An Algebraix Whitepaper

The Algebraix Platform

April 2018, Version 1.3

Notes for next revision.

Emphasize will work in browser on multiple platforms (desktop. laptop, tablet, mobile phones), but with focus on mobile devices. PSV in cloud or on device - you choose. Seamless experience.

Table of Contents

Overview of the Personal Secure Vault

The Algebraix Vision

Since the dawn of the Internet web-based businesses have profited from exploiting our personal data. They have gathered petabytes of our data, not just our names and email addresses, but—as we skipped from website to website—they collected our buying patterns, our interests, our political leanings, our health concerns, our investment choices and our social interactions. They harvested our data, categorized it, aggregated it, analyzed and used it for their exclusive commercial benefit. They did so without seeking our permission or rewarding us for it, and they will continue to do so until we take back ownership and control of our own data.

Algebraix intends to level the playing field. Algebraix will deliver a platform that enables individuals to conceal their identities and control, by means of smart contracts, exactly who has access to their data and how it can be used. We will empower individuals to monetize their data through rewards they receive from organizations and businesses who wish to advertise products and services.

As blockchain technology has matured, one thing has become clear; blockchain computing will supersede the current structure of the Internet. In doing so, it will revolutionize every aspect of computing; in government, in the corporation, in the cloud, on the desktop, on mobile devices and even in the nascent Internet of things (IoT). This technology revolution will bring profound changes, impacting the individual, businesses, the many mechanisms of commerce, and government, both in respect of legislation and taxation.

While it may not be clear exactly how this new blockchain ecosystem will evolve, we already know it embodies technology that can enable the individual to own, precisely manage and monetize their own data. Algebraix will actualize that capability.

As the technology has matured, one thing has become clear; blockchain computing will supersede the current structure of the Internet. In doing so, it will revolutionize every aspect of computing; in government, in the corporation, in the cloud, on the desktop, on mobile devices and even in the nascent Internet of things (IoT).

What Is Personal Data?

Personal data, by our definition, comprises the following:

1. **Personal information.** Name, gender, date of birth, address, telephone numbers, marital status, employer and so on.

2. **Personal documents and credentials.** Driver's license, work visa, passport, birth certificate, marriage license, social security number and so on. These are credentials from some issuing authority (usually some department of government) that verify a person's identity.

3. **Interests and Preferences.** This is data that an individual voluntarily provides for the sake of monetizing their data. For example: I like angling, I am a baseball fan, I collect stamps, etc.

4. **Financial Information.** Data relating to bank accounts, debit cards, credit cards, crypto wallets, stocks and other investments, as well as mortgages and other similar financial assets and liabilities.

5. **Personal History.** Records such as previous addresses, phone numbers, educational record, transcripts, employment record, certifications, etc.

6. **Health Information.** Data such as vaccine history, medical history, doctors' reports, lab results, medical insurance, etc.

7. **Memberships.** Data or documents related to membership in associations, societies and groups of any kind, such as for sports clubs, retail warehouses, air mile programs and so on.

8. **Personal Permissions.** This comprises all digital permissions (such as login details) that provide access to web sites or software applications or anything else that requires digital permission for access.

9. **Titles.** Deeds, titles, provenance, appraisals and other documents that relate to or prove an individual's ownership of possessions such as a house, car, antiques, etc.

10. **Digital Possessions.** An individual's digital possessions such as photographs, videos, music, sound recordings, data files and so on.

11. **Personal Digital Tracks.** This data comprises an audit trail of an individual's personal digital activities and interactions, in effect their Internet history. It embraces whatever an individual chooses to track and can be tracked in respect of the digital activities.

12. **Personal Buying and Selling History.** This comprises a history of what an individual has bought or sold, for which there is a digital record.

In short, we regard an individual's personal data as being their full digital footprint, including details of who they are, their history, their access to digital services, their financial and physical possessions, for which there is or can be a digital record, and their actual digital possessions.

Algebraix will enable individuals to secure, command and productively use their personal data. To that end, Algebraix will build a blockchain-based platform and issue Algebraix Tokens (ALX) that will enable the purchase of services provided by the platform. Individuals will be paid in ALX by advertisers who will use their data for targeting purposes. Individuals in turn will be able to use ALX to pay for other services the network provides.

Algebraix will enable an individual to secure, command and make productive use of all their personal data.

The Algebraix Platform and the Personal Secure Vault

The Personal Secure Vault (PSV) is the user facing component of the Algebraix Platform. It is a mobile phone application that provides access to the services of the Algebraix network. It delivers the following:

1. **A personal secure data store.** The mobile app will store encrypted personal data locally, using the Algebraix network for back-up and if necessary for overflow storage. Initially, we expect individuals to store their basic identity profile data. Eventually they may choose to store some, if not all, of the data we previously described. End-to-end encryption will ensure that data is accessible only to its owner through using a private key. The owner will have the ability to grant access to this information to others (individuals or organizations) through purpose-designed smart contract permissions, which they alone will be able to set and manage.

2. **Multiple device implementation.** The mobile app is designed for synchronizing across multiple mobile devices so the intention is to support all existing and new mobile devices over time. The mobile device will be the individual's gateway to load their data, access to their data and confer permissions to people or organizations to access their data if they so choose.

3. **Digital wallet.** The mobile app will also be a digital wallet, for storing ALX tokens earned (or bought) and for paying for any services the network provides. It will include wallets for other cryptocurrencies and it will have a secure messaging application built in so that users will be able to send each other direct payments in cryptocurrency as well as secure messages.

4. **Video Ad Browsing.** The mobile app will enable the user to browse through and view ads. It will be designed to create a compelling user experience, making the application easy to understand and use when selecting and responding to ads and promotions, and also when uploading data, accessing data, trading from one cryptocurrency to another, and reviewing one's activity.

5. **An anonymized database.** All data held by the Algebraix service will be encrypted using cipher AES-256 encryption as a matter of course to protect it from compromise. The network will house an anonymized database of users' profile data that they have given permission to advertisers to use. Advertisers will query the database to create target lists of users to whom they will publish ads or make product offers. Individuals will be at liberty to view ads and respond to offers.

End-to-end encryption will ensure that data is accessible only to its owner through using a private key. The owner will have the ability to grant access to this information to others (individuals or organizations) through purpose-designed smart contract permissions, which they alone will be able to set and manage.

6. **Access to other applications and blockchain services.** There is already a wide variety of blockchain-based services for individuals and more emerge month by month as new blockchain business-es emerge. For example: BitShares offers financial services, Steem provides a social media platform and so on. The mobile app will be built to run applications that provide direct access to such ser-vices. Algebraix also intends to provide external developers with an ability to build applications. Algebraix will create and manage an auditing and approval procedure for this.

The InterBlockchain Communication Fabric

The interblockchain communications fabric (IBCF) is a major component of the Algebraix Platform. It will allow applications that use the Algebraix network to access the services of multiple blockchains for any blockchain services that Algebraix chooses to support, including transactions that are governed by smart contracts. Data Algebra (discussed later) will play a key part in enabling the creation and delivery of this functionality. It will be used to create a scalable distributed catalog for applications to reference when locating and processing data. The structure of the IBCF, which enables applications to reference external ledgers, is discussed later in this white paper.

Algebraix will build a development environment for its own use that targets the creation of applications that exploit the IBCF, but will also make this environment available to independent developers and ISVs. The intention is to offer bounties to serious developers who undertake approved projects for the development of further applications to enrich the network.

Algebraix Platform Applications

No-one (including Algebraix) will have access to data held in the Personal Secure Vault (PSV) unless they are granted permission by its owner. The owner may confer access to specific data items to others and will grant such access in the context of specific personal or business interactions – for example when visiting a doctor. Algebraix's principles of data security which embrace the European GDPR principles and the use of zero-knowledge proofs are discussed later in the Algebraix Ethos section of this paper. All software will be designed to involve the minimal exposure of data and to make it uneconomic for any business to attempt to aggregate PSV data.

Data vault interactions, aside from data upload, will include the ability for the data owner to monetize their data. Advertisers will publish advertisements and promotions which data owners can choose to view and respond to. In the course of such interactions, advertisers will be granted access only to data that the data owner chooses to reveal in accordance with a well-defined smart contract. This puts the data owner in a position to monetize their data while preventing other parties from exploiting such data without agreement.

Advertisers will publish advertise-ments and promotions which data owners can choose to view and respond to. In the course of such inter-actions, advertisers will be granted access only to data that the data owner chooses to reveal in accordance with a well-defined smart contract.

