a cost of $12 per 1,000 images[11]. This would mean a single customer who wanted to process 1,000,000 images using Google would pay $12,000. GPU providers are critical to AI innovation due to the tremendous processing power required by AI models. This is driving up the price of GPU hardware; the average cost of GPU hardware cloud rentals ranges from $300 - $3400 per month.

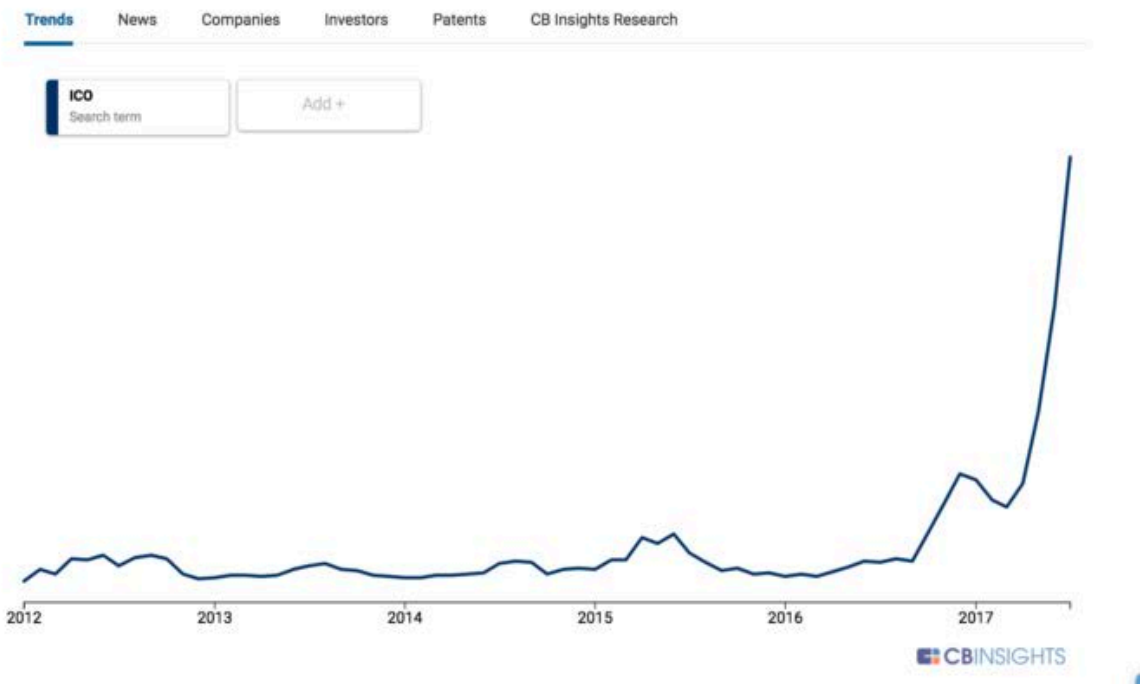
We put forth that AI training services can be much more accessible on a decentralized network, keeping the cost of services lower and allowing more participants to create and retain value in by contributing to the AI training process.

[11] https://cloud.google.com/vision/

THE TOKEN MECHANISM

Crowdsale Token Launch ("CTL")

Our crowdsale token launch (CTL) will be used to raise capital to build the TPAI ecosystem and to issue utility tokens to fuel the network.



How CTL Tokens are traded

Once the CTL is completed and project launched, the CTL tokens can get listed on cryptocurrency exchanges to trade against other cryptocurrencies. The price for tokens in these exchanges is often reflective of the cryptocurrency market, token-specific news and the realization of new features.

TraneAi Crowdsale Token Launch

TraneAi is preparing to issue a token called TPAI (Transaction Protocol for Artificial Intelligence). The crowdsale token launch (CTL) for TPAI tokens will commence following a pre-sale period and will run for a duration of three weeks. The crowdsale token launch enables us to build the ecosystem, develop the TraneAi application, acquire essential hardware and provide tokens to allow participants to exchange value within the ecosystem.

