BLOCKCHAIN FOR TRANSPORTATION:
WHERE THE FUTURE STARTS
Blockchain for Transportation: Where The Future Starts

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Introduction

As digital technology reshapes the transportation industry, Blockchain has become one of the top priorities for most organizations. Blockchain is a decentralized distributed technology designed specifically to transform business operations. The concept was introduced in a white paper by Satoshi Nakamoto in October 2008. A year later, the first transaction was executed to transfer assets between two parties. Since then Blockchain has been widely adopted by the financial industry and has slowly entered other sectors, including the supply chain and healthcare. Lately, the film industry has begun exploring the benefits of implementing the technology.

Blockchain could be applied to help address global health issues. For example, large enterprises such as Walmart, Nestle and Unilever have partnered with leading technology companies to reduce food contamination. Remember the e-coli outbreak experienced by Chipotle? While Blockchain might not have been able to prevent the problem, it could be used to more rapidly trace the source(s) of outbreaks. The shared behavior of the Blockchain allows organizations to not only track products within their control but also across vendors participating in the transaction, thus providing a 360-degree view to business stakeholders. The permissioned aspect of the technology would limit the required view to authorized participants. Each of these benefits, together with smart contract capability, make Blockchain attractive to leading businesses. While Blockchain has clearly been embraced by the supply chain community, there are as of yet no open standards to help ensure successful implementation.

This paper focuses on providing suggested practical applications and an overview of implementation guidelines for Blockchain within the transportation marketplace.
What is a Blockchain?

To understand the applications and implementation details of Blockchain, it is necessary to understand its fundamental principles, architecture, types and components.

At its core, Blockchain is a shared digital ledger encompassing a list of connected blocks stored on a decentralized distributed network that is secured through cryptography. Each block contains encrypted information and hashed pointers to a previous block, making it difficult to retroactively alter without modifying the entire chain and the replicas within the peer network. New blocks are validated by peers on the network, providing credibility and preventing malicious activity and policy violations. Cryptography and membership functions provide easy data sharing between parties without privacy breach and tampering of records. All confirmed transactions are timestamped to provide full record provenance. Shown below is an illustration of a Blockchain transaction in a Bitcoin network.

How a blockchain transaction works

1. A and B wish to conduct an ‘interaction’ or ‘transaction’.
2. Cryptographic keys are assigned to the interaction that both A and B hold.
3. The interaction is broadcast as verified by a distribution network.
4. Once validated, a new block is created.
5. This block is added to the chain, creating a permanent ‘golden source’ of interaction.
6. The transaction between A and B is completed.

There is some confusion about how Bitcoin differs from Blockchain. In fact, most people wrongly assume they are the same. Bitcoin implements Blockchain technology to allow anyone with Internet access to read and send transactions using PoS as the consensus mechanism. There are some 900-plus cryptocurrencies within the market with Bitcoin being the most popular and having highest market capitalization. It is also the first cryptocurrency to use a decentralized public ledger—the blockchain. (Cryptocurrency is beyond the scope of this paper.)

Types of Blockchain

There are three main types of Blockchain platforms—public, private and consortium. Organizations use these platforms based on their specific needs. Public Blockchain, the de facto platform for cryptocurrency, is a decentralized framework that allows anyone to add themselves to the network, read transactions, transfer assets and participate in the consensus process using PoS, PoW or other mechanism. Bitcoin and Ethereum are a few popular examples.

Private Blockchain, by contrast, is largely centralized in nature and strictly permissioned, allowing only a pre-approved set of members to read and send transactions and participate in the consensus process. It is often built to manage internal organizational functions, mainly for audit purposes. Reference data management system is a good example of a private Blockchain. Speed and performance are among the leading advantages of private Blockchain. Because it is set up in a controlled environment with a limited set of nodes, transactions are executed much faster. It is important to note, however, that while public Blockchain can require between 2 and 10 minutes to validate transactions, the benefits often outweigh the performance concerns.

Consortium Blockchain is a hybrid of the public and private Blockchain platforms. It leverages the decentralized nature of the public Blockchain and the permissioned capability of the private Blockchain. As with any consortium, the entire network, along with validation rules and policies, is defined and governed by members/nodes. They control every aspect of the Blockchain, including validation of transactions, addition of nodes, managing node privileges, smart contracts, deployment of chain codes, etc.

