The (re)Distributive Enterprise

HOW A NEXT GENERATION DISTRIBUTED LEDGER TECHNOLOGY IS TRANSFORMING ENTERPRISES FOR THE ECONOMIC EMPOWERMENT OF PEOPLE AND THE PLANET.

Next Block Group

Garrett Minks
distributed technology analysis
garrett@nextblockgroup.com

Gunther Sonnenfeld
cryptoeconomics & ecosystems
gunther@nextblockgroup.com

Martin Casado
business systems design
martin@nextblockgroup.com

Ed Prado
capital + business strategies
ed@nextblockgroup.com

Holo

Dan Quinton
enterprise partnerships
dan.quinton@holo.host

Moritz Bierling
ecosystem catalyzation
moritz.bierling@holo.host

David Atkinson
commercial direction
david.atkinson@holo.host

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Table of Contents

Introduction

Holo is a global organization that has invented a (r)evolutionary system for a new, truly decentralized Internet infrastructure. This includes an open source development codebase called Holochain. Holochain, in an enterprise context, is a framework for organizing and operating distributive microservices. These microservices transform the way enterprises can develop digital utilities - applications that people and groups can use to improve workflow, optimize supply chains, measure value, and exchange both civic and commercial products. As such, Holochain can be thought of as an independent operating system, enabling organizations to operate their own infrastructure and high-performance currency systems. Unlike blockchains, Holochain has a unique architecture and development approach, which will be explored in detail here, specifically with its relevance to the enterprise. The net-net result is a faster, leaner, more profitable, and more responsible way of doing business.

Next Block Group (a subsidiary of Novena Capital Holdings) was created in May of 2018 to respond to a major gap in the blockchain marketplace: Viable use cases that transform enterprise operations for the highest possible social and ecological impact. As such, Next Block Group is a resource development platform that matches leading-edge protocols with later stage companies and enterprises to create exciting new revenue opportunities. Unlike many advisory and development entities, NBG approaches these opportunities through a unique, holistic vetting process that takes into account real market needs, advanced leadership practices and custom technology solutions. NBG's partnership with Holo (Holochain's parent organization) is reflective of this push for enterprise innovation.

This litepaper will address three critical components:

1. **CONTEXT:** The macro and micro context driving the value of distributive microservices;
2. **DEPLOYMENT:** What the Holochain framework for microservice strategic development and functional deployment actually entails;
3. **USE CASES:** Applied uses for this microservice development along with a new way to frame new markets as social and ecological solution sets.

Distributive as important as Decentralized

The Holochain framework, along with its distributed infrastructure system, Holo, is leading a new wave of next generation ledgering technologies that are moving past the myths and misconceptions of decentralized networks. We will explore how enterprises can leverage Holochain to build scalable and adaptable microservices in ways no other distributed architecture can. As microservices enable enterprises to offload single use tasks without

disrupting existing systems, the Holochain framework will enable forward-thinking enterprises to adapt new patterns for deploying and maintaining critical IT/backend/cloud functions in a collaborative manner while increasing operational security and resiliency. To begin thinking in a decentralized microservices mindset, instead of existing centralized command-and-control mindsets which have dominated the enterprise IT space for decades, we must understand three crucial concepts.

First, decentralization is a process which evolves.

Decentralization is commonly defined as *the **process** by which the activities of an organization, particularly those regarding planning and decision-making, are distributed or delegated away from a central, authoritative location or group.* We can reduce this further: It is ***the state of operations by which a company (an enterprise) can shift from command-and-control functions to more distributive, collaborative and cooperative functions.***

To be clear, becoming more distributive, collaborative and cooperative does not mean that a company or organization is decentralized. As such, *becoming decentralized* is, indeed, a **process**. So, being **distributive** means that an enterprise has the capacities to manage assets, foster better data visibility, and build data structures with privacy, ownership, and access provisions clearly defined.

Second, it is critical to establish that nothing on the current Internet is truly decentralized.

Examples include:

- The fact that the Internet infrastructure itself is built on top of cables and wires that are owned and controlled by multinational corporations in conjunction with governments.
- W3C protocols - the foundation for the latest version of the Internet's commercial web layer - which are not designed for development beyond command-and-control type functions.
- The IPFS (Interplanetary File System) which does show great promise, but is still ultimately tethered to the many centralized databases running on the current internet. That can change, of course, as more autonomous structures, and cloud replacement solutions like Holochain in particular, proliferate the digital landscape.
- Key encryption protocols - such as the SHA family - which were developed by the NSA and other 'three letter' intelligence agencies (CIA, DIA, DOD, et al.) for the purposes of security as well as backdoor capabilities, which are not only used for surveillance, but for other potentially nefarious means, such as corporate espionage.

Hence, just about anything is hackable with the right people and their relevant competencies to exploit single points of failure.

Third, distributive enterprises are more profitable.

Larger business functions, particularly with respect to supply chains, are shifting dramatically towards what we would call ***'collaborate-and-coordinate'***. The main reason? It is more cost-effective.

- In 2017, McKinsey published this report on importance of collaboration within digital ecosystems. More recently, Deloitte published this report on the digital supply network, followed by another report on the blockchain's effects on global supply chains. What this institutional research reveals, in short, is that supply chain ecosystems are not only sharing resources, but they are forming **new trillion-dollar marketplaces**. Thus, the capabilities of enterprises to collaborate and coordinate resources are prescient and absolutely necessary.

- Deloitte's most recent 2019 Blockchain survey, in which 1,400 senior leaders were interviewed across the Americas, EMEA and AsPac to get a detailed read on the state of Blockchain adoption and Consortium participation, included these highlights:

  - 53% see Blockchain as a 'Top 5' priority (+10% vs. 2018)
  - 86% expect mainstream Blockchain adoption (+2%)
  - 81% plan to replace legacy tech with Blockchain (+12%)
  - Reasons for joining a Consortium: Aligned objectives, quality/stature of members, evidence of influence - implementation challenges now the key 'barrier' (vs. regulation in 2018)

And here is the greater challenge: For 'collaborate-and-coordinate' functions to fully take effect, the technological functions must exist independently of the mainnet (mainstream Internet). Why? Because assets, data, and rights-of-use ultimately cannot be controlled or throttled by third parties, such as banks or ISPs (Internet Service Providers) if supply chains are to scale integratively.

This transitions into how corporations are managing, and will manage, intellectual property differently. In the foreseeable future, supply chain ecosystems will exhibit both closed and open attributes. Apple is a closed ecosystem, meaning that its products are manufactured and distributed in a tightly controlled fashion. Visible is a more open ecosystem.

What we see with more and more enterprises is a combination of both - closed and open attributes. As this happens, the enterprises themselves will become more decentralized not only in their operations, but in how they make decisions, and naturally, in how they build solutions through digital means.

Which brings us around, full circle, to how Holochain's framework enables the transformation of enterprise systems, how those systems can operate more collaboratively, and how they can optimize supply chains through the coordination of better, more advanced decision-making processes.

- Decentralization is a process which leads to more distributive capabilities within operations and supply chains
- Enterprises are shifting from more 'command-and-control' functions to 'collaborate-and-coordinate' functions
- Enterprises that build these types of infrastructure are more profitable

The Holochain + Holo fuel Platform

Together, the Holochain framework, along with the Holochain network, form a decentralized, autonomous network solution that is positioned to help provide the infrastructure for 'the next Internet'.

- **Holochain** is an embedded operating system, as well as open source code ecosystem, that enables developers to build completely distributed and autonomous applications, while users can access applications in a distributed and autonomous manner.
- **Holo** is a system that provides truly decentralized web hosting, managed and distributed through what are known as HoloPorts. HoloPorts can integrate with other hosting systems on the main Internet ('mainnet'), but are actually designed to exist independently from the mainnet, again, as a truly decentralized network. *Holo is also the name of the Holochain parent organization*.
- **Holo fuel** represents the currency to support development and pay-for-compute (server capacity) models on the future mainnet launch of the network.

Making the Old New Again

This core concept of shared distributed infrastructure to prove data integrity is nothing new, and in fact, predates the Bitcoin blockchain by decades. At a high level, Holochain works by simply combining two existing technologies into a more robust and cohesive package:

Distributed Hash Tables (DHT) - This technology was originally developed to allow many unreliable peers to reliably share local data with each other. With the advent of Bitorrent and Napster platforms, the technology became practically useful, at scale, where even if individual nodes went offline during a data transfer other nodes with partial copies of the file could continue to propagate the information across the network.

In an enterprise context, DHTs are immensely powerful as they ensure mission critical data is not lost (e.g. fault tolerant) when hardware issues or malicious attacks destroy individual copies of the data.

Hashchains - Whereas DHTs solve data propagation problems, hashchains are a related technology that solves data integrity. Both DHTs and hashchains rely on an underlying mathematics methodology called “hashing” which creates a unique fingerprint of any data regardless of size. These highly compressed fingerprints prove data integrity in a resource efficient way when they are stored on nearby nodes.

This concept was originally developed in the source control world as a way to validate the integrity of source code checked into the same repository from multiple disparate sources, and is used by millions of users daily on open source development platforms like Github.

Whenever a new application is deployed by a user for the first time, a “Genesis hash” is created, hard-coding the rules of the application into the beginning of the user’s hashchain. As the user makes new entries to their chain such as social network messages, supply chain transactions, etc. they will always refer back to the original Genesis hash to prove they are following the rules set forward by the application.

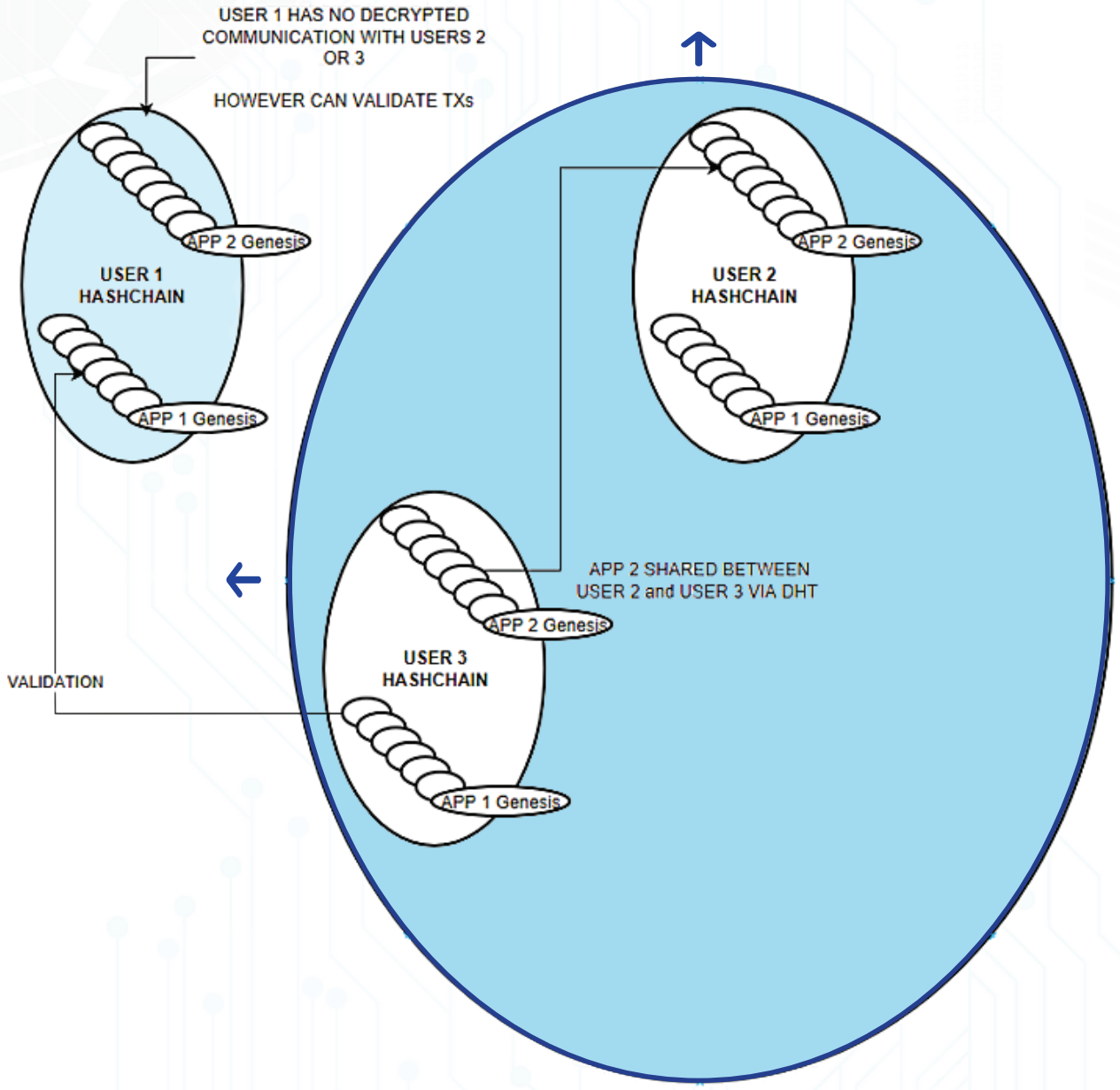
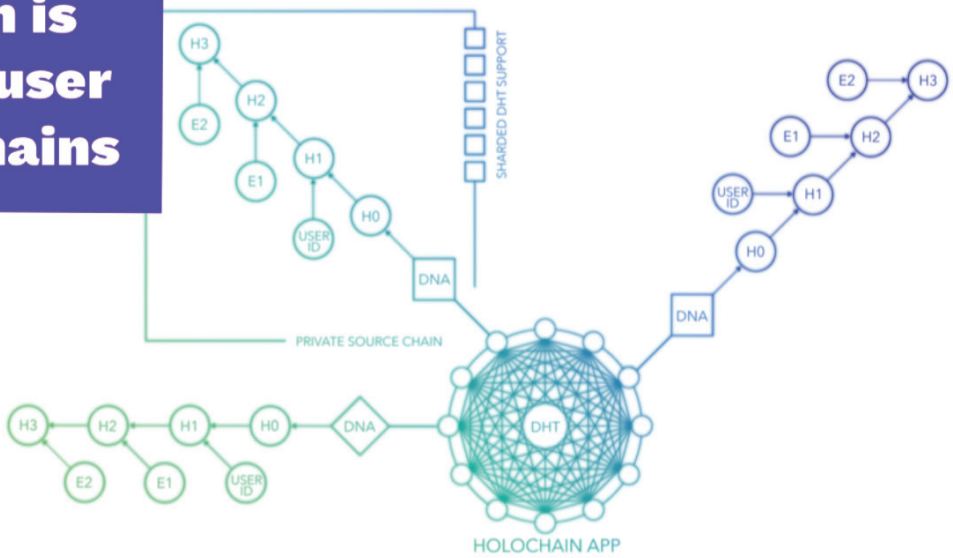