TPAI Token Launch Value

During the crowd token launch one TPAI token is equivalent to $0.10

TraneAi Crowdsale Token Launch (Pre-Sale)

Prior to the crowdsale token launch there will be a pre-sale with a 30% bonus.

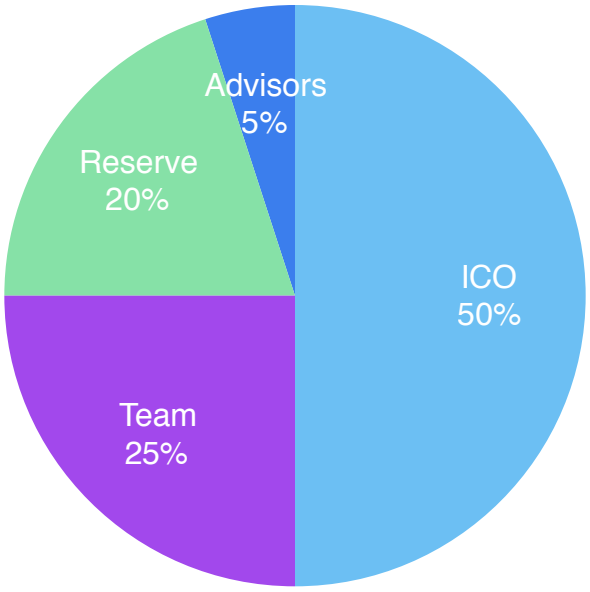
Reserve Usage

The TPAI tokens set in reserve will be initially locked and released under the following schedule:

- 25% will be unlocked after the first 12 months (year 1)
- 25% will be unlocked after 24 months (year 2)
- 25% will be unlocked after 36 months (year 3)
- 25% will be unlocked after 48 months (year 4)
- At each release the tokens will be used for mining and data acquisition

TraneAi Crowdsale Token Distribution

There is a total supply of one billion TPAI tokens with distribution as follows:



- Issued: 50% of the tokens will be issued for the CTL
- Reserves: 20% will be used for data purchase to miners
- Company/Team: 25% for company primary for market growth, research and development
- Advisors: 5% of tokens will be used for advisors

FINANCIALS

The Offering

We are creating 1,000,000,000 TPAI tokens. We will sell 50% of the tokens in the token launch over a three-week period. We need to raise $50 million in order to establish the ecosystem and develop the storage and processing infrastructure.

- Day 1 - we will TPAI tokens with a 20% bonus
- Week 1 - we will sell TPAI tokens with a 15% bonus
- Week 2 - we will sell TPAI tokens with a 10% bonus
- Week 3 - we will sell TPAI tokens with a 5% bonus

Use of Funds

The funds collected in the CTL will be used to cover expenses of the project until the project starts making profits sufficient enough to function on its own. TraneAi is expected to make profits in 2018. Key expenses that will be covered by the raise include:

- GPU hardware
- Storage
- App development
- Sales and marketing
- Staff

Secondary Markets

We plan to distribute TPAI two weeks after the crowdsale token launch and make it available on the secondary market within a month.

TPAI Token Value

The value of the TPAI token is in data quality, training resource availability, storage availability and GPU availability. Today, these resources are in high demand. TraneAi and TPAI tokens together create an ecosystem that gives access to these resources to drive AI innovation.

Customers will pay for various services all of which are based on data sets that they supply or want to access.

