botchain

by talla

The Blockchain Platform for Managing Bots

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Executive Summary

Advances in bot design, Artificial Intelligence, and more expansive use of contextual awareness (through increased adoption of APIs and IoT technologies), will create more powerful and less predictable bots. In addition, thousands of bots will collaborate through millions of transactions. As these bots become more intelligent and make more independent decisions, they will become more difficult to manage. These changes will create new challenges as well as new opportunities.

Humans perform better when managed to improve performance, compliance, knowledge sharing, collaboration, and communication. Similarly, bots will require a platform to audit and nurture these capabilities.

BotChain is a bot registration, identification, audit, and marketplace platform built to utilize the public Ethereum blockchain and focused on businesses. BotChain will provide a platform for business bots to be managed. Bot builders will incorporate BotChain capabilities into their bots so that businesses can utilize the management capabilities. The BotChain platform will provide businesses with bot management capabilities such as audit trails of bot actions (what they did and why), bot identity management, knowledge sharing, and skill sharing.

Bot Definition (aka “Intelligent Agent”)

For purposes of this white paper, a bot is an autonomous agent that can independently make decisions based on inputs (including context) and take independent actions — both proactively and responsively. A bot may communicate with a human or it may communicate with other computer systems.

Background

As software becomes increasingly intelligent due to advances in bot design, Artificial Intelligence, and the more expansive use of contextual awareness (through increased adoption of APIs and IoT technologies), software will evolve to become both more powerful and less predictable due to its increased complexity. And, in addition, we'll have thousands of intelligent agents collaborating with millions of transactions. These changes indicate the need for a bot management platform.

Just as humans require oversight and audits in the workplace to facilitate performance, compliance, knowledge sharing, collaboration, and communication, bots will require a platform to manage these capabilities. Blockchain technology provides the foundation for many independent, trustworthy peer-to-peer platforms. And, Talla's BotChain platform builds upon blockchain technology to provide services for bots that are used within business enterprises.

As software becomes increasingly intelligent… [it] will evolve to become both more powerful and less predictable.

The BotChain system is designed to be a platform to support an array of future services for business bot developers. The BotChain system allows for the identity verification of a bot so that its identity can be authenticated by any other entity it may encounter. The BotChain system also allows a bot to both create and store an audit trail of its actions and "thought process" of what the bot did and why. And, in the future, the BotChain will also allow for additional services, like the sharing of knowledge and skills between intelligent agents. BotChain will serve as the common management infrastructure for the business bot market.

For purposes of this whitepaper, any reference to "Talla" refers to Talla, Inc. or any of its wholly owned subsidiaries that may, in the future, be the entity actively developing the technologies described in this whitepaper and responsible for the management of BotChain and distribution of the BotCoin tokens.

The future of Bots (aka “Intelligent Agents”)

Bot management becomes more difficult as they grow more intelligent and unpredictable. Similar to how groups of independent actors (employees) need oversight to develop trust, communicate, coordinate, and share knowledge.

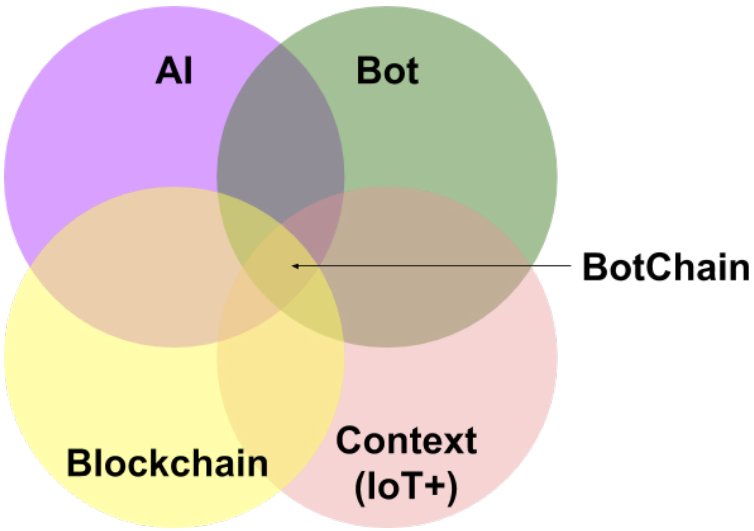
Therefore, we envision an infrastructure to support intelligent agents (bots) that include some characteristics:

