Handling Invoice Data on a Trade Finance Blockchain

JEDTrade White Paper

1. BACKGROUND

Trade finance concerns the financing of both domestic and international trade transactions. A trade transaction requires a seller of goods and services as well as a buyer. Various intermediaries such as banks and financial institutions can facilitate these transactions by financing the trade; helping merchants with their cash flow. However, trade finance can also happen organically within the seller-buyer relationship chain.

JEDTrade's core business revolves around negotiating better payment terms between suppliers and buyers with mutually beneficial outcomes. The objective is to help businesses find and unlock financial value from their organic supply chains first, which is the easiest and most direct avenue to optimize trade and cashflow for the business. Suppliers can ask for early repayment to finance their cash flow instead of sole dependency on lenders for liquidity, which may not be easily accessible to all SMEs. Similarly, buyers who have surplus liquidity, can enjoy discounts on the total repayment amount for paying back early. JEDTrade automates and formalizes this process via her digital platform that helps both buyers and sellers initiate and accept these trade arrangements. While such a practice is possible even in the absence of JEDTrade, formalization and digitization makes it scalable. In the past, suppliers may only reach out to a handful of people a day via manual calls and individual emails. With JEDTrade, they can now connect with all their clients and have volume trade data and variations calibrated meaningfully for decision-making within seconds[1].

Establishing new repayment terms involves the modification of existing sales contracts on which a consensual agreement has been established between the parties involved. Further changes to the contract, therefore, need to be recorded and stored in ways that guarantee non-repudiation. Traditional methods of achieving this involve the use of a centralized database or a third-party service, or, at times, necessitate the involvement of a notary or a legal entity to attest to the validity and legality of the amendment.

In a trade finance ecosystem, there is a myriad of stakeholders and, in most cases, the vast geographic separation between trading partners causes the current trade finance system to be plagued with problems as a result of inefficiencies in information flow. This leads to problems like double financing and long processing time. The root cause of the apparent malaise can be construed in three ways:

1.1. ASYMMETRY OF INFORMATION

Counter-parties are usually not notified when the applicant receives financing. This is a key cause of double financing; a well-known problem where the same invoice is financed more than once

[1] To find out more about JEDTrade, visit www.jedtrade.com

by different financial institutions. Due to the lack of transparency, the institutions themselves are unable to determine if the invoice presented to them has already been financed.

1.2. LOW VISIBILITY AND LACK OF SYSTEM INTEGRATION

Although information about a trade is digitally recorded and stored as it moves along the trade process, the inputs are usually localized within companies' own databases; and the same invoice may exist on multiple databases. The lack of a shared database leads to unnecessary and duplicate procedures because either emails or paper documents are required for parties to communicate.

1.3. LACK OF A SCALABLE SOLUTION

Traditional solutions to system integration are mostly centralised, which is functional but not scalable. The barrier to scaling could be considered from two perspectives – technological scalability and business scalability. Although it remains a technical challenge to operate such a gigantic system with so many participants and a high transaction volume, the challenge is a lot more tractable than business scalability – it is inconceivable for a centralised solution provider to conquer the whole market across all continents.

We believe blockchain is a potential solution to the much-needed system integration, allowing for information to be shared within the trade ecosystem in a trusted, private and scalable manner. The issue of trust is always the Achilles heel of any third-party services. Lacking transparency, no middle-man service is immune from foul play.

Blockchain is a potential and promising alternative to the current modus operandi. Allowing relevant participants to see what is being written onto the common ledger, blockchain promises greater efficiency of achieving consensus. All proposed changes will be recorded on the blockchain and new contracts will be considered valid as soon as all parties have cryptographically signed it. Since all parties have access to the blockchain system, any of the following claims will automatically be false and invalid:

- that parties involved were unaware of the contract
- that malicious changes have been made to the records stored on the blockchain without his knowledge
- that a certain party did not consent to a change that has been cryptographically signed by it

Although the admissibility and the plausibility of evidence based on blockchain are still an issue waiting to be addressed by relevant agencies in different jurisdictions, we have reasonable grounds to believe that data from blockchain can provide a useful and effective means of proving parties' intentions or commitment to a change that has been proposed. In summary, the use of blockchain demarcates responsibilities in an unambiguous, real-time and indisputable fashion without any of the bureaucracy involved in the customary practices of going through the 'official channels', while potentially provide legal grounds for resolving any potential conflicts.