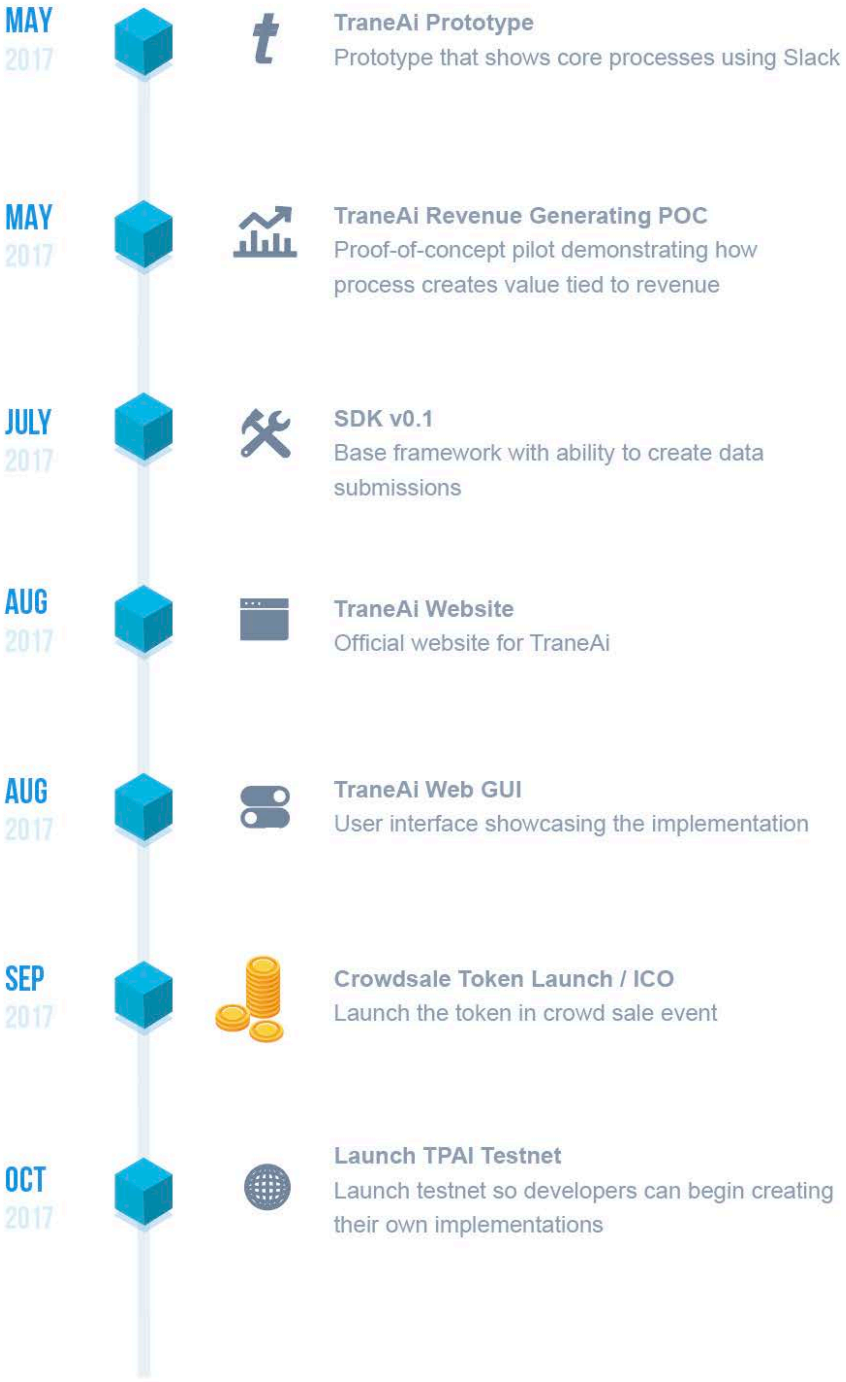
Customer Use Case A: Customer wants to pay Crowd-miners to label and train data. The customer pays for each concept that is labeled. For example; customer wants to build a training dataset using 1,000 images. TraneAi's pre-process will generate approximately five questions for each image in which the crowd will provide answers. The result is 5000 concepts labeled quickly.