Fig. X: 3 users shown each running 2 Holo apps. User 1 Validates transactions, while User 3 makes without having access to information shared between User 2 and User 3.

Thus, Holo really works by propagating individual hashchains through the network via Distributed Hash Table technology. In other words, each individual agent creates their own data, which is then efficiently processed, validated, and stored redundantly by an optimal number of other nodes on the network.

Holochain is a DHT of user source chains



- ***Processing***: *WebAssembly to efficiently execute bytecode*
- ***Validation:*** *Efficient hashed based validation*
- ***Storage:*** *Optimal redundancy*

Holochain as a Framework

The Holochain framework is a compilation of enterprise grade toolsets that allow anyone to build their own private encrypted networks. Unlike other distributed architectures currently available, **Holochain does not require consensus** to work. This means Holochain can scale (non) linearly with the number of nodes running on the network as only nodes involved in the actual transactions need to update when new changes are pushed to the network.

- Holochain can run as a standalone backend or middleware on almost any infrastructure from your own dedicated servers to full cloud deployments.
- Holochain can also run natively on Holo, an inexpensive community-run network of servers called Holoports.
- You can scale or integrate in whatever capacities you deem necessary for your enterprise from deploying fully into the Holochain cloud to fully inside of your own walled network depending on the needs of the application.

The basic architecture of the Holochain framework is as follows:

1. Your Application
(Written in common languages like Javascript and RUST)

2. Preconfigured SaaS (Software-as-a-Service) layer
(In Holospeak, Zomes and DNA files are published as open source code)

3. Scalable IaaS (Infrastructure-as-a-Service) layer
(Deploying your app to Holochain infrastructure or your own infrastructure)

As we will explore throughout this paper, the implications of solving scalability by foregoing universal consensus establishes the groundwork to fundamentally rewrite how enterprise applications are conceived and deployed on distributed ledger networks.

What makes Holochain's IaaS Different from Cloud 'Blockchain-as-a-Service' Offerings? (BaaS)

Amazon's recent foray into the blockchain space has been led by the introduction of its quasi-blockchain based, cloud services offering, QLDB (Quantum Ledger Database), and more rrecently, its understandably bold claim to offer a BaaS suite of cloud options including private Hyperledger versions, and eventually Ethereum deployments.

While Amazon is potentially the largest incumbent yet to fully enter the BaaS space, other competitors such as Microsoft Azure, Google Cloud, and IBM cloud already offer managed virtual blockchain deployments. In a fitting example of centralized business models colliding, Microsoft Azure began offering managed blockchain service for JP Morgan Chase's internal blockchain payment network in 2019. **With no public validation, an opaque centralized banking ledger is now being run inside of an opaque centralized cloud deployment.**

Ultimately, there is no practical difference between deploying a series of distributed databases on end user laptops and smartphones versus massive centralized server farms from a computation standpoint, other than efficiency gains from economies-of-scale when large amounts of data need to be processed in parallel. However, from a resiliency standpoint, there is a massive difference.

- If all validation nodes are run by the same centralized server farm, what prevents a single point of failure from being attacked?
- Also, doesn't offering a BaaS service potentially cannibalize existing cloud profitability when anyone can spin up a competing node?

The small amount of computation Holochain requires to gossip hashes between nodes can be more than handled by any modern computer, and even runs on something as simple as a Raspberry Pi. So why deploy blockchains whose defining feature is **resiliency** into cloud environments, which are designed to perform large-scale centralized compute processes?

Facebook's recent problems with data privacy and management highlights the importance of data sovereignty and resiliency as it relates to decentralized compute processes. And now, Facebook is allocating $1 billion to develop its own stablecoin (fiat-pegged) cryptocurrency, called GlobalCoin. Perhaps not so ironic, given the contexts we've explored here.

The net-net is this: If people and companies don't have provision over their own data, they don't really have control over their own civic or commercial agency.

Again, it is potentially far more cost-effective for Amazon (used as a stand-in for this section to personify all cloud providers) to offer BaaS as a platform provider, and offer more revenue potential to enterprise customers, whether they currently use AWS services or not. Amazon receives toll payments whenever computing happens on its servers and is agnostic to whether users run centralized SQL servers or more robust distributed databases.

It is important to point out, per the observation that nothing on the current internet is truly decentralized, that Amazon's offerings are not only highly centralized, but they are also not **economically redistributive**. With Amazon's core AWS cloud services, 30%-60% of all profits are taken off the top, depending on the size and type of the business using AWS. Licensing AWS is also exorbitantly priced considering that, particularly for small businesses, this amounts to a huge outgoing cost while a business fights for revenue and vies to keep its margins healthy.

With BaaS, there is somewhat of a false promise: That a 'decentralized' cloud service, in which profits can be 'spread out' among users or business constituents, provides a more equitable, distributive profit structure. It doesn't. Profits are merely redistributed within the 'Amazon funnel' through things like microtransaction fees, and extended licensing fees for things like user seats on a BaaS platform (akin to having seats on a SaaS or 'Software-as-a-Service' platform). In other words, a business using Amazon's BaaS is beholden to Amazon's centralized sales funnel and monolithic revenue structure. Right, wrong or indifferent, this limits what enterprises can do

in terms of the integrative capabilities required to share resources or redistribute them. In other words, a highly centralized system, 'blockchained' or not, limits the autonomy businesses need to integrate and scale on their own terms.

The ultimate irony with Amazon's "blockchain" cloud is by offering decentralized database services on a centralized platform, they continue to benefit from asymmetric information sharing by knowing more in aggregate about all computation performed on the network than any individual user.

With Holo, businesses and organizations have complete autonomy. The IaaS layer is designed to provide this autonomy at the individual user or group level. Each user or group acts as an agent and node from which network rules and network actions are validated, without consensus from the entire network, or even the majority of it; rather, just a few nodes are required to run code and script functions. Thus, transactions and revenue streams are shared and (re)distributed however users or groups see fit, while actually ***using far less computing power***. This is where, using Holochain's IaaS, the 'enterprise rubber meets the road', so to speak.

Now imagine a scenario in which the Holochain IaaS not only provides development and revenue autonomy, but the ability to expand in the creation of new markets, or *micromarkets*. We will explore this further in the use cases section, but it is worth noting that a truly distributive app development infrastructure leads to true decentralization, and thus revenue that can be (re)distributed. A big part of this is removing malicious activity from the network, as well as validating how transactions are actually made.

- IaaS employs an agent-centric model for cloud and operating software functions
- An agent-centric model leverages computing, storage and distribution efficiencies
- The IaaS layer itself optimizes code and scripting functions, making it easy to develop applications (hApps) of any complexity
- IaaS can integrate with any kind of blockchain, DLT or DHT… or replace them outright
- Security and scalability are improved with each software or design iteration

This leads us into the next section where we discuss the differences between Holochain and other blockchain/DLT/DHT networks.

What Makes Holochain different from Bitcoin and Ethereum?

The problem every 'decentralized' network attempts to solve revolves around stopping malicious activity on the network by storing truthful versions of transactions in enough places (which hopefully are not entirely AWS or Google cloud servers). Let's recap how existing decentralized ledgers like Bitcoin work.

1. Alice sends 1 Bitcoin/Ethereum etc. to Bob.
2. This transaction is registered in the monolithic global ledger assuming Alice pays her mining fee.
3. If Alice then tries to send the same 1 Bitcoin to Carol all of the ledgers storing the same version of the truth can see that Alice no longer has the 1 Bitcoin, and thus prevents the transaction from being accepted.

On Holochain, Alice tries to perform the same attack:

1. Alice has 1X (X could be a real estate title, supply chain transaction, or representative US dollar) that she sends to Bob.
2. Immediately after sending her balance to Bob, Alice erases her Alice-to-Bob transaction and replaces it with an Alice-to-Carol transaction attempting to spend the same funds.

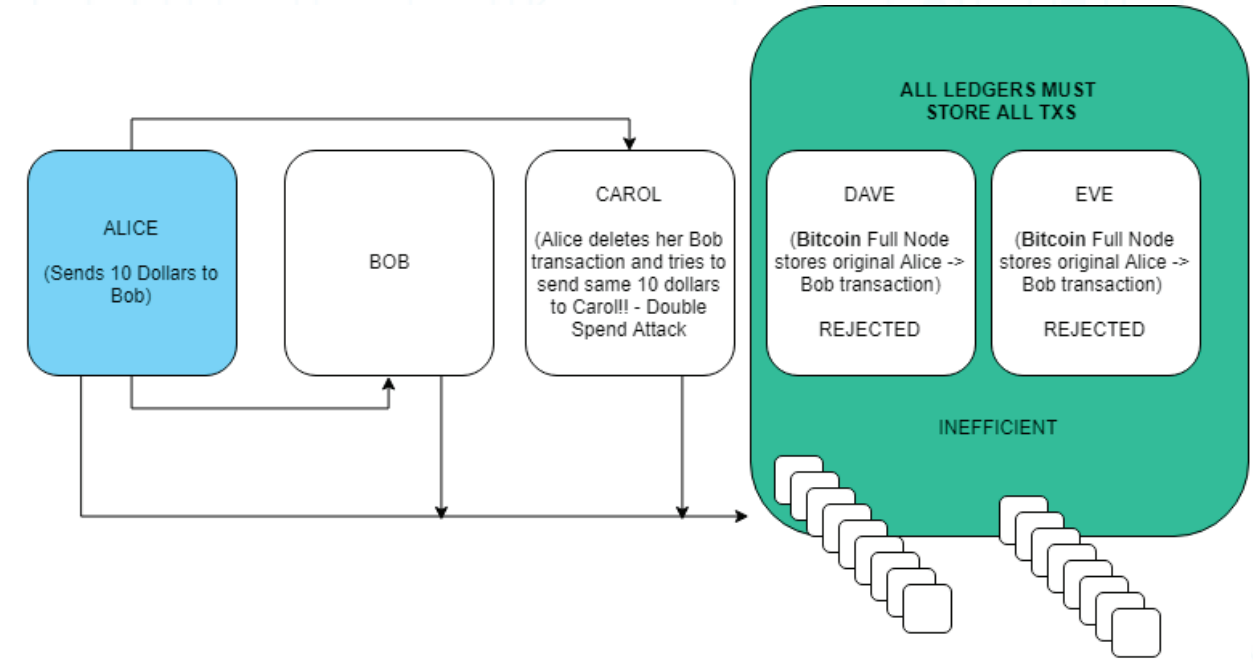
   Unlike Bitcoin, very few nodes need to know Alice's history with Bob to prevent her from double spending to Carol.

