Adaptive digital platform for next-generation applications

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Abstract: Designed to address the user-interface deficiencies within blockchain, Blockhub is a decentralized, smart contract enabled marketplace, a secure platform and engine where users can search and install new and existing blockchain applications. Blockhub will be powered by the Republic Token (see the "Republic Whitepaper" for details), and will consist of three elements:

I) Marketplace/Digital Distribution Platform - enabling users to search and securely download conventional and decentralized applications. As an open-source environment Blockhub will promote and support developers, providing their products with visibility and user volume.

II) User Interface - As a straightforward and secure point of entry to blockchain, Blockhub is a gated virtual environment, augmenting the web 2.0 experience with customized blockchain integrations, while providing wallet support for major blockchains.

III) Data Collation & Monetization - In addition, Blockhub will be the value creation engine for the Dataforce blockchain (See Dataforce Whitepaper). Through the use of the platform, users can enable the collection of data, which will be encrypted and stored in decentralized silos. Users will then have the power and control to granularly release or sell data to researchers and marketers.

Contents

1   Problem

The proliferation of blockchain has resulted in technological advancements that span a variety of sectors: from insurance to law, to finance, banking, gaming and beyond, distributed database technologies are spurring on the next leg of the technological revolution. Belief and excitement in these technologies is evidenced by the surge of capital investment into new projects and companies.

At present, blockchain applications are in their infancy, mostly consisting of currency wallets and P2P payment solutions, but are expanding into services and products such as identity management, licensing, organization, gaming, messaging, and social media to name a few.

Despite rapid growth with the the decentralized application (dapp) and blockchain space, there are a number of obstacles that we wish to address with Blockhub:

1) **Participation and utilization of applications remains limited.** Applications need users, especially so with many of the decentralized applications being launched that use a token model for funding and economic transactions within the app. All too often though, post ICO product launch does not generate sufficient user volume and token utility and price wildly fluctuates, eventually languishing in value. This inability to attract and develop a user base means that a valuable and beneficial application may never get off the ground as it should

2) **Make it easier for users -** In order for blockchain technology to gain utility and widespread use the people require a service that is easy to use, one that aggregates services, reduces obstacles and improves user experience. Current and prospective dapp users require a unified point of entry.

3) **Blockchain Interoperability -** though efforts are being made to address multi-chain operations on a blockchain to blockchain level. Often the problems of scalability and efficiency go unsolved or are amplified through such intermediation.

4) **Security Risks -** the current atmosphere poses significant security risks. Each new service, although decentralized, exposes users to an additional point of attack. In the absence of market supported safety protocols and coding audits, users remain susceptible to potential failures present within an app they have downloaded.

2   Solution

2.1   Marketplace and Platform

We propose to build an easy and secure point of entry, both for blockchain veterans who want to simplify and streamline their experience, and for newcomers who want a straightforward access point with which to get started using blockchain technology. Users will be able to install and use applications from our Marketplace. These apps will have wallet support for major blockchains, and if given permission, they will be able to make transactions on behalf of the user. Having access to all desired blockchains, users will be able to manage multi-chain commands without intermediation.

Blockhub will launch as a desktop application, designed to augment the standard web browsing experience, while also enabling users to manage their blockchain experience. Preloaded features will allow new users to easily setup wallets, allowing them to collect, exchange and transact currencies; while seasoned blockchain users will easily export their existing wallets and currencies, using the application to manage their blockchain life, whether that involve trading, investment, research or development. Additional features will be available for integration on the marketplace, including data management (VPN), user-permissioned data monetization, and monetized ad viewing.

As users will be behind a gated virtual environment, Blockhub will protect the security of their wallets and identity. If an app needs access to a data or currency, the user will have granular control over all parameters (including sending limits and frequencies). These applications will be comprised of existing solutions (such as Facebook) and new blockchain-based solutions (such as Civic) . These applications may also include decentralized apps (dApps), standard websites and conventional apps.

The initial application suite available on Blockhub will be built by Hyperbridge Technology, however future application developments will be available to third-party developers. An essential goal of Blockhub is to create an ecosystem that enables organizations to bring their blockchain solutions to market, and to a new group of users.

Blockhub will be free and open source software ("FOSS"), open for anybody to integrate, re-use and improve. It will function similarly to the Google Play Store, Xbox Store, et cetera. Users will be able to purchase/upgrade features, using any supported wallet (initially Ethereum/Bitcoin). There will be a nominal Republic Token fee for these transactions.