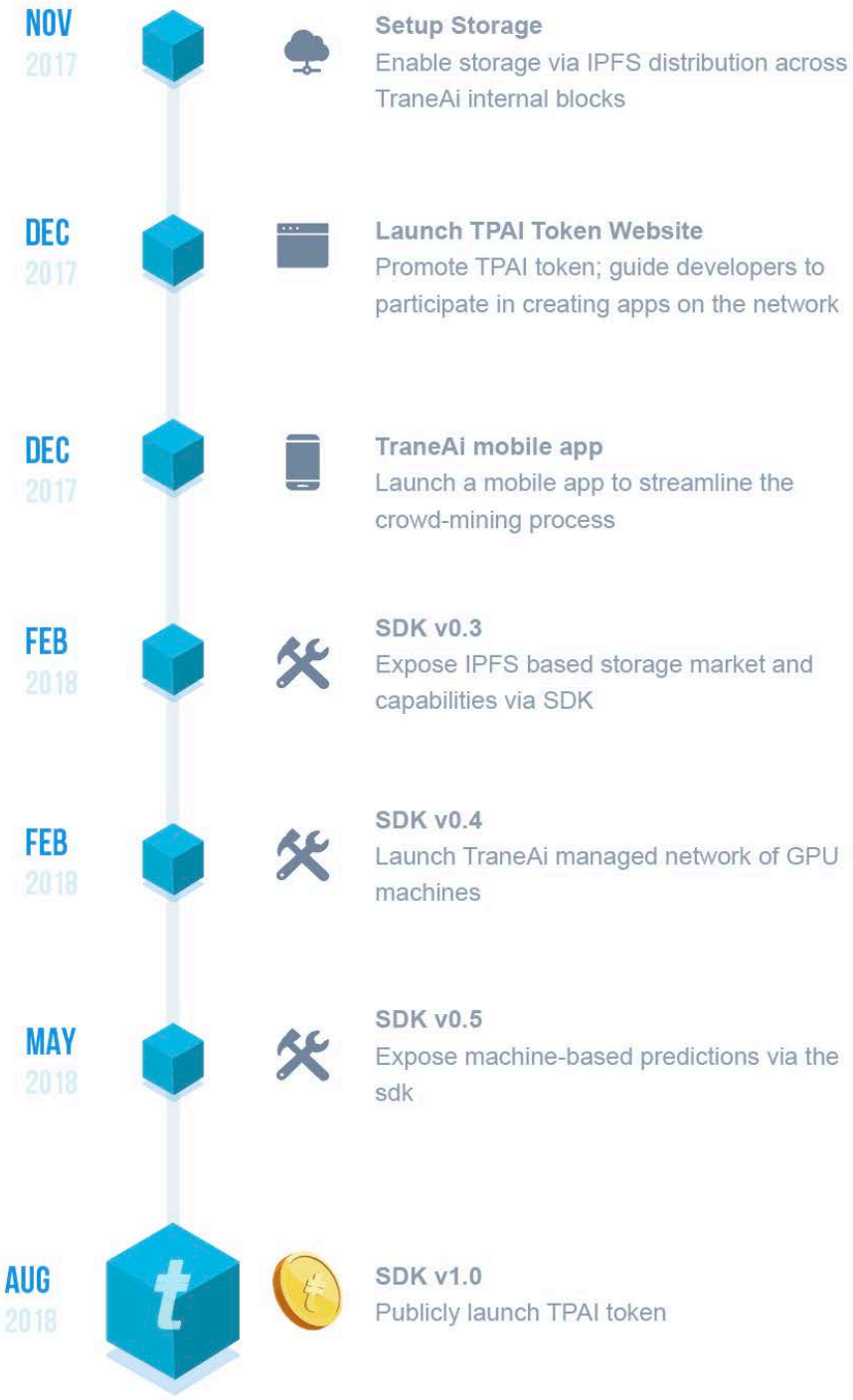
Customer Use Case B: Customer has a video app that streams user content. The customer has a problem with nudity on the network and wants to use AI to find videos with nudity and cover the body parts with black squares. The customer pays for a model that is authored by a ecosystem participant designed for identifying nudity. Using TraneAi, the customer sends one image (keyframe) for each 30 seconds in the video clip allowing the AI to detect if there is nudity in that image.

