HYPERION

MAPCHAIN THE WORLD

Hyperion

Spatial Consensus Driven Map of the World for Decentralized Map Economy

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Hyperion

Noun

1. Latin, from Greek *Hyperiōn*
: a Titan, son of Uranus and Gaea, and father of Eos (dawn), Selene (moon), and Helios (sun). Later identified with Apollo, from Greek, literally “he who looks from above.”

2. an irregular-shaped outer satellite of the planet Saturn that tumbles chaotically

3. A new consensus-driven open map ecosystem created by global community

Map Chronology

"Maps, like faces, are the signature of history." ~ Will Durant

Map 1.0	Digital Map	Maps are made digital, interactive and searchable. Lack of openness, privacy, large-scale community contribution.	Google Map and Baidu Map etc.
Map 2.0	Open Map	Open data and map technology by the Open Street Map initiative with global community support Lack of technology superiority and social-economic structure for community governance and incentive	Mapxus, Mapbox, and Mapillary etc.
Map 3.0	Consensus Map	Coherent system design of technology, community and economy. Enabled by decentralized map technology, self-governed community and sustainable map economy.	**Hyperion**

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INTRODUCTION

In several dimensions, the current centralized map system of the world is flawed and is ripe for disruption. Blockchain technology – with its ability to facilitate global collaboration in an open and secure manner – has huge potential to disrupt the status quo by underpinning the birth of a new, open, decentralized map economy that will appeal to the mass market.

We have pioneered a new open map architecture, the Hyperion ecosystem, based on the our widely adopted open map technology and latest advancements of Blockchain technology. This ecosystem is designed to reward everyone with a share in the wealth they create and will ensure privacy is protected whilst hosting a new generation of decentralized applications requiring quality map services.

This paper outlines our vision for the birth of this new transformative ecosystem capable of addressing the needs of 10 billion users and 100 billion devices. This will lead to a much more egalitarian, prosperous society where everyone will get a share in the wealth they create.

The Power of Place

"Mobility is the fundamental essence of intelligence…[ ]. If you want to move, you must memorize and generalize."

~ Dr Qi Lu, ex Baidu COO, CES 2017 Keynote

To better understand the significance of the Hyperion ecosystem, one must first comprehend the significance of location data. Did you know that 80% of all business data has a location component to it[1]? This is not surprising given that maps constitute the building block of mobility, providing the memory block that underpin mobility for people, IoT devices and robots.

Some of the far-reaching impact of location data are summarized below:

1. Location data is a fundamental element for enriching business data sets with no obvious links and helps visualize business data in familiar ways, providing more in-depth analytics. This enables companies to make smarter and more informed business decisions.
2. Location data fuels innovation. In services that are particularly location-aware, such as Uber and Waze, accurate location and routing are fundamental to the value they provide to users.
3. Location data and analytics has helped advance the advertising technology and marketing space. This aids with better customer profiling and therefore targeting, and extends beyond just location-based mobile advertising.

With smartphone penetration rates on the rise, proliferation of location infrastructure, as well as the IoT tipped to go mainstream within a few years, location data will only continue to be a growing component underpinning all business data. To put that into perspective, the global market of location analytics worths 16.34 Billion USD by 2021[2] alone not including the use of map services.

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[1] William Huxhold's 1991 book 'An Introduction to Urban Geographic Information Systems'

[2] https://www.marketsandmarkets.com/PressReleases/location-analytics.asp

Problem Statement

As the fundamental building block of mobility, maps should be and remain pervasive, accurate and privacy-preserved. However, the current map system is flawed as elaborated in the following:

Incomplete, Inaccurate and Outdated Map Data

Location data is widely distributed and long-tailed, which means that the production and maintenance of a global map ought to be distributed by nature. However, the production of maps are currently centralized and as such, has resulted in maps that are incomplete, inaccurate, and outdated.

Did you know that most of the Earth's surface lacks an address? According to the United Nations, 70% of the world is unaddressed, including more than half of the world's sprawling urban developments. By outsourcing map production to third parties, we are effectively giving them control over not only what gets shown on the map, but also the power to dictate where we go and how we get there. In the Capitalistic 21st century era, it seems inevitable that large companies like Google will monetize location-based searches, with either premium results or priority ordering (if it hasn't done so already).

Limited Transparency, Privacy and Ownership

People have increased concerns of misuse of our location data - we have no transparency on how data were monetized - often by the third parties in control our data. There is no true user privacy in front of map service providers that even pseudo-anonymous data can be cross-referenced with other data to identify the user[3]. There is a saying that neatly summaries this state of play, "if you are not paying for the product, you are the product."

As popular apps harvest location data of the masses, the potential for leaking or exploiting this data has never been higher. The recent Facebook-Cambridge Analytics scandal is case in point and has brought to our attention how the large players have been making money off users data all along without them knowing. If everyone has data that they own and generate, isn't it about time that they should directly benefit from their own data instead of just relying on "free" services?

Furthermore, it is prohibitively expensive and cumbersome for users to build their own map service due to the high technology barrier. Innovation and entrepreneurship are therefore stifled. We need autonomy not on just data but the technology to provision map services at our will - not to let map companies decide what shows on the map and in which way we use map services. In short, in a more egalitarian society, people are calling for autonomy over digital location.

[3] https://www.fastcompany.com/3068846/how-your-location-data-identifies-you-gilad-lotan-privacy

Vision and Proposed Solution

"Making maps together means piecing together collective experiences, discovering patterns, and arriving at a collective understanding of the root causes of these shared experiences."
~ Eli Moore and Catalina Garzón,

Hyperion organically integrates innovations of three important dimensions, coined as the *Hyperion Trinity* of map technology, economy and society structures, to eventually achieve a sustainable and self-governed map economy of the world. People are empowered to build map technology, share economical return and govern map communities. High level dynamics of the Hyperion Trinity is illustrated in figure 1-1.

- **Crowd-build** to incentive quality global map data contribution and distributed system infrastructure hosting with Hyperion Digital Location Right (HDLR) as reward, i.e., *HDLR mining*;
- **Crowd-share** to establish a sustainable decentralized map economy, in which map services fees are distributed to HDLR owners accordingly by smart contract, i.e., *HDLR dividend*;
- **Crowd-govern** to reach consensus on technology and social-economic transition with delegated governance, i.e., *HDLR voting*. The Hyperion global community is consisted of multi-level regional communities governed by HDLR holders delegates of respective regions.