2.2   Data Exchange

Blockhub will also serve as an entry point for data collection to the Dataforce Network (please see "Dataforce" whitepaper). Rather than centralized corporations stockpiling data in a silo, data is controlled and permissioned by the user, who can granularly release/monetize it.

Through the use of the platform, users can enable collection of data, which will be encrypted and stored in decentralized storage through Dataforce, and give them the ability to granularly release or sell data to researchers and marketers. That data will be available for apps to improve user profiles and recommendations.

Blockhub will come pre-integrated with the Dataforce Network. Dataforce will enable users to capture the data they produce into a network of decentralized blockchains and databases.

2.3   Decentralized Governance

Blockhub will make use of the Republic specification to mint the Hyperbridge Republic Token ("GOV"). The GOV token is managed by a decentralized organization formed initially by Hyperbridge Technology. Voting takes place using the Republic system, ultimately controlled by token holders, known as the Republic (please see "Republic Whitepaper"). Blockhub will allow basic features entirely free, and GOV tokens will be used for network operation fees and premium features and apps.

GOV will be be used for these specific operations within the platform:
- Premium features (such as built-in VPN, mining, etc.)
- Unlocking marketplace apps
- In-app purchases/upgrades
- Publishing apps
- Fees from transactions, mining, and other non-basic operations

2.3.1 Economic Model

The Blockhub marketplace will function similarly to other digital distribution platforms, where app developers pay a publishing fee and a percentage of sales back to the ecosystem to have their products available for download within the marketplace. Developers and users can use a variety of currencies or tokens to conduct commerce. Publishers and users will have reduced fees for using the official token as a primary medium of exchange.

As Blockhub is a smart contract based ecosystem, payments to developers can be near instantaneous, not subjecting them to arbitrary time and revenue thresholds.

Publishers who choose to use Blockhub as their publishing platform will have access to SDKs that enable monetization possibilities within their apps, using any supported token (initially GOV, ETH, etc).

2.4 Adaptive UI

At the heart of Blockhub's vision is improving UI/UX for the world. To this aim, Blockhub will feature a unique AI-driven UI system allowing third-party extensions to build dynamic UI experiences. These will be generated with a combination of a UI specification and datasets fed into the resulting UI engine.

2.5 XR (VR/AR/MR)

We foresee great applications of the blockchain in the mixed reality space, and intends to be proactive. Blockhub can already be built for Virtual Reality, Augmented Reality, and Mixed Reality. We believe in the near future there will be demand for heads-up displays (HUDs) connecting our physical life to our digital life. We seek to reduce the barrier to entry and technical difficulty of blockchain solutions (amongst others) by proactively building support for the most demanded devices on the market (currently the Vive, HoloLens, and Microsoft MX products).

3 Integrations

With the creation of a searchable, well-indexed, app marketplace, users will be able to find, download and integrate apps. We have outlined a few of those below.

3.1 Identity

A majority of the valuable use cases provided by emerging blockchain technology are dependent on reliable identification. Blockhub will support various identity providers (potentially Civic). Users will have the option to upload their identity, and apps will then be able to integrate solutions that make use of a secure identity management protocol. Users will be able to manage their third-party certifications from government or educational institutions within Blockhub, allowing for ease-of-access. Additionally, we seek to work with license vendors (such as Microsoft, Sony, Valve Steam, EA Origin) to bring disperate licenses into a single cohesive experience (more on this in section 3.6).

3.2 Wallets

Blockhub will come with a built in SmartWallet. Initially there will be support for Ethereum, and eventually all major blockchains. Many wallets exist to solve this problem, and they do the job well enough, but this functionality will need to be built directly into Blockhub to operate effectively. In addition, we may support existing wallet applications, such as Exodus or Jaxx.

Where our SmartWallet will stand out, is it will have a few unique capabilities. First, it has the capacity to auto-detect specific blockchains within environments (such as a browser) and utilize the currencies necessary to operate within that environment. Second, trusted wallets on the Blockhub network can securely send funds to each other in ways that avoid the losses incurred in erroneously sending cryptocurrency to non-existent addresses, as Blockhub identity-linked wallets can operate trustlessly. Third, the wallet will make attempts to automatically converts held tokens to the required token through a "chain of value" (ie. you have starbucks tokens and you can use those to pay for your rent, because your landlord accepts IGA tokens and IGA accepts starbucks tokens).

The following are proposed for near-term integration: Bitcoin, Ethereum, Litecoin, and others to be determined. See the Roadmap for up-to-date details on future development plans.