The PSV is intended to assemble an individual's complete data record in every dimension of their lives: personal, family, social interactions, educational history, health history, hobbies, sports activities, political activities, Internet activities, banking, investments, financial interactions, purchases and sales, the title to their physical possessions: houses, cars, household appliances and so on, as well as their digital possessions (photographs, video, sound and various other data files).

The initial applications that will be built—aside from storing, securing and making data available through smart contracts—will (we intend) be achieved through directly linking to other blockchain capabilities that currently exist or are in the process of being created. For example, existing blockchain services include: retail, mobile game playing, competitive eSports, gaming (gambling), document storage, banking, digital asset management and financial services. The blockchain ecosystem is growing rapidly and, as new services for the individual are added, we will, where there is sufficient demand, integrate directly with them through the Algebraix IBCF.

Many services now offered through the Internet will, over time, become available through blockchain applications, including: every variety of social media application, every kind of data storage, email and messaging, buying and selling new and second hand goods, publishing, banking, investment, mortgages, credit checking, educational services, health services, dating, advertising and more. Many of these activities will be transformed by block-chain technology as many of them currently involve intermediate actors whose role can be superseded by the blockchain itself and the intelligent use of smart contracts.

Many of these activities will be transformed by blockchain technology as many of them currently involve intermediate actors whose role can be superseded by the blockchain itself and the intelligent use of smart contracts.

The Monetization of Personal Data

In the Global Advertising Forecast report published in December 2016, Magna estimated revenues from digital advertising for 2016 to be over $178 billion (36% of the total global spend of $493 billion). Approximately 54% of this was shared between Google and Facebook. Magna expects this 36% figure to rise to 50% of the total by 2021 (i.e., $300 billion of an estimated $600 billion). Digital advertising revenues are thus considerable, averaging about $89 per Internet user, and $287 per US Internet user, and they are projected to grow at 11% per annum.

In our view, the expected rise in digital ad spending reflects the fact that digital ads are more effective than any other form of advertising. Digital advertisers are armed with big data and the best analytical software money can buy. They invest in it heavily to push targeted ads at almost every person who accesses the Internet via PCs, tablets or mobile phones. Digital advertising is thus dominated by a push approach, which seeks to disrupt our attention and activity while we journey from one web site to another.

What Algebraix will establish is an alternative approach, based on a true permission "publish-subscribe" approach to advertising and promotion, where advertisers publish advertisements to selected groups of prospects (data owners) and the data owner chooses whether to subscribe or not. It is not a "push" approach and is not weaponized with machine learning and AI. Nevertheless, it will give rise to accurate targeting (more accurate, we believe, than analytic approaches to push advertising). People who want specific products or services will be able to subscribe to relevant published information and may choose to enter into a sales dialogue once they have reviewed the "ads." As part of the process they will be rewarded in ALX coin in line with the agreed smart contract.

Most web users resent the attack on their attention that digital advertising exerts. In our view, advertisers that devote large revenues to push advertising will happily direct a good deal of that expenditure to self-selected potential customers.

In outline, we envisage the system for creating such interactions will have the following steps:

- Data owners will choose to expose profile information in a profile database that reveals targeting information (date of birth, gender, zip code, interests, and so on) but not their name or address or any other such identifying data. They will thus be represented by an anonymous avatar.

- Advertisers will be able to query the profile database to identify possible targets for their advertisements, i.e. prospects for their products or services and thus generate an anonymized target list.

- The advertisers will publish their ads to the target list of data owners, declaring the details of the reward (in ALX) for those who choose to view or read the ads.

- Data owners who view the ad will be paid for their attention, receiving the specified reward.

- It is expected that in most instances the ad will include a "call to action" and the data owner may then choose to take the next step and develop an interaction with the advertising business which may involve further rewards.

- Every step up to and including a sale could be governed by smart contract and include an escalating set of rewards for the data owner.

The rewards to the data owner can be viewed either as payment for attention or as promotional discounts offered for a product or service, or a combination of the two.

Most web users resent the attack on their attention that digital advertising exerts. In our view, advertisers that devote large revenues to push advertising will happily direct a good deal of that expenditure to self-selected potential customers.

Integrity Management and The Reputation Engine

Just as the blockchain enforces immutability, provenance and security, the advertising system will seek to enforce honesty and integrity. Algebraix goal is to build trust into the consumer advertiser relationship in a way that satisfies both. The problem of "How do you keep both sides to this arrangement honest?" will be managed in the following way:

The system will include a sophisticated reputation score for both data owners and advertisers.

Data Owners' Reputation: The ideal behavior of the data owner, a behavior the system will incentivize, is that they browse through ads in the same way that they browse the Internet—searching for specific products or services that interest them and, when the mood takes them, making purchases. To be exact, we expect their browsing and shopping behavior not to vary significantly from the current norm.

We will encourage advertisers to provide potential buyers with promotion specific (encoded) vouchers that entitle the buyer to rewards/discounts as they move through each step of the sales process. By doing this we will be able to analyze not only advertising responses, but also sales cycle behavior, "from ad to purchase." Using machine learning data analysis techniques, we will thus be able to identify the normal range of consumer patterns, both for browsing ads and for the "ad-to-purchase" cycle.

For data owners, the reputation engine will analyze their behavior and calculate a reputation score which advertisers can take into account when creating target lists. Those data owners who try to game the system by viewing many ads for goods or services in which they have no interest, and hence never buy, will be excluded from the more rewarding advertisements by their reputation score.

Data owners will be advised of this policy. They will be able to read how the reputation algorithm works and will be able to access and know their reputation score. Additionally, we will warn data owners when their activity is damaging their reputation score.

It will be at the discretion of the advertiser as to how they incorporate the reputation score in their advertisements. There may be some advertisers who may not want to use the reputation score when targeting. For example, if the intention of the ad is brand recognition, reputation score might not matter to the advertiser.

Advertisers' Reputation: Advertisers will be accorded a reputation score by data owners in two ways. Data owners will be able to report advertisers that indulge in misleading advertising or deceptive practices and such reports will be provided as feedback to advertisers and may be published to all data

We will encourage advertisers to provide potential buyers with promotion specific (encoded) vouchers that entitle the buyer to rewards/discounts as they move through each step of the sales process. By doing this we will be able to analyze not only advertising responses, but also sales cycle behavior, "from ad to purchase."

owners depending on the circumstance. However, we will also be able to report analytically on data owner ad viewing behavior, providing advertisers with some indication of the reasons why data owners chose not to view ads.

System Refinement

As advertisers often wish to know preference details about potential customers that are difficult to discover, the system will include the ability for advertisers to suggest new attributes for (some or even all) data owners to record and expose. For example an advertiser of food products may wish to know which data owners like spicy food or a sports company may wish to know whether a data owner enjoys cycling. We expect data owners to be willing to provide such information if they believe they will be rewarded for it and knowing that they cannot be individually identified by it.

Once data owners realize that they have ways to monetize their data, we expect an entrepreneurial spirit to arise among some of them. We thus expect, for example, that they will organize economic groups (golfing enthusiasts, stamp collectors, chefs and cooks, and so on) so that they may be able to negotiate for products and services as a group. The system will cater for the forming of such groups, but Algebraix will not seek to organize any such groups – preferring to let them evolve of themselves. We will also support such activity by enabling software developers to build applications that might assist the organization of such groups.

In our view, if we enable individuals around the world to own their data it is incumbent upon us to enable them to monetize their data so that they begin to understand that it has value and begin to appreciate exactly what its value is.

We believe that network effects will naturally develop from many user activities, including using cryptocurrencies to make person-to-person payments, collaboration among groups of users to negotiate discounts and so on.

We believe that network effects will naturally develop from many user activities, including the secure messaging service, using cryptocurrencies to make person-to-person payments, collaboration among groups of users to negotiate discounts and so on.

Data Algebra and the Personal Secure Vault

Algebraix is the originator of data algebra, a new field of mathematics. The company has spent eight years developing it, proving its power to drive high performance data retrieval in many software contexts and to scale out over very large volumes of data. Data algebra is capable of defining and manipulating all possible data structures at any scale.

Software based on data algebra will play a central role in the implementation of the Personal Secure Vault and will be critical to its success. Its importance to the project is difficult to overstate since the software that is being developed requires a highly versatile metadata directory (or data catalog), which will ultimately need to cater to very large volumes of data distributed across multiple blockchains and stored in a wide variety of data structures.

Preliminary design work has determined that the data managed by the owner of the data vault will include flat files, structured data (as organized in traditional relational databases), data objects (as defined in so-called document databases), complex data relationships (organized in a graphical form) and, to capture and preserve its inherent meaning, semantic metadata structures (also called ontologies). The data itself will be encrypted and self-defining, in the sense of knowing its origin, its lineage, its ownership and the usage permissions it grants or is able to grant.