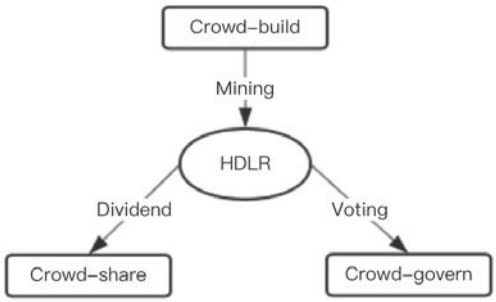

Figure 1-1: Hyperion Trinity

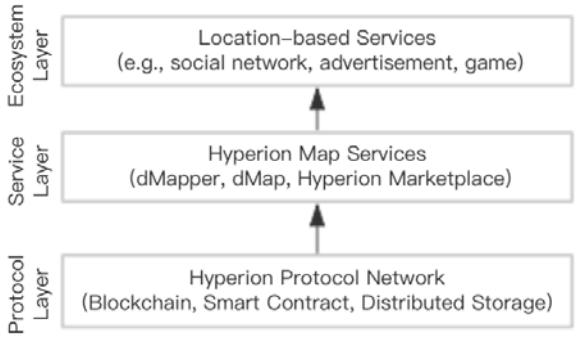

Figure 1-2: Hyperion Technology and Service

Technology and Service Architecture (figure 1-2)

- Protocol Layer: the Hyperion Protocol Network is a global network of Hyperion Protocol Nodes with *MapChain* (Hyperion Blockchain), smart contract, and trusted distributed storage. MapChain, optimized for location data, supports cross-chain communication for enhanced interoperability and smart contract for extensibility. MapChain natively integrates our innovative *Spatial Consensus Protocol (SCP)* to reach consensus of static location data (map) and dynamic location data (localization) in a secure and verifiable manner. MapChain employs BFT + dPOS as block producing consensus algorithm to support scalable map services and enforce a consistent delegated governance structure of the Hyperion community;
- Service Layer: this layer includes full-stack map services with tight integration with MapChain. Specifically, it includes map production service (*dMapper*), map service (*dMap*) and location data intelligence platform (*Hyperion Marketplace*). Users can stake HYN (pay-by-inflation) to access dMapper and dMap services, and spend HYN (pay-by-fee) for Hyperion Marketplace services;

- Ecosystem Layer: Location-based services (LBS), such as location-based social network, advertisement and gaming, accrue value to HDLR. Hyperion will collaborate with a wide spectrum of LBS to enrich the Hyperion ecosystem. To demonstrate the full power of Hyperion services, Hyperion will develop example LBS, e.g., a consuming-facing map service named Titan and a location-based game.

Mission and Vision - Spatial Consensus and Autonomy over Digital Location Right

Time and space attributes are meta data. It implies that all services happen on the map. The invention of clock provides human with the consensus of time, i.e. the *Temporal Consensus*. However, the ability to correctly understand our surrounding by community, i.e. the *Spatial Consensus*, is constrained due to centralized control and censorship. Our *mission* is to provide Spatial Consensus driven map of the world.

The need of accurate and precise Spatial Consensus, together with the highly distributed nature of map data, demands a decentralized Relation of Production for map economy. We envision a future in which people have autonomy over digital location - people are incentivized with Hyperion Digital Location Right reward to contribute underlying map utilities, and use their digital location rights to share economy benefit and govern important community transitions in a sustainable manner.

Brief History of Hyperion

Our mission to decentralize the map economy began in 2013. Dr. Isaac Zhang, upon commencing his PhD, realized the partiality and shortcomings inherent in the centralized model of maps. Curious to solve this problem, he began researching on a model of global open mapping crowdsourced by its people, for the people, and powered by innovative technologies. To that effect, he founded Mapxus (Maphvie Technology Limited) in 2016. Already, Mapxus has become the largest open indoor mapping platform in the world, serving various industries ranging from hospitality, government, medical, and commercial sectors.

Inspired by the emerging token economy and the possible paradigm shift enabled by blockchain technology, he envisioned for a map system that redistributes the excessive power away from centralized authorities. Realizing the inherent limitations of existing centralized map services and open map services, Mapxus together with other Hyperion founders decided to take it one step further, designing a global consensus-driven protocol with robust social-economic structure that will incentivize open mapping in a manner that is quality assured, self-sustaining and self-governed. That leads to the birth of Hyperion, the *Autonomous Map* that includes much more than open data and technology, but also a sustainable and self-regulated social-economic structure. Hyperion aims to provide autonomy over digital location, enabling everyone to build collaboratively and use better map services in an open and secure manner.

Determined to realize the vision and effect change, Hyperion was born in November 2017. Hyperion founders quickly assembled a dedicated and passionate team who shared a similar vision and were driven to upheave the current centralized model of mapping. Already, the Hyperion team has sought – and continues to seek – the best minds in token economics, blockchain technology, map technology and open data marketplaces. It is upon this robust and determined foundation that Hyperion will soon emerge as the thought leader and strongest advocate in open mapping.

HYPERION MAP SERVICES

Primitives of Map

In an abstract sense, a map is a symbolic depiction emphasizing the relations amongst elements of some space. The map we use everyday generally refers to geographic maps that describe the distribution of location-determined information in relation to physical space. In the context of Hyperion, a map is a collection of location-indexed information.

Maps can be broadly categorized into physical map and semantic map, which represents maps of physical quantities such as visual and wireless signal, and maps of usage data, respectively. Some examples of these two types of data are shown in the Table 1. A branch of Maps is built for human, i.e. consumer maps for people to find place, find people and find things. consumer maps suffer from map data that are incomplete (large unmapped public indoor space) and inaccurate (fast-changing data especially for POI). Another branch of maps is built for robot, i.e., HD Map normally by hybrid SLAM technology[4]. HD MAP are increasingly more important due to the wide spawn of robotic devices such as drones and self-driving vehicles. Primary challenges of HD Map are the sheer cost of map production and lack of an open global database (500 billion to 1 trillion miles driven data to train self-driving model[5]). The OneMap alliance[6] of self-driving vehicles suppliers proposed to make a harmonized global HD Map database for pervasiveness, openness and cost reduction.