Because this paper focuses on the transportation landscape, we will explore the applications of private and consortium Blockchain platforms that are most apt for logistics.
Components of Blockchain

To better understand the applications of Blockchain, it is necessary to understand the basic elements:

1. **Membership Services** – Responsible for managing identity, certificates and permission levels
2. **Consensus Manager** – Responsible for validating data and maintaining consistent data across all nodes
3. **Distributed Ledger** – Stores timestamped validated transactions
4. **Smart Contracts** – Executes business logic through chain code

The figure above shows Hyperledger’s architectural design for Blockchain. It encompasses Membership Services, core Blockchain components such as Consensus Manager and Distributed Ledger, and the smart contract services that executes verified chain codes.
Applications of Blockchain

For many organizations, the ability to more effectively track goods across the supply chain is one of the most appealing benefits of Blockchain. Our research shows, however, that there are many more, equally appealing, applications for the technology within the transportation industry.
**Freight Tracking**

Tracking in-transit freight isn’t new; organizations have been using GPS technology to track freight-hauling assets for multiple decades. Historically, location updates were provided by check calls and the use of fax machines. Later, they were replaced with automated systems such as EDIs and APIs. Yet, as the industry faces ever-rising customer expectations and retailers increasingly promise same-day or even one-hour delivery services, traditional methodologies won’t scale. We feel the next wave of innovation will come through Blockchain, which not only addresses the newer requirements but also existing authenticity issues.

Organizations seek updated information so they can make proactive decisions and share data so other users/systems can do the same. Hence, the authenticity of the data is pivotal for decision making. As data passes through various systems, there are chances for it to be misinterpreted, altered or tampered with or without the owner’s knowledge or consent. This causes turmoil in a global supply chain. Blockchain, through which the entire network contributes to data validation, brings trust to the entire eco-system. In addition, because data is stored in a decentralized manner, the integration of data is simplified—all systems connect to a single node to access trusted data.

### ADVANTAGES

1. Single trusted source  
2. Simplifies integration  
3. Shared data
Carrier Onboarding

Onboarding a carrier isn’t easy. It involves validating the carrier’s driver records to ensure they maintain a strong safety rating, verify insurance coverage and confirm their ability to meet service level requirements. Traditionally, shippers and brokers rely on carriers to provide this information either in paper or electronic format. The problem with this approach is that there are thousands of trucking companies in the U.S.

As freight brokers look for capacity, they often find new carriers who are closer to the pickup location, but need to onboard these carriers before assigning loads. Traditionally, shippers and freight brokers have a team of resources dedicated to validating carriers and managing information within a transactional database. The problem with this approach is that this data isn’t shared with others. As a result, each business must invest time and resources in onboarding many of the same carriers.

We believe we can solve this problem through the use of Blockchain to validate transactions and store and share records. Rather than rely on internal resources to validate carriers, we could use the Blockchain network itself. Network members could be incentivized for their work similar to the manner in which miners are currently rewarded with ethers through the Ethereum system. Another significant advantage of this model is that the network adds the new node to the public ledger, allowing other participants to consume the data without additional effort.

ADVANTAGES

1. Decentralized effort to validate carriers
2. Reward for performing the work
3. Shared data source
4. Lower cost

Trusting Load Board

One of the leading concerns associated with load boards is trusting the data itself. In many cases, load board data is outdated and inauthentic. When a shipper works with a set of freight brokers to transport goods, that information is typically entered in multiple load boards, causing data duplication and inaccurate demand forecasts. For this reason, the use of load boards has been discouraged by many organizations.
We believe data authenticity problems associated with load boards can be addressed by implementing a Blockchain in the heart of this business model. For example, when a shipper posts a load in the Blockchain, it would be timestamped with key information.

In the Blockchain scenario, when Broker A attempts to post a load in a load board, the technology first checks to see if the load already exists by comparing the timestamped information. If Broker B attempts to post the same load, the load board would identify it as a duplicate and alert the user. This can ensure that each load board will only have one record for a given load. Another advantage to this model is that it also addresses the issue of outdated information: When a load is taken by a carrier and updated in the Blockchain, all load boards will reflect the updated status.

**ADVANTAGES**

1. Single source of truth
2. No duplication
3. No stale data
4. Accurate demand forecasting
Streamlined Factoring

By some estimates, there are approximately 500,000 trucking companies in the United States, 80% of which operate 6 or fewer trucks. Typical pay period varies from 7 to 21 days, while it can extend beyond 21 days in some cases. Small trucking companies with limited cashflow can’t wait that long and generally rely on factoring companies to be reimbursed faster for a small percentage of revenue share. There are two main aspects to this business model:

1. Validation – In addition to the proof-of-delivery receipts captured and uploaded by drivers, factoring companies rely on freight brokers and receiving parties to acknowledge satisfactory delivery. Therefore, factoring companies need more information from trusted parties before paying drivers, and they need it faster. In addition, data validation could be handled by a network rather than an internal resource.