The unique capability that data algebra can provide to metadata management will be complemented by its effectiveness in other important areas of data management and network performance. Specifically, it will accelerate processing speeds significantly using its proven query acceleration capabilities and it will enable data volumes across the Algebraix network to scale far beyond the petabyte level. Ultimately the software will need to cater for hundreds of millions of Personal Secure Vaults and their frequent individual usage. For that reason, data algebra will be key to delivering acceptable performance, irrespective of scale, while ensuring the economic use of resources.

Algebraix Data Corporation has been issued 9 patents that relate to the use of data algebra in data management and database applications. In particular, several specific techniques have been developed to accelerate the performance of queries accessing files or databases.

Most of these techniques work by monitoring query activity and identifying opportunities for data reuse—they enable the precise mathematical caching of results. They have proved to be effective for queries serving BI, analytics and ETL workloads, and for RDF database workloads—often accelerating performance by one or two orders of magnitude.

Aside from query acceleration, data algebra can be usefully employed in monitoring and managing a large data resource. By monitoring all data usage within a given data environment, it can optimize data storage structures and data location in ways that will reduce access times and minimize resource usage (CPU, RAM, etc.).

Data algebra will be an integral part of the data layer that presides over all Algebraix Platform applications and an inherent part of the blockchain implementation. Because we believe that the benefits data algebra confers need to be available to the whole community, source code will be made available on an open source basis. Additionally we intend to create an independent open source project that involves extensive use of data algebra.

Readers of this paper who wish to explore data algebra in greater depth are advised to download the free eBook, The Algebra of Data, A Foundation for the Data Economy (by Professor Gary Sherman, PhD, and Robin Bloor PhD) at https://algebraix.io/get-book/ For those who prefer paper, it is also available on Amazon.com.

The unique capability that data algebra can provide to metadata management will be complemented by its effectiveness in other important areas of data management and network performance.

The ALX Platform

Algebraix intends to build its own blockchain platform, although in doing so it will lean heavily on development work already done and code already written by other blockchain projects. Currently no blockchain provides all of the capabilities the ALX platform needs. These include: need for just a single token, proof of stake consensus, smart contract capability, anonymous transactions, high throughput (scalability to above 1000 transactions per second) and low transaction costs. There are some blockchain projects that have many of these characteristics, but none we are aware of which have all. Consequently, we will need to build some of these capabilities ourselves.

IPFS will be our preferred file system layer for storing data. We believe this to be a good fit to our algebraic approach to metadata (alternative approaches will be catered for as needed, for example where data is stored on other ledgers). Points worth noting about IPFS are that:

- Every file can be found by human-readable names using the decentralized IPNS naming system.

- Each IPFS file and all blocks it contains are given a cryptographic hash (unique fingerprint).

- IPFS removes duplications (across the network) and tracks version history.

- Each network node stores only files it is interested in along with indexing information that can be used by the algebraic metadata catalog (to figure out what is stored where).

- When looking up files, it asks the network to find nodes storing the content behind a unique hash.

Personal Secure Vault Architecture

The Personal Secure Vault (PSV) comprises a sophisticated system with many possible applications. Here we only describe the organization and function of its fundamental components. The PSV has three primary components:

a) The PSV Client

b) The Permission Engine

c) The InterBlockchain Communication Fabric
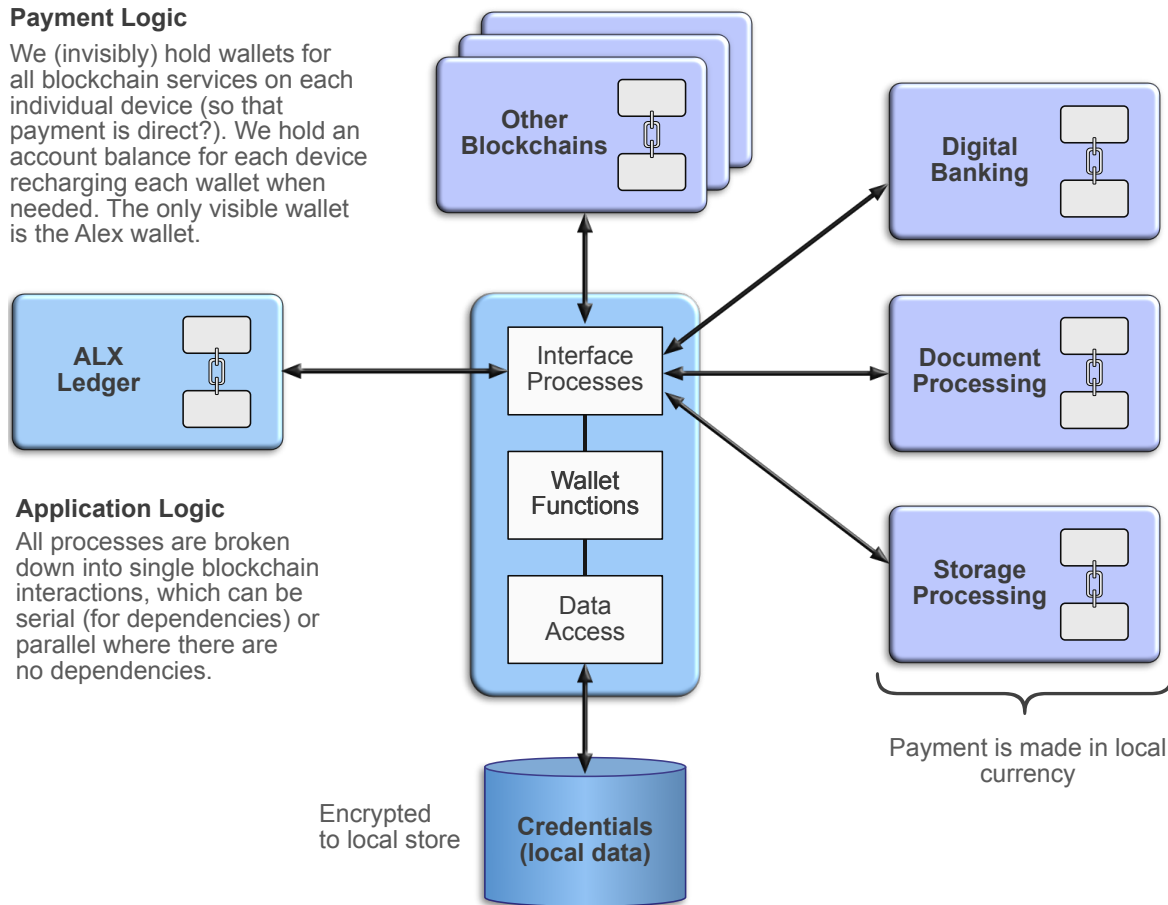
The PSV Client

Diagram 1. on the following page provides an overview of the PSV client and its interactions with the ALX ledger and other blockchains that it utilizes.

The PSV client will reside on one or several client devices: a mobile phone, tablet, laptop, desktop or any other suitable client device. The PSV Client has three primary functions:

Payment Logic

We (invisibly) hold wallets for all blockchain services on each individual device (so that payment is direct?). We hold an account balance for each device recharging each wallet when needed. The only visible wallet is the Alex wallet.

Application Logic

All processes are broken down into single blockchain interactions, which can be serial (for dependencies) or parallel where there are no dependencies.

Diagram 1. The PSV Client

1. It can access and store data to a local store of credential information.

2. It is a wallet for ALX coin and other cryptocurrencies.

3. It is client software and initiates all of a user's PSV applications.

An individual PSV user may have multiple instances of the PSV client on multiple devices. Each instance will, when initiated, check its status and where necessary update the local credential store via interaction with the ALX blockchain. When a PSV application needs to provide credentials to run an application, they will be accessed from the local store and used accordingly.

The credential store will be encrypted using AES-256 and backed up twice by the ALX blockchain. If the user loses their client it will be possible to recreate it from a seed provided to the user when they initially create their PSV. A specific procedure will be defined and built for PSV restoration.

The PSV client will hold a wallet of ALX coins (and possibly other coins) which may be required to run a PSV application. Where payment in ALX is required, the amount will be sent from the wallet. When the PSV user earns ALX, the amount earned will be credited. The user will also be able to buy (i.e. deposit ALX) into the account using Bitcoin, Ethereum, or any other cryptocurrency that we accept. In all cases the current price of ALX will be used (determined with reference to the market price). The PSV client will thus maintain an ALX account, and the PSV user will be able to check the account and all its transactions at any time.

