NATURAL LANGUAGE BLOCKCHAIN

FOURTH INDUSTRIAL REVOLUTION PLATFORM LEVERAGING ENTERPRISE PATTERNS AND PRACTICES

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This whitepaper describes a Fourth Industrial Revolution facing concept for platform-based transactions, named Natural Language Blockchain and how this technology would be applied in real-world scenarios. The Natural Language Blockchain is not a future concept whereas the assets and technology stack to implement Natural Language Blockchain already exists in enterprise organizations to immediately develop and deliver solutions.

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INTRODUCTION

A new paradigm Era known as the Fourth Industrial Revolution is enabling transactions between humans, robots and devices. As a result, new platforms such as Internet of Things, Smart Cities, Sharing Economy and Omni-Channel Retailing are emerging as solutions and opportunities for the 21st century. One technology suggested as a mechanism to enabling Fourth Industrial Revolution innovation is the blockchain.

One of the challenges regarding blockchain technology are various entities vying to own the definition of the blockchain to establish marketplace leadership, causing market confusion. It is important to note the technology skill and assets to develop blockchain-based solutions has been available for decades in many enterprise development platforms from Java to C# to SQL. As a result of the existing technology available to create blockchain solutions, many new blockchain-based platforms being touted as innovative and disruptive are actually redundant efforts for enterprise environments with existing capability to create blockchain solutions internally.

In addition to blockchain technology redundancy already available within enterprise IT environments, non-enterprise concepts have been introduced to the blockchain ecosystem. Many of the concepts such as anonymous and decentralization are not based on enterprise architecture best practices but political ideology such as technocracy (“code is law”) and libertarian (“non-fiat currency”) evangelism. Other concepts such as cryptocurrencies were originally introduced to fund blockchain platforms but instead created an environment for unregulated speculative trading instruments, making these blockchain platforms an unattractive option for enterprises dedicated to integrity and compliance.

For enterprise environments as well as technology solution providers, we are proposing a new approach for a blockchain platform built upon proven patterns and practices as a new iteration of distributed computing services. The solution is the use of natural language expressions as the data container of a blockchain distributed ledger. The natural language can be interpreted by humans, artificial intelligence and smart devices. Our proposed name of this blockchain solution approach is the Natural Language Blockchain to develop solutions and new opportunities for the Fourth Industrial Revolution.

DEFINITION AND BACKGROUND

The word “blockchain” in this paper is used as a generic label to describe a bigger platform ecosystem. Technically, the blockchain is just one component of a bigger platform known as a cryptosystem. A cryptosystem is a platform driven by cryptographic patterns and practices as the core component. A blockchain-based cryptosystem is made up of the following components.

Primary Key Infrastructure. This is known as PKI and is mostly used for identity management of public and private keys. Most identity in a cryptosystem platform use a public key as their account identifier and the private key is used to digitally sign or verify they are the actual owner of the public key.

Unconfirmed Ledger. A ledger containing all incoming transactions not yet verified or processed. The ledger is interpreted by entities such as bots validating the ledger before executing against the ledger data or committing to the confirmed blockchain ledger.

Confirmed Blockchain Ledger. A ledger of confirmed transactions employing a hash tree technique loosely based on the 1979 Merkle Tree implementation. A one-way hash is generated from the content within a data ledger. A previous hash is then combined with the hash of the new data ledger entry to create a new hash, establishing a hash tree "chain" of one-way sequential hashing to prevent tampering. If a ledger content was tampered, the blockchain would generate a different hash tree pattern than the original.

Distributed Ledger Technology. A data sync mechanism designed to push the latest changes to a confirmed blockchain ledger to nodes hosting their version of a ledger. To verify a ledger several nodes or hosts maintaining one of the distributed ledgers are validated to ensure no tampering has taken place. By verifying multiple ledgers for the same blockchain, a consensus of trust is established the ledger can be trusted to conduct transactions against.