3.3 Data

Blockhub will build frontend solutions for the utilization of the Dataforce Network. With Dataforce, the flow of data can be reversed, putting data back in the hands of the people producing it. We believe this is powerful for various reasons:
● Puts control of data back in the hands of the people producing it.
● Builds an opportunity for reverse marketing - analyzing data to find unmet demand.
● Scaling the flow of data storage and ease of access.
● Release data to allowed apps for improved experiences.

The ability to do any of these has effectively not existed or been realistically possible until now. Dataforce is building a protocol to grant and retract permissions to control of distributed data to meet these needs. Through these, users will be able to carry over their data from old services to replacement services, release data to enhancing services, release data to research institutions, and monetize on data directly. Learn more about Dataforce on the official website.

3.3.2 Monetization / Basic Income

Due to the current economic framework related to data consumption versus data creation, a disparity is obvious given that the group that creates data, that is then sold to marketers, sees no

economic benefit from the process. As billions of dollars is generated from the sale of data, compensation is due. Although theorized as a basic right[1], the maintenance of privacy and protection of personal data has and will remain a user responsibility. Institutional support of data rights still lacks, as protections and equity models have not been built in to this largely corporate sphere. From privacy to fair compensation for the use of your data, we contend that equal data monetization will be the vanguard of the next era of internet rights, but as with privacy, it must be initiated and facilitated from the user end. Blockhub will actively work toward this goal of fair data monetization, as personal information collected through the platform will be designated, at the user's discretion, for monetization.

Mining and/or staking of users' computing capacities or tokens will also be available at the user's discretion, enabling further optimization of user's latent capacities for income generation. Users will be given an easy-to-use flow to begin mining, with more detailed options for power users. The user can simply choose the resources they want to allocate to mining, and they can rent their resources. A nominal amount of NAT will be required as a fee. Initially the fee will be recorded locally and charged in one pass when sufficiently accumulated, however in the future will use a persistent and economical state channel.
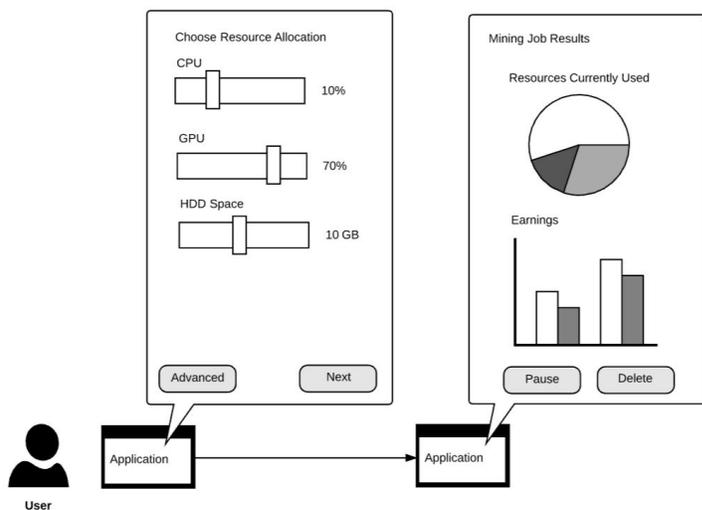

Figure 1: Basic UI for renting computing resources and monetization results.

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[1] *CHARTER OF FUNDAMENTAL RIGHTS OF THE EUROPEAN UNION,* Article 8 Protection of personal data, "Everyone has the right of access to data which has been collected concerning him or her, and the right to have it rectified."

Figure 2: Advanced UI for renting computing resources defining exact flow taken.

3.3.3 Attention

We are now seeing services designed to return the value created through data to those that have created it.

Attention swapping seeks to replace traditional web advertisements with ones coming from a blockchain publisher network, such as the Basic Attention Token (BAT). It will allow users to configure how they would like advertisements displayed, how often, and how much they would like to earn on a specific number of impressions. To facilitate a user-centric experience, Blockhub would show, ad view frequency, history and publisher pool matches.

BAT is the first of many potential participants within this space. We will seek to integrate whomever will benefit users most, striving to work with those that demonstrate the most potential for market adoption.

3.4 Recommendation Engine

Currently, there is a lack of interoperability and communication between entities and organizations, or services, that house impressions of user profiles and tastes. Going beyond the inefficiencies that come from having to constantly establish new profiles as new services emerge, there is a call for a streamlined and congruent user profile, that maintains user data along a multitude of channels. The benefits of more permanence and transportability is that user identity can build and evolve over time versus having to consistently re-establish tastes and preferences. In addition, it sets the user up for more meaningful and targeted marketing engagement.