- Bots will need to have a trustworthy **identity**
- Bots will need to be able to be **monitored** for performance
- Bot owners will need a trusted **audit trail**
- Bots will need to **communicate**, **collaborate**, and **negotiate** with each other and people
- Bots will need an **index of other bots**
- **Trusted knowledge** will need to be shared between bots
- Trusted **workflows** will need to be shared across many bots
- **Human-in-the-Loop** work will need to happen against data in order to improve the bots on the platform
- **Task completion** will occur between multiple bots

The Blockchain and Technology Convergence

The convergence of technologies around AI, bots, Blockchain, and context (IoT, etc.) will create the need for a common, peer-to-peer, trusted platform to ensure that bots can be managed effectively.

Enter BotChain from Talla, the first blockchain solution specifically designed to host business-driven bot services. The BotChain from Talla allows for discovery, identity verification, audit, trusted communications, collaboration, negotiation, knowledge, and workflows among bots that are facilitating business for companies. Offering these types of services are designed to improve bots by facilitating trust, collaboration, communication, and knowledge sharing. Businesses will appreciate this added layer of business bot management.



Artificial Intelligence (AI): The pattern recognition and prediction capabilities of software will improve over time driven by advancements in Artificial Intelligence related technologies. This will create software that will make sub-second complex decisions based on multiple inputs that will be too fast and too multifaceted for a human to understand in real time.

Bots: Independent software agents (aka “bots” or “intelligent agents”) will utilize AI in order to become more autonomous, leading to more proactive and reactive decision-making within their environment. They will become more probabilistic — taking into account past experience and complex decision making in order to become more autonomous, sometimes leading to unpredictable outcomes.

Blockchain: The decentralized, immutable ledger will allow trusted, immutable transactions to enable services such as discovery, identity verification, audit, communications, collaboration, knowledge sharing among bots.

Context (IoT+): IoT technologies and APIs will expand the array of inputs and outputs available for bots to interact with the world. Additional inputs and outputs, along with the aforementioned advanced decision making will increase their complexity and the need for a management platform.

Why is a blockchain needed for this solution?

The blockchain allows for several capabilities that make it an ideal platform for bots:

1) **Trustworthy Network**: The blockchain can become a trustworthy networked supplier of services among many organizations building and operating bots.
2) **Transactional Guarantee**: A key characteristic of a blockchain technology is the ability to solidify a transaction among one or many parties. Once a transaction is submitted within the blockchain environment, it has a high probability of execution.
3) **Immutability**: Monitoring what a bot did and why can be stored safely by a networked, trustworthy blockchain solution, making it ideal for single bot solutions or workflows involving many bots that may be owned by different entities.
4) **Shared Economic Value**: The work of maintaining a blockchain solution is done by multiple nodes that get paid fees for completing work. This creates an ecosystem that can maintain a fair cost structure for all parties.
5) **Community Involvement**: Companies that create bots also have an incentive to create and maintain a blockchain solution to serve their needs as a community.

Using BotChain

Bot Identity

Just as the Bitcoin blockchain can verify and validate the address of a unique digital asset - a Bitcoin - this technology can be used to store other forms of data. By putting the identity and ownership of a bot on the blockchain, a decentralized identity verification mechanism for bots can be created.