While blockchain technology is just one component of a cryptosystem platform, the term blockchain is used in a broad generic fashion to describe the platform. In this paper, we will use the term blockchain in the same generic pattern for clarity and common use.

NATURAL LANGUAGE BLOCKCHAIN

A Natural Language Blockchain is a distributed ledger compose of directives agreed upon between two parties and ratified by an interpreter of the directive. The natural language is a phrase understood in plain language by the parties of the directive and can be interpreted by artificial intelligence or a human broker. While other blockchain platforms requires an archaic practice of structured parameterized inputs such as TxIn or TxOut, Natural Language Blockchain only require simple phrases such as *"reserve table #21 for address #8843 at 8pm"* where a bot can interpret the statement to make a dinner reservation at a restaurant on behalf of a customer.

Unlike other blockchain platforms advocating a completely new paradigm, Natural Language Blockchain is an evolutionary progress established upon existing enterprise patterns and practices. Message-orientated middleware (MOM) or message queue service brokers (MSMQ) has been implemented in enterprise environments for decades for scalability and flexibility. Service-orientated architecture (SOA) or XML web services established a structured messaging platform over the Internet to facilitate distributed computing and API-based architecture. Enterprise Service Bus (ESB) combined both message queuing and service-orientated architecture to create a highly scalable broker system. In addition, mobile SMS technology allowed API access to parse simple SMS statements to send payments or subscribe to an SMS notification service.

It is important to understand existing natural language platforms (voice-assistants, chat bots, voice-recognition, SMS commands) provide an abstract user-interface to the customer in the form of natural language where a user-expressed phrase is interpreted by an underlying processing engine. For blockchain technology to rapidly proliferate in the 21st century, the same logic should be applied to provide an abstract level of providing natural language in the form of simple agreements to be interpreted by processing engines such as a bot. Creating blockchain platforms with in-line routines or virtual machines such as Ethereum is not future-facing and will not compete against the light footprint and highly scalable architecture of a Natural Language Blockchain platform.

Enterprise architects should realize at this point blockchain platforms leveraging “on-chain” programming routines such as Ethereum are not future-facing and do not represent the directional path of the Fourth Industrial Revolution. Natural Language Blockchain is based upon the patterns and practices of message queuing, service-orientated architecture and enterprise service bus. The Natural Language Blockchain distributed ledger also leverage enterprise assets such as web server systems and relational database systems. Simple phrases such as *“turn on street lights when sunlight intensity reach 40%”* as a digitally signed directive to a smart city AI engine is the accurate directional path of blockchain technology with natural language processing.

Sender Address	**Receiver Address**	**Bot Address**	**Message**	**Checksum**
ABC123	XYZ123	JIK123	青山誌を購読する	-------xyz
RST123	UJK123	DCS123	# RST123 के लिए निकटतम लॉन्ड्रोमैट खोजें	-------xyz
FM3EDF	RFV123	MMD123	purchase item #775 for in-store pickup	-------xyz

It is also important to note Natural Language Blockchain is multi-lingual by design by leveraging globalized encoding such as UTF-16 character encoding. A Natural Language Blockchain bot developer can process messages in any language creating new entrepreneurial opportunities to create global-ready micro-services with less effort than current globalization and localization techniques.

PROCESS AND WORKFLOW

A natural language blockchain transaction involves the following entities:

Sender. The initiator of a natural language directive, usually the requestor making a request.