TABLE 1- CATEGORY OF MAPS

Category	Data Type	Example Usage	Example Methods of Data Production
Physical	Vector	Digital Map	Manual/auto sketching, parsing from other data
	Signal	Wireless Positioning	Survey-based (Supervised learning) or machine-learnt (unsupervised learning)
	Visual	Street/scene view, visual positioning, AR/VR	Computer Vision and vSLAM
	HD MAP	Robotics (Self-driving, drones etc)	Computer Vision and SLAM
Semantic	Usage	Location trace and comments for data analytics, extracting real-time traffic etc.	Using map applications or applications with map SDK
	Point of Interest (POI)	Search, online-to-offline services, analytics	Manual editing, data mining from test, image and other data sources

[4] https://en.wikipedia.org/wiki/Simultaneous_localization_and_mapping

[5] Nidhi Kalra and Susan M. Paddock, “Driving to Safety: How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?”, RAND Corporation, Apr 12, 2016

[6] https://unwire.hk/2018/05/25/onemap-alliance-maps-for-autonomous-car-2020/life-tech/auto/

Location Service and Tradable Data

The *Services layer* is consisted of three main modules, namely dMapper, dMap and Hyperion Marketplace. All location data generated within the Service layer are tradable. We coin these data as Location-Tradables. The overall service flow (Figure 2) are as follows:

- Registered mappers can use dMapper (decentralized mapping tools) for mapping to capture raw physical location data, *the Captured Location-Tradables*, submit to dMapper to process into *the Map-ready Location-Tradables, which* are ready for Map use. Mappers have full ownerships of the data they produced - that they can set them as *open, private* data for sale or *regulated* data for special use cases.

- dMap (decentralized map services) consumes Map-ready Location-Tradables and publishes full range of map services such as routing, map search and visualization. dMap will record user usage data, the *Usage Location-Tradables,* upon the consent of users and store for later usage.

- All Location-Tradables are persisted in Hyperion Protocol Network securely in a privacy-preserved manner. The Hyperion Marketplace publishes Location-Tradables for user to query using the native MapChain Smart Contract (MSC) built into Hyperion Marketplace. Hyperion Market also exposes programmable native contracts and high-level applications such as a configurable location-based advertisement platform.

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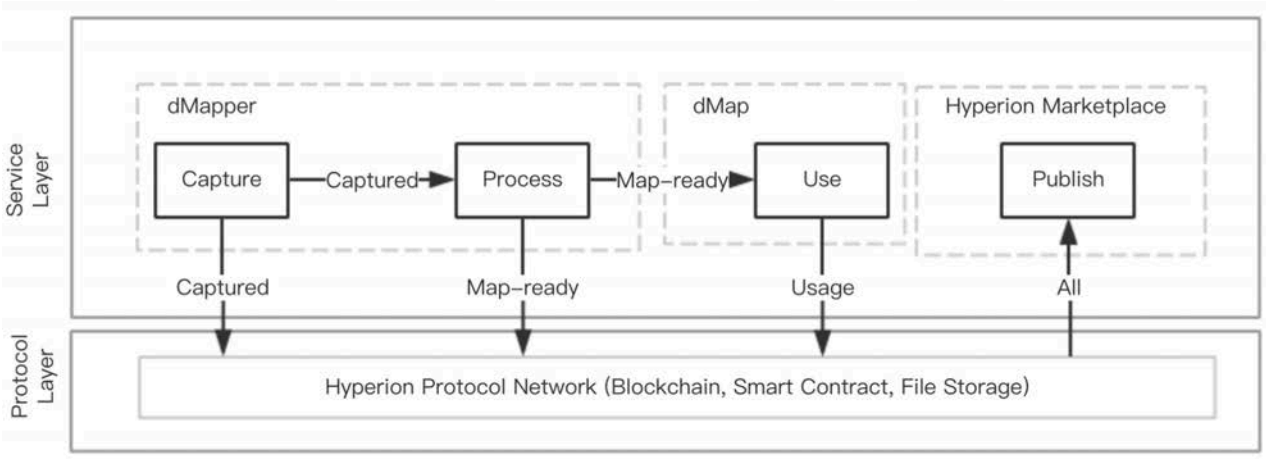

Figure 2: Overview of Location Services and Location-tradable

dMapper

Decentralized Mapping Services, dMapper, is a mapping tool suit for fast mapping by everyone. The idea is to make mapping simple - the simpler mapping is for everyone with consumer electronic devices such as Smartphone and drones, the more people can provider map data and thus the more complete and updated of the map database. dMapper has a dMapper HD version for High Definition Map construction for robotic devices e.g. self-driving cars and drones with integrated mountable mapping device on cars and drones.

Token Model

Map data produced by dMapper are recored as transaction (Map Block) on chain, owned by the mappers themselves. The Map Block content describe the map data and the metadata of the Map Block. The value of Map Block is determined automatically if the contents of Map Block can be validated by algorithm, or evaluated using crowd curated model if otherwise. Non-validated Map Block contents will be separated into a new database branch and would not be merged into main branch until positively validated.

The crowd curated model, Map Block Test, is a generalized version of A/B test with time duration constraints - that dMap serves different branches map data for different users to rate at the scene. Users rates are collected over time to proof the test of time of the Map Block content. With enough user rates for the Map Block Tests, system will compute a value of the Map Block for reference of token distributions later on.

Mappers can be paid in two schemes: (1) instant payment contract that transfers tokens to mapper for data buy-and-sell, which is equivalent to transferring ownership of the Map Block to others by signing on the buy-and-sell contract (2) Deferred Sharing Contract (DSC) that grants mappers an ongoing share of the dMap token revenue based on the content of their Map Block. DSC is valid until the Map Block contents are invalidated afterward (Change of environment). DSC model incentives people to contribute Map Block on the early stage. All of functions related to Map Block evaluation, ownership transferring and payment schemes are all implemented on MSC for self-regulating and sustainable mapping on the globe.

Primary Features

dMapper are mainly characterized by following features:

- Unified Open Mapping Schema: dMapper will devise a flexible and effective map data representation compatible to Open Street Map (OSM) schema.

- Decentralized mapping by everyone: dMapper features are accessible by consumer-grade electronic devices e.g. smartphones, personal computers and drones. Full spectrum quality mapping: dMapper is simple to use and most of the mapping process are automated. All data types included in the Table 1 can be produced using dMapper.

- Larger open mapping community: dMapper connects with OSM mapping community - over 4 million registered mappers and large ecosystem players like Mapbox, Mapxus and Mapillary.

dMap

Decentralized Map Services, *dMap*, deliver full range of map services (indoor and outdoor seamless localization, search and routing etc.) for consumers, enterprise and robots. dMap can be accessed in forms of API and SDKs (web, mobile, unity) or purpose-built hardwares. dMap has a dMap HD branch for robotic devices such as drone and self-driving cars. Hyperion will develop a consumer-facing map application, *Titan*, to demonstrated the use cases and exploit the underlying power of native MSC.