Every transaction involving the PSV user will be stored on the ALX block-chain and thus a full audit trail of all activity will be available for the user to browse through. The PSV will provide details of every smart contract and every exchange of information or permission granted by the PSV user to any external organization.

Specific applications may require interactions with other blockchains. Algebraix intends to provide the base capability to enable this, but also intends that it serve as a platform on which other developers can build. We thus envisage the possibility of PSV users running applications where the only role of Algebraix is to provide the audit trail (using the ALX blockchain) and enable blockchain intercommunication.

The Permission Engine

The Permission Engine, an integral part of the Algebraix Platform, is an application and database available to external organizations who wish to carry out targeting queries of data owners' information. External organizations will pay for the service and data owners will be rewarded for their participation in any given selection. In the business sense, the idea of a selection can be understood in the following way: the external organization wishes to identify a particular subgroup of data owners. This could be any subgroup, such as: all males between the ages of 25 and 50, who play golf and live in Texas, people who collect Civil War memorabilia, people who are fans of a particular sports team and so on.

The purpose of the selection will primarily be to advertise to and engage with data owners. It could be for any purpose, such as recruiting people for specific jobs or finding people who might want to join a specific club or carry out some kind of survey. The selection might wish to identify data owners who seek to take advantage of a particular promotion (for example, inexpensive hotels or air flights) or who are currently interested in buying a car or who are interested in assisting a particular charity.

The permission engine will connect organizations that want to provide some kind of product or service with data owners who are genuinely interested (anonymously) in engaging (anonymously) with the organization. The organization identifies a particular subgroup of data owners and publishes (what

they want or are willing to provide) to them. The data owners can then choose to take advantage or not. If it is, for example, about subscribing to a magazine, then the interaction will be covered by a smart contract and the data owner on viewing the advertisement will be rewarded in ALX from the fee provided by the publishing organization and further rewarded when completing their magazine subscription.

A small portion of the fee will go to (proof of stake) nodes.
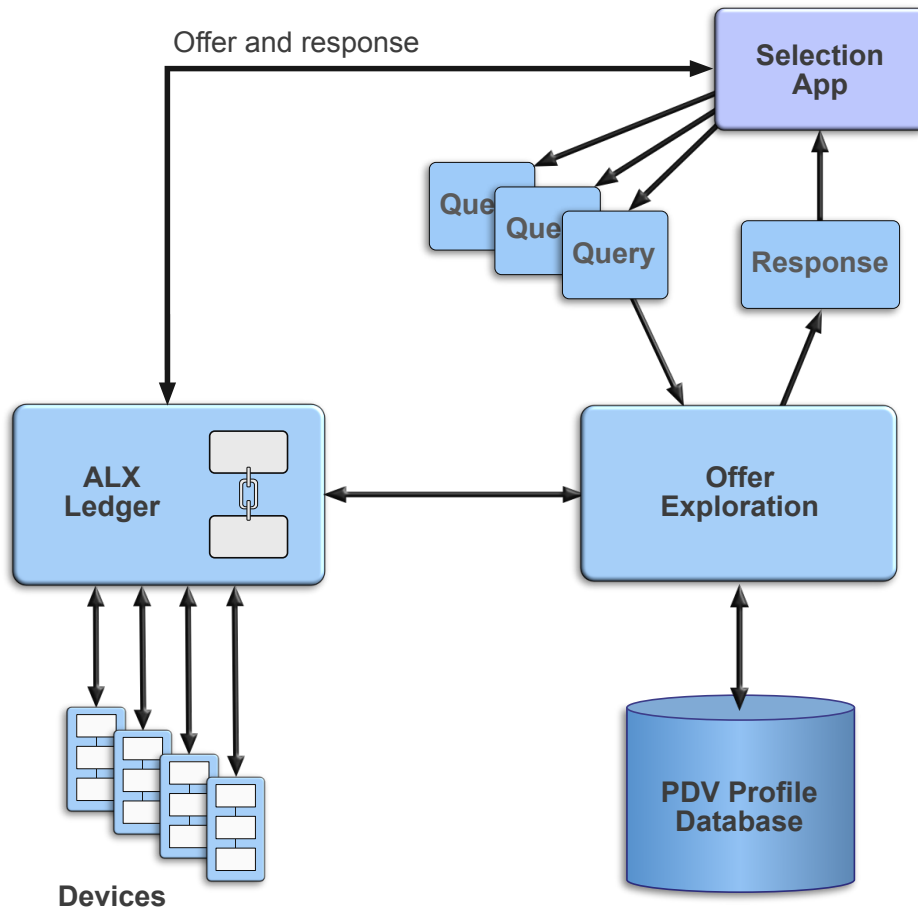
Diagram 2. The Permission Engine

Diagram 2 provides an outline of the Permission Engine and how it interacts with the ALX ledger. The PSV database, although shown as an individual entity in the diagram, will be implemented in a distributed fashion. It can be thought of as a single extremely broad table, each row of which represents one PSV owner and characteristics about them that they have willingly revealed so they can be targeted. This might be, for example, month and year of birth, current zip code, gender, household salary range and so on. Each row will also contain a unique anonymized identifier of the individual.

At any given point in time multiple queries may be queuing up to be answered and the Offer Exploration application will query the database and send the response to the Selection application. For the sake of performance, the queries will use an algebraic query language to access the data, rather than SQL or any other existing query language. The response will be, for example: "1364 people were found with the desired characteristics." The organization can then choose to create a smart contract (of which several templated smart contracts will be available) and publish their offer to those 1364 PSV owners.

PSV owners will not necessarily respond. The offer will simply be put on a stack of other offers that the PSV owner has received. If, however he or she chooses to respond, they will participate in the execution of the smart contract which covers their interaction. This may simply involve viewing an ad. However it may also involve filling out some details to complete their part of the bargain. This is illustrated in diagram 2 by the offer and response arrow between the Selection App and the ALX ledger which results in interactions with PSVs. All activity will be recorded on the ALX ledger, as will payments to PSV owners and payments by organizations doing promotions.

The IBCF

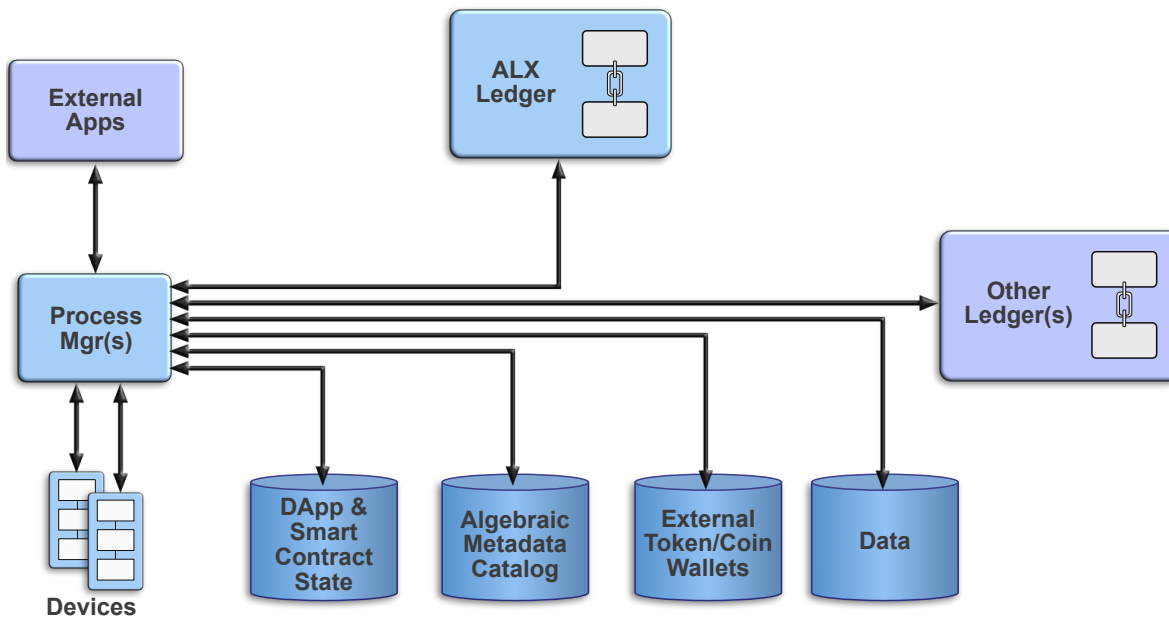The IBCF is illustrated in the diagram below.