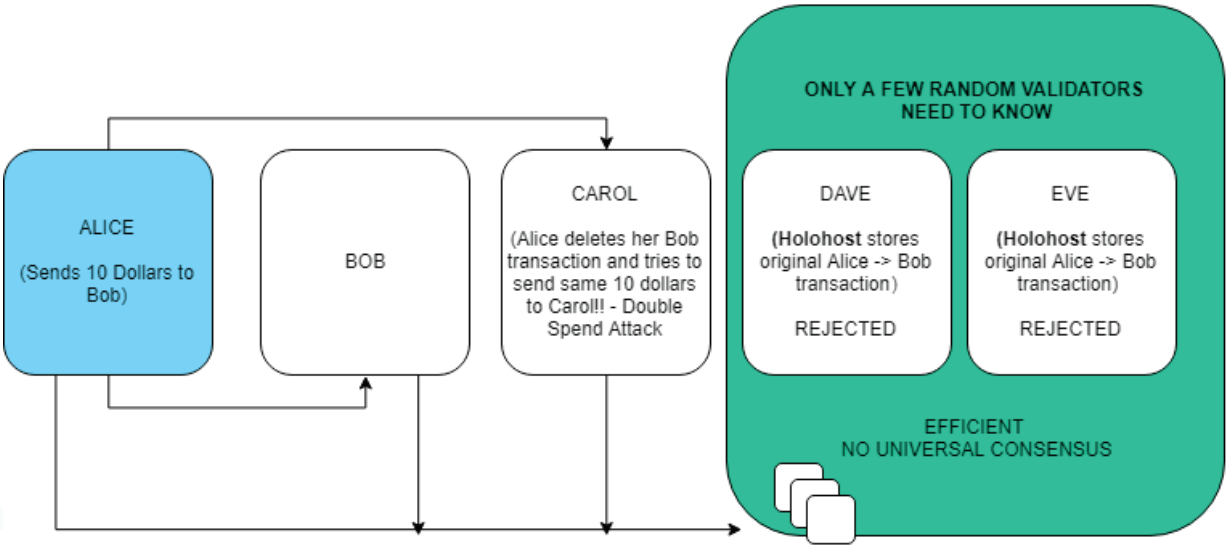
3. Holochain uses what is called a "gossip" protocol to spread news of Alice's first transaction to randomly determine nearby nodes Dave and Eve. When Alice tries to double spend her transaction with Carol, the network checks Dave and Eve's log of transaction history to determine she has already spent the funds.

The key difference between Holochain and other public ledger systems like Ethereum and Bitcoin revolves around only a FEW nodes needing to know about transactions rather than ALL nodes.

- If Dave and Eve are nodes running on a private Holochain network, there are no transaction fees.
- If Dave and Eve are nodes on the public Holochain network, the security public nodes provide by storing a history of Alice's transaction with Bob costs a negligible amount of Holo fuel compared to the security benefits gained by storing the transaction with a truly neutral randomized 3rd party.

The key takeaway when comparing selective consensus systems like Holochain with monolithic universal consensus systems like Bitcoin, Ethereum, and hundreds of similarly patterned projects is to model how each system will behave at scale. By searching for live stress tests of each network under realistic latency, and other node processing constraints such as limited RAM and CPU, you can trust but verify that the network will perform as advertised. Much like the early internet, Bitcoin like systems are flood networks that require ***all*** nodes to update redundant copies of the same ledger, rather than our modern internet which works point-to-point. If sending an email required simultaneously emailing every person on earth to get a message across, we would never be able to leverage the internet at scale.





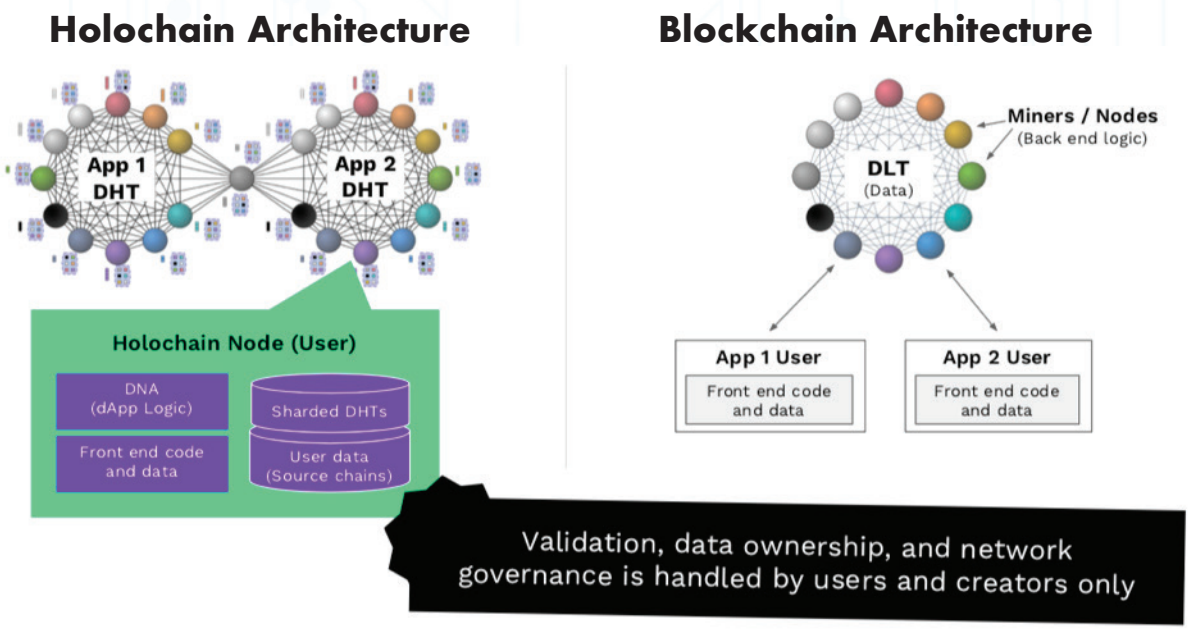
What makes Holochain different from permissioned ledgers like Hyperledger?

Systems like Hyperledger employ Proof-of-Authority type schemes to ensure consensus among a series of validator nodes. This means that all transactions processed on the network must go through selected validators that decide if transactions on the network are valid or not.

For enterprise setups, this type of system makes sense as validator nodes can control access to the network by creating and revoking rights to view the data or make changes to data. However, as networks seek to scale or exhibit more elastic capabilities (expanding or contracting per specific business functions), this can prove to be problematic.

- At scale, just like Bitcoin and Ethereum, this type of system will break down as validators are required to review and store ALL transactions processed on the network. If the private Hyperledger network has 5 nodes, then it is 5 times less efficient than a centralized SQL server. For added security, if 15 nodes serve as validators, the network becomes 15 times less efficient.
- Conversely, Holochain becomes ***more efficient at scale*** as processing capacity increases linearly with the number of nodes on the network. As each node on the network only needs to process a small subset of total transactions on the network, adding more nodes adds more processing capacity.

To sum up the differentiation(s) between holochain and other blockchains: Architecture, validation, data ownership, and network governance are handled by users and creators themselves.



The Distinction between Open Source and Open Community Development

Holochain has been set up as an open source code ecosystem. The Holochain team has advanced its applied uses all over the world within the last few years, setting up hackathons and application (hApp) environments for developers to get acquainted with the ecosystem. The Holochain team has also set up development experiments that include ways to create new social media communications (Junto), more independent ledgering platforms and distributed ecological asset platforms such as organic farming ledgers and renewable energy marketplaces, among many other types of commercial and civic applications.

For Holochain to be adopted in an enterprise context, two questions will immediately come to mind when a CTO, CIO, CPO, CBO or IT department head confronts integrating Holochain into their existing business processes:

- If a web or application layer is built using the open source and thus completely transparent Holochain framework, then what are the implications for say, a healthcare or insurance database system, which has significant privacy, data security and data management requirements?
- Further, how does an enterprise software system which is highly centralized and/or built on legacy code (LAMP, LINUX, .net, .asp, etc.) transition into something more autonomous and more decentralized?

The short answer is that it depends on the context for setting up the system, and its intended uses for data, all of which can be facilitated through a Holochain framework for development.

The reality is that it is less important for legacy-based systems to become decentralized as completely autonomous platforms, right now, than it is for them to become more adaptive and more distributive, such that developers can share in the revenue as a result of their important contributions. In other words, the specific types of permissioning across databases and ledgers or blockchains must account for the value provided by developer networks, or what can be considered **open communities**.

Remember, as well, that monoliths like Amazon are ultimately hamstrung in advancing small business enterprise growth if they can't enable easy integration with other software, cloud and ledgering (blockchain or DLT) systems. The business models behind these companies are, of course, monocultural and self-serving, funneling profits 'to the top', but that is also not the point. If they can't integrate and scale horizontally, they can't sustain revenue in this way, even if the profits of large-scale cloud services at the moment are skyrocketing.

One of the more glaring examples of how this hasn't been accounted for is in the sale of companies like Red Hat, which recently experienced a windfall of $34B in IBM's acquisition of its open source software, with no financial rewards or stock upside issued to the open source developers that actually built the code. The Red Hat example is not an isolated one - there are many other examples in which open source developers have significantly contributed to the value of a private or public technology company. Open source LINUX-based operating systems have fueled the commercial growth of many popular enterprise and consumer side platforms.

Unlike existing open source systems, the developer reward system Holochain provides is a novel step towards a more equitable arrangement.

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Holo fuel as Open Source Monetization + Security Strategy

Holo fuel is the native digital asset of the Holo hosting network. Akin to the way Ether works for Ethereum, Holo fuel is essentially the 'operating currency' by which developers in the network exchange, and incentivize, nodal value. In other words, it's a means to build network value at the pace and integration of Holochain technology development.

More specifically, Holo fuel pays for computation performed on the network by hosts akin to computing in an AWS or Azure environment. For enterprises, computing costs remain stable based on supply and demand economics, whereby more computing demand incentivizes more users to run on Holo hosts (hosting environments), or to run Holochain hApps (applications).

Within the Holochain framework, application developers are free to copy the Holochain source code and deploy it inside of their own private environments. In some specific instances, such as a private notes repository or other limited use cases where sharing is not needed, a purely private implementation makes sense. For all other use cases that demand interoperability, as counterintuitive as it may sound at first blush, the **more data is shared** with the public Holochain network, the **more secure the data becomes**.

A key misconception about distributed ledgers is that all data becomes publicly searchable when deployed to public ledger infrastructure. While true in some limited circumstances like pasting plaintext into a public Ethereum- or Bitcoin-like ledger, enterprise deployments can strictly control what is posted for mass consumption, internal consumption, and all variations of access rights in between.

Referring back to our "Holochain vs Bitcoin and Ethereum" section, it is of critical importance that Dave and Eve (the validation nodes) are truly neutral third parties with no incentives or practical means of modifying their validation data. Inside of a purely private Holochain implementation, it is much more straightforward to compromise validator nodes as there is no way for the private network to communicate with an unbiased node outside of the immediate network.

A key point that can sometimes be misconstrued is that data posted to validator nodes is not the actual data itself, but rather a hashed fingerprint guaranteeing the honesty of the data.

Thus, when enterprises use the public Holochain network, they are both gaining immense security benefits while maintaining complete privacy over who has access to their data. Rather than data being persistent indefinitely, which could raise, for example, GDPR concerns, private enterprise networks have the ability to delete data from their system assuming the logic instantiating the system allows for such behavior. Once deleted, the only remnants of the data are the hashed fingerprints posted to validation nodes which without the base data can ever be decrypted.

By choosing to join the public Holochain network with gossip encrypted proof-of-data integrity rather than a purely private deployment, microtransaction fees are generated which in turn pay for users to run validation nodes, and developers to build better and better open source toolsets.

Incorporating microtransactions into the data validation and execution process ensures the Holochain development fund is continually supported natively by activity on the platform. This virtuous cycle model stands in stark contrast to fallible centralized schemes such as the Red Hat equity model where there was no clear link between the open source contributions of developers and the equity based compensation enjoyed by a small group of internal Red Hat employees and investors.