Token Model

Users need *Pulse* to consume dMap services. Pulse is generated monthly, with a dynamic ratio, based on the amount of HYN users stake for dMap. Unused Pulse by the end of the month would be emptied, and excessive use of Pulse will halt the service with a 5 day extension for users to increase the stake for dMap.

dMap meters the use of following resources and compute the Pulse consumptions accordingly:

- The number of transaction recorded on MapChain;
- The number of API calls grouped by map functions used;

Primary Features

dMap are mainly characterized by following features:

- Open and secure service: We will open source dMap, both client side to back-end codes on MSC. Privacy related service such as localization, location-based search and recommendation will be implemented as native MSC to fully exploit the privacy-preserved features of MapChain. MapChain supports reproducible and verifiable proof of timestamped localization, the *SpaceTime Verification (STV),* that provides zero knowledge proof of location and allow data owner to validate it afterward. Example uses of SpaceTime Verification include verifying the location attribute of location-based comment to avoid fake comment, and verifying the physical presence of users to claim location-based coupons or received location-based advertisements .
- Pervasive and accurate maps: Map data are intrinsically distributed and long-tailed. With incentivized decentralized mapping with help of dMapper, map data are expected to be more complete and updated.
- Aligned incentives: With the consent of dMap users, dMap will publish usage data as Location-Tradables to Hyperion Marketplace for monetization in a secure and privacy-preserved manner. dMap users will received token rewards upon existence of completed transaction of their usage data. For example, a third party can registers a deferred, conditional and token-staked MSC for location-based advertising. The MSC is completed automatically if a SpaceTime Verification of fitting target is generated and token staked in the MSC will be distributed as a transaction to the viewer of the advertisement.

Hyperion Marketplace

Hyperion Marketplace can be considered as a collection of location services other than those included in dMap (map usage) and dMapper (mapping). It is built on top of native MSC and provides interface for users to interact via browser or programmatically via API or MSC. Hyperion Marketplace mainly provides two broad streams of services: (1) location data: curation and trading of Location-Tradables; (2) location intelligence: location-based advertising, geo-fencing, real-time tracking and triggered events etc.

Design principles of Hyperion Marketplace are:

- Discoverability: the ability to identify, promote and curate location data and intelligence;
- Transactability: the ability to reach transactional agreement of data and service;
- Verifiability: the ability to prove that data were untampered, computation were correctly executed and transactions were completed

Token Model

Token models of Hyperion Marketplace services vary from case to case. However, there are guiding principles - that for transaction of ownership transfer (e.g. buying Location-Tradables), the new owner should pay-by-fee, and that for transactions of service usage, the user can pay-by-fee (e.g. advertising) or use-by-staking (e.g. data analytics). The actual token model depends on the legal contract accompanied in the MSC performing the transaction.

Primary features:

Primary features of Hyperion Marketplace services include:

- Location data: Provides discovery, analytics, curation and trading tool suits of Location-Tradables.
- Location intelligence: Provide a collection of native MSC of location-based intelligence and events support. Example usages include location-based advertising platform, location-based gaming and location-triggered events;
- Transparency on Blockchain: Hyperion Marketplace is built on native MSC so all transactions are easy to audit and verifiable by all parties.

HYPERION PROTOCOL NETWORK

Design Principles and Discussions

Hyperion is built to underpin a global decentralized map economy in which interests of stakeholders are well-aligned and everyone has the autonomy to access the utility of Hyperion, that is, pervasive and autonomous location and map services. The overall design goal of Hyperion Protocol Network (HPN) is to power the aforementioned location and map services in an open, censorship-resistant and fault-tolerant manner.

Usability & Performance

Map services should be low-latency, low-cost, high-availability and secure and it is challenging to provider the service level at *global scale*. As reported[7], Tencent serves over 50 billion localization requests per day for over 600 millions users in various contexts such as social network and car hailing services etc. With linear scaling assumption to 2 billion[8] global users, the number of localization requests exceeds 165 billions a day, equivalent to roughly 2 million Transaction Per Second (TPS) if all requests run on Smart Contracts. It also reports that nearly one third of searches of Google are location based queries[9].

Extensibility & Interoperability

Map is the greatest common denominator of location-based applications such as Uber and Foursquare etc. Pokemon Go is a prime example of location-based service built on primitive map data. Other applications may want to develop location-triggered events based on dMap services. It requires HPN to be able to support partners to flexibly program Smart Contract based on the native location functionalities implemented as Native Smart Contracts (NSC) that can be called as inline function in other Smart Contracts.

For interoperability with other native Blockchain, HPN supports cross-chain communication which requires the ability to bi-directionally verify existence of transactions in a provable secure manner. The cross chain design will also enhance system throughput by side-chains or off-chain channels via secure state synchronization across chains.

[7] https://hr.tencent.com/news_detail.php?id=244

[8] https://www.theverge.com/2017/5/17/15654454/android-reaches-2-billion-monthly-active-users

[9] http://www.thesempost.com/one-third-mobile-searches-local-queries/

Decentralization & Governance

Scaling Blockchain system is difficult in a full decentralization and secure setting as discussed in the Blockchain scalability trilemma[10], albeit with years of efforts in both academic and industry down the path. MapChain, the native Blockchain system of HPN, is of no exception. Latest open research results such as Elastico[11], ByzCoin[12] and RsCoin[13] exhibit different trade-off preferences of the Trilemma setting.

However, from the perspective of HPN, decentralization is not an objective itself, but a feature for other system design goals: **censorship resistance, open participation and fault-tolerance**. Importantly, decentralization is a spectrum and increased degree of decentralization often incurs higher costs, as demonstrated in the sheer cost of mining Bitcoin. We consider having each and every transaction validated by a large node network is both unrealistic and unnecessary. MapChain scales throughput and reduces latency by using only as much decentralization as necessary to maintain useful levels of openness, censorship resistance and fault tolerance.

Moreover, architectural decentralization does not necessarily guarantee political decentralization[14] - they are often *misaligned* that the block production in Bitcoin and Ethereum, albeit with complete architectural decentralization protocol design, is far more concentrated than commonly thought[15]. The inherent political structure of Blockchain network should be taken into design consideration that demands a coherent high-level design of technology and a fitting social-economical structure with proper incentive scheme to mobilize and regulate collective community behaviors. Importantly, a formal governance process is required to prevent informal governance devolving the network into gridlocks, e.g., forking or inability to upgrade protocol.