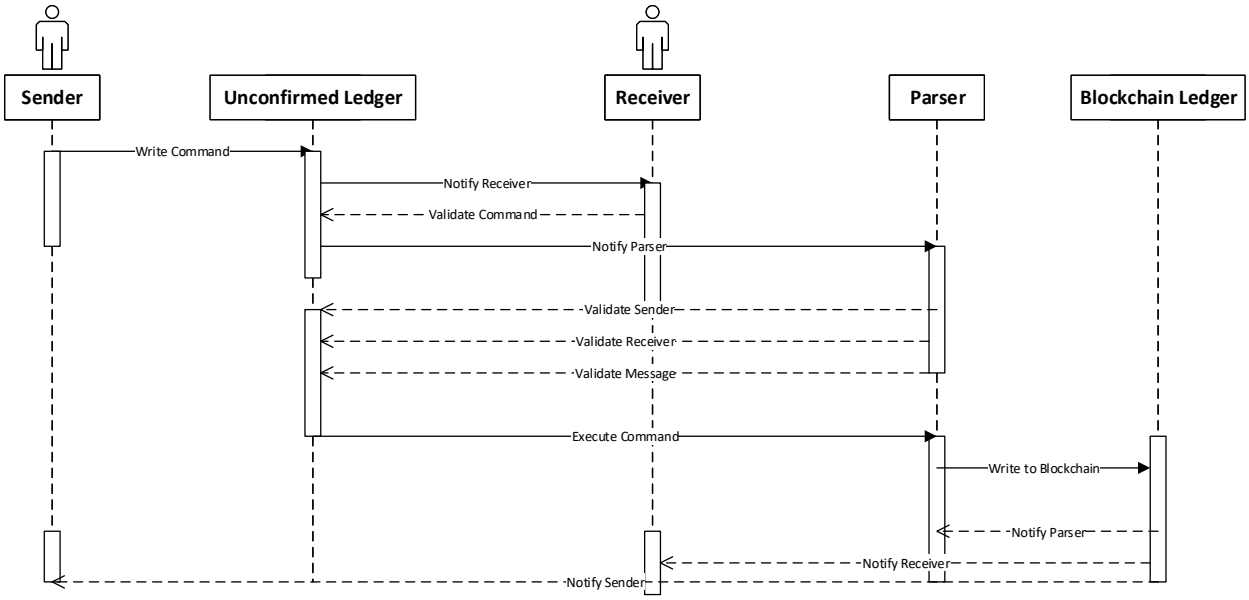
Receiver. The receiving party of the directive, usually the owner of an asset or facilitator of a service.

Parser. The entity validating the directive. Usually a bot interpreting and validating the directive as well as the digital signatures of both sender and receiver.

Unconfirmed Ledger. The temporary or holding ledger containing all initiated and in-process transactions

Blockchain Ledger. The confirmed ledger containing a record of the final output of a transaction and is immutable.

The following diagram illustrate a natural language blockchain transaction:



The steps are as followed:

1. Sender write natural language directive to the unconfirmed ledger, addressing both the receiver and the parser in the initial entry. Sender digitally sign the message with their public/private keys.
2. Receiver discover the message addressed to them and use public/private key to validate message is authentic. If message is valid, receiver digitally sign the message on the unconfirmed ledger to indicate an agreement.
3. Parser finds messages addressed to the parser with digital signatures from both sender/receiver. Parser validate both sender/receiver messages addressed to parser. If both messages are correct. Parser execute the natural language directive.
4. Parser writes to the blockchain ledger a confirmation of the transaction. Sender and receiver is notified the parser carried out the task.

Blockchain Ledger is made available for distribution as a distributed ledger. Distributed ledger owners can sync their ledger with others based on the last entry date and verify the blockchain hash algorithm.

COMPARISON TO OTHER BLOCKCHAIN PLATFORMS

The primary differentiator of Natural Language Blockchain from other blockchain-backbone platforms (Bitcoin, Ethereum, Corda and Hyperledger Fabric) is immediate use and scalability. Natural Language Blockchain is based upon existing messaging and service bus frameworks familiar to enterprise architects who can incorporate into existing and future systems. Enterprise environments can begin developing Natural Language Blockchain solution immediately leveraging their existing technology stack.

There are fundamental differences between Natural Language Blockchain and other blockchain-backbone projects:

Virtual Machine. Corda and Ethereum leverage a virtual machine scheme to process directives. Creating new virtual machines requires retraining developers on a new programming platform. History has demonstrated embedded virtual machines such as Adobe Flash, ActiveX, Java, Silverlight and others have not reached their hyped potential over the years. In addition, new language-based platforms as well as virtual machines are considered a security risk for enterprise environments due to immaturity and isolation versus native platforms.