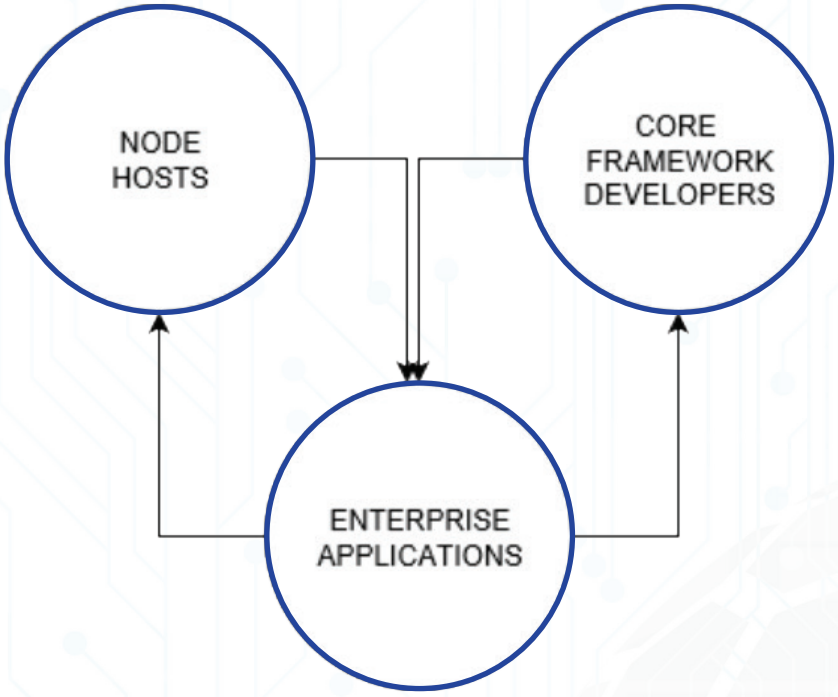


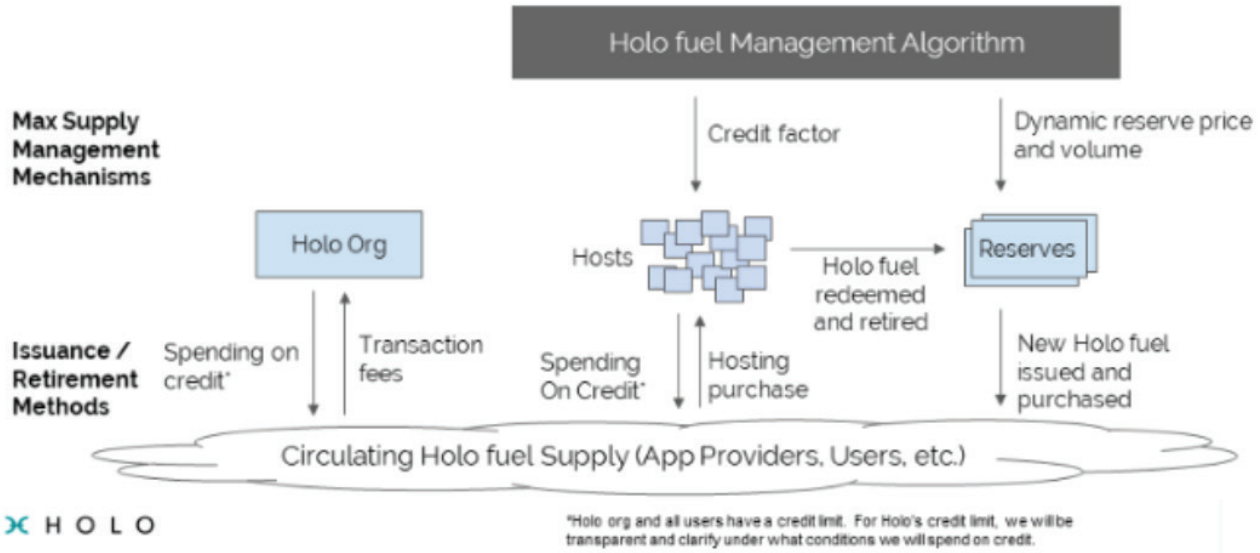
Fig. circulation of Holo fuel through the system.

Over the short term, centralized schemes to concentrate wealth and power can be successful. However, for enterprises thinking in a long-term mindset, deploying onto distributive and regenerative networks offers a more sustainable computing platform, as all participants in the ecosystem benefit from the success of the shared commons.

Compute Costs Explained

Unlike a system such as Bitcoin or Ethereum, supply is not based on a fixed mining reward scheme, but rather, is adaptive based on system demand.

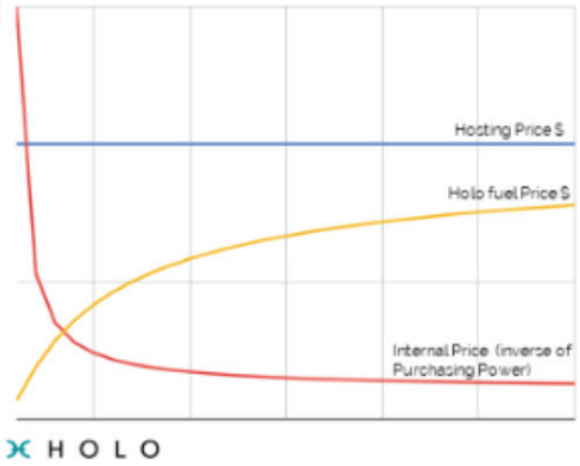
Holo fuel supply issuance, retirement, and management



Important for enterprises, the natural supply/demand dynamic creates a cost stable compute environment where more nodes are incentivized to join the network based on compute demand.

Holo fuel price and internal price interplay

Holo fuel price, internal price and hosting price are all interlinked



Several factors influence how changes in hosting prices impact Holo fuel price and purchasing power

- Competition between hosts increases the purchasing power of Holo fuel
- Supply and velocity of Holo fuel in the system reduces internal price competition
- Reserve price exerts direct influence:
  - As a floor or ceiling price
  - As a price signal to markets

For a full explanation of how compute costs function in the Holo/Holochain development framework see the official Holo fuel documentation.

Scale and Security

Scale: Enterprises demand their IT systems behave consistently at scale, and with known compute costs. When building on centralized cloud infrastructure like AWS or Azure, compute costs are a known quantity. By contrast, public networks like Bitcoin and Ethereum have unknown costs as the price paid in transaction fees to the network varies with real-time demand on the network.

Imagine trying to send dividends in mass amounts to investors, or paychecks to employees with an unknown variable cost. One month it might be pennies per transaction, while the next it could be dollars, as evidenced on the Ethereum network with the rapid rise and fall in popularity of the "CryptoKitties" distributed application. Conversely, the Holochain framework scales linearly with the number of new nodes added to the network in a manner superior to both the Hyperledger-, Ethereum-, and Bitcoin-style redundant universal consensus approaches.

Security: Universal consensus systems work only when there is a winning version of "the truth".

In systems like Bitcoin, this creates a 51% attack risk where a more powerful set of miners can co-opt the network and fill blocks with their version of the truth. This creates critical issues when trying to perform enterprise-grade work such as issuing securities or other assets. Imagine creating an asset-backed real estate token which receives dividend payments when a network split occurs. Now there are two competing versions of the same token representing the same

underlying asset. Which version is the “real” token? Does the deprecated/depreciated token trade at a discount to the original until the matter is resolved in a court system?

In systems like Hyperledger, an even more insidious attack can occur where “the truth” is completely overwritten. In node based systems, a set of super administrated, full nodes store transaction data across all network data. If a high enough percentage of the nodes agree on a new ledger, then data can be modified or deleted.

Conversely, in a Holochain-style approach, independent verification nodes will always store an original copy of the truth unless the application is written in such a manner that nodes are explicitly told to forget previous datasets. The immutability of data is in the hands of each individual agent, rather than being sent to single point-of-failure consensus nodes that can arbitrarily choose to reject transactions, or overwrite history.

How does Holochain work?

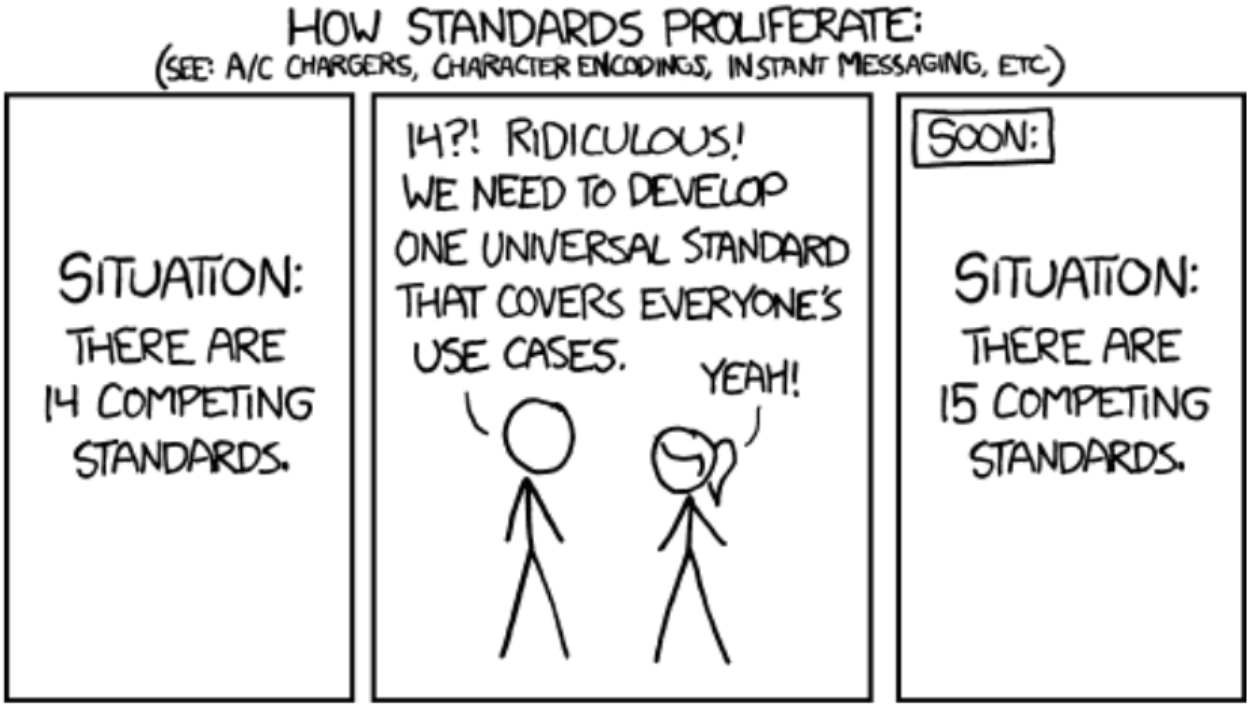
The most straightforward way to view how Holochain works is to focus on each individual Holochain application (hApp) which, individually, has its own unique logic-based rules. Users running a Holochain application store their own transaction history locally (or via a surrogate running a Holochain instance) which other app users then reference when they want to access each other’s data.

As an example, a user running a supply chain application regularly posts data aggregated from a network of local IOT devices. If the user ever went offline, all other users on the network would not be able to access the data, as the only copy has just gone offline. To solve this issue, other nodes on the network create redundant access by also storing some or all of the user’s local data on their own nodes.

Each application can set their own rules for redundancy where mission critical data is stored in more places, while less critical data is stored in less places. This allows the network to scale (non)linearly as more nodes add more processing power to the network.

Microservices as an Emerging Architectural Pattern

Horror stories of ERP implementations gone wrong fill volumes of Harvard Business School case studies, and for good reason. Getting multiple disparate power centers to agree on a shared set of standards is an incredibly complex and difficult process to navigate. Teams of SAP, Oracle, and AWS consultants can spend years struggling to integrate decades of legacy systems into a single-functioning structure.

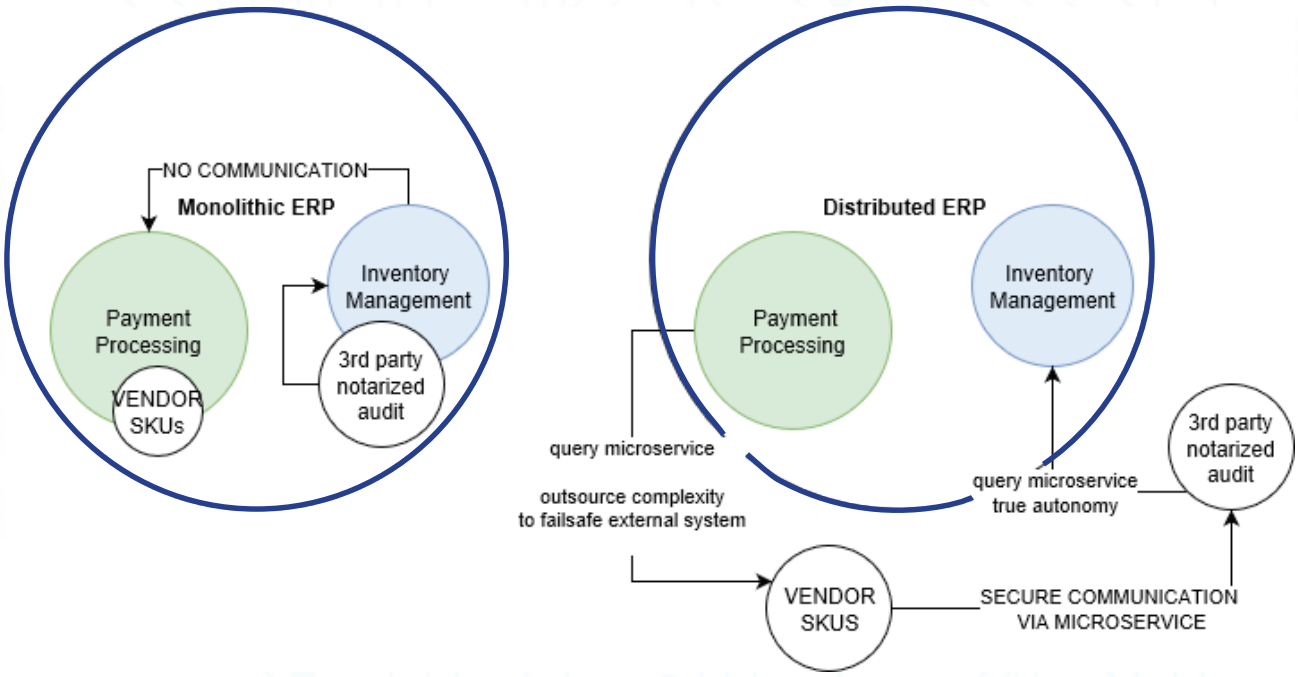


(Link to XKCD comic https://xkcd.com/927/)

The root cause of much of this pain and expense stems from a fundamentally outmoded software development pattern. Small, fast, agile development teams can quickly hack together basic functionality in a matter of hours, yet without a rigorous framework to lean on, their code cannot be trusted to work in all circumstances at scale.