To sum up, governing design principles of HPN include:

- Usability & performance: support billions of users with low-latency, low-cost and highly available services with native security and privacy-preserved features;
- Extensibility & Interoperability: support Smart Contract with native location functionality and secure and provable cross-chain communication;
- Decentralization & Governance: achieve long-term censorship resistance, open participation and fault tolerance via coherent and organic design of technology and social-economic structure.

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[10] https://multicoin.capital/2018/02/23/models-scaling-trustless-computation/

[11] L. Luu, V. Narayanan, C. Zheng, K. Baweja, S. Gilbert, and P. Saxena. A Secure Sharding Protocol For Open Blockchains. In *Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security*, CCS '16, pages 17–30, New York, NY, USA, 2016. ACM.

[12] E. Kokoris-Kogias, P. Jovanovic, N. Gailly, I. Khoffi, L. Gasser, and B. Ford. Enhancing Bitcoin Security and Performance with Strong Consistency via Collective Signing. In *Proceedings of the 25th USENIX Conference on Security Symposium*, 2016.

[13] G. Danezis and S. Meiklejohn. Centrally Banked Cryptocurrencies. *23rd Annual Network & Distributed System Security Symposium (NDSS)*, Feb. 2016.

[14] https://medium.com/@VitalikButerin/the-meaning-of-decentralization-a0c92b76a274

[15] https://arxiv.org/pdf/1801.03998.pdf

MapChain Design & Optimization

MapChain is built on top of academic-grounded works and integrate latest industrial best practice, protocol design and system tooling from continuous rigorous experimentations. Important design decisions of MapChain are as follows:

Block Producing Nodes & MapChain Core Network

BFT + dPOS. BFT is for improving the robustness and shortening the time to finality (1s) and dPOS is for providing a incentivized, liquid and representative model for the requirements of global token holder suffrage. The model provides performance level of federated chains while ensuring open participation and censorship resistance by token voting of eligible delegates.

Keepers of the Hyperion Protocol Community will host a global distributed *MapChain Core Network* of 15 active Block Producers and 30 idle Block Producers in case the failure of active Block Producers. The MapChain Core network is built on a secure underling Secure Communication Layer, an protocol agreed on and maintained keepers to provide secure and fast communication. The idea is to shield block producing nodes from potential attacks and decrease the attack surface to a minimum required level (fully meshed, P2P private tunnel and etc.).

Other System Nodes & MapChain Access Network

In addition to the MapChain Core Network, keepers will also host a *MapChain Access Network* of auxiliary systems to provide an extra security layer of request filtering and buffering, and a place for block producers to establish their credentials to the community. Public request to block producers are all filtered by a hardened API Node with private and secure communication to block producing nodes. API Nodes need to be protected from network attacks, e.g., DDoS attacks, and have sufficient processing and networking capability to preprocess and queue public requests to the block producers.

MapChain Access Network also include Query Nodes and Validating Nodes. The Query Node maps blockchain state into traditional database for scalable read access and easy maintainability and resolve the need for applications to run through the blockchain full history themselves. The Validating Node tracks the validity of transactions on blockchain signed by blocker producers and report suspicious behaviors for the community for token reward.

Parallelization and Cross Chain Verification

Parallel chain is an effective pattern for scaling transaction throughput by dividing transactions to different chains to process separately. Fast cross chain transaction validation is enabled by Light Client Validation. Light client, implemented as a Native Smart Contract, is baked into the protocol level to allow cross-chain transaction verification without having to process the entire blockchain. Light client verifies the existence of

transactions on other chain and take actions accordingly. With a 1s transaction finality, a cross chain action can finish in 3s.

MapChain employs message based[16] architecture rather than a state based architecture to improve system scalability. It is easier to parallelize transactions if Blockchain is designed as a log of actions combined with deterministic logic for generating and verifying states, than to record a log of state changes on Blockchain. States can be replayed and verified by going through the message history.

Protocol Level Account Support

In addition to general system specifications, such as low latency, high availability and security, protocol layer user friendly account support is crucial for success of decentralization applications. Features include human-readable username, recoverable accounts and fine-grained function control. Users have complete control of their own private keys, while also having recourse in the case that their keys are stolen by invoking multi-signature account restoring procedures.

Easy Upgrade and Bug Fix

A preferable design pattern is to separate bare-bone block producing logic and other native functions e.g. token, delegated voting. By moving non block producing logics to NSC, the community has greater flexibility to update the network without a hard fork. Code update, agreed by the community, can be propagated to the main net automatically by enforcing an on-chain governance pattern and therefore allowing the system to evolve faster.

Transaction Compression

Reducing the size of transactions can improving system throughput and block size, reduce time for state synchronization and reduce cost of Blockchain operation. Examples include the Smart Contract codes, ABI specification and large text or media content. The general idea is to prune contents that are irrelevant to Blockchain states after a block is immutable. This proves that the content was once known without the need to store the contents on chain forever. Segregated Witness can used to keep large contents as segregated data while putting the digital digest of data as hash on Blockchain.

System Optimization

High-performance message streaming is an important feature of high throughput distributed systems. We will refer to the implementation of Reliable Messaging to Millions of Users [17] to a solution to handle millions of

[16] https://steemit.com/blockchain/@dantheman/blockchains-should-be-designed-like-massively-multiplayer-games

[17] https://arxiv.org/pdf/1712.09876.pdf

concurrent connections and support a reliable notification service despite server failures and network disconnections.

Smart Contracts & Persistence

MapChain supports high-performance Smart Contract with tight integration with location Oracles. Location Oracle index data with optimized location-based schema and provides trusted data feed for Smart Contracts on MapChain. Smart contracts are registered on MapChain and support atomic, inline and deferred actions. Smart Contracts are pure and safe without side-effects that do not share working memory be default.

Contracts are written with Web Assembly Virtual Machine (WASM) and compiled into a canonical bytecode format that nodes can retrieve and execute. Each Smart Contract must be accompanied by a Contract that defines the legally binding terms and conditions of the contract. It is important to note that MapChain is a message-based system with deterministic logic. All non-deterministic Smart Contract behaviors such as floating point operations are needed to be sanitized. For example, Smart Contract library should include support for software determined floating point number generator.

Native MSC is broadly classified into four streams: (1) system: system level behavior such as token transfer, account management, messaging and light client validation etc.; (2) real-time location: continuous tracking or event driven models such as geo-fencing and location-based advertisement; (3) data management: curate location data via Token Curation Registry (TCR)[18] or querying location-based data and spatial aggregation queries; (4) cryptography primitive: Zero Knowledge Proof (zkSNARK) and Secure Multiparty Computation etc. (2) and (3) both require tight integration with location oracles feeding trusted data securely.