Future Capabilities

After launch, the BotChain leadership team and BotChain ecosystem will consider additional features including:

• **Audit and Legal Trails**: As bots perform more tasks, tracking that they are doing the right things be more important. In particular, the audit industry is poised to significantly benefit from the development of autonomous software designed to read, sort, and meaningfully analyze financial documents as well as relevant trails. These trails could include bot enabled workflows tracing a purchase through natural language processing empowered bots or document analysis powered by bots. For true auditing applications, the tools themselves must be transparent for peer evaluation. BotChain allows humans to create an audit trail of bot activity in order to validate their activities. As bots complete work on behalf of humans, the BotChain would record a permanent snapshot of what the bot did and why. For example, bots that deal with HIPAA data or partake in SOC2 compliance programs would provide a set of records verifying their decisions and actions. The BotChain allows for a blockchain audit trail of bot activity in order to validate these activities.

• **Marketplace For Bot Add-Ons and Code Enforcement**: As artificial intelligence progresses and bots become more complex, there will be opportunities for third parties to release skill and knowledge modules that can upgrade a bot's brain.

Version Available At Launch

The version of BotChain available at launch (aka MVP, "Minimum Viable Product") will be a fundamental platform for bot identity by creating a way to find and validate the identity of other bots. Bot developers will be able to register their bots on the BotChain. Other users and bots will be able to query the BotChain for available bots that exist on the BotChain. Also, bot identities will be able to be validated. In order to access the BotChain for these features, BotCoin will need to be paid to the BotChain platform. These identity services will provide immediate value while building the foundation for future BotChain capabilities.

The Ecosystem Token

BotChain Token

ERC20 Specification

BotCoin will use the ERC20 draft specification as the standard it's token contract will follow.

Ecosystem Payments Utilizing the BotCoin

Developers & Users

BotChain will invite developers of Bots, AI, and other automated services to use the platform.

Validation for Access

Users of the BotChain platform will need to possess some portion of a BotCoin to access the BotChain platform, as well as to deploy bots and interact with them. Users who do not possess any BotCoin will not be able to access the platform. A user may make their bots available to a separate set of end users (such as participants in a chat room), but the user is responsible for any fees in BotCoin charged.

Payment for Services

Users of the BotChain platform will be required to pay fees for services provided by the BotChain platform.

Examples of what the fees will be used for include:

1. **Gas payments**: Payment to the Ethereum network nodes in order to build and maintain new blocks on the Ethereum network
2. **BotNode Payments**: If nodes are implemented, payment to the BotChain platform may be made to pay for work done by nodes on the BotChain platform such as storing and processing data
3. **Marketplace Sellers**: Payment to marketplace sellers that provide access to a service on the BotChain platform
4. **Operational Payments**: Payment to the BotChain administrator (currently Talla) as a fee to pay for maintenance and upgrades to the BotChain platform

Total Token Supply

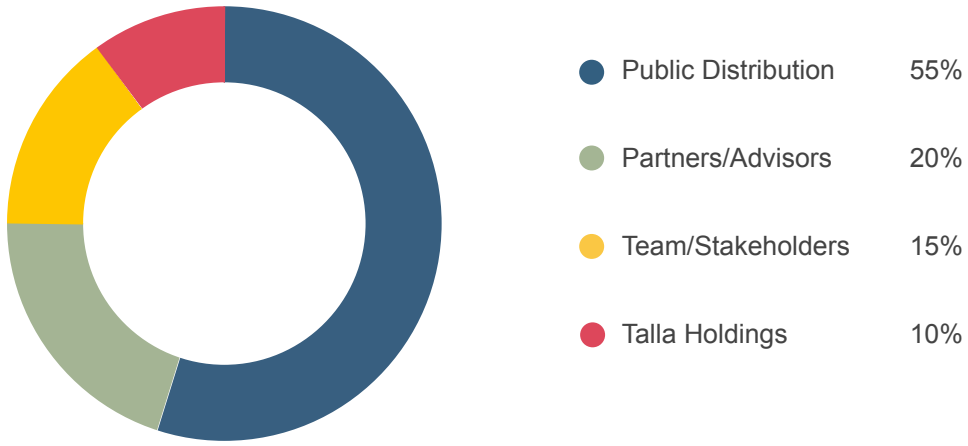
It is currently anticipated that forty million (40,000,000) BotCoin tokens will be generated. All tokens will be created and distributed in a one-time Token Generation Event (TGE). After this, no BotCoin tokens will be minted and any unretained and undistributed tokens will be burned.