The legend of Microsoft Windows developing at a rate of 10 lines of new code per day is much more nuanced than the glacial pace it seems to move, upon first glance. In high-throughput real production environments, high-assurance development practices such as functional programming and test-driven development become paramount, lest a single rogue code checkin derail the entire development mainline, or worse, introduce subtle backdoor exploits into the code.

The solution is an adaptive **microservices suite** with a small, easy-to-read code footprint that is developed using a rigorous test-driven framework. If all code is strictly typed and cannot compile unless it will execute flawlessly every time and in every conceivable environment, only then can it be trusted to execute critical enterprise functions.



The key with microservices is they can start small and scale as needed. Instead of writing complex monolithic routines that perform many functions, you can instead call a single microservice when simple functionality is needed. Slowly, over time, the microservice can be trusted to do more and more, and eventually integrate with over microservices to form a new enterprise fabric built on simple-to-understand (and debug) encapsulated logic.

This structure provides enterprises with two immense benefits:

1. As mentioned earlier in the open source monetization section, **enterprises can efficiently leverage the open source community to build and improve on microservices**

- As you read this sentence, thousands of updates have just been checked into code repositories like Github. Gaining secure access to a worldwide network of developers is only possible if the code they write can deploy safely and efficiently using a robust framework.
- Fortunately - as we will learn in the next section - system agnostic compilers like WebAssembly allow for code to be written in high-level languages like Javascript and still compile to efficient and secure machine code in any virtual environment.

- With the Holochain framework, microservices can be built, tested, and deployed quickly by non-specialist programmers, yet have the benefits of using a framework with source code vetted by coalitions of experts from leading-edge companies like Google and Microsoft who all contribute to the evolving open source codebases.

2) Pay-as-you-go computing on an even more granular level than traditional SaaS.

- Instead of sinking large CapEx into employing internal development teams, or being beholden to centralized cloud providers like Azure and AWS, simply call a native microservice when needed.
- If the service is small enough, you can deploy onto your own internal systems including something as simple as a desktop service installed on employee's individual machines.
- As the service becomes more useful and throughput increases, more nodes can quickly be brought online locally inside of your own network, or by leveraging cloud services.

Installing the Development Environment

From a development perspective, Holochain can be viewed as ***a code compilation and execution engine*** that allows applications to run securely on a decentralized network of processing servers. Holochain is built using the resource efficient and secure RUST programming language combined with a WebAssembly compiler. As WebAssembly is largely programming language agnostic, this approach opens Holochain application development to a wide variety of developers from diverse programming backgrounds. For Instance, Javascript developers can use Node.js to compile to Webassembly just as easily as writing RUST applications that compile using the same WebAssembly backend.

The basic components to make Holochain work are as follows.

Core Framework: The core development framework features a RUST library for writing zomes (which we will define later as being roughly similar single purpose Javascript modules) as well as APIs with implementations for both RUST and Node.js.

WebAssembly Compiler and RUST Programming language: The Core framework is written predominantly in RUST, though the WebAssembly compilers allows applications to be written in many common languages including Javascript that compile to the same encapsulated runtime environment. The benefits of the RUST + WebAssembly (WASM) technology stack includes a robust lower level execution layer that is designed to run in a resource efficient manner and, more importantly, as system agnostic.

With many corners of the development community from video game developers, to data giants like Google, Amazon, Apple, and Microsoft providing resources to the WebAssembly codebase, choosing WASM as the virtual machine environment for the system ensures Holochain remains future-proof as local and virtual execution environments converge over the coming years.

Within the core framework there are two very important binary files:

- **The command line interface (CLI)**: these tools allow developers to initialize new applications as well as generate zomes (modules), test, package, and run code, as well as generate keys.
- **Conductor:** This toolset allows end users to run Holochain apps through a command line, while GUI-based toolsets are in active development

N3H: This is a series of packaged network tools that allow Holochain instances to communicate over the open internet or through private encrypted networks.

Components

Full documentation for quickly deploying a Holochain development environment that can run, build, and test Holochain applications is available through the link provided in the next section.

Recently, a Nix-shell version of the Holochain environment was released to simplify the process further via a single install solution.

Architecture

Holochain apps consist of front end UI and business logic that interfaces with the underlying Holo network via the Holochain core framework.

- **DNA files:** Applications are packaged into deployable JSON files with the extension .DNA (Multiple .DNA files can be combined together using the Conductor)
- **Zomes:** Single purpose functions that can be called similar to modules in Javascript.
- **Traits:** Naming conventions for the functions inside of each Zome which allow Zomes to be extended.

The goal of the Holochain architecture is to allow developers to focus as much of their energy as possible on the front end logic and UI while leaving the backend heavy-lifting to the framework. By using best practices such as the SOLID philosophy (single responsibility, open for extension, closed for modification, Liskov substitution, interface segregation instead of monolithic design, and dependency on abstractions over concretions) developers can create scalable, reliable, and efficient applications quickly with simple calls to the underlying framework rather than being forced to create backend functionality from scratch.

For full details on how to get started developing with Holochain, follow [this link to the official reference guide](#).

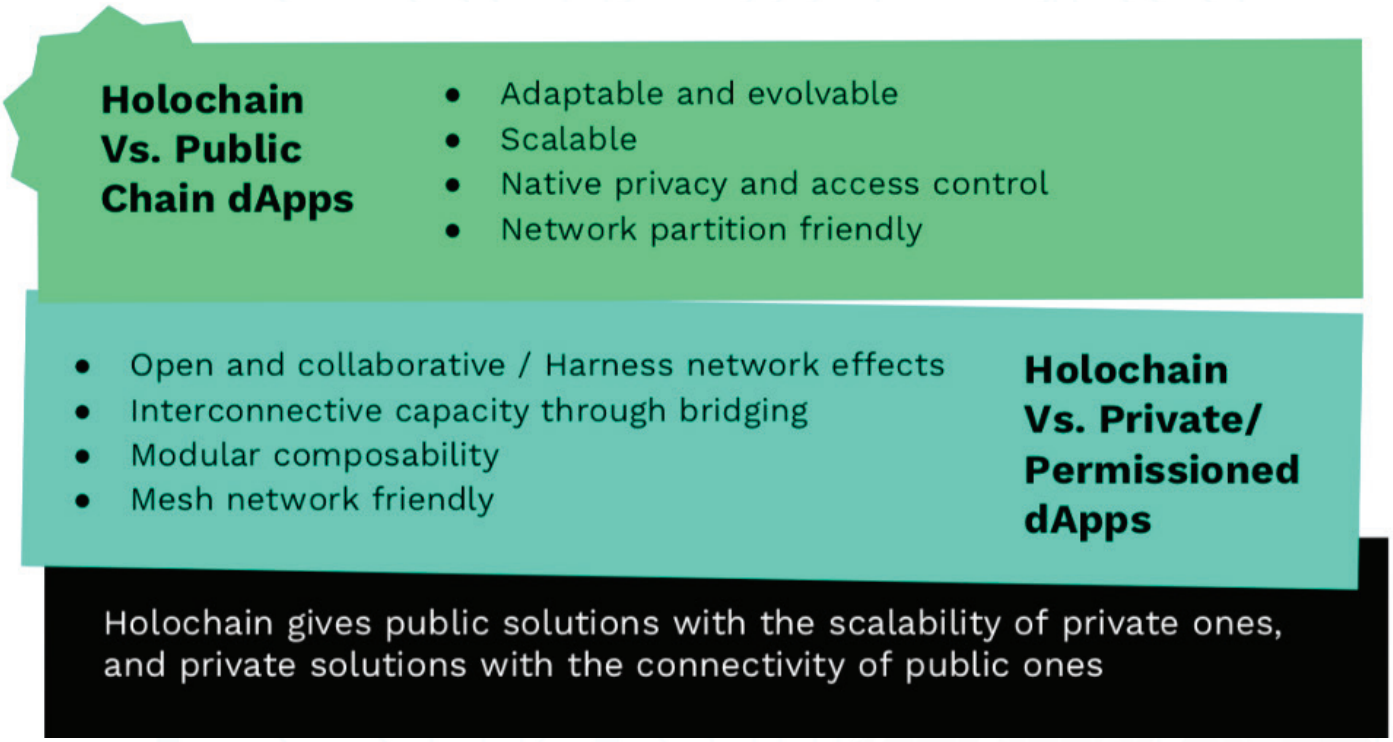
Prewritten Applications

The following are examples of core functionality being developed and released open source that any project can pull from to gain similar functionality in their own private encrypted network.

File Storage: Holochain offers the ability to share storage resources among the nodes in the network in a similar manner to the aforementioned Bit Torrent though with more granular redundancy options to reduce compute cost or increase data security.

Key Management (DPKI): A key management solution to create a user friendly key management solution where users can create and revoke access rights for various accounts and individual machines without worrying about losing their keys. In effect, DPKI allows a master key to control an unlimited number of child keys.

Messaging: The default demonstration application for the Holochain network is a Slack/ Twitter like clone that allows users to send and receive messages directly, via groups with access rights, or publically.

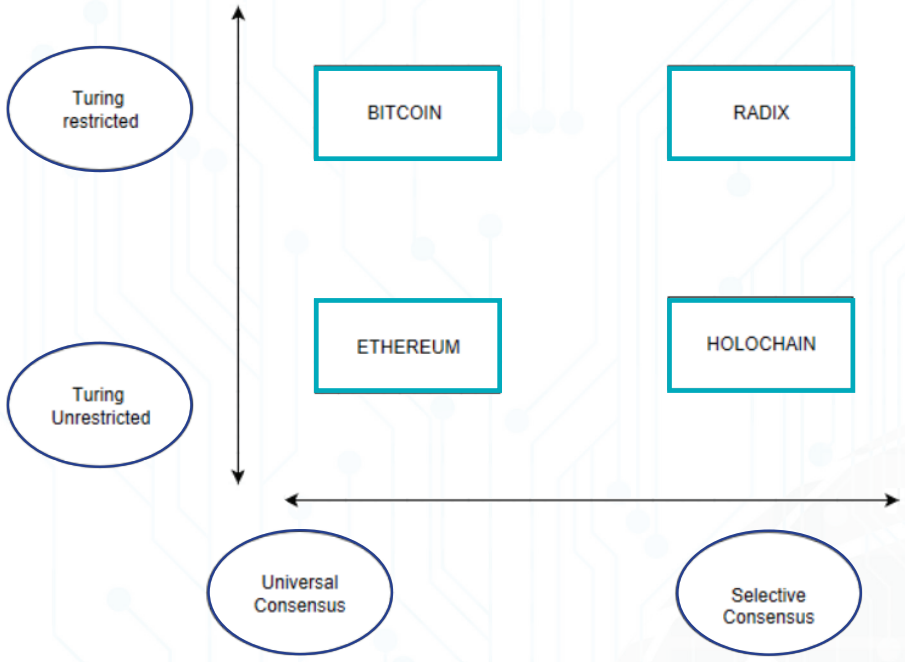


Other Public Networks and Tradeoffs between Turing Restriction and Full Computation

This paper has exclusively focused on the Holochain development framework which seeks to build scalable applications of any complexity via the WebAssembly compiler. The selective consensus architectural pattern is rare in the distributed ledger space, though Holochain is not the only project developing selective consensus distributed computing environments.

Despite thousands of projects launched over the last few years, there are very few other projects in the space taking a similar development path. The overwhelming majority of projects in the space are committed to developing universal consensus which, as we have discussed throughout this litepaper, cannot scale effectively.

- The dominant universal consensus pattern involves attempting to scale by keeping the majority of the network volume off of the universal main chain and onto side chains or off chain transactions.
- The dominant computation pattern has been to allow any arbitrary code to execute to a distributed compiler such as in Ethereum, the dominant “smart contracting” platform that allows any computation to be performed on the network, provided network fees are paid.



Y axis = Security (theoretical)
X axis = Scalability

Holochain falls into the **Selective Consensus + Turing Unrestricted pattern** which makes it a particularly powerful development environment, though one with a larger attack surface. By allowing developers to execute any arbitrarily complex code on the network, there is potential for critical bugs and exploits to affect individual applications, or potentially affect the network as a whole.