MapChain provides a persisting API to store states across sessions - contract can share states among actions with flexibly schema for data abstraction. Logs of produced blocks are stored locally on the block producing nodes and synced over the block producer network via the native state synchronization mechanism of MapChain. Large files like images and map data are stored in fault-tolerant distributed object storage and database. Data in the distributed database and file storage are synchronized and verified across Block Producer keep network via a oracle network consensus layer. Contracts can query location data via the interface of location Oracles for trusted and verifiable computation in a secure manner.

[18] https://medium.com/coinmonks/token-curated-registry-tcr-design-patterns-4de6d18efa15

PROGRESS AND ACHIEVEMENT

In year 2016, Mapxus was founded with the vision to build a global open indoor map platform via crowdsourcing, enabled by technology innovations to make mapping simple, for everyone. The vision of Mapxus is best illustrated in figure 3 that a child can be an eligible mapper using Mapxus's tools and build useful maps as shown in Figure 4.

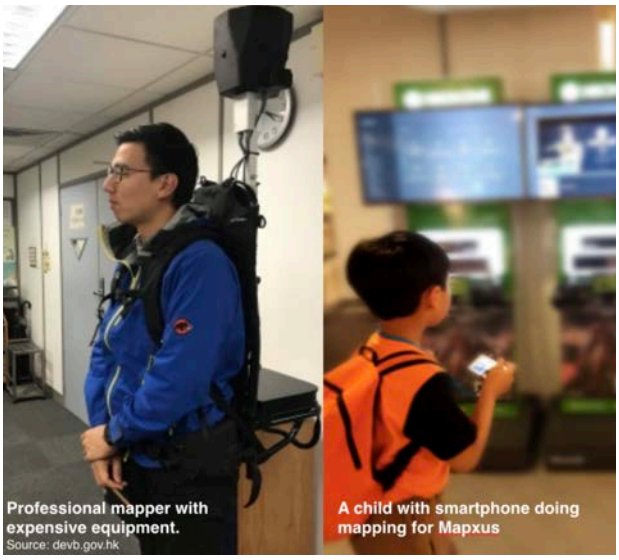


Figure 3: Centralized and decentralization mapping

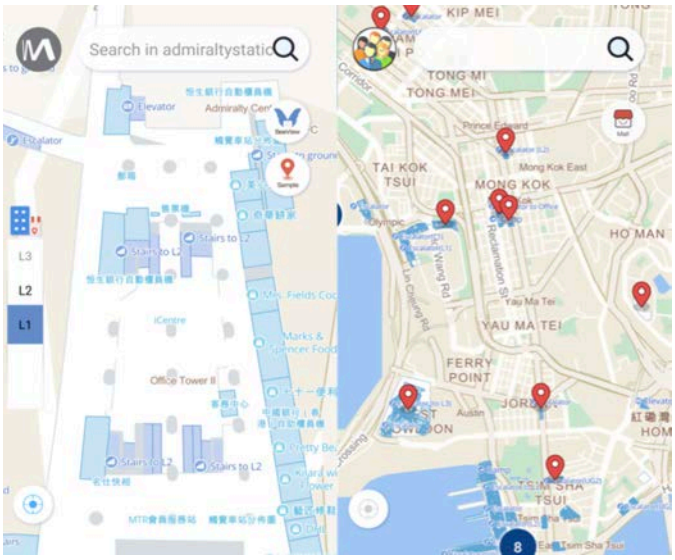


Figure 4: Screenshot of Mapxus map services

Already, to our knowledge, Mapxus has become the largest crowdsource open indoor mapping platform of the world with exemplary use cases in many sectors such as healthcare, first responder, commercials and location-base gaming. Mapxus extends the previous research works since year 2013 and serves as the launchpad of Hyperion - to ensure technology superiority in map services and drive early growth of global map communities.

Technology and Product

Mapxus provides technology in two dimensions: mapping and map use, which are the basis of dMapper and dMap of Hyperion. With the mapping tools, anyone with smartphone is empowered to become a cartographer, capable of producing quality map data in full spectrum: vectorial, signal and visual data. Raw data are captured and processed with the mapping engine in the cloud to produce useable maps and related map features.

Mapxus is one of a few companies with full spectrum of map services, covering indoor and outdoor areas. Map data can be accessed via cross platform SDKs (IOS, Android and Web) providing map services such as seamless positioning, map rendering, search, routing and panoramic visual view.

Growth of Data Coverage

Since Mapxus released the mapping tool suite to partners on Aug 2017, volume of data started to surge and now already has covered indoor areas of over 1300 buildings with over 60 million square meters space coverage (Figure 5), over a few countries and regions in Asia (Figure 6). The primary focus of the first year growth to cover Asia market and dominate a few developed regions (e.g. Hong Kong) for city-scale open map demonstration. The market of indoor maps for consumer applications is still a blue ocean. To illustrate, Mapxus has mapped 728 commercial buildings in Hong Kong - about 10 times as the indoor maps found on Google Map (about 70 on June 2018).

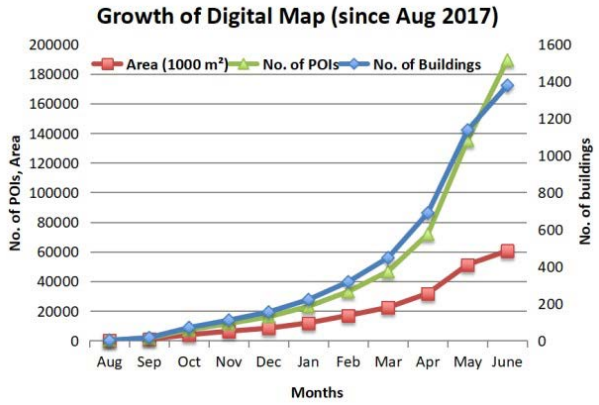


Figure 5: Growth of data coverage

Figure 6: Data coverage by region and city in Asia

Selected Use Cases

Following use cases are selected for their effective demonstrations of map functions and application domain.

- Hong Kong Internation Airport (HKIA): HKIA is one of the largest (with over 1 million square meters in total) and busiest passenger gateway of the world. It is challenging to find ways and places in HKIA especially for passengers in hurry. The primary feasters of maps used in HKIA is indoor positioning, route planning, POI search and visual view, as shown on Figure 7. Keywords include **large indoor spaces, location search and routing**.