The percentage allocations listed herein represent the percentage of all tokens. The burning of undistributed tokens that were allocated for public distribution will change the percentages of remaining tokens. As more tokens are burned, remaining tokens will take up a larger percentage of the overall number of tokens.

Up to 55% (22 million) BotCoins will be available. Tokens available for public distribution and not distributed will be burned. For example, if only 20% of the tokens are distributed, the remaining 35% of tokens that were made available to the public will be burned.

BotChain will retain 45% (18 million) tokens to support development efforts, operations, and compensate advisors, partners, and customers. The 45% of retained tokens will be broken out as follows: 10% will be retained for Talla, 15% held for team and stakeholders, and 20% held for partners and advisors. Talla may change token allocations at its discretion.

Tokens Generated (40 Million)



Any tokens available for public distribution but left undistributed will be burned.

Team

The Talla team has been dedicated to building intelligent, AI-driven bots for the enterprise for two years before deciding to pursue their idea for BotChain. Talla is based in Boston, Massachusetts and has raised over $12 million dollars in venture capital, making it one of the most well-funded startups focused on building A.I. autonomous agents for the enterprise. The leadership team represents decades of experience in software development, Artificial Intelligence, startups, and innovation.

Rob May is the CEO and Co-founder of Talla. He is the author of Inside AI, the most popular AI newsletter online, and an active angel investor in the AI space. Previously, Rob was the CEO and Co-founder of Backupify (acquired by Datto in 2014). Before that, he held engineering, business development, and management positions at various startups. Rob has a B.S. in Electrical Engineering and an MBA from the University of Kentucky.

Byron Galbraith is the Chief Data Scientist and Co-Founder of Talla. Byron has a PhD in Cognitive and Neural Systems from Boston University and a MS in Bioinformatics from Marquette University. His research expertise includes brain-computer interfaces, neuromorphic robotics, and high-performance computing. Byron has held software engineering positions at companies ranging from a multi-national insurance enterprise to a boutique web development consultancy.

Jon Klein is Chief Architect at Talla. Previously he was Director of Engineering at Drync and prior to that, led the Ad Products team at Tapjoy. Jon has worked extensively with research on evolutionary computation and multi-agent systems and has a M.Sc. in Complex Adaptive Systems from Chalmers University.

Catharina Lavers Mallet is the COO at Talla. Previously, she served as the London Studio General Manager at King Digital Entertainment (developer of Candy Crush, and now part of Activision Blizzard), and held leadership roles at Playfish (acquired by Electronic Arts) and Algorithmics (acquired by Fitch Ratings), among others. She has a MBA from MIT Sloan and a BA cum laude from Harvard.

Will Murphy is the VP of Blockchain and Co-Founder at Talla where he was the founding VP of Product. Previously, he was a Principal and corporate entrepreneur within FedEx Innovation, where he led new emerging tech venture development initiatives involving technologies like IoT, big data, AI, blockchain, cleantech, and drones. Will has a B.S. in Economics from Christian Brothers University and a M.S. in Information Systems from the University of Memphis.

Matt Conway is the Blockchain Architect for the Talla BotChain. Previously, he was the founding CTO at Backupify involved in all aspects of its creation and lifecycle. Matt has a B.S. in Computer Science from MIT, originally hails from Kingston, Jamaica, and in his spare time enjoys FPV Racing Drones.

Appendix: The BotChain Platform

In order to support the BotChain ecosystem, improvements will be made to the BotChain technology platform over time as led by the BotChain leadership team, including members of the BotChain ecosystem. Below is a an example of a platform path that the BotChain leadership team may explore. Based on tech changes and future community feedback, it could be implemented in a different way.