Customer Case C: Customer has a chatbot that is central to its new customer service initiative. They want to crowd-mine a new dataset based on 25,000 emails they have collected from customers. TraneAi would break down each email into statements of two-three sentences each, generating approximately three questions for each statement for which the crowd will provide answers.

As the ecosystem drives AI innovation, the demand for services increases and drives the value of TPAI tokens on the secondary markets and exchanges.

ROADMAP


MAY
2017
TraneAi Prototype
Prototype that shows core processes using Slack
MAY
2017
TraneAi Revenue Generating POC
Proof-of-concept pilot demonstrating how process creates value tied to revenue
JULY
2017
SDK v0.1
Base framework with ability to create data submissions
AUG
2017
TraneAi Website
Official website for TraneAi
AUG
2017
TraneAi Web GUI
User interface showcasing the implementation
SEP
2017
Crowdsale Token Launch / ICO
Launch the token in crowd sale event
OCT
2017
Launch TPAI Testnet
Launch testnet so developers can begin creating their own implementations


NOV
2017
Setup Storage
Enable storage via IPFS distribution across TraneAi internal blocks
DEC
2017
Launch TPAI Token Website
Promote TPAI token; guide developers to participate in creating apps on the network
DEC
2017
TraneAi mobile app
Launch a mobile app to streamline the crowd-mining process
FEB
2018
SDK v0.3
Expose IPFS based storage market and capabilities via SDK
FEB
2018
SDK v0.4
Launch TraneAi managed network of GPU machines
MAY
2018
SDK v0.5
Expose machine-based predictions via the sdk
AUG
2018
SDK v1.0
Publicly launch TPAI token

TECHNICAL DETAILS

Proof-of-performance

Proof-of-performance audits are performed by an AI-powered autonomous agent capable of performing key actions, without human interaction, to ensure label/annotation quality from Crowd-miners is acceptable.

Parameters Used in Proof-of-Performance

TraneAi uses TPAI as the standard to govern parameters accessible directly in the business interface. This will streamline the user experience, making it easier to drive adoption. These parameters are set in the smart contract. Beyond the TraneAi implementation, others could use TPAI tokens to leverage parameters including:

- Speed - the elapsed time between each question answered during crowd-mining.
- Accuracy - based on the frequency of providing results shared with the consensus
- Redundancy - frequency in reacted answer to the same questions

Storage

TPAI tokens can be used to store files across a distributed network for both private and public access. The token establishes smart contracts between users across the network. In the TraneAi implementation these contracts are pre-established in an intuitive user interface to make it easy to make submissions and utilize the capabilities of the network.

Once formed, these smart contracts can enable storage capabilities which include the transfer of data, retrieval of data and for verification of integrity and availability. The data results which are labeled/annotated and verified by the proof-of-performance AI-powered agent are stored according to the terms of the contract. In the TraneAi implementation of TPAI tokens, the contract requirements are template-based for utility purposes.

Encryption Shards

Shards are portions of an encrypted file stored on the network. Sharding has a number of security related advantages including privacy and performance. This is needed to support use

cases for both public and private access to data, labels and models. Data will be encrypted client side before being sharded. Files stored on the network are saved as encrypted shards. Shard size can be negotiated in the smart contract in a standardized byte multiple (8, 16, 256mb) in order to prevent making specific shards conspicuous regardless of network size and shard volume.

Availability and Bandwidth

Bandwidth should be distributed evenly, when serving models distributed across shards in the network. Given the shards are typically running on separate hardware infrastructure the correlation between the hardware and general data availability doesn't exist. Creating redundant shards improves availability.

Developers can create new mining opportunities by providing contracts that provide greater availability through the process of increasing redundancy across the network on demand.

Data Transfer

Data is transferred via REST HTTP API. Storage-miners expose endpoints where client applications can upload or download shards. Client application requests are authenticated via AUTH routes. The SDK streamlines this process reducing overhead or wasting TPAI tokens when developing. Other alternatives may be implemented in the future.