2. Payments – With cryptocurrencies gaining relevance in today’s business world and a single bitcoin currently valued at nearly $4,000, we foresee a future when drivers and vendors will be paid through this model. This shift will require major adjustments in the transportation world, however. To begin with, users will need to be trained to work with cryptocurrencies, and TMS applications will need to support them.

Internet of Things (IoT)

Internet of Things (IoT) is a popular topic in many industries. According to Cisco, there will be 50 billion connected devices by 2020. The introduction of V2V and V2I communications and other smart projects will only increase these numbers. With the continued proliferation of connected devices and associated data, securely storing that data will always be a challenge. IoT, together with Blockchain, can help solve the issue of core data capture and security. Moreover, IoT alone has become less of an advantage in today’s world of technology; it needs to be coupled with a system such as Blockchain to provide significant competitive advantage.

From a transportation perspective, there are several applications that could benefit from the marriage of IoT and Blockchain. In terms of telematics, it would enable manufacturers to add more sensors to help service centers securely capture and store engine diagnostics data and other vehicle performance information. This information can be used with machine-learning algorithms to determine when a vehicle will require maintenance. The role of Blockchain in this example is to provide decentralized data storage, eliminate a single point of failure, provide a tamper-proof record and enable smart devices to autonomously communicate with one another.

Similarly, the combination of IoT and Blockchain can be used to ensure safe delivery of perishable food products by controlling the temperature throughout the transportation process. It also can be used to automate order fulfillment, invoicing and settlements using smart contracts. Each of these capabilities makes Blockchain an ideal component of an IoT solution.
Protecting Sensitive Information

Throughout this paper, we talked about how an entire network can be used to validate transactions. The basic idea behind the validation is that data is replicated on all nodes within the network, allowing members to access them. While this makes sense for validation, there are certain types of sensitive information such as bids & contract, freight lane, freight volume, rates, etc., that shippers and carriers want to keep private.

Since Blockchain is built on a decentralized concept, all nodes will have exact copy of data. However, the data itself is protected using cryptography algorithms requiring members to have appropriate permission levels to access the data. Without the permissions, the data can’t be decrypted. For years, carriers have been reluctant to share their data with technology vendors for the purpose of cross-network optimization, machine learning, etc. They were worried that they would be at risk by exposing valuable information. Through the use of Blockchain permission levels and smart contracts, the system can perform these activities without human involvement and thus offer the protection members seek.

Master Data Management

Let’s look at Blockchain from a different perspective, exploring its potential application beyond operational needs. Thus far, we have focused on the use of Blockchain to capture and store data. Yet, if the technology can store all pieces of information in a single place, it could also very well serve as a Master Data Management (MDM) system. If it were implemented as the core system, with access to key information such as:

. . . then Blockchain becomes the perfect solution for building a data lake for MDM. Because it inherently supports data validation by network members, Blockchain could provide the function of “data stewards” in an MDM solution. A key difference—in fact, an advantage—is that the data validation process is much more refined in the Blockchain model since it would provide cryptocurrency incentives to members who provide this value. This model would also encourage research by providing all pertinent data in a single location. The decentralized phenomenon allows each business entity to have a node in the local network, providing easier integration to the single version of truth while protecting sensitive information via cryptography. All of the above make Blockchain a perfect framework for building a data lake for MDM.
Conclusion

TMW Systems believes Blockchain technology can have a significant, positive impact on modern supply chain processes, and particularly in the transportation category. Its abilities are virtually limitless. But a successful implementation of Blockchain requires a strong partnership with a technology provider that understands its intricacies and potential applications. In this paper, we have intentionally ignored the technical aspects of the Blockchain framework, focusing instead on a few leading applications within the transportation environment.

Building a Blockchain system that provides high availability, performance and security services is a challenge. It requires extensive planning and design. TMW Systems, with its transportation expertise and technical knowledge, can help its partners get there faster, and thus deliver a clear competitive advantage.

As a final note, it is our hope that we have raised awareness of Blockchain and its ability to help the transportation industry solve difficult challenges. For more information about Blockchain and its application within a transportation business, please contact Tim Leonard at tleonard@tmwsystems.com or Vasanth Srinivasan at vsrinivasan@tmwsystems.com.
Wondering how to prepare your business for the future of Blockchain?

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