This paper thus outlines how blockchain can provide the technological means to construct a data communication channel for industry stakeholders. It is also a system that allows aggregate data to be collected without divulging sensitive information. To demonstrate this, we have built a blockchain

proof of concept on Hyperledger Fabric[2] (selected for this Phase 1 POC) and populated the database with mockup JEDTrade data. The demo allows the query of invoice information as different personas; allowing one to preview how our suggested invoice data format can work in a real-life trade finance blockchain ecosystem. In this paper, we aim to present our thought process in a blockchain data methodology to handle invoice information that should be applicable across any trade finance blockchain and is not platform dependent. It is how we imagine invoice data (including those from the JEDTrade system) can sit on the blockchain in a purposeful and private way.

2. Blockchain Applications In Trade Finance

There have been numerous publications and commentaries on how blockchain and distributed ledger technologies can change the trade finance landscape. The processes that were paved for centuries, till now still relied heavily on paper documentation. Take the case of Letters of Credit (LC). LCs existed since the 19th century and emerged as a result of trading partners not trusting each other. Suppliers do not trust that their buyers – especially new buyers or export buyers – can make good on their payment obligation; buyers do not trust that their suppliers – especially new suppliers or export suppliers – are reliable and can deliver the goods or service according to contractual terms. Hence, bank intermediaries were introduced to take care of this 'trust', expecting banks to honor their obligations according to a standard set of UCP (Uniform Customs and Practice for Documentary Credits) guidelines and an implied protocol for everyone in the financial ecosystem to uphold their responsibilities and obligations.

Addressing this lack of trust or thereof, a smart contract on the blockchain could pave the way for thought leadership in establishing a 'trustless' system for international trade to be carried out responsibly and data to be upheld with integrity. Achieving the respective beneficial outcomes for trade parties without heavy paper documentation. Figure 1 suggests a possible method where a smart contract may replace the need for an LC.