IPFS Bitswap

IPFS Bitswap[12] is a data trading module for IPFS. It manages requesting and sending blocks to and from other peers in the network. Bitswap has two main jobs, the first is to acquire blocks requested by the client from the network, and the second is to judiciously send blocks in its possession to other peers who want them. BitSwap ledgers count bytes sent and bytes received. Rather than attempt to reach a network-wide consensus about the reputation of a data transfer transaction, these bitswap ledgers deal only with one-to-one relationships and do not account for latency, bandwidth, availability, or other quality of service factors of the overall network implying bit swap ledgers scale.

[12] https://github.com/ipfs/go-ipfs/tree/master/exchange/bitswap

Ethereum Name Service

EIP137 or Ethereum Name Service (ENS) will be used to resolve human-readable names, such as “mycoolmodel.eth,” into machine-readable identifiers that may represent Ethereum addresses, Swarm and/or IPFS content hashes or other identifiers. ENS will be used by 0x TPAI to create more intuitive message formats.

ACKNOWLEDGEMENTS

This work is the cumulative effort of the TraneAi and CraneAi teams and would not have been possible without the guidance and help of our advisors and development team. Ryan Hickman wrote the original TraneAi/TPAI token white paper in 2017, establishing the foundation for this work. He and Tomer Dicturel developed the new protocol and completed this white paper in collaboration with members of the entire team. Special thanks to Jennifer Crews (CraneAi) for editing this white paper for clarity and serving as a thought-partner on the ecosystem strategy; Susan Oh (Mukr Media) for encouraging us to explore how AI innovation can be accelerated on the blockchain and advising us on implementing that; Tom Lammers (EpicAi), for gaining critical early feedback from the financial industry and thought leaders; Jordan Brown (CraneAi) and Ruben Touitou (CraneAi) for creating the illustrations; and Jay Taylor, Esq. (Taylor Louis LLP) and Mark Donovan (CraneAi) who reviewed and edited this white paper.

CHANGE LOG

September 5, 2017: TraneAI website launch version (v4.2)
September 6, 2017: Advisory Team and pre-sale/crowdsale timing adjustments (v4.3)
September 7, 2017: Advisory Team adjustments (v4.4)

DISCLAIMER

Trane.AI, Ltd ("Company") has prepared this white paper and other materials for review concerning the sale of Transaction Protocol for Artificial Intelligence ("TPAI") and Company's business model incorporating TPAI, (the "White Paper").

In accordance with its business plan, Company will offer TPAI for sale to individuals and entities interested in purchasing the cryptocurrency for use in Company's products and services ("Buyers"). TPAI will be distributed to Company's Buyers, customers and other third parties in the manner and methods set forth in this White Paper. Company makes no representation or warranty, express or implied including, without limitation, any warranties of title or implied warranties of merchantability or fitness for a particular purpose, with respect to TPAI or any related product or service offered by Company or the utility of TPAI, or the ability of anyone to purchase or use TPAI. Without limiting the foregoing, none of the Company or its employees or agents, represent or warrant that the process of purchasing and/or receiving TPAI will be uninterrupted or error-free or that TPAI will be reliable and error-free.

Buyer shall provide an accurate digital wallet address to Company for receipt of any TPAI to be distributed to Buyer. The sale of TPAI is not securities as defined by the supreme court in SEC v. Howey Co. 328 U.S. 293 (1946), and do not fit within the legal definition of commodities, swaps on either securities or commodities. This White Paper, and all documents and information referred to herein, do not constitute a prospectus or offering document, and is not an offer to sell, nor a solicitation of an offer to buy an investment or an investment contract, a security, commodity, or a swap on either a security or commodity. This White Paper is solely informational and should be viewed as such. To the best of Company's knowledge, the information contained in this White Paper is true and correct as of its date of publication. Any statements made herein regarding the performance or viability of TPAI is a forward-looking statement which may or may not be realized. Buyer should not participate in the TPAI purchase for investment purposes as TPAI is not designed for investment purposes and should not be considered an investment. Buyer acknowledges, understands and agrees that Buyer should not expect, and there is no guarantee or representation or warranty by Company, that: (a) Company's business model will ever be adopted; (b) the Company's business model will be adopted as developed by Company and not in a different or modified form; (c) a blockchain

utilizing or adopting Company's business model will ever be launched; and (d) a blockchain will ever be launched with or without changes to Company's business model.