In the last decade, there has been rapid switching between different services, whether in music, gaming or online shopping. With each new interaction, there is no migration of data, history,

favorites, et cetera. Each of these services is a black box, and the ones that are not require custom integration. There is a trust problem within this space.

A solution to this dysfunction and inconvenience can be solved through blockchain. If music providers saved data on the blockchain, trusted services could access that data to improve customer experience. Services could analyze recent listening habits across all blockchain connected services and give better artist suggestions, local concert ticket sales, new albums in the marketplace, and other ancillary services. Using Blockhub will facilitate this reality.

How can this be achieved? Spotify could record listening history into NEO, while Ticketmaster encodes ticketing history into Stratis. Blockhub would create a transaction on the Ethereum network that has a reference identifier to the history on both NEO and Stratis, indicating the person on Spotify also has associated ticket history on Ticketmaster. It could include granular permission, that the user has allowed.

In the absence of blockchain integration, unique user preferences and profiles can be set up independently, but will never achieve the seamlessness and specificity of user experience made possible through a blockchain enabled recommendation engine. The vision is to have blockchain function in such a way that effort and inconvenience is shifted from users to an intuitive recommendation engine.

3.5   Smart Home

Society is quickly moving towards a persistently connected Internet of Things (IoT). Connectivity is being built in to all modern devices. Since Blockhub is connected to all major blockchains and will be deployed on all major platforms, it is in a unique position to serve as a management and communication portal for smart homes and devices.

3.6   License Management

As technology adoption has grown, and more platforms enter the space, there has been greater support for multi-platform solutions. Software and games can now be deployed to Windows, Mac, Xbox, PlayStation. However, they are still licensed through central authorities like Microsoft, Sony, EA Games, Valve Corporation, etc. These authorities issue their own product serial keys, that are not compatible with other platforms. As a result, consumers are forced to repurchase the same product on more than one platform. This is another trust issue, and blockchain is poised to remedy it. Because of issues of trust between centralized databases, and integration difficulties between non-standard, cross-platform APIs, license issuing authorities will not likely communicate with each other to grant product usage on multiple platforms. With the blockchain, however, they can all operate with the same shared state, allowing them to service customers who own a product, even if not purchased through their licensing servers. This results in more freedom, better options, and

savings that are passed down to consumers. This type of service will be in demand as awareness spreads and industry leaders are pressured to maintain their competitive edge over the market.

Blockhub will act as a gateway for the biggest providers in the license management space, working with these oracles on integrating, either with our own smart contracts, or through an official partner offering similar services. These oracles can choose which oracles they trust to distribute licenses in their Trusted Oracle Group (TOG). We will also develop an official apps for the platform that support license management (i.e. digital assets) on the blockchain. Third-party developers will also be able to create their own apps if they wish.

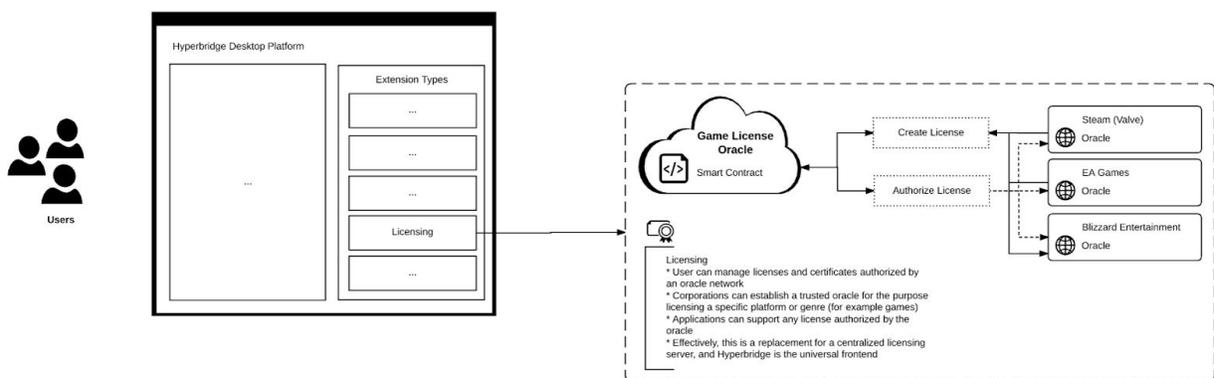Below is a diagram detailing how this will work:

Figure 3: Example interaction of a Game License Oracle in the platform.