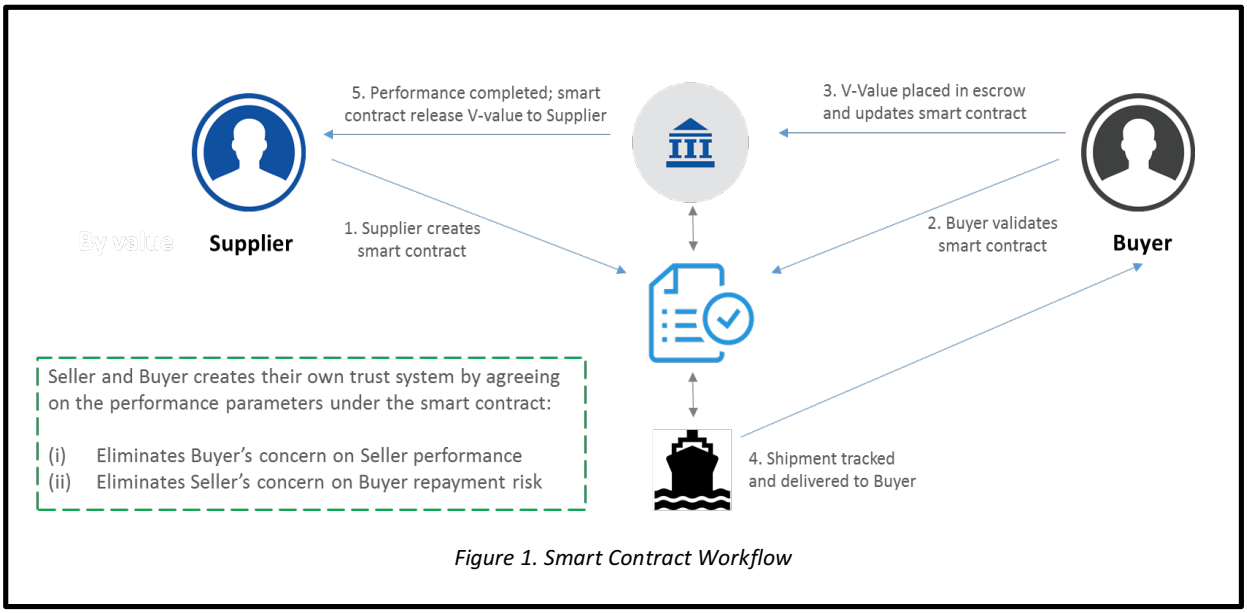

Figure 1. Smart Contract Workflow

[2] Demo Link: https://jedtrade.com/blockchain/

Another key challenge of paper-based trades is the proliferation of money-laundering activities that can be layered within the international trade and financial systems checking and operating against prima-facie documents. According to a Thomson Reuters report[3], a staggering 80% of illicit financials flows from developing countries are made through trade-based money laundering. This exploits the complexities of international trade which traverses across jurisdictions and counterparties. The gaps in detecting these fraudulent activities are also apparent in the financial systems, where an approved trade transaction may not necessarily come with 100% knowledge of the presence of physical goods flow or the ability for inspection. The authenticity and transparency of an underlying trade flow is thus of utmost interest and a highly regarded application of what blockchain and DLT can potentially achieve.

As illustrated above, there are many gaps in the current trade landscape that render as opportunities or potential use case applications of blockchain. There seems to be significant interest in eliminating paper-based trades and processes, and finding new ways to digitize important trade data with technology. In fact, according to Accenture[4]: Corporates are shifting to meet their own financing needs to ensure health of entire supply chain, and getting more selective in trade finance instruments due to high fees, complexity and delays with heavy paper documentation. By 2020, traditional trade finance for banks will drop from 52% to 36% of the trade-related revenues for banks while supply chain finance will increase from 33% to 45%. In terms of dominance, LC trades make up 40% of global trade by value, while open account trades make up 80% of global trade by volume.

JEDTrade's solution leverages on existing trade relationships transacting on open account credit terms. The objective is to help businesses find and unlock financial value from their organic supply chains first, which is the easiest and most direct avenue to optimize trade and cashflow for the business. Blockchain would facilitate the sharing of data not only within the JEDTrade ecosystem but the larger supply chain ecosystem. It could extend beyond trade finance to supply chain management, allowing various parties to share crucial information and increasing efficiency on the network. In the next section, we propose a blockchain solution to this starting from the system architecture to the formatting of invoice data.

3. AN INVOICE DATA BLOCKCHAIN FOR TRADE FINANCE

In the case of information sharing among the industry players, we instantiate our proposed blockchain system centering around invoices and illustrate how the system could effectively prevent double financing while at the same time protect data privacy.

3.1. OFF-CHAIN INTEGRATION

Figure 2 is a diagrammatic overview of how our blockchain connects the different stakeholders. On the very top are graphical interfaces with which users will interact in order to carry out

[3] https://www.thomsonreuters.com/en/press-releases/2016/october/thomson-reuters-launches-trac-to-combat-trade-based-money-laundering.html

[4] https://www.accenture.com/t20160412T053548__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_21/Accenture-Trade-Finance.pdf

different tasks. Immediately below the user-facing interfaces is the JEDTrade API layer which facilitates communication between the blockchain backend and the graphical frontend by providing the necessary application programming interfaces (APIs). At the very bottom is the blockchain engine where the data is stored and consensus established.

Blockchain acts as the medium for informational exchange. Instead of relying on peer-to-peer direct Internet communication, we use blockchain as the transmitter of information. Stakeholders, instead of establishing connections with each other, listen to the blockchain for new entries and perform the necessary actions when a relevant update is detected. If they wish to send a message, it should be broadcasted to the blockchain network. The consensus and synchronization algorithm will take care of the dissemination of the message.