By contrast, turing restricted environments found in projects like Cardano, Waves, and Radix do not allow developers to execute arbitrary code on the network. While this can hamper creativity to develop novel complex applications, turing restricted environments do allow developers to call proven APIs that execute code in a safe, reliable manner.

An important goal for framework-level projects should always be to favor building secure toolsets that developers can safely leverage, rather than needing to write difficult lower-level logic themselves.

Take token generation as an example. The ability to quickly create a token with fixed parameters such as initial supply, inflation rate, whitelisting/KYC, etc. should not require ground up development. Instead, developers should be able to leverage off-the-shelf solutions knowing that a core development team has audited and verified that the code which will execute reliably using the smallest computational footprint.

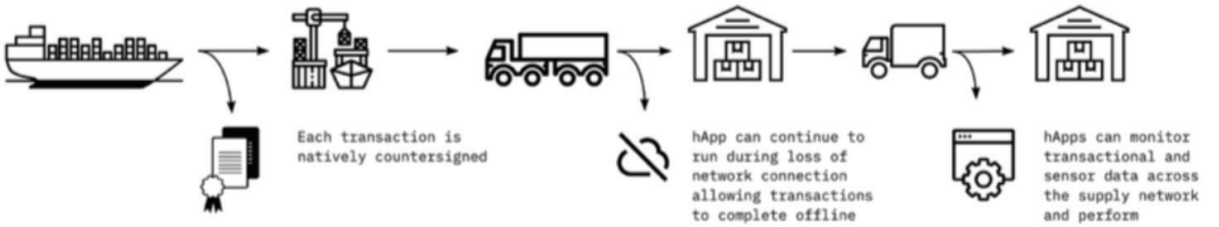
Use Cases

The validation-based, agent-centric architecture Holochain provides is a fantastic alternative, and perhaps the only viable alternative, to consensus-based models found on blockchains and other DLT or DAG platforms. More specifically, when applied to real world scenarios - such as supply chain optimization, energy usage, distributed analytics, disaster relief or refugee identity - this approach can yield very impressive results. Here are seven compelling use cases currently in development, each leveraging a hApp ecosystem of strategists, developers and enterprise partners.

It is important to note that these use cases are not hypothetical - rather, they are being implemented in various iterations through select projects and ventures around the world. Follow-up documentation will be provided as these projects and ventures progress, and as the details/results from these efforts lead to distinct case studies. For now, consider these use cases ample representations of what can be done based on these efforts.

Supply Chain

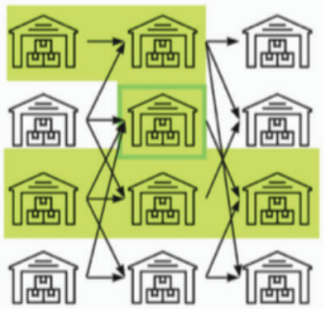
Data visibility is perhaps the most important element in supply chain optimization. Chain of custody, provenance and transactional accountability are all affected by data visibility, which can then avoid counterparty risk and competitive oversight. As we can see here, the logistics subset has huge advantages in merely running hApps between producers, suppliers and value partners.



Each transaction is natively countersigned

hApp can continue to run during loss of network connection allowing transactions to complete offline

hApps can monitor transactional and sensor data across the supply network and perform appropriate response



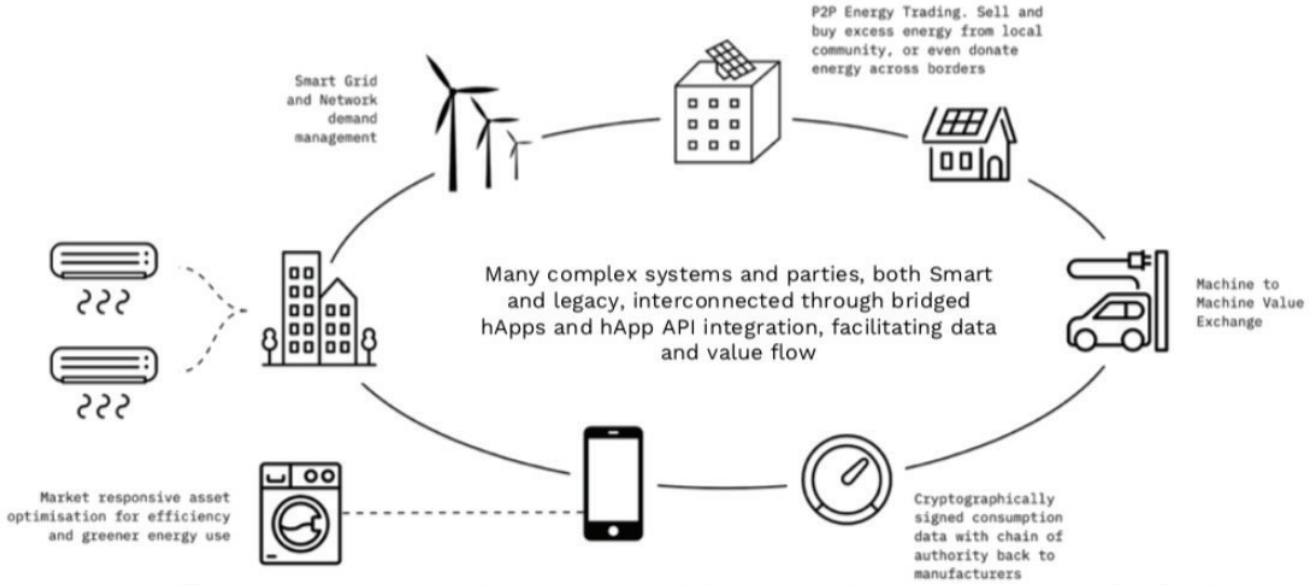
Bridging and Membranes ensures appropriate visibility of data in complex supply chains, and provide the ability to hide data from other parties and competitors.

History of all Agents in the supply chain is maintained across all hApps, building trust in transport conditions, chain of custody and provenance

hApp functions (zomes) can be set as public forming an API for ease of integration to existing systems

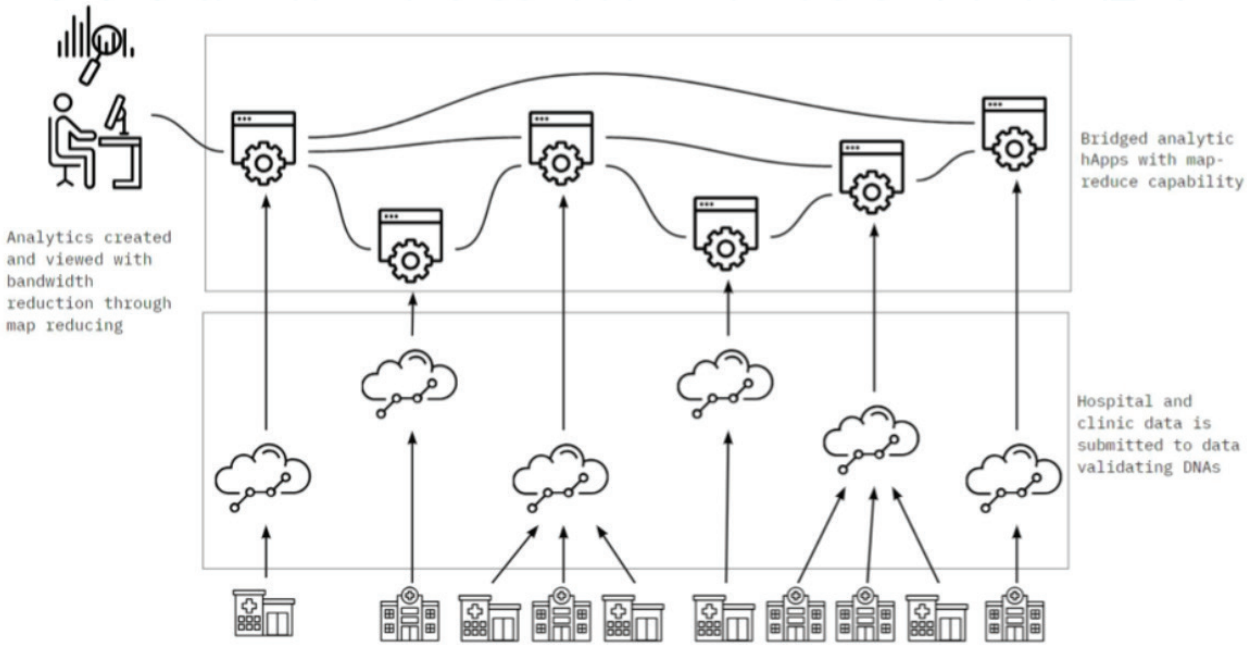
Internet of Energy

Microgrids are fast becoming the new energy models for more and more local communities around the world. From actual production, to redistribution, to trading, true peer-to-peer (P2P) networks are emerging, replacing the top-down, monocultural models driving more traditional energy companies. As throughput costs for renewables are getting incredibly cheap (actually, heading towards a 'net new zero' cost), along with incredibly cheap processing and storage on the technology side (Holochain et al.), the ease, affordability and leverage local communities have in running their own, self-sustaining energy systems is becoming the norm. Watch out for them… They are also becoming the next wave of energy utility companies.



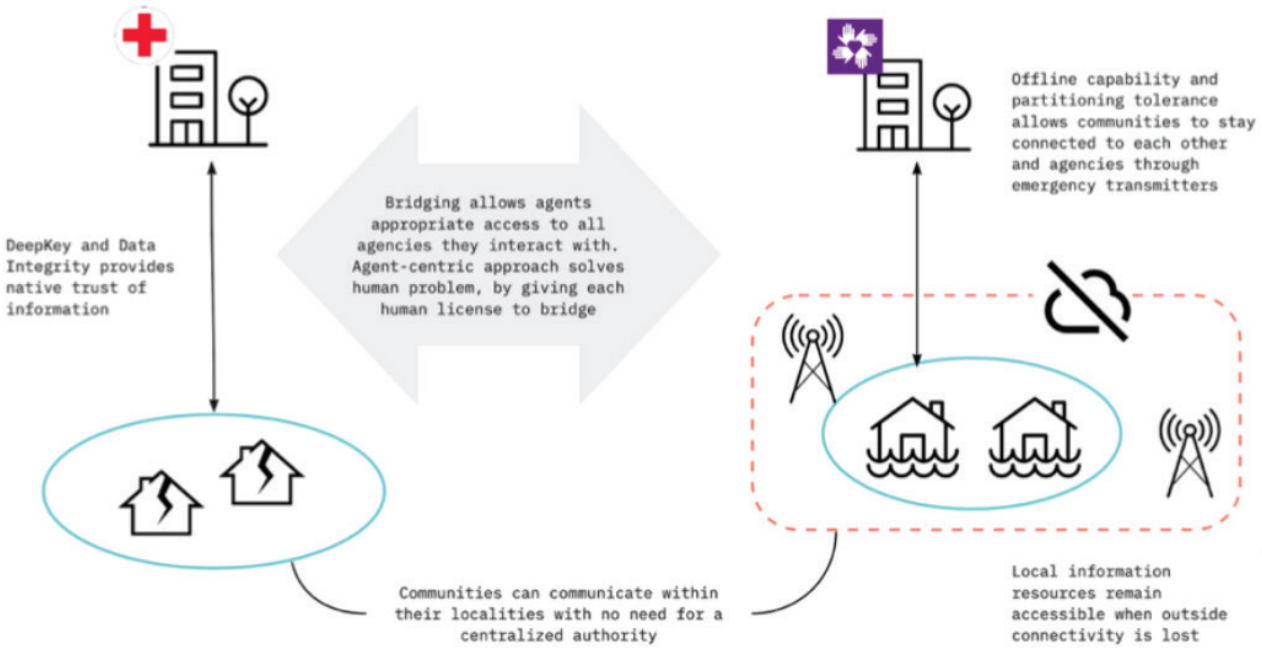
Distributed Analytics

Map reduction, or mapping optimization, is a really big deal in the analytics world. This essentially boils down to presenting data and insight within analytics tables that can constantly adapt to new datasets, while contextualizing the real meaning of those datasets through powerful visuals. In a day and age where there is no shortage of data and huge shortages of understanding around what those data actually mean, bridging analytic map reduced hApps with highly complex validators - such as patient DNA - is a huge step forward in advancing preventative measures for industries like healthcare, which seek economic solutions in addition to solving major enrollment, processing and fulfillment issues.