4   Architecture Overview

4.1   Smart Contracts

There will be a number of contracts in the Blockhub to facilitate the operations of the platform.
- Marketplace Smart Contract
- User Profiles Smart Contract

4.1.1 Marketplace Smart Contract

All the app information such as the UUID, name, bytecode reference, version, et cetera will be stored in a smart contract, which will ensure the immutability of the app source code and features. The marketplace in the Blockhub platform will be a browser for the approved apps in the smart contract. Users can pick the apps they desire, and the the installation details will be fetched through a call to the smart contract.

4.1.2 User Profiles Smart Contract

Blockhub user profiles will be stored in a smart contract that includes their personal information such as ID, name, et cetera. In addition, users can store their private keys such as wallet keys or app specific access keys. All data will be encrypted to ensure the security of the user's data. Users can only decrypt their own data with their own private key, and 2-factor authentication if enabled (see 4.2.4). After installing an app, the UUID will be added to an app list in their profile, in additional to metadata such as the version of the app. The user will be asked for the permissions they are willing to give to the app, and the selected permissions will be stored in the smart contract data. The user can revoke or opt out of these permissions at anytime.

4.3 Application Framework

The Blockhub Platform is a powerful underlinecomputing platform capable of being extended by third-party developers. Users can install apps. Apps can interact and utilize the Core Framework through the App Bridge over an API communication layer. The Core Framework comes with a number of components, as seen in the diagram below.
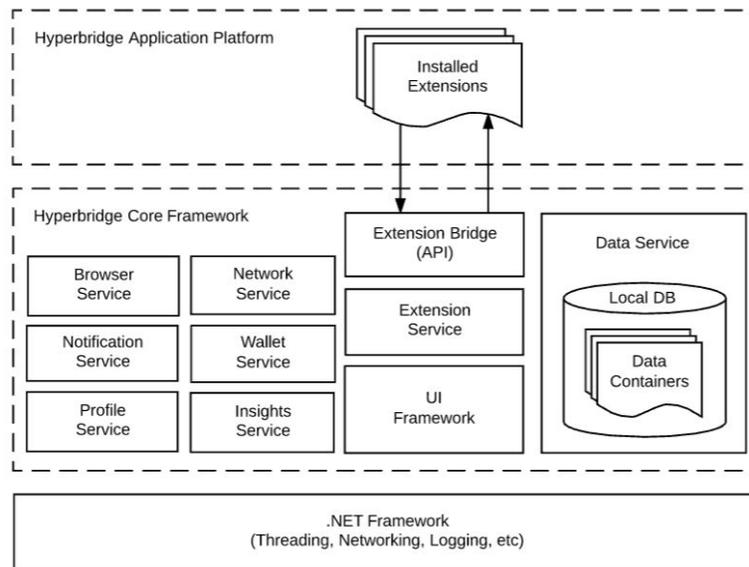

Figure 5: Architecture of the Blockhub Platform.

4.3.1 App Security

When apps are loaded by the platform, the bytecode representing them is scanned to validate they contain no malicious behavior. Additionally, apps are limited in what operations they can access in the main application.

4.3.2 Bytecode Validation

Apps are built into bytecode, and thoroughly validated for security before execution within Blockhub.

4.3.3 Access Control

When Blockhub boots, it will load installed apps. These apps are notified by the initialization event and given access to approved capabilities specified by the user. Of the two main approaches to securing computer systems, the one most familiar is Access Control Lists (ACL), where the access permissions are defined on the object in question (e.g. a file) and in terms of defined agents (e.g. user accounts). The object-capability model turns this on its head and represents the capability to access a resource as a bearer token, which itself can be copied and transmitted. This is a computer security model: capability describes a transferable right to perform one (or more) operations on a given object.

Users can manage the capability permissions of apps within the desktop platform. The platform will send an unforgeable reference (uref) in an event to the app, granting it the capability of certain objects. For example, the platform would send a message to the Wallets app, allowing the capability to call the Wallet Service objects' Add Wallet operation.
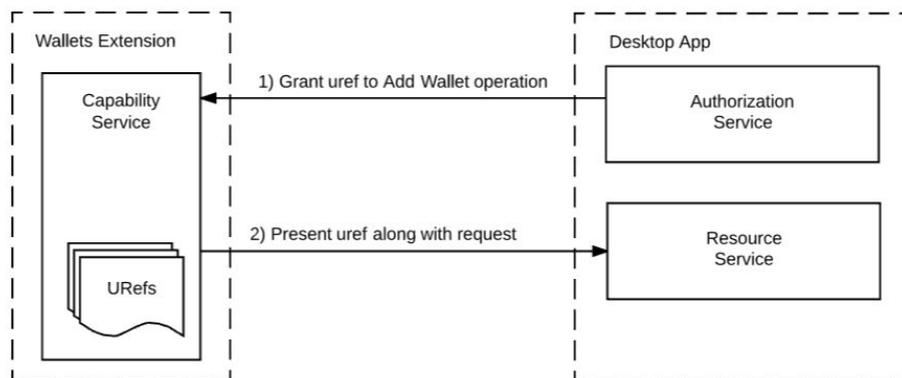

Figure 6: Authorization between an app and the desktop platform.