To create the shared infrastructure for Intelligent Agents, IOT, and Artificial Intelligence, the BotChain will develop the services on a blockchain solution. This will include services and applications for the support of developers and users, blockchain services and smart contracts to provide bot identity and secure communication channels, and a native token called BotCoin to pay for services leveraged on the BotChain platform.

The BotChain will contain a Service Layer to provide a base level of functionality and shared infrastructure for all users. This will include a number of applications and developer support products that will face the BotChain blockchain services. These services will be initially developed by BotChain, but will be left purposely open to 3rd party developers to develop on the shared infrastructure layer.

While the ultimate goal of the BotChain is a shared blockchain infrastructure layer where all services are completed on a public blockchain, this sort of robust and flexible platform does not yet exist. Recognizing this, BotChain has developed a hybrid public/private blockchain solution that will allow users and developers alike to harness the power of blockchain.

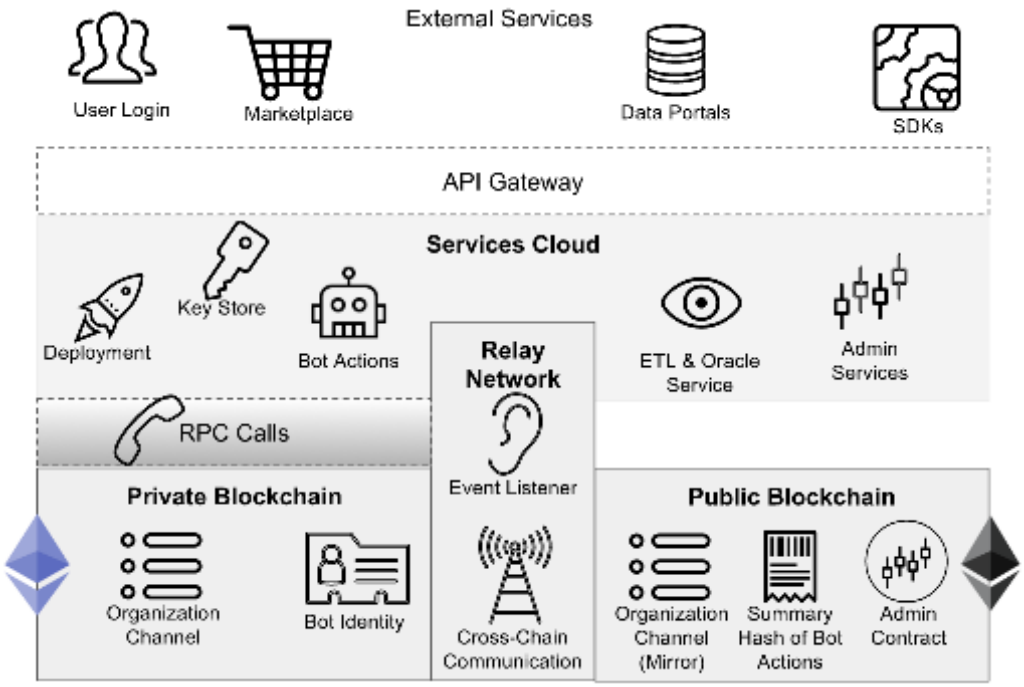
The private blockchain solution will be a federated Ethereum fork, supported by verified developers and other verified agencies. For this service, small amounts of BOT spent for BotChain services is reserved for partners on the private fork. By using an Ethereum fork, we can leverage the same key addresses as the public network, minimizing code changes and keeping the audit log streamlined. Since contracts deployed on the private network will have different addresses, a Bot Name Service (BNS) will be deployed on the private chain to provide a simple link between the public and private chain.

To maximize security, hashes of bot activities and certain actions will be periodically published to the public Ethereum network through a relay network. This will serve as a public hash stamp of all records recorded on the private chain, preventing any alteration of those records. In addition, as the public network evolves, BotChain will continue to develop and move services to the public network.