Diagram 3. The IBCF

All external interactions with the fabric are through Process Managers (that fulfill the role of Oracles, masking information about the network). The Fabric operates through the action of multiple distributed Process Managers. Every event that occurs within the network is asynchronous. The process manager's

first action on receiving any message/directive is to interpret the request so that it can identify which application or specific smart contract it refers to and then record it as a transaction to the ALX ledger. It subsequently interacts with the four data stores described below.

The four data stores shown are distributed (and replicated for resilience) across multiple nodes and have the following functions:

1. The leftmost data store (DApp and Smart Contract State) records the current state of every DApp and smart contracts—and also the registry of DApps and smart contracts. For the purposes of this paper, we define the difference between a DApp and a smart contract to be that a DApp will consist of multiple steps, some of which may involve the use of one or more external ledgers and the service such ledgers provide, whereas a smart contract consists of a single ALX smart contract. By virtue of this data store it will be possible for any Process Manager to execute the next action for any DApp or smart contract. The Process Manager will load the existing state from the data store and check whether the requested action is valid and if it is, will write the appropriate record to the ALX ledger and execute the action. It is possible that all state information will be stored on the ALX ledger.

2. The second data store holds the Algebraic Metadata Catalog for all data related to any DApp or smart contract, including any data stored via other ledgers. This catalog will resemble a file directory in the sense that it will contain references to individual data files (which account owns the data, on which nodes the data resides, time of creation, last time accessed and so on). It will also store the algebraic structure of the data. The catalog will also be capable of representing and storing whole databases or database shards. The algebraic metadata catalog will be self-referential, defining itself and its structure. Note that we will employ IPFS for all file storage.

3. The third data store (External Token/Coin Wallets) is for wallets of other currencies that the IBCF may need to use to pay for the services provided by other ledgers. The intention is to set up proxy wallets for individuals to pay (in the appropriate currency) for the services provided by other ledgers. In that way, charges will always be brought back to the individual who is using the service.

4. The fourth data store is for data that is local to the ALX ledger. There is no intention here to provide storage for all the data that an individual might wish store within their PSV. Most likely other blockchains that specialize in data storage will be used for that. However, we intend to store replicated copies of any individual's credentials (as described on page 3) within the ALX ledger nodes.

There are multiple Process Managers executing on multiple nodes with activity load-balanced between them. Nodes will be geographically distributed (worldwide) and, to minimize network latency, processes will attempt to use geographically local node resources where possible. All nodes (we think of them as farming nodes) will be monitored for activity and will be rewarded in ALX according to an agreed smart contract for work carried out.

If a Process Manager determines that the network is becoming overloaded it will instantiate a new Process Manager instance on a PoW server node in an appropriate location. When activity diminishes Process Manager instances may be closed down. The Process Managers execute processes or smart contracts which have a unique instance identifier and require a valid key to execute.

The intention is to release all the software discussed above as open source.

The DApp and Smart Contract Registry

The Algebraix Platform and its ecosystem of capabilities will grow to become a complex environment of data and associated applications. It will implement multiple remuneration agreements governed by smart contracts. Those remunerations agreements will vary in respect to the parties involved, but may include:

- PSV owners

- Resource providers (for Proof of Stake resources)

- Other ledger DApps (for services rendered to users of the Algebraix blockchain)

- Application authors/software developers, who build applications that leverage the Algebraix blockchain.

- Payments to software developers may include one-time payments as well as payment by usage, which might mean payment per user or per transaction or per hour. The intention is to be flexible, so that in some instances payment-specific "unique" agreements may be made.

The payment transactions that occur within the ecosystem may need to cater for:

- Micropayments

- Batches of payments

- Off-chain payment channels (e.g. for transactions using fiat currency)

- Per-unit use of software

- Custom receipts

- Time locked payments

- Escrow payments

The Algebraix DApp and Smart Contract Registry will itself be a smart contract, to which developers can publish their own applications that have been validated and are ready to run on the ALX network. Algebraix will define development standards. The goal of the registry is to:

- Provide developers a way to publish applications both for vetting by Algebraix and for use within the network.

- Provide data owners or external organizations with a directory of applications to use if desired.

- Provider visibility to all PoW nodes of all applications (and their source code) that they may agree to run.

The exact process of code review and validation has yet to be formally defined. However, our intention is to exert rigorous security control over all new applications to eliminate the possibility of application-based attacks on the network or on PSV owners.

Product Roadmap

In this section we present planned milestones for Algebraix software development. The successive versions of the PSV software are split into milestones. This plan should be considered preliminary, as Algebraix is using sophisticated software technologies to implement what will grow to become a complex set of capabilities, involving the novel application of data algebra.

Each milestone mentioned below will be preceded by research, the results of which will be described in technical white papers. At every stage new functionalities are added. The scope of deliverables at every milestone will depend on the level of SAFT funding raised.

- **Milestone 1:** The network launch: when this occurs the ALX ledger will be operational and ALX holders will be able to hold ALX in a wallet and transfer amounts of ALX to and from that wallet. A base capability will provide for the storage of personal data by a PSV client application. It will store personal and profile data encrypted locally on the device and via the ALX blockchain.

  The PSV app will also be a wallet for ALX so that it can facilitate payment and reward activity. The securing and storage of data will be carried out by smart contracts on the ALX blockchain.

- **Milestone 2:** The completion of a permission engine that enables any organization to select subsets of the PSV population who wish

to participate, to present advertisements and receive responses. The development will run concurrently with the development of the PSV.

- **Milestone 3:** The project to develop the InterBlockchain Communication Fabric (IBCF) will also start concurrently with the PSV application project. Once running, it will enable PSV owners to take advantage of services available through other blockchains.

Our intention for the further development of the system is to be guided primarily by the PSV owners and our own research to determine how and when to further expand the capabilities of the ALX blockchain and the PSV.

Security and Resilience

The principles under which the Personal Secure Vault (PSV) will function are as follows:

1. All data stored in the PSV will be encrypted and will be made available in the clear only with the direct permission of the PSV owner through an approved smart contract. (If PSV owners wish to send their personal data in the clear to other people or organizations in any other way, they will need to download it from the network and send it outside the network.) Only the PSV owner will know what is stored in the PSV. Access to such data will require the PSV owner's private key or will be provided by the PSV owner to another party only through explicit permissions provided by the PSV owner by means of a smart contract which can be created only with the PSV owner's private key.

2. Data stored by the PSV falls into one of two categories:

   c) Credential Data: Data relating to personal credentials (name, address, mobile number, driving license, passports etc.) and personal preferences, which may need to be provided in specific circumstances to enable smart contract agreements, and possibly also for other applications.

   d) Other Data: Data, such as digital possessions, documents and digital records that are not personal credentials.

3. Data of type a) will be encrypted and cached locally with the PSV, while data of type b) will be encrypted but stored only in the network or possibly on other ledgers.

4. For the sake of resilience three (or more) copies of all data will be held, so that the failure of any given network node cannot result in data loss.

5. The Algebraix network which registers all PSV interactions or transactions is a fully decentralized, open source P2P network that

resists censorship, and has no single point-of-failure.

6. All messages passed through the Algebraix network will be signed and encrypted messages to ensure authenticity and protect against man-in-the-middle attacks and passive data collection.

7. Smart contracts and DApps will execute in the isolated virtual machine environments with minimal privileges and external network connectivity.

8. All smart contracts and DApps created by external developers will go through a registration and audit process.

9. Taken together, the registry (for DApps and smart contracts) and PSV InterBlockchain Communications Fabric (IBCF) will mitigate against Sybil and whitewashing attacks by providing an incentive to participate, introducing an economic and computational cost to participation.

10. The smart contract technology employed will make it possible to create custom payment-based security mechanisms, such as escrows, deposits, insurance and audit proofs.

11. Security audits performed by external contractors will be conducted for every major release of software.

> *Individuals need to be empowered to own their own data so they can hold it securely, make more productive use of it and earn from it, by being paid for their attention.*

The Issuing and Distribution of ALX Coin

All ALX tokens will be pre-mined and the volume will be fixed at 100 billion ALX with no inflation rate. The tokens will be issued according to a planned schedule, as follows:

- 25% will be made available for a SAFT (Simple Agreement for Future Tokens) token pre-sale which began in late October 2017.

- 15% of the ALX supply is initially reserved for staff.

- 5% is reserved for advisers, agents and partners.

- 55% is a company and contingency reserve for use at Algebraix's discretion. Some will be used for customer download rewards and viral marketing incentives. Some will be provided as developer incentives, staker rewards and blockchain integration payments to stimulate productive alliances with other blockchain businesses.

Algebraix expects that it will need to use ALX coins to incentivize all of the actors in the ecosystem it is building and thus is allocating ALX supply accordingly.