Buyer acknowledges and agrees that Buyer is not purchasing TPAI for purposes of speculation, as an arbitrage strategy, for immediate resale, or for immediate resale. Company's business model remains under development and may undergo significant changes over time. Although Company intends for its business and TPAI model to have the features and specifications set forth in this White Paper, Company may make changes to such features and specifications for any number of reasons.

Buyer also acknowledges and understands that the proceeds from the sale of TPAI may be utilized by Company in the execution of its business plan in its sole discretion. Buyer acknowledges that TPAI will be built on the Ethereum blockchain and therefore accepts the risks of Ethereum in accordance with Ethereum's terms, conditions and agreements governing its user's assumption of risk regarding the Ethereum blockchain. Buyer acknowledges and understands that the Ethereum blockchain may not include the Buyer's transaction at the time Buyer expects and Buyer may not receive TPAI the same day of purchase. The Ethereum blockchain is prone to periodic congestion, during which transactions can be delayed or lost. Individuals may also intentionally spam the Ethereum network in an attempt to gain an advantage in purchasing cryptographic tokens. Buyer acknowledges and understands that Ethereum block producers may not include Buyer's transaction when Buyer wants or Buyer's transaction may not be included at all.

TPAI may be subject to expropriation and or/theft. Hackers or other malicious groups or organizations may attempt to interfere with TPAI in a variety of ways, including, but not limited to, malware attacks, denial of service attacks, consensus-based attacks, Sybil attacks, smurfing and spoofing. Furthermore, because the Ethereum platform rests on open source software and TPAI is based on open source software, there is the risk that Ethereum smart contracts may contain intentional or unintentional bugs or weaknesses which may negatively affect TPAI or result in the loss or reduction of Buyer's tokens, the loss of Buyer's ability to access or control Buyer's TPAI, or the loss of ETH in Buyer's account. In the event of such a software bug or weakness, there may be no remedy and holders of TPAI are not guaranteed any remedy, refund or compensation.

The business model and forward-looking statements set forth in this White Paper are new and untested. Company's business model might not be capable of completion, implementation or adoption. It is possible that no blockchain utilizing Company's business model will ever be launched and there may never be an operational platform. Even if Company's business model is completed, implemented and adopted, it might not function as intended, and any tokens associated with a blockchain adopting the business model may not have functionality that is desirable or valuable. Technology is changing rapidly, so TPAI and the business model could become outdated if not implemented in a timely manner.

The regulatory status of cryptographic tokens, digital assets and blockchain technology is unclear and unsettled in many jurisdictions, including the United States. It is difficult to predict how or whether governmental authorities will regulate such technologies in the future. It is likewise difficult to predict how or whether any governmental authority may make changes to existing laws, regulations and/or rules that will affect cryptographic tokens, digital assets, blockchain technology and its applications. Such changes could negatively impact TPAI in various ways, including through a determination that TPAI is a regulated financial instrument which requires registration. Company reserves the right to cease the sale and distribution of TPAI, the development of its business model, or operations in any affected jurisdiction in which governmental action makes it unlawful or commercially undesirable to continue to do so.

There can be no assurance that governmental authorities will not examine the operations of Company and/or pursue enforcement actions against Company. Such governmental activities may or may not be the result of targeting Company in particular. All of this may subject Company to judgments, settlements, fines or penalties, or cause Company to restructure its operations and activities or to cease offering certain products or services, all of which could harm Company's reputation or lead to higher operational costs, which may in turn have a material adverse effect on TPAI and on Company's business model.