The BotChain team is also developing a number of blockchain smart contracts to support chatbots and other intelligent agents' use of the blockchain. First to be developed are bot identity and activity summary contracts. The identity contract will allow bots to be quickly deployed to BotChain and easily discovered by other bots. Activity contracts will record each bot action in a provable transaction log, and publish summaries of these actions from the private chain to the public ledger.

The BotChain platform is designed to meet the needs of business bot developers and business users alike. The BotCoin token allows for users to pay for the services of bots instantly over a blockchain network, and incentivizes developers to accept (and develop more applications for) BotCoin as more and more agents are deployed on the network.

High-Level Architecture



External Services
BotChain provides a host of external services that provide easy access to users of all types to the platform. While these are standard to most applications, BotChain will provide robust support to users of its infrastructure.

User Login
User onboarding and login features will provide secure access to the BotChain infrastructure. Users can establish two-factor authentication to provide additional security. Developers may also request API access keys, which will be securely tied to their user accounts.

Marketplace
Developers may list their intelligent agent services in BotChain's marketplace. This creates a multi-developer store for customers to compare and shop for services.

Data Portals
Intelligent agents use varied sources of data to accomplish their tasks, and therefore must have streamlined access to external sources. BotChain provides a simple data portal service to provide access to deployed bots. This makes connecting external data to your chatbots easier than ever before. Simultaneously, by imposing a standard data validation and security controls we can greatly reduce cyber risks.

SDK
As BotChain aims to be the infrastructure for all autonomous and intelligent agents, we are providing a comprehensive software development kit for free. The SDK provides complete documentation, simple recipes, and guidance for making BotChain-compatible bots. Through this, developers completely unfamiliar with distributed ledgers will have their chatbots up and running on the blockchain in a matter of minutes.

Services Cloud

To fully utilize BotChain's blockchain solution, additional services have been developed to support bots. These services are provided to partners seeking to deploy their bots on the BotChain.

Deployment

Bots selected from the marketplace will be configured and deployed from the services cloud. Before each bot is deployed, a variety of actions must be completed: a public and private blockchain address must be assigned, the address is registered to an Organization Channel contract, additional smart contracts may be transacted or be registered against. The BotChain deployment services solution streamlines this activity.

Key Store

Blockchain transactions require a private key to sign and commit transactions. A managed key store and wallet service is provided to allow bots to easily transact on the blockchain solution while minimizing the risk of lost or compromised keys. With these addresses bots can securely record their actions, be identified by users as authenticated, and even pay for secondary services on BotChain. Addresses will be generated using Hierarchically Derived Keys, allowing for the Organization Channel to quickly identify all associated bots.

Bot Actions

BotChain provides a simple bot action interface, where bots can request services and actions from either BotChain or other bots deployed on the network. This service provides a simple query feature for bots to discover other intelligent agents and services. Bots will be able to query the BotChain to discover other bots based on characteristics such as name, capabilities, etc., or those needed to complete a secondary action through the Organization Channel.

ETL & Oracle Service

An extension of the Data Portals, BotChain provides a simple Extract, Transform, and Load service layer. Various data feeds, including bot actions and external data sources, can be transformed through the service. In addition, the hashes of raw and transformed data can be published to the BotChain, creating an immutable record of the changes that occurred to the data.

Once a data portal and ETL layer has been established, the BotChain treats these as an oracle service. Users may choose to publish information to the blockchain with a low-cost publishing service. This will allow BotChain intelligent agents to interact with non-BotChain applications, and will also allow developers more flexibility in how they source and report data.

Admin Services

Each user will have an admin service feature based on their user role. While the admin service layer provides typical user functionality, it also doubles as a user interface for control contracts issued on the blockchain. In a simple GUI, users can view the Organization Channel contract for both private and public blockchains, alter the time between cross-chain and summary hash publishing, deploy more or kill existing bot services, add additional registered users or contracts, etc.

Relay Network

To facilitate communication on the Hybrid Blockchain implemented by BotChain, a cross-chain relay and tools will be developed to ensure the unaltered and easy transaction between chains. This is not a full bridge between networks, but rather a communication channel that seeks to enforce message formats between the private and public Ethereum blockchain implementations.