Finite Ledger with Forking. Bitcoin and Ethereum operate on an infinite ledger going back to the first system entry. Bitcoin and Ethereum networks both implemented a process called "forking" to mitigate major incidents with their distributed ledgers where the "forking" was mandated by a self-appointed central authority. Forking is term borrowed from code-based source control versioning systems also known as "branching" where a new derived version of a code base is created from the original code base.

Underlying Stored Value. Many of the blockchains established cryptocurrency as a unit of transaction to conduct operations against the blockchain network. However, many if not all of the blockchain-based cryptocurrencies are traded in unregulated market exchanges based on speculation instead of a unit of transaction. The negative result of speculative trading of blockchain platform cryptocurrencies created a volatile non-fixed cost of operation and an instable environment for enterprises to effectively operate against cryptocurrency-backed blockchain platforms.

Sector-Focused. Due to virtual machines operating against the blockchain ledger container, many blockchain platforms such as Corda are niched towards a specific sector such as fintech. Most sector-focused blockchain platforms are merely creating redundant solutions already in existence such as cross-border remittance, promoting the concept blockchain can deliver the same solution at a lower cost of operation. The line of thought blockchains can deliver a lower TCO is skeptical with consideration to the cost to retrain developers and retooling a technology stack to accommodate the blockchain VM approach.

Decentralization. The concept of decentralization expressed in many blockchain evangelists is based on political leanings than information architecture patterns and practices. Activities such as forking has proven many blockchain platforms are not decentralized but actually controlled by a centralized self-appointed authority who may not share the enterprise stakeholders' interests. In addition, the entry writing to the confirmed blockchain ledger is a centralized bottleneck in many blockchain platforms claiming to be decentralized.

Consensus. In enterprise environments, having a 50% or greater consensus among distributed nodes is unacceptable – the data must be completely trusted to be valid. Current distributed relational database platforms such as Microsoft SQL Server or Oracle have industry proven, scalable synchronization systems to consider or introduce the primitive concept of "consensus" to an enterprise environment.

Unlike other blockchain-based platforms, Natural Language Blockchain does not host a virtual machine and operates only as a simple encrypted ledger containing natural language directives to be interpreted. The Natural Language Blockchain light footprint provide a high level of abstraction and scalability to give

developers and enterprises flexibility to create solutions as needed. In addition, Natural Language Blockchains focus more on distributed ledger technology without an underlying unit of transaction or cryptocurrency to access the blockchain network. In most Natural Language Blockchain platforms, a per-access billing fee can serve as the revenue model to sustain operations in lieu of a speculative cryptocurrency trading scheme.

Overall, many of the concepts in many existing blockchain-based platforms such as virtual machines and consensus increase security risks and scalability risks for enterprise environments. A natural language blockchain allow owners to focus on transactional activity and open interpretation to quickly focus on developing solutions.

BENEFITS, CHALLENGES, RISKS

Benefits. Business and developers can leverage their existing talent base and technology stack to develop natural language blockchain solutions immediately. Natural Language Blockchain can reside on a powerful RDMS platform and carry a light footprint establishing immediate enterprise-level service.

Challenges. Querying and serialization operations of encrypted datasets from the distributed ledger can be time-consuming causing slower responsiveness than on-premise applications. Natural Language Blockchain bot processing has total responsibility to carry out execution of contract with no oversight.

Risks. Because ledger address identifiers can be viewed by anyone with access to the distributed ledger, external parties can gather “soft” competitive intelligence based on assumptions about competitor activities such as frequency of transactions, time of day trending and additional information.

USE CASES

Unlike other blockchain platforms currently developing proof-of-concept modeling, Natural Language Blockchain can immediate go to critical mass with solutions due to leveraging existing enterprise technology stacks serving as the foundation. Each use case presented will feature the problem, the solution, the parties, the bot service agent role and distributed ledger analysis.

