Supply chain shipment tracking using ethereum blockchain based smart contracts

Objective

The problem served to us by our customer was many errors and delays in tracking the entire lifecycle of shipments starting with the purchase order acknowledgement and then final receipt of goods in the warehouse. Delayed and conflicting information was causing demurrage, lost sales, expediting costs to the tune of millions of dollars.

Blockchain technology based smart contracts can be used to track movements in the supply chain, and validate the same on a real time basis. This will improve tracking, and also result in quicker, real time transactions. The question then comes why only blockchain and not any simple database. The answer to this question was the need to make each parties event and action to be captured and validated as per the conditions of the contract and hence reducing cross checking and verification/counter verification. Thus, there is a real business case for moving shipment tracking business process on a blockchain based platform.

Introduction

The shipment tracking process involves tracking a cross border shipment from its initiation in the form of a purchase order to it receipt is the buyer's warehouse.

The objective is to track all changes to the said shipment and inform all to the said shipment and inform all related parties about the changes.

- **Parties involved**
  Exporter
  Importer
  Customs
  Government Authorities
  Freight forwarders
  Custom House Agent
  Insurer
  Re insurer
  Bank
  Transhipment parties
  Shipping carrier

- **Documentation involved**
  Purchase order
  Sales contract
  Commercial invoice
  Shipment bill

Certificate of origin
Bill of lading /AW bill
Customer duty paid documents
Bill of entry
Letter of credit
Bank payment advice
HSN codes book
GATT declaration form
Licences
Test report
Adhoc exemptions
Freight invoice
Insurance declaration

The process requires multiple artefacts listed above being shared with multiple parties. The following table captures the events as they happen.

The table below lists the creation, informing and updating of the artefacts as they flow in the process. Blockchain should be able to create, update and inform the different parties when any of the events in the process.

	Documentation involved																
Parties involved	Purchase order	Sales contract	Commercial invoice	Shipping bill	Certificate of origin	Bill of lading /AW bill	Customer duty paid documents	Bill of entry	Letter of credit	Bank payment advice	HSN codes book	GAT declaration form	Licences	Test report	Adhoc exemptions	Freight invoice	Insurance declaration
Exporter		Create	Create	Create	Submit	Review			Review		Review					Review	Review
Importer	Raised PO	Review	Review		Submit	Review		Create	Review		Review			Create		Review	Review
Customs	Inform	Inform	Inform	Inform	Review		Create				Review	Create	Review	Review	Review	Review	Review
Government authorities			Inform		Review	Review	Review				Publish	Review	Create	Review	Review	Create	
Freight forwarders	Inform		Inform	Inform	Review	Create	Review			Review			Review				Review
Custom house agent	Inform			Inform	Review	Review	Create					Review	Review		Create		
Insurer	Inform		Inform	Inform	Review		Review		Review								Create
Re insurer			Inform				Review		Review								Review
Bank	Inform	Inform	Inform	Inform	Review		Review		Create	Issue							
Transhipment parties	Inform				Review		Review			Review							
Shipping carrier	Inform			Inform	Review	Create	Review			Review							Review

It may be noted that there can be more parties in the entire process based on a specific business's process.

The requirement is to:

Create smart contracts with the elements of data that would be tracked in a verifiable manner.

Generate event alerts on certain events taking place.

Documents and payments get released automatically when the events get verified against the smart contracts. The goal is to minimize rechecking, revalidation, reverification, and automate the process.

Solution

By providing trusted, automated transactions without the need for third parties, blockchain enables efficiency and agility wherever products, information, ownership, location or payments change hands.

Improved visibility, reduced risk and greater automation will drive down costs, improve timely delivery of goods, reduce wastage, and enable new financial models that could eliminate middlemen. The overall process flow would be as below.