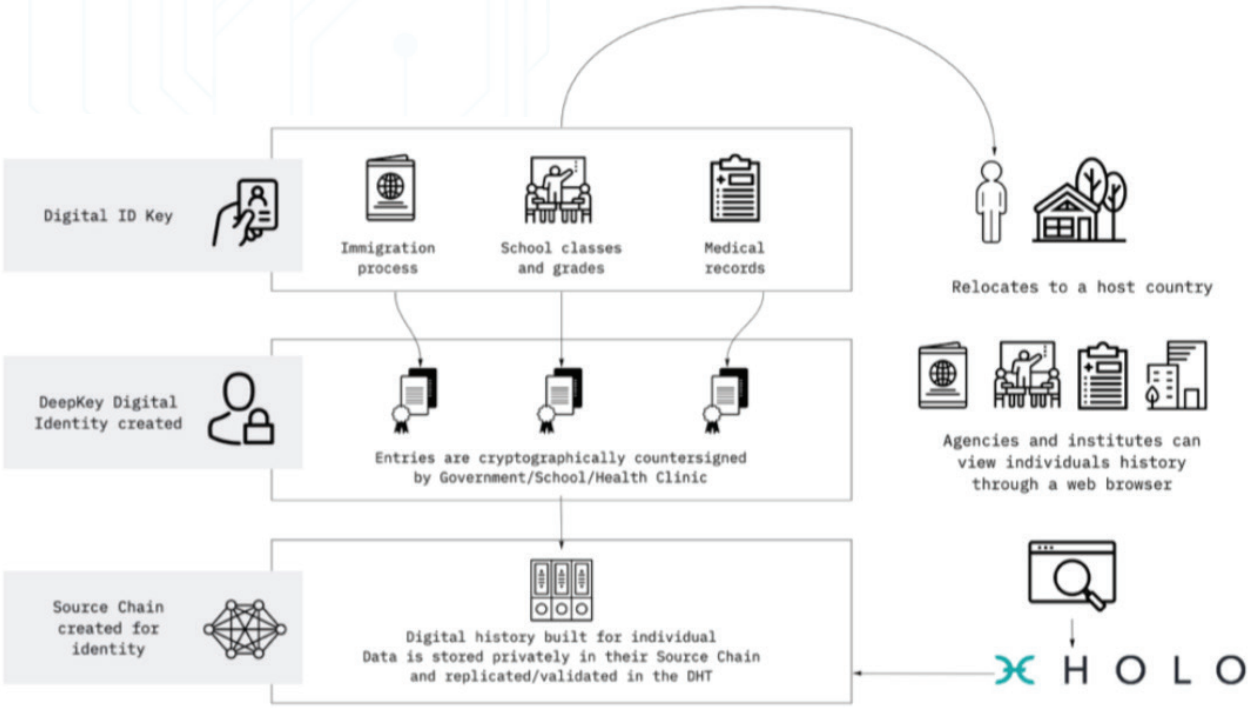
Disaster Relief

Bridging survivors with relief participants and field workers is vital for making critically expedient decisions. In this context, the mechanism of *bridging allows* all appropriate agents to access all the agencies with which they interact; each agent solves his/her own specific problem, while exercising a validated '*license to bridge*', extending that agency network if need be, without time-intensive approval or consensus. As important is the offline capability to partition tolerance such that communities can stay connected to each other even if there are no cloud service or limited WiFi services available in an afflicted region. Removing the need for a centralized authority while enabling rules-based and real-time data supported decisions is the future of disaster relief.



Refugee Identity

This is another huge advancement, especially as we see more refugee migrations occurring as a result of environmental disasters and geopolitical warfare. Here, we see how digital identity evolves through a carefully managed refugee history, along with encrypted agreements between government and private entities. As refugees relocate to host countries, identity verification is reinforced, while protecting against documentation fraud. Digital IDs will not only be critical as more refugees relocate to new host countries, but as they proactively participate in those regional economies.



Municipal Finance Tracking

While cross-border payment systems have become en vogue across both centralized and more decentralized blockchains and various other ledgering platforms (and for good reason), this use case features a situation in which finances are kept contained within a local economy. Elements like construction development fraud, side laundering and multiple accounting schemes are still huge problems plaguing municipalities. This solution focuses on tracking finances and rewarding good actors for their participation in not only protecting the local ecosystem of citizens and government leadership, but in supporting smarter choices that lead to better governance in go-forward capacities.

Distributed Digital Rights Management (DDRM)

Note: *This DDRM use case is an internal project of Next Block Group, using, in part, Holochain resources and source code.*

The DDRM solution functions as a publishing platform (called RAIR) that has been designed to enable content creators of all types the ability to develop, cross-reference and redistribute that content - books, whitepapers, journalistic articles, etc. - while monitoring the flow of distribution across network participants, whether they are casual readers or contributors to said content.

This DDRM platform provides a unique economic model for content redistribution, using the key encryption features to determine a piece of content's real market value, based on variables attributable to supply, demand and reputation-based dynamics. The platform also features unique content analytics, which further reinforce network value without inflating content value, or speculating on demand. We see this as a tremendous alternative to top-down publishing platforms (Amazon) and the limited content creation features of more niche web players (ProPublica).

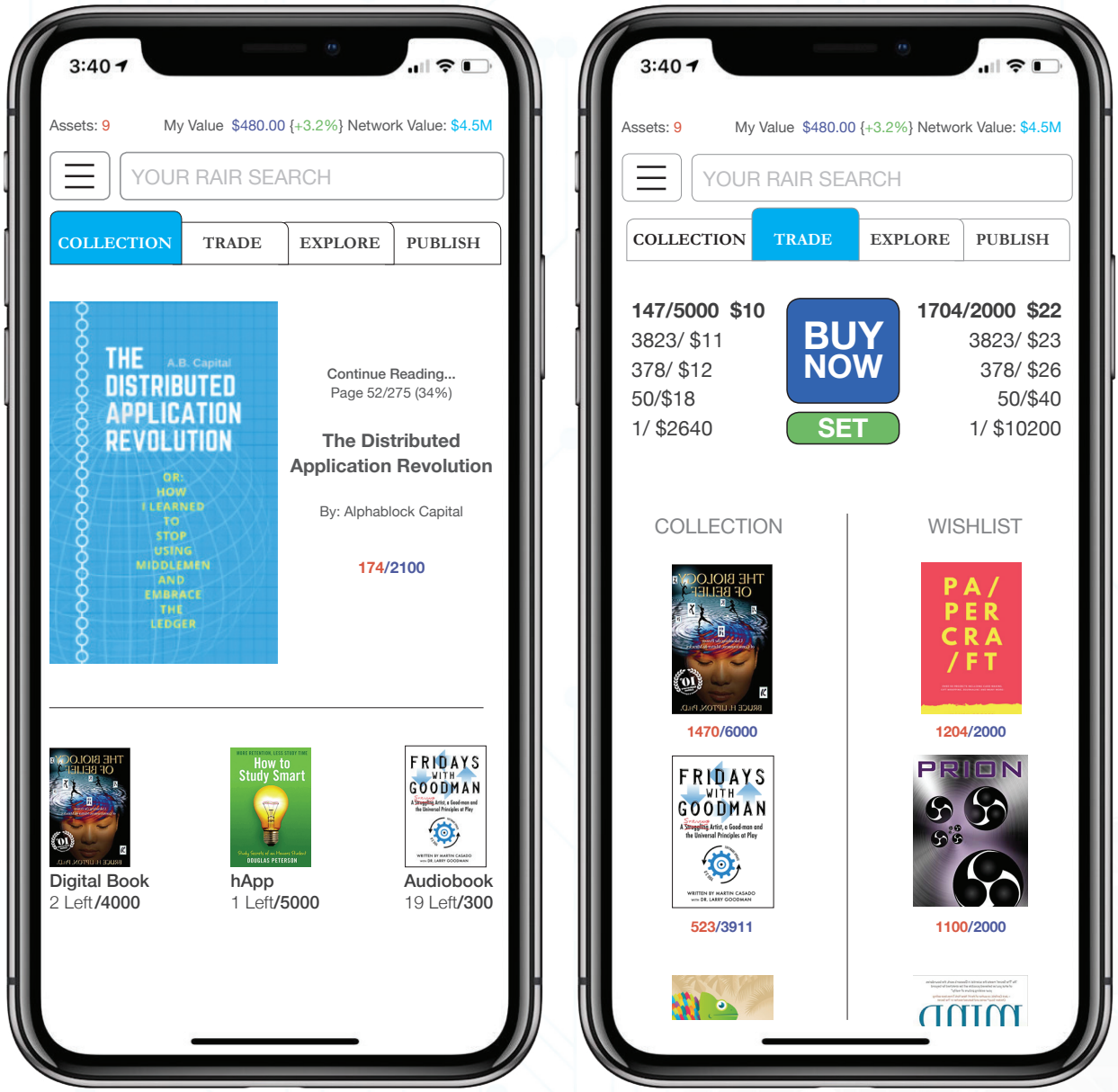
When an author publishes content to the network, the content is stored and validated on their own personal hashchain as well as broadcasted to the network with Genesis rules about how their content functions.

Core functionality in the system includes built-in limits on supply to encourage digital content to behave like real world content with limited run production. Further, the content can be resold (redistributed for a revenue share, dividend or royalty) by the purchaser once the initial run is fully released.

This approach both gamifies and monetarily rewards:

- The **purchaser** by being the only way to resell natively digital content
- Rewards the **original author** with a built in royalty fee on each resale
- The **network** with a small network fee to fund maintenance and upgrades

Below is a preliminary XML mockup of home page (left) trading functionality (right).



Solving Real Social and Ecological Problems as New Markets

The novelty of the Holochain approach, both as a redistributive network and a decentralized platform, is that significant real world problems can be solved with true autonomy. This also bares close examination of how, strategically, companies can approach markets in a completely new way.

The historical method for entering the commercial or civic landscape is commonly known as a '*product-market fit*'. Be it pureplay startups, joint ventures or new lines of enterprise business, the 'product-market fit' has been the litmus for revenue potential and in-market growth. In recent years, the complexities of horizontal supply chain integration along with significant shifts in consumer behavior have made it more and more difficult to build companies on the backs of technologies, as well as products and services, merely seeking to find or create a market. Now it has become more clear that addressing real societal or environmental needs is the best way to actually create a true '*market fit*'.

By **equating a real problem to a real need** we can create a '*market fit*' that satisfies the supply and demand sides of the market, as well as one that manages the associated risks. Holochain as a framework is not about technology merely for technology's sake, but rather a practical means to achieve specific use cases, such as the aforementioned examples, that do, in fact, address real social and ecological needs.

The **strategy to sustain that value** doesn't have to speculate on what people need, as in the example from our distributed energy utility use case. With a tight feedback loop between all participants in the system, the enterprise will gather granular data reflecting actual 'on the ground' behaviors, such as times of use, amounts consumed, and conservation methods.

The **hashchain process incorporates that data relevance**, so that all market actors - producers, innovators, retailers, technology developers and consumers alike - can create a supportive infrastructure for management and redistribution of a particular solution as a valued asset.

This new approach is critical for three primary reasons:

1. **Companies no longer have to make inaccurate or wild assumptions about their target markets, their customers or their cohorts;**
2. **Data sharing and respective insights from customers and partners are far more participatory - ex: the transition from focus groups and market batch analysis to more active survey structures and adaptive, 'on the ground' means to understand a market;**
3. **Brand and product loyalties are directly tied to the real world utilities they provide - things people actually need to live and work better, be it food, water, energy, data, reputation-based identity, or new forms of currency.**

As a framework, this amplifies the relationship between human ingenuity and what technology can provide, particularly in the various forms of data that this new generation of blockchain-oriented platforms provide us.

In other words, if we can see, track and measure the actions of market players securely and transparently, we can make far better supply chain and organizational decisions, thereby cutting costs and creating new revenue opportunities. This is revolutionary, given that corporate half-lives have been reduced from 35 to 18 years, and it is predicted that over 60% of corporations as they exist now will no longer be in business 15 to 20 years down the road. Corporate consolidation via mergers and acquisitions is a deceptive bellwether for the survival of enterprises in this context; as such, it is incumbent upon internal teams and outside partners to do a far better job of anticipating seismic socioeconomic and ecological shifts that can be reflected in the functionality and real world utility of their products. Naturally, microservices can be transformative in this regard.

From a technology development perspective, this also puts enterprises in a potentially favorable light, since they can use their market resources to develop sound strategies, initiate lean or agile development cycles, and piggyback off of preexisting platforms so as to avoid 'reinventing the entire wheel', as it were.