The SAFT

Following legal best practice, as advised by our legal advisers, Cooley LLP, we are conducting a SAFT, making future ALX tokens available to accredited investors. We will sell the rights to 25 billion ALX tokens at a discount to the price at network launch. For more information on the SAFT, please email investors@algebraix.io or visit Algebraix.io/saft.

Currently the intention is to keep the SAFT open until the first release of the Algebraix platform and the mobile app, however the SAFT will most likely be closed if the cap of $17,000,000 is reached.

The Use of Funds

Algebraix will devote the funds raised from the SAFT to the development of its business model and the development of its software until MVP (Minimum Viable Product) is achieved. The SAFT funds will finance the following activities:

- Growing the software development team to build our mobile application, Inter blockchain Fabric, and our own blockchain based on Data Algebra

- Building an exemplary marketing team focused on creating viral expansion of users through sophisticated use of influencers, social media, and our own advertising campaigns.

- Build a team of business development experts to educate major advertisers on the new platform.

- Create a product management excellence feedback loop from users and advertisers to create an internal ecosystem of continuous product enhancement.

- Administer and expand our Austin offices

Aside from financing the ongoing activities above, the SAFT funds will be dedicated to audience development and bringing cryptocurrency mainstream through the use of ALX. This will involve a significant spend on advertising across all media channels.

Additionally, a significant proportion of the company proximately 35% of the supply of ALX coin will be devoted to incentivizing new users to adopt the platform and rewarding early adopters for helping to recruit new users. Our intention is to induce a network effect.

Current Market Trends

Before discussing our Go to Market Plans, we need to review the key business and technology trends that relate to digital advertising, personal data, and the adoption of cryptocurrencies. The Algebraix platform design and the services it will provide ride on the back of these market trends. Fortuitously, they are converging and the timing is right. The Algebraix business model and its blockchain-based platform leverage the following specific market needs.

Data Ownership

The ownership of personal data is a self-evident right. In our view, it is as important as the right to free speech or the right to vote. Were people asked to vote on whether they owned their data, they would vote overwhelmingly to affirm that they did.

Prior to the digital age there was no need to defend the ownership of personal data. However, nowadays, personal data is harvested by a host of businesses and organizations. The data, which is often carelessly managed, is exploited in many ways without the permission of the owner, without rewarding the owner for its use, and too frequently to the personal detriment of the owner.

Case in point: the September 2017 Equifax hack drew a great deal of public attention to this. The personal financial details of 143 million people (more than half the adult population of the U.S.) were stolen. Equifax had never sought the individual's permission to hold this data, and because they failed to secure the data, the data owners are exposed to its fraudulent use.

In recent years the need for laws to be enacted to protect data ownership has become increasingly clear – and urgent. In May 2018, Europe will implement General Data Protection Regulations (GDPR) legislation which will apply worldwide to any company that holds data on European citizens. GDPR focuses on the use of personal data and the duty of care required of organizations that collect such data. The penalties for violation are severe: rising to 4 percent of an organization's previous year's annual revenue.

GDPR is based on explicit principles, which we list and describe in the Algebraix Ethos section of this document.

Algebraix Solution: The Algebraix platform will provide individuals with a Personal Secure Vault (PSV) where they can store any data of any kind in an encrypted form, where they (and only they) can provide controlled access to it, should they so choose.

Data Exploitation

The exploitation of personal data without permission or payment to the owner is rampant. Digital behemoths have harvested petabytes of our data,

The personal financial details of 143 million people (more than half the adult population of the U.S.) were stolen. Equifax had never sought the individual's permission to hold this data, and because they failed to secure the data, the data owners are exposed to its fraudulent use.

and not just our names and email addresses, but also our pathways through and our activities on the web. These giants track our buying patterns, our interests, our political leanings, our health concerns, our investment choices, and our social interactions – all without our permission and frequently without our knowledge. They aggregate our digital behaviors and habits, attack our digital person with algorithms and squeeze precious knowledge from it – to their exclusive profit and often to our disadvantage.

Data owners have had little or no control over their data and none over the value extracted from it. Their data is held hostage by data brokers such as Facebook and Google, and it does their bidding. Put simply, the data has become a commodity and the data owner a mere product. The inequity of this situation has recently become apparent with many commentators criticizing the status quo and calling for change. And change will inevitably occur.

Algebraix Solution: Reward data owners for viewing the ads they choose to view. Give them a level of control over the ads presented to them. If they do not wish, for example, to receive ads in a particular category (say, electronics) they will be able to elect not to receive such ads. Their secure personal data will only be used to determine which ads they will receive.

Data Insecurity

2016 was a record year for data breaches, having beaten the 2015 statistics by about 40 percent, according to the [Identity Theft Resource Center](). 2017 is likely to be worse, given that it includes the jaw-dropping hack of Equifax. There is an uncomfortable irony in this. Not only do businesses exploit your data, but they fail in their duty to keep it secure – and just as bad – to ensure it's even accurate.

The trend towards blockchain-based technology, and the consequent trend away from centralized systems towards decentralized systems coupled with sophisticated encryption techniques, is driven in part by the need for data security.

Algebraix Solution: The Algebraix network and the PSV will be fully secure and its data will be available only to its owner via a private key. Algebraix itself will have no access to the data. Platform applications will use the blockchain to indelibly record all interactions.

Inaccurate Data

Data held on behalf of its owner is often inaccurate. When it comes to something a like a credit report, actions taken based on inaccurate data can and probably will cost the data owner dearly. This was the finding of a 2014 report from the Federal Trade Commission, which revealed that approximately one in five credit reports contained inaccuracies that resulted in lower credit scores and made borrowers falsely appear to be poor credit

Data owners have had little or no control over their data and none over the value extracted from it. Their data is held hostage by data brokers such as Facebook and Google, and it does their bidding.

risks – a negative financial impact that often proves to be long-lasting. If data owners controlled their own data, such inaccuracies would be rare and quickly corrected.

Algebraix Solution: The PSV owner themselves will be personally responsible for all the data the PSV holds and will thus be able to ensure its accuracy. It may even be possible, in time, if the appropriate application is built, for PSV owners to create their own validated credit reports or provide other personal data based services that companies now profit from.

The Cost of Attention

Advertisers pay for your attention. In fact, in the U.S. in 2016, advertisers paid a total of $180 billion for consumers' attention. It paid for junk mail, billboards, radio ads, cinema ads, TV ads, print ads, Brand labels, product placement, web site ads, social network ads, search engine ads, in-app ads and more. The clamor for consumer attention is intense, so the consumer is bombarded – often indiscriminately. Marketing experts estimate that most Americans experience around 5,000 ads and brand exposures per day (2014 figures).

In an important Harvard Business School report, *The Rising Cost of Consumer Attention: Why You Should Care, and What You Can Do about It* by Thales S. Teixeira, the author shows that the cost of attracting the consumer's attention has increased dramatically in the last two decades by a factor of between seven and nine (when corrected for inflation). No wonder the advertising sector is growing so quickly.

With digital advertising, the advertising cost is driven up by the presence of a whole ecosystem of companies: ad agencies, agency trading desks, analytics companies, DSPs (demand side platforms), aggregators, exchanges, ad networks, ad servers and publishers. All of these businesses earn a piece of the pie for the services they provide.

Algebraix Solution: The Algebraix platform will provide a market where the only middleman is the Algebraix blockchain. All of the functions of the digital ad market will be provided by the platform, with Algebraix taking a modest commission on each transaction. The advertising service will have a considerably lower overhead, in respect of such costs. Advertisers will still bid against each other for consumer attention. However, the advertising process will be far simpler and the effectiveness of ads will be easy to measure.

Alienating the Audience

Digital advertising is growing at a much faster rate than any other form of advertising. The global growth rate for 2016 was 17%, while traditional (off-line) media advertising showed negative growth (-0.3%). Magna predicts

...the author shows that the cost of attracting the consumer's attention has increased dramatically in the last two decades by a factor of between seven and nine (when corrected for inflation). No wonder the advertising sector is growing so quickly.

that digital ad sales will become the No.1 media category in 2017, with a market share of 40% ($202 billion), compared to TV ad sales with a market share of 36% ($186 billion) and it will grow to capture 50% of the market by 2021.

The explanation for this is simple enough: digital advertising provides far better targeting because the digital ad brokers are better able to exploit the consumer data they gather. Nevertheless all is not well. Digital advertising is intrusive and often obnoxious.