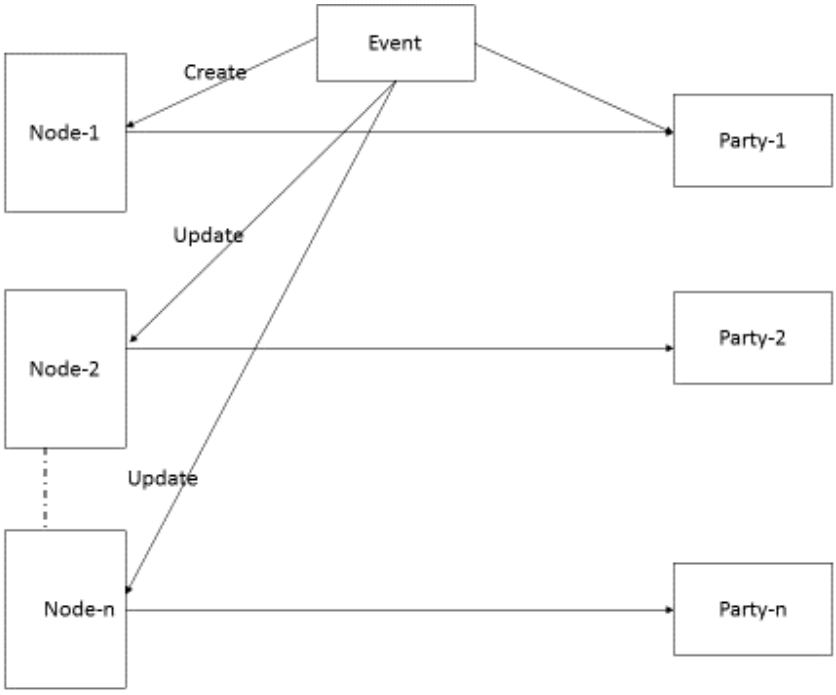

Smart Contract 1
Smart Contract 2
Buyer or Smart Equipment
Supplier
Carrier or Smart Container
Bank
Purchase order
Receive products
Accounts payable
Payment
Product catalog with pricing
Sales order
Shipment
Accounts receivable
Cash application
Product movement using carrier
Payment processing

Provisioning the solution using Ethereum

Enterprise Model

An Enterprise Model Company (em entity) that will use the blockchain based solution as an independent entity that manages all the partners and stakeholders of the supply chain. All the data of the em entity will be separate from others such entities that will be supported by the system. This entity will be the highest level of user. This entity has the ability to register further entities (client entities) that will be involved as stakeholders for a complete ecosystem for entities like shipping companies, exporters, importers etc. are going to use the supply blockchain contract, supporting enterprise alerting system and rules for alerting.

The information would be verified and reconciled by the various nodes. The flow will resemble the process flow given below.



Below are screenshots from the Shipment tracking using blockchain based smart contracts.

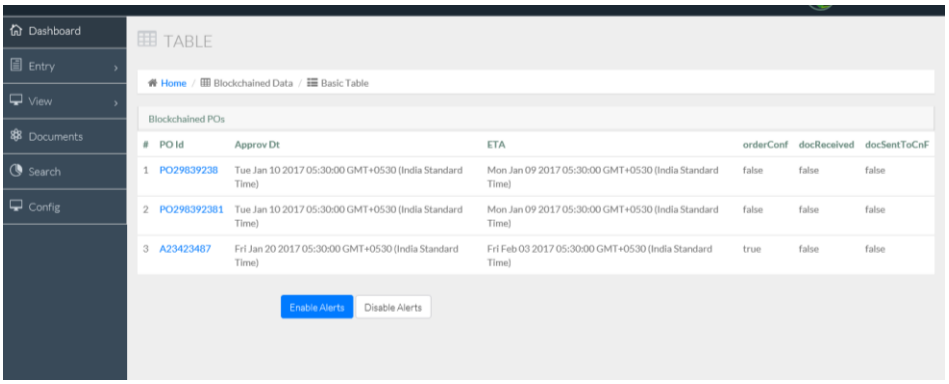


Figure shows data related to a PO stored in blockchained format. Further details can be viewed by drilling down on the link for that particular PO and it's related shipment.

Based on the block chain verified event, the next event can be triggered.

For example, when the event for title passage takes place, which can be verified by sensor/IOT data, linked to that shipment, the bank can be instructed to release the payment.

Current status of solution and future direction

The solution developed is available on a SaaS model, though it can be a private blockchain setup.

It has customers who have subscribed to the service.

Currently data is being provisioned either through respective ERP's of the stakeholder parties, or through manual data entry.

Subsequently, data can be provisioned through sensors, IOT, scanners, automatic feeds from multiple systems.

Conclusion

Technically using blockchain to manage and track smart contracts in an actual business case has been proven through this solution. Further enhancement of automatic data feeds and related business events