Figure 7: Demonstration of map use in HKIA

- Government of a city in China: It is essential importance to have indoor and outdoor location visibility for routine operations of patrollers and emergence of first responders. Primary feature, in addition to generic indoor and outdoor map functions, this use cases emphasis of the change management of location intelligence (Figure 8). Patrollers update the visual views of the area on a weekly basis and the object detection modules identify change of object of interest (e.g.. fire hydrant) automatically. Keywords include **seamless *indoor and outdoor, first responder, location intelligence***

Figure 8: Indoor and outdoor seamless map services

- Augmented Reality (AR) gaming in Melaka, Malaysia: Mapxus maps 10 shopping malls and roads connecting the malls, as the pilot area of city-scale AR gaming of Melaka. Map data will be rendered with Unity platform to build the background context of the game like the world of Pokemon Go. Enabling functions of this use case are the open and interoperable map data, and visual positioning system to align the visual world with the physical world in both indoor and outdoor environment, which is a differentiating feature from Pokemon Go only available for outdoor environment. Keywords include ***AR Gaming, interoperable map data, visual positioning system***

- Smart watch seamless tracking in Hong Kong: Mapxus develops a smart watch solution integrated with positioning SDK to provide seamless indoor and outdoor tracking services. Users put smart watch on people they care, such as children, elders and visually-impaired people. Keywords include ***seamless positioning (indoor and outdoor)*, IoT *device integration***

ROADMAP

Infrastructural Capacity Building

2013 Q3: Start of research on building global open map system via decentralized mapping

2016 Q3: Mapxus, an open decentralized indoor mapping platform, was founded

2017 Q3: Launch of mapping tools for decentralized mapping with partners

2017 Q4: Launch of full range map services and start of research on building high performance Blockchain

2018 Q1: Formation of founding teams of Hyperion

2018 Q2: Research and Development of Hyperion Map Services and MapChain

Hyperion Early Stages and Beyond

Code Name	Time	Hyperion Map Service Roadmap	Hyperion Protocol Network Roadmap
Galatic	2018 Q3	System development & map community building	System development & Blockchain community building
	2018 Q4	Release dMapper for public use	Standalone test environment of MapChain
	2019 Q1	Release Titan	Pilot-scale test network of MapChain
Stellar	2019 Q2	Release Hyperion Marketplace	Testing and security audit of MapChain
	2019 Q3	Release dMap for public use	
	2019 Q4	Release location-based advertising platform on Hyperion Marketplace	Stable MapChain 1.0 deployment
	2020 Q1	Release dMap integration with IoT devices	Global Blockchain Developer Program
Planetary	2020 Q2	Release a location-based game	
	2020 Q3	Release dMapper HD	Release MapChain 2.0
	2020 Q4	Release dMap HD for drones and UAVs	

TOKEN ISSUANCE MODEL

"Show me the incentive and I will show you the outcome" - Charlie Munger

The design of token issuance model should balance long-term and short-term commitments of teams and communities, drive fast growth of Hyperion ecosystem, achieve anti-speculation and eventual self-governance by community.

Totally 10 billion Hyperion Token (HYN) will be issued in form ERC20 as placeholder and mapped to native HYN on Hyperion MainNet once activated. The hard cap of *proposed* annual inflation is 3% as incentives to keepers of the Hyperion Protocol Network and community programs. The exact number of inflation can be adjusted upon community consensus. We hereby define T0 as the day of the first HYN crypto exchange enlistment.

Initial Token Distribution

Sales & floating (35%):

- Seed round (5%): 20% release (T0 - 3 days); 20% release (T0 + 6 months) ; 30% release (T0 + 9 months); 30% release (T0 + 12 months) ;
- Private sale (10%): 40% release (T0 - 3 days); 20% release (T0 + 6 months) ; 20% release (T0 + 9 months); 20% release (T0 + 12 months) ;
- Other rounds (20%): 40% release (T0 - 3 days); 20% release (T0 + 6 months) ; 20% release (T0 + 9 months); 20% release (T0 + 12 months) ;

Founders & team (16%):

- 4 years vesting, 22% release (T0 + 6 months), and 6% release for every 3 months afterward;

Community and Marketing (15%):

- Incentive programs, airdrop, partner networks and global evangelists etc.

Global Developer Program (8%):

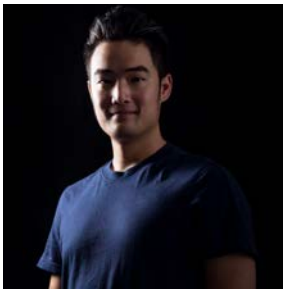
- 4 years vesting, 6.25% release every 3 months after T0. Open source developer and technology collaboration etc.

Foundation Reserve (26%) :

- 6% as long-term incentive to distinguished contributors. 4 years vesting, 6.25% release every 3 months after T0.
- 20% reserved for driving network growth, anti-speculation, merge and acquisition and etc. 3 years vesting, 8.33% release every 3 months after T0.

FOUNDERS AND TEAMS

Founding Team Members



Isaac Zhang, the Architect

- Co-founder and CTO of Mapxus, largest decentralized indoor mapping platform of the world
- Visiting scholar (Maths), University of Cambridge
- PhD on localization (Computer Science), University of Nottingham
- Veteran in maps stacks, large distributed systems and algorithm design
- Strong advocate of decentralized mapping since 2012

Eric Huang, the Executive

- Co-founder and ex-CTO of Mobvista, the largest Mobile marketing platform in Asia, over 1B USD market valuation, listed on Neeq (834299), business success with operation in 10+ countries
- Bachelor and Master of Shanghai Jiaotong University, major in EE&CS
- Expertise in high concurrence & distributed cloud architecture, serving 10 billion advertisement per day across the world
- Community hero (best honor) of AWS China

Kai Law, the Evangelist

- Double Master of Media and Business, Loughborough University UK
- Co-Founder & COO of Liuxuebao, largest study-abroad SAAS platform in China
- CBO of Vienna Group, Senior Director of Plateno Group, Director of BlueFocus
- Journalist of Phoenix TV channel London branch
- 4 years crypto investment experience, angel of BTS, EOS, IPFS
- Blockchain influencer and forum speaker of multiple countries