News articles are surrounded by ads and click-bait links. Unwelcome pop-ups are always popping up. Videos you want to watch are blighted by intro ads you have no interest in. Autoplay videos start-up without so much as a by-your-leave. Search results are led by masquerading ads. Creepy ads stalk you across multiple web sites, sometimes even after you've bought what they are trying to sell. It is a virtual blizzard of interruption, even more intrusive than ads on the legacy media of TV or radio.

It is no surprise then that ad blocking software is remarkably popular. eMarketer estimates that in the U.S., 27.5% of Internet users (about 75.1 million) have installed ad blocking software. The figures are lower for rest of the world, but the numbers are growing everywhere.

And it isn't that Internet users never want to view ads; they would simply like to do so on their own terms. The issue here is permission. The user's permission is never sought, and it should be.

Algebraix Solution: The Algebraix digital advertising solution is based entirely on permission marketing. Users select which ads to view from the collection of ads presented to them and have the ability to block advertisers or categories of ads that they prefer not to view.

Other Problems of Digital Advertising

Accidental clicks. There are many other problems with digital advertising. A survey by mobile location firm Retail estimated that 60% of clicks on mobile banner ads are mistakes. Accidental clicks are more prevalent on mobile phones, because of the "fat finger" problem, but they also occur on tablets, laptops and desktops. Most likely, the advertiser will have to pay for those useless clicks.

Click fraud. Click fraud is common. It is the false traffic created by advertisers trying to drive up ad costs for their competitors or by ad publishers trying to increase their revenue. Click fraud is often due to malevolent hackers with a grudge against a particular advertiser.

Attribution. And then there is the problem of attribution. When a sale occurs it is difficult to know which ad channel should get the credit, if any.

News articles are surrounded by ads and click-bait links. Unwelcome pop-ups are always popping up. Videos you want to watch are blighted by intro ads you have no interest in. Autoplay videos start-up without so much as a by-your-leave. Search results are led by masquerading ads. Creepy ads stalk you across multiple web sites, sometimes even after you've bought what they are trying to sell. It is a virtual blizzard of interruption, even more intrusive than ads on the legacy media of TV or radio.

The customer may have visited the site several times before buying, through different conduits (Google AdWords, a display ad, or simply by searching on the product name). There is no way to know who deserves credit for the sale.

Algebraix Solutions: Taking this issues one by one:

- Accidental clicks will be far less frequent.

- Ads appearing alongside offensive content will not be possible.

- Click fraud will not be possible.

- Attribution will be far less of a problem as user engagement will be tracked for the benefit of both the user and the advertiser.

The Shift in How Media Is Consumed

The Internet has usurped the television as the preferred means of consuming video. A June 2017 survey by Frank N. Magid Associates found that the vast majority of young adults, ages 18-24, prefer to watch entertainment on a laptop, smart-phone or tablet, rather than on a TV. The broader population is following suit, with about 60% of Americans, ages 8-64, preferring to avoid the TV, and only 40% preferring cable, satellite or broadcast TV.

In the U.S., 2017 is on track to set a record for conventional pay-TV subscriber losses, surpassing last year's 1.7 million. This downward trend has been in progress since 2013, and is likely to continue. It is led by millennials, now the largest demographic cohort in the U.S. According to Common Sense Media, millennials are not viewing less media, but rather much more media than their elders, with teenage millennials spending about 9 hours per day consuming video or music, mainly on smart phones.

The point is that smaller devices, from laptops to smart-phones, are portable and therefore media can be viewed in multiple contexts: in bed, in any room, on a train, on a plane, on a park bench or in a cafe. It is an established trend.

Algebraix Solution: The Algebraix approach to viewing ads aligns with the trend towards consuming media on mobile devices. Our app will be launched on mobile phones first and in time tablets and PCs will be supported. We will market directly to millennials, as we expect them to be early adopters and help the app go viral.

Cryptocurrency Adoption

Cryptocurrencies have come a long way since the birth of Bitcoin. Bitcoin and Ether have established robust ecosystems and other coins, such as Ripple, Litecoin, and Dash, seem to be following in their footsteps.

Nevertheless the cryptomarket is still a niche market compared to other financial markets. In our view this is partly because it is relatively difficult

According to Common Sense Media, millennials are not viewing less media, but rather much more media than their elders, with teenage millennials spending about 9 hours per day consuming video or music, mainly on smart phones.

to invest in cryptocurrencies and the various hacks of the cryptocurrency exchanges have made many investors nervous.

Additionally, although the use of crypto wallets is widespread among enthusiasts, the general public is unfamiliar with the practical value of cryptocurrencies and with managing them. Currently there are very few consumer blockchain applications that can encourage the general public to get involved with cryptocurrencies.

In our view, blockchain businesses need cryptocurrency to go mainstream in order to thrive.

Algebraix Solution: Through a powerful marketing campaign that incentivizes users, we will help to push cryptocurrencies into the mainstream. We will provide an easy to use and elegant multi-wallet capability, which not only allows the user to store and use ALX coins, but also allows them to store and use other cryptocurrencies.

We will provide an easy to use and elegant multi-wallet capability, which not only allows the user to store and use ALX coins, but also allows them to store and use other cryptocurrencies.

The Go to Market Plan

Algebraix is strongly focused on the goal of attracting millions of users to the network as quickly as possible, while simultaneously engaging with advertisers to provide advertising content. The go-to-market plan following the Network Launch will accomplish this goal by:

They are as follows:

- Running a powerful audience acquisition campaign, with the intent of seeding a viral ecosystem
- Rewarding our users with ALX coin for adopting our app
- Delighting users by paying them to consume entertainment
- Bringing the cryptoeconomy mainstream

The Algebraix Audience Acquisition Campaign

Our advertising campaign will concentrate on three themes:

1. Users can own their data and be paid for their attention.
2. Users can earn through entertainment and making recommendations.
3. Users can become part of the cryptoeconomy

As part of this marketing push we will run ad campaigns involving celebrities and influencers promoting our app. The intention is to sow the seeds for a viral ecosystem that grows under its own momentum. Concurrently, we will maintain a strong media presence as an advocate for personal data ownership.

We expect to be seen as a welcome antidote to the big data brokers who exploit personal data.

Rewarding Users for Choosing Our App

As stated previously in this paper, 35% of ALX coin supply is reserved for rewarding our customers, particularly early adopters. Users will be rewarded with an amount of ALX coin, sent directly to their ALX wallet in the PSV. It will be possible to earn further rewards by encouraging friends and acquaintances to become users.

Users will earn ALX by viewing ads and will also be able to earn more by recommending ads they like to other users. They will be rewarded if the ads are subsequently viewed. We have a number of additional ideas planned which aim to create a viral ecosystem that will expand under its own momentum.

Delighting Users by Paying Them To Consume Entertainment

Algebraix has decided to focus on the entertainment industry as the first advertising vertical market to attack. It is particularly suited as a target market because movies and TV shows do not need as precise targeting as many other products. We expect the entertainment industry to be an enthusiastic adopter.

Early adopters will thus be rewarded for viewing movie trailers, TV trailers, music videos, and games ads. It is our expectation that, by this focus, we will attract the millennial age group, who will be influential in recruiting both their contemporaries and older users. The PSV will be new, entertaining, and cool.

Bringing the Cryptocurrency Economy Mainstream

Only a small proportion of the population knows what cryptocurrencies are and how to manage them. Traditionally the young are early adopters of new technologies and services, so Algebraix is deliberately targeting younger age groups both in the initial advertising services it delivers and by delivering a multi-currency wallet and trading capability with the PSV.

This may itself have a viral effect, so that the average Joe will see the importance of cryptocurrencies and become adopters. For some, perhaps a considerable number, ALX will be the first cryptocurrency they possess and the one that opens the door to the use of other cryptocurrencies.

Company Ethos

Early adopters will thus be rewarded for viewing movie trailers, TV trailers, music videos, and games ads. It is our expectation that, by this focus, we will attract the millennial age group, who will be influential in recruiting both their contemporaries and older users.

Algebraix sees TRUST as by far the most important aspect of a cryptocurrency-based business. In our view, the cryptocurrency world is destined to replace many existing businesses that are based on faith in the ethical behavior of the business owners – a faith that has been violated far too often by government and commercial organizations.

Many people have reached the conclusion that corrupt behavior is an inevitable risk in both government and commerce. Disillusionment has provoked their interest in cryptocurrency businesses where trust is placed in the technology underlying the business operation rather than in the business owners. In its effort to deliver a trusted service Algebraix has adopted a set of principles which it has implemented or it is in the process of implementing.

Algebraix Principles

Transparency. The business will be operated on a transparent basis so that its commercial activities are recorded and open to audit.