Event Listeners

Event listeners monitor a smart contract or address for certain transactions and calls an action in return. This can be used for reporting activities across the Hybrid Blockchain, or triggering functions in response to certain activities. BotChain's event listeners will monitor both the public and private chains, allowing for reporting actions across both.

Cross-Chain Communication

Communication between the two blockchains of the Hybrid Blockchain is coordinated through a cross-chain communication channel. This channel enforces that all activities on the private blockchain are recorded via a hash to the public blockchain, including both the individual bot's activities and a snapshot of the entire blockchain.

Hybrid Blockchain

The Ethereum network cannot yet support the high volume of transactions necessary to record all activities a bot performs. To meet these needs, BotChain will implement a hybrid blockchain solution, consisting of a private Ethereum instance with periodic publishing to the public Ethereum. This allows BotChain to transact at the volume necessary with the same signatures and transaction formats as the public network, while maintaining auditable records for a fraction of the transaction cost.

Private Blockchain

The private Ethereum blockchain deployed by BotChain will have no fees for transactions, and will use a federated consensus algorithm. Partners will have the option to be a confirming node. For this service, they will receive a small amount of BotCoin from transactions occurring on the Ethereum public network.

This solution allows BotChain to run a higher number of transactions that would otherwise be infeasible on the public Ethereum network. In addition the private blockchain will be needed in order to create and manage platform specific "bot contracts."

Organization Channel Contract

Organization Channel (OC) contracts aggregate the activities of numerous bots deployed by a user. This consolidates all of a user's bots to a singular contract, while allowing for complex bot activities and smart contracts to run without interference from the platform. The OC contract also allows for BotChain to load balance the activities of bots via blockchain—as each bot records their activities, the BotChain can assign new tasks to underused bots.

Bots will be deployed and registered to an OC contract, locking them to the registered user. This provides immediate tracking of a bot once deployed, while also maintaining an auditable record of the bots activities. Bots report to the OC contract by signing transactions containing the Merkle hash of their information.

Bot Identity

Bots will be assigned a child key of an HD parent key, allowing for bots to be provably associated with an organization and recovered without needlessly complex key stores.

Upon deployment, Bots are immediately registered and authenticated on the BotChain. While the address assigned to the bot provides a simple reference, additional identifying details are recorded. The bot type, deployment manager, user, publisher, and any access credentials necessary to access data feeds are organized into the bots Merkle hash (also called a "root hash"). Through this structure bots can not be easily traced to a single activity or use case unless the user is provided the proper nonce and child leaf node.

This allows the bot to remain pseudonymous on the network but also able to seek out and positively identify other bots once it has been provided the correct information.

Merkle Roots

BotChain encodes bot information on both the public and private network into a Merkle Root. This process is similar for both Bot Identity and Summary Hash functions, though Summary Hash does not require an additional nonce for obfuscation.

This allows the BotChain to commit a verifiable information to the blockchain in a low-cost and highly structured way. By knowing the proper leaf node to review, bots can quickly identify other bots for a task, confirm the activities of another service, or accept trusted input from a previously unknown actor.

Public Blockchain

BotChain will periodically publish information to the public Ethereum blockchain, leveraging the collective security of the network.

Organization Channel Contract Mirror

On the public Ethereum blockchain, an Organization Channel contract will be published at the same time as the deployment of the private Organization Channel contract. Each will have their counterpart's address registered to them in a private variable, creating a known association between these accounts.

Summary Hash of Bot Actions

Summary transactions of bot actions on the private Ethereum network will be collectively hashed and published to the Organization Channel contract on the public Ethereum network. This will create a permanent and unchangeable record of the actions committed on the private chain.

The hash will be structured in a Merkle Tree, with a designated leaf node for the bots actions and another leaf node for a hash of the entire private blockchain. Since these hashes can be verified on the private blockchain, this creates an immutable record of the private blockchain on the public blockchain.