4.3.4 Data Containers

Data containers will be encrypted with a user provided secret passcode. Optionally, it will support 2-factor authentication, using a physical hardware wallet, such as Trezor or Ledger.

4.4.1 Blockchain Synchronization

By default Blockhub will store data on the users local computer, and provide an option to sync data to the desired destination blockchain on a periodic interval or manually on demand. By default, it will sync with a directory stored on Ethereum network, and the raw data on the IPFS network. After storing remotely, data from the local database will be pruned.

4.4.2 Migration Assistant

Blockhub will come with the ability to migrate data between blockchains. Initially we will support IPFS, but as more options become available, users may want to switch. They may also want to store different data on different providers. Blockhub will allow storing Data Containers separately across various providers (see 4.2.4). There will be basic and advanced modes available.
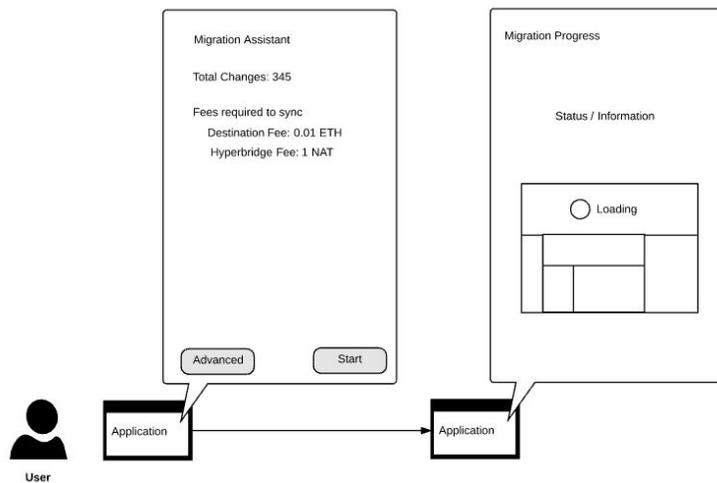

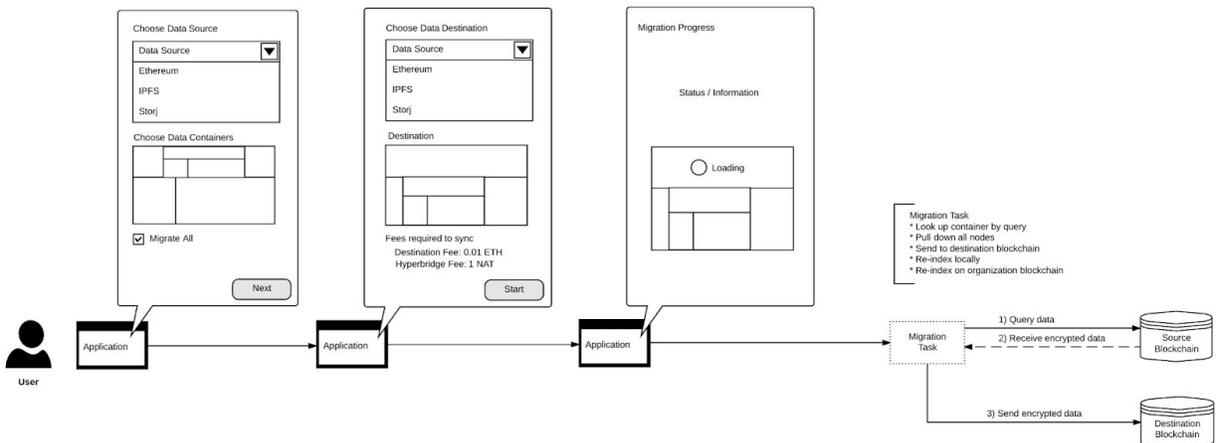**Figure 7:** Basic UI for a data migration assistant.

Figure 8: Advanced UI for control over exact steps taken in data migration.

4.5   Mobile Application

Blockhub will port the desktop application to mobile, initially with a subset of features. As there are limitations on mobile operating systems, Blockhub will only be able to support integrations via Inter-App Communication (e.g. URL scheme appname://blockhub). In the case of large data, assuming the application has gone through proper authentication, it will be given a reference to the tree of data on the associated blockchain (see 4.1.1).