SMART CITY SECTOR: PUBLIC ASSET REPORTING

Urban citizens would like to report issues with public assets in their community to the proper municipal authorities to address. On a Natural Language Blockchain platform, an urban citizen records the address identifier of a public asset (scan a light post QR code) and write the issue on a blockchain using XML structure as the output of a mobile or web form. The public asset will be assigned to a specific municipal bot by category. The bot will scan for incoming requests and notify a municipal contact to sign the request to address the issue as a receiver. Once the municipal contact indicate approval by signing the request as a receiver, the bot will create a service order to address the public asset utility and write to the confirmed blockchain notification of completed service.

RETAILING SECTOR: SHARED MEMBER SERVICES

Small merchants along a High Street shopping district would like to affordably offer “bricks and clicks” mobility services to their customers such as membership check-in, discounts and loyalty points. Merchants can establish a shared distributed blockchain ledger to read and write against and also share

customer address identifiers within the local area. Customers can initiate membership to one retailer and the address identifier is automatically available to other retailers using the same blockchain ledger. A customer can scan a QR code to register as a new loyalty program member or fill out a quick form which is written to the blockchain. A customer can initiate a pickup at store fulfillment option on the blockchain to notify retailer. Delivery orders written to shared ledger can be viewed by a local delivery company to pick up and deliver product to customer. It is important to note an opportunity here – a Natural Language Blockchain bot developer can provide these "bricks and clicks" services to provide shared member loyalty services and omni-channel to local SME retailers around the world as a testament to the scalability and opportunity available.

BUSINESS SECTOR: SMART CORPORATE ENTITY

A smart corporation provide a high level of transparency with shareholders and reduce the need for top-heavy organizations. All activities are written to a blockchain ledger from press release announcements to board of directors meeting notes and transactional activity for distribution among shareholders. Shares can be sold and assigned on a blockchain distributed ledgers to raise money and compliance reporting is automatic based on ledger activity. Shareholders researching distributed ledger can make informed decisions and provide feedback about corporation performance in peer reviews providing an unprecedented level of transparency and confidence as well as loyalty to a corporate brand. New venture for financial service firms includes maintaining distributed ledgers for corporations and managing corporate assets. In addition, banks and other lending institutions can use corporate distributed ledgers as a "black box recorder" to review activities to identify success patterns and practices to implement in future corporate endeavors. It is possible to sell the historical distributed ledger of one corporation to another corporation to study the activities and extract teachable moments and opportunities.

LOGISTICS SECTOR: PACKAGE TRACKING

A subscription box startup would like to sell their subscription box to thousands of subscribers but do not want to risk data breaches compromising personal information risking fines and loss of reputation. A natural language blockchain distributed ledger can facilitate blind shipping and tracking by providing the subscription box firm just the address identifier of the customer. A delivery service managing the customer shipping address via public/private key can view the distributed ledger to pick up packages and deliver on behalf of a customer without the subscription box startup knowing the customer information. A bot developer creates an agent tasked to create service tickets to pickup or dropoff packages and notify parties of distributed ledger events. Customers can track the journey path of their package from the distributed ledger.

SHARING ECONOMY SECTOR: BIKE RENTAL

Bike rental services are very popular in many Asian countries such as China. One implementation of a bike rental service is to allow bike owners share their bike to a bike renter at a bike rack space owned by an independent entity. A natural language blockchain distributed ledger allow a bike renter have an address identifier and scan a bike on the blockchain. A bot determines if the bike is available for rent and process payment. After a transaction has settled, distribution of payment is facilitated by the bot to split the revenue of the rental between the bike owner, the bike space unlocking location and bike space locking location as well as the bot commission. The distributed ledger is shared between all parties to validate the distribution.