- Algebraix will make the majority of its code, including all smart contracts, available on an open source basis. In particular, we will be releasing to open source all software that makes use of Data Algebra.
- Algebraix will have regular independent audits conducted on its operation, particularly in respect of security. All smart contracts will be available as open source.

Self-Sovereign Identity and Self-Sovereign Data Management. Data owners will have full control of their data and the confidentiality of their data.

- Personal identity information will be managed entirely by the data owner on the basis of self-sovereignty. Only the data owner will have access to the data. Only the data owner will be able to give permission for it to be used.
- Other personally stored information will be treated in the same way. Only the data owner will be able to give permission for its use.

Responsiveness to Stakeholders. Algebraix will seek advice from and interact with all stakeholders of the Algebraix network.

- From the Algebraix perspective everyone participating in the network is a stakeholder, including: data owners, farmers (resource providers), developers, advertisers – and including any category of users that may arise as new applications are added to the network.
- The intention is to enable consensus on the evolution of the Algebraix blockchain. To the extent that consensus is possible, it will be implemented as rules that determine changes to the blockchain and associated software.

Security. Algebraix will implement Defense-in-Depth and Privacy by Design

Many people have reached the conclusion that corrupt behavior is an inevitable risk in both government and commerce. Disillusionment has provoked their interest in cryptocurrency businesses where trust is placed in the technology underlying the business operation rather than in the business owners.

systems for data storage and any needed, minimal logging.

- All local application data will be encrypted when at rest and in motion, with the data owner holding the private key. Any server side data will be encrypted at rest and in motion by following NIST standards.

- Where practical the platform will use zero-knowledge proofs. (In cryptography, a zero-knowledge proof or zero-knowledge protocol is a method by which one party (the prover) can prove to another party (the verifier) that a given statement is true, without conveying any information apart from the fact that the statement is indeed true.)

Regulation. Algebraix will abide by all appropriate regulations in every jurisdiction within which it operates. In particular it will abide by GDPR.

Consumer rights under GDPR can be summarized briefly as follows:

- Individual Unambiguous Consent
- Right to Access
- Right to Change
- Right to Erasure
- Right to Portability
- Right to Complain.

A table of GDPR principles is provided on the next page. These principles, where applicable, have been adopted by Algebraix. Some of these principles do not apply directly simply because within the Algebraix Platform, users have direct control of their data.

Principles	Explanation	GDPR Ref
Lawfulness, fairness and transparency	**Transparency:** Tell the subject what data processing will be done. **Fair:** What is processed must match up with how it has been described **Lawful:** Processing must meet the tests described in GDPR	Article 5, clause 1(a)
Purpose limitations	Personal data can only be obtained for "specified, explicit and legitimate purposes." Data can only be used for a specific processing purpose that the subject has been made aware of and no other, without further consent.	Article 5, clause 1(b)
Data minimization	Data collected on a subject should be "adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed," i.e., no more than the minimum amount of data should be kept for specific processing.	Article 5, clause 1(c)
Accuracy	Data must be "accurate and where necessary kept up to date" Base-lining ensures good protection and protection against identity theft. Data holders should build rectification processes into data management/archiving activities for subject data.	Article 5, clause 1(d)
Storage limitations	Regulator expects personal data is "kept in a form which permits identi-fication of data subjects for no longer than necessary," i.e., data no longer required should be removed.	Article 5, clause 1(e)
Integrity and confidentiality	Requires processors to handle data "in a manner ensuring appropriate security of the personal data including protec-tion against unlawful processing or accidental loss, destruction or damage."	Article 5, clause 1(f)
Accountability	The controller shall be responsible for, and be able to demonstrate compli-ance, with the all of the above GDPR principles.	

ALGEBRAIX®

In Summary

Consumers have become accustomed to their data being exploited and violated without either their permission or any reward. Algebraix will provide an environment that protects against such data abuse as vigorously as possible. We will provide sovereignty to the data owner, enabling them to put their data to work on their own behalf and realize its value, should they so choose.

In our view, the Algebraix Ethos is the foundation of its business and integral to its operation.

The Algebraix platform will be built on the technologies that ensure trust, it's operation will be transparent to engender trust and it will be regularly audited to prove trust.

Trust, Trust and Trust.

Algebraix Executive Team

Charles Silver, Chief Executive Officer

Charles Silver is CEO of Algebraix Data Corporation and leads the effort to develop the Algebraix Platform. Charles is a career entrepreneur with 30 years of experience of raising capital and building successful enterprises that focus on finance, technology, and media. He was an early visionary in the dot com era as founder and CEO of RealAge.com which was amongst the first companies to use Big Data to connect individuals to relevant advertisers. The company raised capital in the dot com boom, survived the crash by building a profitable business, and was sold very successfully to the Hearst Corporation. He is also a co-founder and board member of Reality Shares, an innovator in the securities industry with 5 publicly traded ETFs.

As an early investor in Algebraix Data Corporation, he recognized the significance of Data Algebra to the entire software field and has financed the applied math R&D for 7 years. With the growth of the blockchain industry he is leading the effort to allow individuals to take ownership and monetize their data.

Andy Shah, Chief Technology Officer

Andy Shah is the primary architect for all development involved in the implementation of the Algebraix Platform.

Andy brings more than 18 years of technology leadership and executive management experience to Algebraix Data Corporation. He has grown both emerging and Fortune 500 technology companies. Andy served as AVP of Software & Technology for Westell Inc (NYSE:WSTL), where he innovated and built the patented Homecloud technology-based product and platform, which securely protects, shares and synchronizes end users' personal data

with permission-based sharing to various online services. The Homecloud platform also supported building and distributing third-party developer's applications using Homecloud SDK and API. Andy also served as a Director of Engineering & Project Management for Sears Holding Corp (NYSE:SHLD).

He also held the Sr. Software Engineering Manager position in VC-based startup company Cleversafe Inc (acquired by IBM for $1.3 billion dollars). Prior to Cleversafe, he also occupied various technical roles as a Solution Architect, Software Architect and Software Engineer at Motorola Inc. Andy has a dual M.S. degree in Computer Science and Chemical Engineering from Illinois Institute of Technology. He has also published several white papers and holds several U.S. Patents.

Robin Bloor, PhD, Chief Strategy Officer

Robin is the Chief Strategy Officer for Algebraix Data Corporation and will act in that role during the development and implementation of the Algebraix Platform.

Robin Bloor, Co-founder and Chief Analyst of The Bloor Group, has more than 30 years' experience in software development, IT analysis and consulting. Robin has been an influential and respected IT analyst for two and a half decades both in the U.K. and the U.S., and has detailed expertise in almost all areas of IT both from consultancy activities and his work as an IT analyst.

He has written a multitude of white papers and research reports on many aspects of IT. He has been a presenter and speaker at many IT industry events in the U.S. and internationally. He is a frequent blogger and also a published author, having written a business bestseller on electronic commerce entitled, The Electronic Bazaar, which, among other things, predicted the advent of personal data monetization. He is also the joint author of The Algebra of Data along with Professor Gary Sherman. Robin has a B Sc in Mathematics from Nottingham University and a PhD in Computer Science from Wolverhampton University (in the U.K.).

Steven Wilkinson, CISSP, CBP, Director of Security

Steven is the Director of Security for the Algebraix Platform and all associated applications.

Steven Wilkinson is a certified cryptocurrency, blockchain and information security professional. He brings more than 10 years of experience in technology leadership, IT and security consulting to Algebraix Data Corporation.

While researching a solution for value transfer across the Internet, Steven discovered Bitcoin in early 2011 and began mining it. Since then, he has been working and advising on a variety of different blockchain projects and startups in this emerging ecosystem, including multiple token crowdsales.

In 2013, Steven founded the Bitcoin consulting firm, Austin Bitcoin, which was one of the first BitPay merchant integration partners. He is also one of the co-founders of the Texas Bitcoin Association which produces the Texas Bitcoin Conference.

Steven holds a Certified Information Systems Security Professional (CISSP) certification and a Certified Bitcoin Professional (CBP) certification.

Professor Gary Sherman, PhD, Founding Mathematician

Gary will act in a consultancy capacity to Algebraix Data Corporation focusing on the application of data algebra to the data catalog and to database functionality required by the system.

Gary Sherman has a long history of studying (PhD from Indiana University, 1971), teaching (Professor Emeritus, Rose-Hulman Institute of Technology, 1971 to 2006) and doing mathematics (29 refereed publications). He was a founder and the Principal Mathematician for Algebraix from 2008 to 2014 where he invented and gradually proved the applicability of Data Algebra.