4.6   Browser Extension

Blockhub will automatically detect your browsers and suggest an associated browser extension to install that will improve the user experience. Initially it will support Google Chrome, Firefox and Internet Explorer support will be added in the future. Inversely, the Blockhub Browser Extension will detect if you have the desktop app installed, and if not, require the user to install it. The official Blockhub Browser extension only pipes data to the desktop platform, and as such does not do any processing.

Below is a diagram showing how the browser will communicate with the Blockhub Platform running in the background.
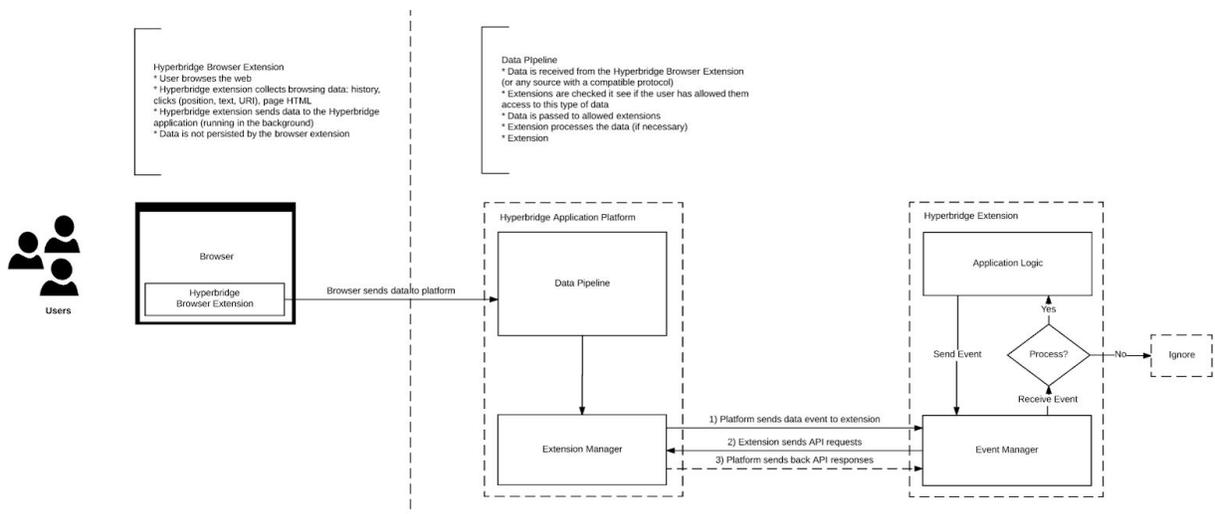

Figure 9: Utilization of data gathered during a user browsing experience.

4.6.1 Integration

Apps will be able to integrate into the Blockhub platform in 3 ways:
1. Official Blockhub app
2. Website (via a Blockhub-enabled browser)
3. Inter-app communication

All of these integrations will use a standard API (defined in section 5.2).

4.6.2 Commands

The Chrome extension will send commands to the desktop app, which will figure out which apps need to know about them and have permission to know about them. The app's OAuth token will be checked to see if it has permission to access that command.

See Section 5.2.1 for more information.

5 App Development

Organizations and independent developers will be provided tools to develop custom apps for the platform.

5.1 App Creation

To build an official Blockhub app, developers will need to download the development tools for the Windows or Mac operating system. The App Starter Kit comes with all the tools needed to start building an Blockhub App (See 3.2). Apps are written in C# (currently 4.6). The starter kit includes a customizable build pipeline for exporting apps used in Blockhub. Each app has 1) the resources bundle and 2) the compiled source bundle. After the app has been created, it can be uploaded to the blockchain using the tool provided. Alternatively, we will provide instructions for uploading directly to the blockchain manually.

It is possible to upload an app to the marketplace that is not using the official development tools. There are 3 types of apps that can be uploaded:
1. Official Blockhub app bundle
2. Website hyperlink
3. App schema hyperlink

5.1.1 Resource Bundle

Blockhub Development Environment will include assets you can reference in your apps, and you will be able to include your own custom assets as well.

5.1.2 Source Bundle

Blockhub Starter Kit will compile C# into an bytecode known as Common Intermediate Language (CIL) and package it into a source bundle for use in the Blockhub application. This bundle can be loaded into the Blockhub application manually via the filesystem or URI, as well as through the Blockhub App Store once published.

5.2   Protocol

The Blockhub platform will use the JSON.API standard for all communication. All commands documentation can be found in the Blockhub API Documentation.