As Next Block Group's own strategic framework points out, we can now move away from the common process of focusing almost exclusively on math and code problems (predominant across blockchain and DLT domains and early stage ventures), and begin to understand how to align business needs with that of the market. As applied uses emerge, enterprise participants can test their assumptions against in-market realities

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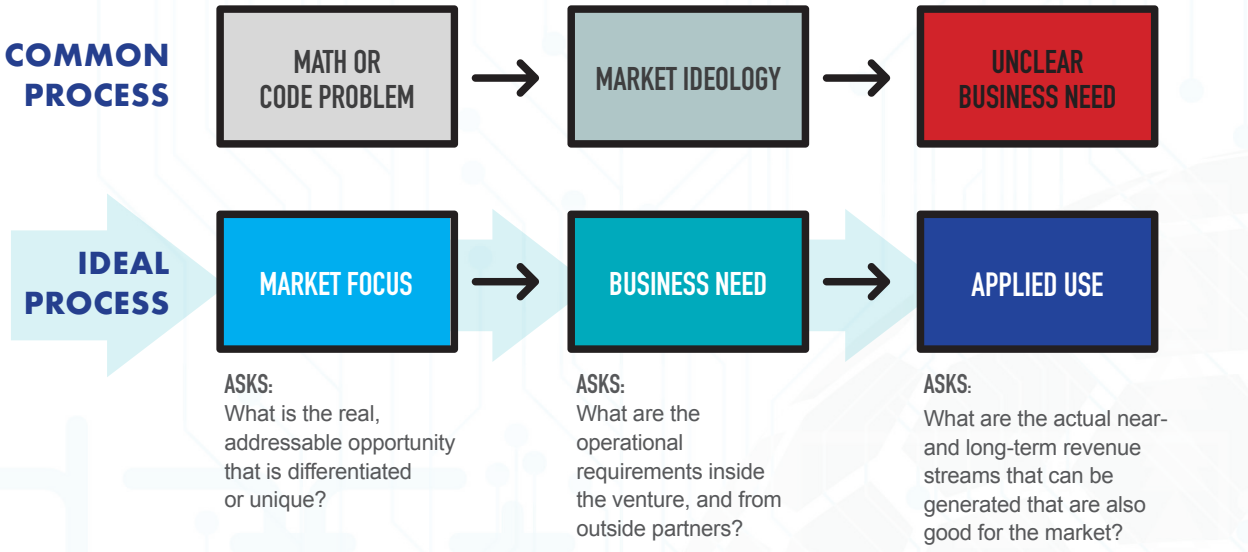
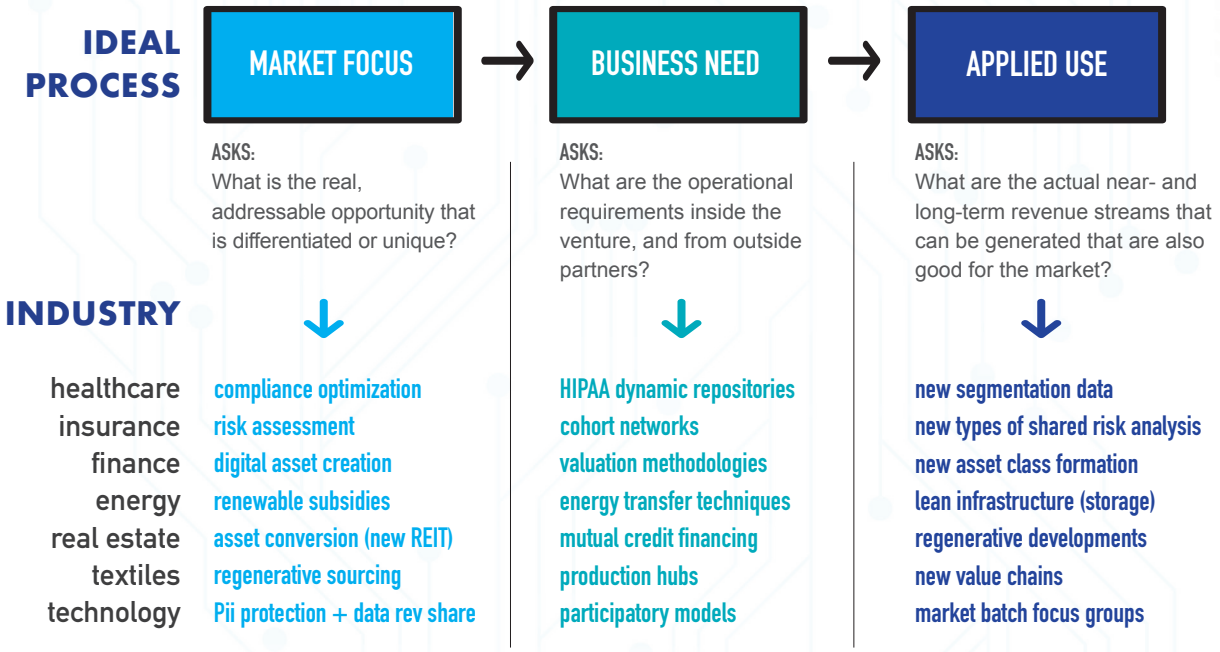
Most important, these applied uses become new markets, or micromarkets, from which more innovations and revenues emerge.



Related to seven high-profile industries, we can see how this framework, along with the Holochain hApp approach, moves enterprises quickly into market focus by identifying very specific applied uses as solution sets.

PROTOCOL CONFIGURATION FRAMEWORK



This is just a representative sample for the purposes of providing enterprise application context; nearly every known industry is exploring uses of blockchain and DLT infrastructure to optimize business practices.

The '*uberization*' of the technology landscape has made it such that derivative startup and joint-venture ideas abound; even worse, they tend to overlook critical needs of society and of the planet. Yet, these needs address how people can access better healthcare, how they can access alternative forms of energy, how they can be protected from or during climate shifts, how they can attain affordable housing, how they can source cheaper more durable materials for their small businesses, or how they can achieve more autonomy over their own mobile devices. The reality is that despite the size and footprint of many well-financed companies like Uber, providing casual utilities such as driving service apps is a replaceable business. Meanwhile, *real world utilities are in constant need and require consistent upgrades*.

Having a light and adaptable infrastructure to constantly service those needs is becoming the hallmark of a great enterprise.

- Enterprises that identify real world needs have access to real markets
- New strategic frameworking sustains market partnerships, customer loyalty and revenue
- Strategy + adaptive development (hApps) enables enterprises to test core assumptions against market realities, turning insights into profit with real social & environmental impact

In Open Conclusion

All parties from developers, to end users, to enterprises themselves stand to benefit immensely with the transition away from monolithic centralized systems, to an ecosystem of interconnected microservices. We can take a page from nature and realize that diversity outperforms monoculture over the long term in complex adaptive systems. Economies of scale break down when the same scale inevitably increases the attack surface. As a useful analogy: *If a single pest is all it takes to destroy square miles of genetically identical crops, the same is true of a single monolithic ERP system that can take down entire companies with a single critical bug*.

The Holochain paradigm, by contrast, mimics nature and is naturally resilient. Each microservice employed acts as its own simple agent that can quickly be deployed into a meshed framework of other microservices. Rather than an individual enterprise needing to maintain the entire system, each microservice is maintained by a group of outside independent experts in a manner similar to Apache today, except with real monetization returning to developers through microtransactions. Microservices offer the ability to execute higher level logic such as a notary microservice, combined with a key management microservice and an identity management microservice. While individually each functionality can provide benefits to the enterprise, combined, they can offer completely new business processes run securely on a (re)distributed infrastructure.

While the cryptocurrency space reveals its neophyte characteristics with still fundamentally deficient trading dynamics (coming out of a 'bear market'), and the blockchain space seeks more viable use cases particularly across the enterprise, the authors of this Litepaper see that critical technology and product infrastructure is proliferating at breakneck pace, making way for entirely new commercial and civic opportunities.

With the imminent collapse of soverign debt in many countries, financial markets and legacy corporate systems, these opportunities continue to emerge, and there is no shortage of interest and investment capital flowing in these directions. The critical component here is in understanding how to 'tame the train' hauling down the track - it is incumbent upon all strategic players to not only make sound decisions, but to think about the ecosystemic impacts of those decisions… Impacts to society, the environment and legions of people just trying to survive with more dignity and with more resources in their back pockets. Alas, this is what a Holochain + Next Block Group approach truly represents. Instead of looking at enterprises or institutions as the culprits of endless extraction and merciless profit, we can help turn them into beacons of real change which support the best interests of people and the planet, along with the new skills required to steward this change.

- *A strategic, adaptive + agile system for enterprise product & service development*
- *A mindful ecosystem of developers, strategists & partners/collaborators*
- *Solutions that merge profit making with impact-driven market making*

Launching a Holochain Enterprise Project

1. Identify a real market need or challenge
2. Contextualize that market need or challenge as a new market, or ‘micromarket’
3. Establish the microservices needed to service that new market
4. Prioritize microservice needs to guide development
5. Test all in-market assumptions in small steps, adapt and refine
6. Create a private Holochain implementation for small-scale testing
7. Track results in data bundles that reveal decision-enabling insights
8. Share insights with all stakeholders, gather feedback, restage implementation
9. Seek specific partners to provide validation schema
10. Refine and repeat

About Next Block Group

Next Block Group is the development resource arm of Novena Capital (Gunther Sonnenfeld, Ed Prado, Garrett Minks and Martin Casado), which is an investment advisory firm that provides highly innovative technology integration, product growth and capital strategies for companies looking to seize upon the great promise of blockchain and DLT platforms.

The group is an exceptional blend of seasoned emerging technologists, whole systems designers, award-winning strategists and venture capital/capital markets veterans who see an entirely new world unfolding which focuses on true social and environmental impact investments and private-public efforts. The group works with a small portfolio of companies completely disrupting healthcare, sustainable real estate, regenerative agriculture, as well as next generation Internet infrastructure and decentralized government systems. It counts among its unique, proprietary approaches socioeconomic frameworks such as Smart Ecologies, used to provide whole systems solutions for local land development projects, and a holistic vetting tool called The Block Evaluator, which factors in 'A-Z' organizational components such as leadership and communications styles, as well as nuanced technology audits, all in a comprehensive 100-point evaluation process. Next Block Group also has a suite of proprietary technologies and hApps in development, including the content creation and distributed digital rights management platform, RAIR (featured as the last use case). The group's two upcoming books on the unique global impacts of blockchain and distributed technologies, ***The Distributed Application Revolution*** and ***Emerging Frontiers***, will be published on RAIR, Q4 of 2019 and Q1 of 2020, respectively. The group's **Core Thesis Paper**, recent **Blockchain Industry Outlook Report** and **Exploration of Crypto's Non-Flationary Value** can be accessed **here**.

As Holo's primary enterprise partner, the Next Block Group platform represents an emerging crypto protocol ecosystem of 85+ early stage companies that have raised over $2.3B in operating capital since 2017. These protocols seek critical enterprise partnerships to create exciting new revenue opportunities with maximum socio-ecological impact. Among Next Block Group's past accomplishments are the development of the world's first Bitcoin point-of-sale platform, and the world's first online bond trading platform. Next Block Group is based in Newport Beach, CA and West Palm Beach, FL, and works with a wide range of companies across a truly global, integrated network.

About Holo & Holochain

As an organization, Holo, and its evolutionary development framework, Holochain, represent over two decades of work immersed in the principles of holonic design. Holonic thinking proliferated in the late 60s with Arthur Koestler's seminal book, The Ghost in the Machine, and was later encapsulated in Stuart Kauffman's various explorations on the biological dynamics of *emergence*, which focuses on the concept of a holon as being the hybrid nature of sub-wholes and parts within in vivo systems. Applied to complex adaptive systems - which comprise the world we live in today, a 'superorganism' of interdependencies that exist between economic, sociological and ecological systems - holons ultimately reflect complex, multiagent systems that evolve from simple systems much more rapidly when there are stable intermediate forms present in the evolutionary process.

With Holochain, those intermediate forms are the technological applications of a next-generation web layer - a decentralized, autonomous and self-replicating network of human, agent-centric nodes that mimic biological systems and enhance biospheric processes. As nodes are the critical catalyst for any technological system to scale emergently rather than in a predetermined manner, they also are the key to replacing the legacy operating systems that inhibit the current web, and the current economy, from becoming what it should be: *A meta platform ecosystem powered by the people, for the people, through autonomous agency and group capacities supported by the very communities it empowers*.

Holochain was borne from two fundamental elements endemic to all healthy ecosystems: One, a relationship to currency that represents authentic exchanges of value, and two, value that is seen as representative of flows within the entirety of an ecosystem. One only needs to observe the mechanics and business models of an Apple or an Amazon to see that they are not only closed product ecosystems, but that they do not empower economic opportunity for a longer-tail of people and cohorts. As such, Holochain was originally conceived as a unique operating system with a nodal architecture called Ceptr, that endeavored to redistribute individual capacities for development, as well as profits for developer participation and community integrations. Borrowing from their groundbreaking work in the metacurrency domain - inspired by the complementary currency design achievements of Bernard Lietaer, co-architect of the Euro - Holochain founders Arthur Brock and Eric Harris-Braun evolved Ceptr's core emergent functions, which gave rise to Holochain, as the need for truly redistributive web microservices began to grow.

Today, Holochain is a global network of autonomous human agents, and through Holochain, spans hundreds of communities and tens of thousands of developers and stakeholders. As a catalyst in solving our biggest social, economic and environmental challenges, Holochain is emerging as a framework for the ages... One that gives people renewed hope and opportunity apart from the command-and-control functions which currently dominate our everyday lives.

For all enterprise inquiries, including potential strategic consulting, technology development and/or investment needs, please contact:

enterprise@nextblockgroup.com

www.nextblockgroup.com