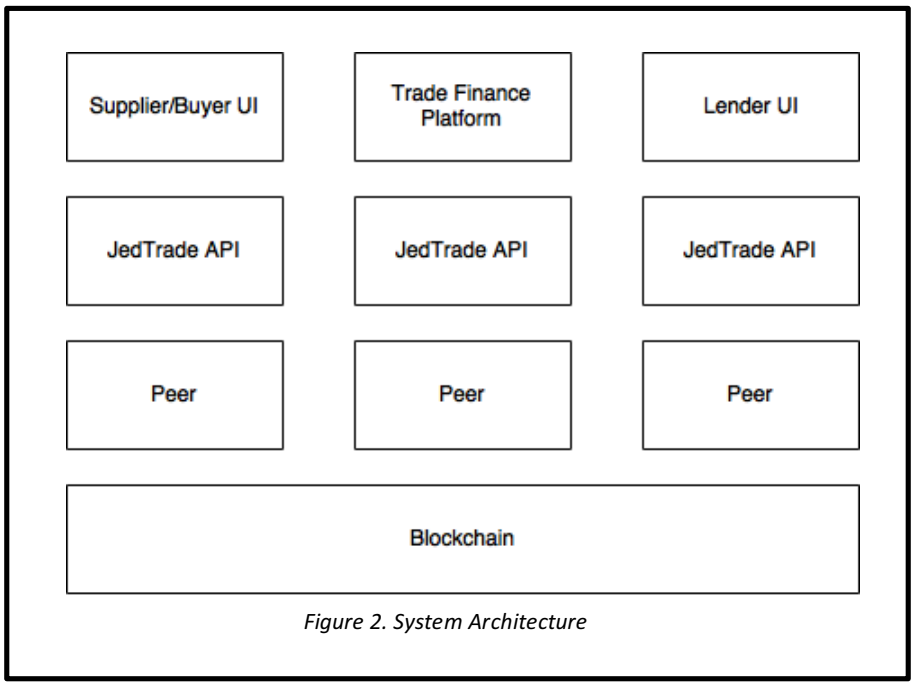

Figure 2. System Architecture

While blockchain can be decentralized and distributed, requiring no central authority to maintain the network, stakeholders themselves need to set up a node and connect to its APIs which in turn provide the building blocks for graphical user interfaces. This could be done by the IT department of the company or any software vendors.

3.2. CHAIN CODE STRUCTURE

For the purpose of invoice exchange in the context of trade finance, invoice details, instead of the invoices themselves, are uploaded onto the blockchain. In recording invoices, we consider two categories of invoice information.

3.2.1. Identity-exposing information

Any parts of the invoice which identifies trade relationships and information which identifies the parties involved in the invoice. This part of the invoice will be cryptographically hashed. The approach is to create two hashes of this component.

The first hash is a fixed component which will be common across all invoices, this forms the basis for any queries on the database.

The second hash will contain all other identity exposing information. Only used for validation if one has the full invoice information.

3.2.2. Non-identity-exposing information

Any parts of the invoice which do not reveal relationships and identity. This should include statuses of trade financing activities on the invoice. Since this part of the invoice is intended to be publicly viewable. Consideration should be made to reasonably disclose information here for data analytics purposes.

The invoice is therefore split into 3 parts:

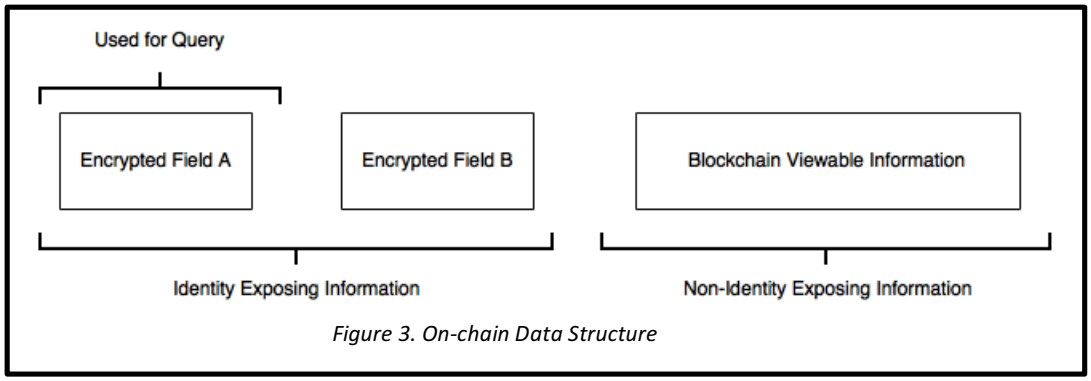

Figure 3. On-chain Data Structure

The benefits that this system would bring are:

- Allow trade partners to access their own invoices statuses easily.
- Allowing lenders and financiers to query invoice statuses which they were given access to.
- Sharing of non-identifying data to allow for more industry transparency and open the door for data analytics.

Invoices and status updates are only recorded onto the blockchain if there is validation by a counter-party. For example, a lender, having financed a buyer to repay the invoice, will send a status update, which has to be validated by the buyer before it is recorded on the blockchain.

4. System Implementation

In this section, we discuss how the proposed solution can be implemented in the ecosystem. A blockchain system can have many implementations. The solution architecture proposed in this paper can be implemented by other blockchain systems as well.

In the case of our Phase 1 Blockchain POC, Hyperledger Fabric is in essence, a database that stores key-value pairs. Unlike the conventional implementation of key-value databases that follows a one-to-one mapping, where one key corresponds to only one value and vice versa, the key here will be able to get all values that have been added to it. We shall call it key-values database. For the sake of immutability, the databases will not be able to delete any entry, once a key-value pair is submitted to the network, processed by peers and added to the database. This key-values paradigm provides a high-level abstraction and is suited for re-creating a Bitcoin-like blockchain where all information can be traced to its origin. See Figure 4 for a graphical representation.

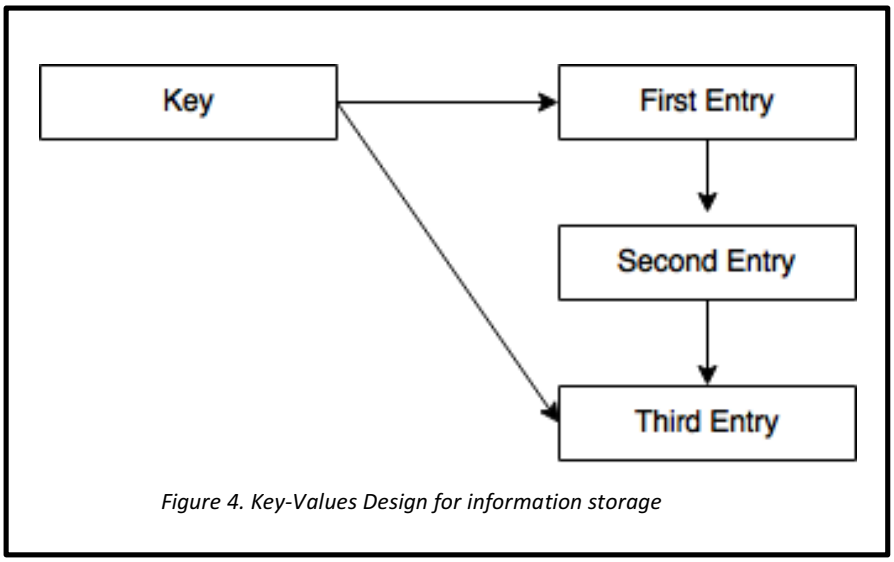

Figure 4. Key-Values Design for information storage

This chaincode exposes four APIs, namely *register*, *addRecord*, *getLastEntry* and *getAllEntries*. Chaincode APIs in HyperLedger can be classified into two categories – **INVOKE** and **QUERY**.

Query APIs will query the local copy of the shared database for information. Query APIs do not change the global state of the blockchain ledger.

Invoke APIs, in contrast, will change the global state of the ledger. For example, it may add an entry into the database. The validating peer to which a request is submitted will broadcast the change to the network. As all changes will be synchronized via the consensus algorithm which takes time, the validating peer will return a JSON message like the one below.

```
{
        "jsonrpc": "2.0",
        "result": {
          "status": "OK",
          "message": "4f7ab40d-f919-4ff8-a510-c3125544928f"
        },
        "id": 3
}
```

However, this does not imply in any way that the operation is successful. Some errors may have occurred and the request made via an Invoke API may have failed. This message only means that the transaction, a proposed change to the ledger which in this case is strictly an addition of information, has been broadcasted on the network. In order to ascertain that a new entry has indeed been added, one should invoke the query function to check the newly added entry.