Apps will be able to communicate over this protocol in various ways, for example:
1. Developer builds an official Blockhub app using the Blockhub Starter Kit, which provides a communication library.
2. Developer builds a custom app, and uses Inter-App Communication with the standard API.
3. Developer builds a customer website, and supports Blockhub-enabled browsers using the Blockhub Browser Extension.
4. Developer builds a custom browser extension, and uses Native Messaging with the standard API.

5.2.1 Commands

Both the desktop platform and the app have a message broker (also called message bus or message queue) that sends and receives JSON messages, called commands. This is similar to libraries like RabbitMQ or ZeroMQ.

Commands will come in from the desktop platform and browser extension. The desktop platform will figure out which app has the permission to know about the command and pass it along. It uses the app OAuth token for the permission check.

Additionally, the desktop platform will send commands to the apps from time to time. For example, during startup or when the user takes action.

When the app receives a command, it deserializes it, and determines if and what it should do with it. Each command's value is an encoded string of valid JSON API which can be deserialized into C# objects.

5.2.2 Authorization

Authorization in Blockhub will be done with the OAuth protocol standard. OAuth allows us to provide secure authorization to Blockhub capabilities to external apps. OAuth is used by leaders in the tech industry, including Google, Facebook and Apple. The steps for client authorization are displayed below:

- The client presents some claims to the Authorization Service, including identity and the id and scope (capability) of the service it wants to access.
- The Authorization Service checks whether the client is authorized, and if so, creates an access token which is returned to the client.
- The client then presents this access token to the Resource Service (the service the client wants to use).
- In general, the access token will only let the client do certain things. In our terminology, it has been granted a limited set of capabilities.

The above provides an introduction, for further details please reference the official OAuth documentation.
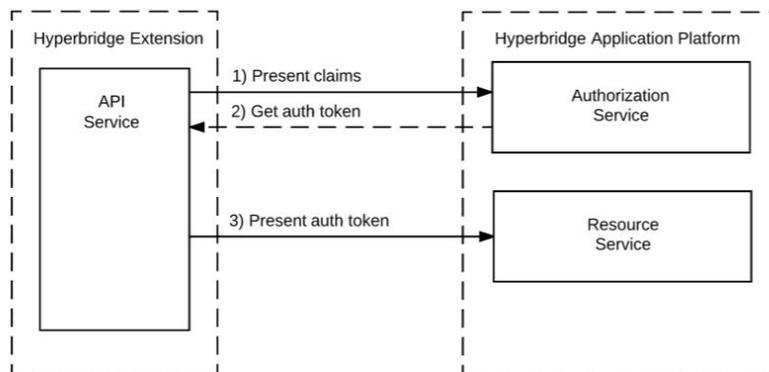
6   Security Services

6.1   Certification Service

Hyperbridge Technology Inc. will offer certification for entities interested in bridging with our ecosystem. Certification will give users confidence in the authenticity and security of the provider's app. Contact partners@hyperbridge.org for more information on this service.

7   Long-Term Technical Strategy

7.1   Security Auditing

We will undergo regular security audits for the Blockhub software. We will use TLA+ software to run exhaustive testing and verification against our systems.

7.2   Standards Committee

Through the Republic Foundation, a committee of the leaders in the blockchain and related technology space will be formed to oversee the progress of the open source specifications. They will work closely with other regulatory and standard bodies, including but not limited to ISO, IEC, and W3C.

8   Conclusion

Blockhub is the user and developer platform designed to bring a broader audience to the blockchain. As an application ecosystem, marketplace, management environment and developer toolkit, Blockhub is the unifying element that the blockchain requires for its next stage of growth.

The success of this project relies on your involvement.

All **feedback, reviews, and improvements** may be directed to whitepaper@hyperbridge.org.
For **community reviews**, head to the /r/hyperbridge subreddit.
If you are a **potential partner** looking to get in touch, contact us at partners@hyperbridge.org.

We are a fast-moving, dynamic team looking for talented individuals. Contact us at careers@hyperbridge.org if you, like us, are as passionate about utility tokens and the communities that can be built around them.

Acknowledgement

References

[1]   CNBC, et al. "Initial coin offerings have raised $1.2 billion and now surpass early stage VC funding" URL:
https://www.cnbc.com/2017/08/09/initial-coin-offerings-surpass-early-stage-venture-capital-funding.html

[2]   Mobile Ecosystem Forum, et al. "MEF Global Consumer Trust Report 2017" URL:
https://mobileecosystemforum.com/programmes/consumer-trust/global-consumer-trust-survey-2017/