MEDIA SECTOR: DIGITAL AD BUYING AND PLACEMENT

Many small to medium enterprises do not have accessibility or the resources to buy and place advertisement space on the scale of larger enterprises with bigger marketing budget. In a local community, there are plenty of advertisement spaces available but also not accessible to major advertisement placement systems. A Natural Language Blockchain distributed ledger can be used to facilitate buying advertisement space between advertisers and the location asset. A buyer can scan available assets for media placement and look at previous history of placements and request for placement. A bot can validate the space is available and log the entry in the distributed ledger. The owner of the digital asset is paid immediately for the space. The bot can validate the advertisement is displayed as expected through IoT or contracting an individual to verify.

IMPLEMENTATION

Our experience developing Natural Language Blockchain solutions in our early trials reveals a relatively short turnaround due to the use of natural language as directives. Microservices such as bots can simply return natural language phrases such as “do not understand” or the bot can explain why a natural language directive cannot be processed. Overall, an application simply talks to a bot using REST APIs passing in natural language expressions as directives.

The steps performed to develop Natural Language Blockchain solutions are (1) define the transaction (2) define the parties (3) establish the bot parameters (4) establish the ledger.

Define the Transaction. What is the exact phrase a sender will describe a receiver will agree to? In addition, what are the parameters. Natural phrases can be “create new member” for a grocery chain bot to register the requesting address identifier as a new member. Parameters can be parsed such as subscribe to gold membership for 6 months.

Define the Parties. Who is the sender and who is the receiver? In most cases, the sender will be the customer and the receiver will be the entity providing the product or service. In some cases, the sender will be the business entity requesting an agreement with the customer to perform a task. In other cases, the sender and receiver can be B2B or P2P.

Establish Bot. A bot should have the following functionalities: ability to encrypt/decrypt with an assigned public/private key, validate digital signatures, execute the task, read and write to the unconfirmed ledger and post to the confirmed blockchain ledger.

Establish Ledger. The ledger will likely follow the same natural language format with little deviation necessary. Ledgers can be horizontal across industries and sectors if localized to a central area or vertical industries or sectors to support access to shared components. An RMDS is good enough for the ledger management. There are two ledgers, an unconfirmed ledger containing messages not validated and confirmed ledger containing the blockchain algorithm to lock in valid and completed messages.

Distribute Ledger. The ledger can be downloaded via HTTP or FTP and also broken into segments using fields such as date (every month) or a sequential number (every 1,000,000 rows). The synchronization task with other distributed ledgers is performed by checking the last date stamp or sequential number and performing from there. Most RDMS systems have synchronization capability to accommodate distributed ledger without additional programming.

CONCLUSIONS

Blockchain technology has the potential to create new opportunities and address challenges as the Fourth Industrial Revolution manifest into reality. However, most of the current blockchain platforms are not truly scalable or enterprise-ready and cluttered with non-enterprise components such as political ideology and speculative trading instruments based on blockchain hype.

Enterprise environments are naturally compelled towards a blockchain solution compatible with their current invested talent pool and technology stack. In addition, enterprise environments want to leverage their patterns and practices to produce future facing solutions in order to remain competitive in a changing landscape. Backward-facing technology such as virtual machines and forking practices utilized in existing blockchain platforms such as Corda and Ethereum are not compatible with Fourth Industrial Revolution concepts such as artificial intelligence and Internet of Things.

The Natural Language Blockchain approach is established upon existing patterns and practices already in place at enterprise environments and can be developed upon existing technology stacks already vested by enterprises looking to create blockchain-based solutions. New market opportunity exists for Natural Language Blockchain bot developers to create agents to perform microservices for vertical and horizontal sector entities. New paradigms of shared distributed ledgers empower SMEs to leverage and offer services to their customer once available only to large enterprises.

The ability to develop services using natural language phrases will open opportunities for businesses and developers to quickly articulate workflows resulting in faster delivery of solutions. The Natural Language Blockchain platform is a compelling approach to begin developing immediately and delivering solutions in the Fourth Industrial Revolution.

ABOUT THE AUTHOR

Edward Dunn is world-respected technologist with over 20 years' experience in the Internet-based and distributed computing platforms. Edward Dunn is a founding member and Chief Strategist of the 3rd Strategic Institute, an organization dedicated to the betterment of urban communities worldwide.