Guangxian Zou, the Technologist

- Co-founder and CTO of AIPAI, a gaming video sharing platform of China, winner of Most Innovative Company 50 in China of the Fast Company magazine
- Winner of Most Creative People in Business of China of Fast Company on 2016
- Owners of multiple national patents
- Track host of QCon, a global conferences of technical Leaders. Chairman of TGO Guangzhou. TGO curates a community of technical leaders in China
- Master in University of Electronic Science and Technology of China on 2014
- Co-author of the book “Game Programming Gems 7”

Michelle Tang, the Growth Hacker

- Growth, brand and marketing guru in scaling communities for a handful of fast growing international tech startups funded by the likes of Sequoia and Alibaba.
- Previously an investment analyst at Macquarie Bank, Sydney, with stints at the bulge bracket investment banks
- Member of the United Nations ESBN and its Task Force in Green Business and the Digital Economy
- Founder of a social dining community focused on connecting like-minds from diverse fields, Masterchef Asia contestant 2015
- Commerce and Law graduate from the University of New South Wales, Sydney

Qun Huang, System Architect

- Bachelor and Master of Computer Science of Sun Yat-sen University
- 10+ years experience in building complex distributed systems
- Previously software engineer at Tencent
- 2008 Las Vegas TopCoder software development, 4th place
- 2013-2016 4 years in a row, TopCoder best software project management award

Jinggang Wang, System Engineer

- 10+ years experience in building quality softwares
- Bachelor of Mathematics of Sun Yat-sen University
- Previously software engineer at Baidu and Tencent
- 2016 TopCoder Washington USA, 2nd place award
- 2015 TopCoder Indianapolis USA, 2nd place award
- 2005 ACM-ICPC Golden Medal in Taipei and Finalist of Asia

Aaron Qi, Research Engineer

- Senior Research Engineer at Mapxus, specialized in Computer Vision and Deep Learning
- PhD candidate in Differential, Manifold and Algebraic Topology (Mathematics) Trinity College, University of Cambridge
- Honor Bachelor in Mathematics, King's College London

Mapxus is one of the founders of Hyperion. Below is a selected list of the management board of Mapxus for their contribution to Hyperion to ensure technology superiority and growth of ecosystem.

John Chan, CEO of Mapxus

- Co-founder of Mapxus
- PhD and Bachelor in the Hong Kong Polytechnic University
- Researcher of the Blake/Roland Laboratory (awardee of Nobel Prize in Chemistry 1995) at the University of California, Irvine
- Researcher of NASA TRACE-P and peaceful aerial survey program from 2001 to 2002
- Nominated as candidate for ENI Award in 2011
- Distinguished Professor, Director of Experimental Center, Associate Dean of School of Environmental Sciences and Engineering, Sun Yat-sen University

Samuel Cheng, Research Scientist of Mapxus

- Research Scientist of Mapxus, specialized in Computer Vision and Deep Learning
- Distinguished Professor Thousand people talent program of China
- Associate Professor of Computer Science at the University of Oklahoma
- PhD in Computer Science, Texas A&M University
- Master in Electrical Engineer, Hong Kong University of Science and Technology
- Bachelor in Maths and Physics, the University of Hong Kong

Ocean Ng, COO of Mapxus

- Co-founder and Chief Operating Officer of Mapxus
- Master and Bachelor of Hong Kong Polytechnic University
- Over 12 years seasoned experience in technology management and consultancy
- Owner of multiple U.S. patents, PMI global certification and GS1 EPC professional certification

Houghton Wan, Business Director of Mapxus

- over 20 years of experience in information technology
- Lead of Asia-Pacific Sales and Marketing of Eli Lilly, a Fortune 100 global company.
- Bachelor of Computer Science of the University of Manitoba, Canada
- Master of Social Science of Baptist University of Hong Kong

Notable Advisors

Guoping Qiu

- Professor (Chair) in Visual Information Processing of the The University of Nottingham,
- Researcher at Hong Kong Applied Science and Technology Research Institute Ltd (ASTRI) and Technicolor (Thomson) Research & Innovation
- Specialized in image processing, pattern recognition, multimedia and machine learning.
- Editing board member & best paper award winners of many Computer Vision top journals such ac CVPR and ICIP

Christopher Ma

- Head of Asia Quantitative Research, CitiBank
- VP of Equity Research, JP Morgan and Analyst at Goldman Sachs
- MBA, Columbia University
- Master and Bachelor (cum laude) of Computer Science, Cornell University

Zhi Wang

- General Manger of JD cloud, the Cloud Service of Jing Dong Group
- Ex-uCloud and Dell executives, veteran in distributed computing

Joe Han

- Co-Founder of 1QBit, the world first quantum computer application company, ”Technology Pioneer of 2016" by World Economic Forum
- Co-Founder of Minor Capital (VCC). Portfolio includes D-wave (first commercial-ready quantum computer), General Fusion (leading maker of Nuclear Fusion Reactor), Kindred AI System (AI Robotic System, "50 Smartest Company of 2017” by MIT Technology Review)
- Bachelor of Science, Science and Business (Physics Specialization) with minor in Economics and Computer Sciences, University of Waterloo

Ran CI

- Growth Investment professional at Sequoia Capital China
- Ex-TMT investment banking analyst at J.P. Morgan
- Co-founder and CEO of VIM International; Founder and Chairman of Fly-On Consulting
- Bachelor of Science, Security Analysis and Real Estate Investment, Cornell University

LEGAL REMARKS

We believe the only way to create a sustainable business in the current cryptocurrency climate is to tackle legal issues head on, working in close co-operation with local governments and judicial authorities, emulating the highly successful model recently set out by Uber UK. This is particularly necessary in light of the potential use local authorities could have for our services (e.g. first responders).

For these reasons, Hyperion has developed its legal and technological teams in parallel, to create a cohesive long-term legal strategy that will allow this technology to proliferate globally, with immediate legitimate utility to users and clarity for investors.

Additionally, we appreciate the need for privacy in mapping within certain spheres, and the subsequent need to ensure certain data is not shared or sold on the network. We have dealt with this by ensuring that some forms of data can only be distributed between members of closed groups who have authority to access said information. This leaves users and investors with peace of mind, faith in our business as a whole, including our ethics, and ensures we avoid pitfalls in gathering or managing data as exemplified in the recent issues surrounding Cambridge Analytica.

Hyperion benefits from having our legal and technical teams closely linked, which has allowed us to develop internal processes for ensuring compliance. This includes regular internal audits of data, with expeditious removal or suspension of unwanted material. Our early emphasis on legal strategy means we are not only ready to comply with current legislation, but are already working on the potential effects of future regulations that we anticipate.