5. BUILDING AN ECOSYSTEM

This whitepaper presents our thought process and methodologies that is 'blockchain-agnostic' and can be incorporated into an ecosystem-wide deployment for trade. We posit that for such a blockchain model to take off in the real world, it can take one of the following three models:

5.1. INDUSTRY LED

5.1.1 Solution provider

End-to-end blockchain solution providers may have the potential to take the lead in building such an ecosystem. Nonetheless being able to reach out to the relevant industry players and integrate into companies' existing systems with the blockchain backend is key. Such endeavors require well-coordinated execution and buy-in of the ecosystem stakeholders.

5.1.2 Consortium

Consortia such as R3 start with the dominant players in the industry (such as banks and FIs) and may extend their network to include the smaller players, forming an ecosystem. Success of consortium led efforts is very much dependent on the ability to concert all members towards the same direction and objectives on how the ecosystem should be run.

5.2. GOVERNMENT LED

The government can be a key driver for successful industry-adopted blockchain. For example, a few central banks have begun exploring a blockchain-powered currency model. As government has a critical role with respect to regulation and law enforcement, it is sometimes the key enabler for a blockchain system for they set the rules for the participants.

Furthermore, blockchain in most circumstances, requires different companies to use the same blockchain network. However there are currently too many variations of blockchain contesting to be the ultimate empowering platform. To help the industry move away from the cacophony of voices and forward into real implementation and testing, the government can decide on the platform because actions by the government will set the direction and confidence for the industry.

6. NETWORK GOVERNANCE

In our implementation, JEDTrade will be the Certificate Authority(CA), specializing in identity verification. Once the identity of a potential applicant is confirmed, he will be given a set of credentials to communicate with the blockchain server. He may choose to run a blockchain server himself for security reasons and efficient data retrieval. Clients can choose to continue using JEDTrade's portal for exchanging information with the blockchain instance or log into the blockchain directly by running a node locally. Overall, we believe that the governance of the blockchain network can have the following models:

6.1. ONE-PARTY GOVERNANCE

The registration of new peers is managed by a representative of all network participants.

6.2. MULTI-PARTY GOVERNANCE

Network parties could install a voting mechanism for the registration of new network peers. For example, for a new company to join the blockchain, it needs to approach at least three existing network participants. Once all three of them agree and subsequently vote on the network to approve the applicant, the new company will obtain access to the blockchain ecosystem.

7. CONCLUSION

In this paper, we present our considerations in the handling of invoice data on a trade finance blockchain. We discuss the desired functionalities of such a system and how our methodology addresses them. To demonstrate this, we have built our Phase 1 proof of concept on Hyperledger Fabric V0.6. In general, we believe that a good trade finance blockchain should be:

1. Efficient: Information exchange can be done in real time
2. Reliable: The system must be able to withstand network attacks and delivers up-to-date information to network peers at all times
3. Privacy: Data cannot be publicly viewable but can be selectively disclosed when the need arises
4. Smart-Contract Enabled: Smart contract is fundamental to streamlining the trade finance workflow and enabling auto-triggering of various events such as payment.
5. Regulator-friendly: Regulators and law enforcement agencies must be allowed to access certain information on the blockchain when the need arises

It is acknowledged that a truly purposeful blockchain for trade finance requires the participation of all relevant players in the ecosystem. Hence with JEDTrade's mission to create an inclusive trade and finance ecosystem, we continue to be actively engaged with industry-led solution providers, consortiums and integrated trade platforms for meaningful collaborations and ecosystem exchange. Nonetheless it is our opinion that ultimately, a government-led effort will be the most probable in onboarding all relevant stakeholders in the trade value chain, and we do propose that such efforts consider adopting our methodology as presented in this paper.

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