**INTRODUCTION**

Any trade transaction, be it domestic or global, involves exercising certain processes to complete. Domestic trade is the exchange of goods within country boundaries in contrast to between different countries in global/international trade. We describe the different processes involved in goods trade using a global trade transaction in figure Fig. 2. Shippers initiate a trade transaction by sending a purchase order (PO which consists of details of the requested goods to the suppliers. Suppliers typically package the goods into intermodal containers either by themselves or with the help of Origin Cargo Management (OCM) team. Suppliers issue dispatch advice (DA) that describes the goods packed details, and commercial invoice (CI) that describes the terms together with the details of the amount that shipper must pay for the goods supplied. Since global trade involves freight transportation across country borders, a typical freight journey involves multiple modes (e.g., road, rail, or sea) of carriers contributing to the container movement from origin to the destination. Moreover, freight transportation may also involve drayage providers to move containers a short distance via ground fright (e.g., move containers from truck to a ship).

Once reight reaches the delivery center at destination, the goods receiving team of the shipper verifies if the receive goods can be accepted or not. If there are any damages to the received goods or discrepancies in terms of received quantity/price against PO, then the receiving team records the same via receiving advice (RA). The different carriers involved in freight movement also issue their respective invoices for their services. Once the shipper has access to invoices of carriers and the supplier, its accounts payable team needs to process the invoices. First, the accounts payable team raises a claim for the discrepancies reported in RA in the form of claim advice (CA). Second, the accounts payable team deducts the amount captured in CA from the appropriate invoice (either from the supplier’s invoice or from a carrier’s invoice whoever is accountable) and generate payment advices (PAs), where each PA captures the net amount payable by the shipper either to the supplier or to a carrier.

Payment processing involves executing a payment method as per the terms captured in the service contracts between trade participants. The most common payment method is open account, where the goods is shipped and delivered before the release of funds from the shipper within an agreed time frame. There is another payment method which involves financing facilitated by banks and financial institutions (e.g., letter of credit [1] for supplier invoices in global trade, factoring [2] for carrier invoices in global trade, and reverse factoring [3] for supplier invoices in domestic trade). Goods trade can be summarized as the shipper acquiring the goods by paying the bills to the supplier and carriers as captured in figure Fig. 2

The sequence of processes that get exercised during goods trade is captured in figure Fig. 1. Different business documents are communicated among the transacting parties electronically in standard document formats known as Electronic Data Interchange (EDI) during goods trade. E.g., GS1 is one such EDI standard [4]. There exist one or more separate freight invoices and one supplier invoice (i.e., CI) in the case of a global trade transaction. In contrast, supplier invoice typically includes freight charges as well in case of domestic trade

The complexity of goods trade increases with the multiple en route handoffs between different parties involved in the goods over ment process. End-to-end shipping visibility becomes significantly challenging to put together. Hence, shippers and other parties involved, try to gather as many details as possible during the execution of various goods trade processes (figure Fig. 1). Eventually, each organization ends up accruing data with their priorities and results in mistrust of information in the multi-party planning and invoice processing. To address the trust and transparency issues among the competitive an mutually distrusting participants of the supply chain network, block chain-based the goods trade industry is adopting innovative solutions of late. Trade Lens [5] is a block chain based solution to provide visibility into the current status of freight transport with the help of real-time shipment tracking events originated from different supply chain participants. Generating the invoices for freight carriers (e.g., OCM, Land Carriers, Ocean Carriers, and Drayage) involved in the goods movement from origin to the destination using the real-time container tracking events and the shipment details captured by Trade Lens as depicted in figure Fig. 2 got carried out in [6]. In this paper, we propose a block chain-based accounts payable system extending the Trade Lens platform with capabilities to fulfill the needs of the supply chain network participants related to invoice processing (generation of CA and PAs) and dispute handling.

Here are the key features of our block chain-based accounts payable platform. CA is generated by a block chain smart contract using the EDI documents PO, DA, RA, and supplier invoice. PAs for supplier and carriers are generated by a block chain smart contract using supplier invoice, carrier invoices, and CA. And our system allows the shipper, supplier, and carriers to raise disputes on the generated claim advice and payment advices and reconcile before payment processing with audit trails. Moreover, our system lets the reconciled and approved CA and PAs be sent to the customer’s (shipper, supplier, or carrier) existing ERP systems via the API interfaces. Thus, our system is seamlessly integrated with the customer’s downstream applications. Our system allows email/SMS alert notifications to be generated as per user notification settings based on different triggers (e.g., CA is issued or dispute raised).

In the following sections, first, we discuss related work in this domain and its shortcomings (Section II). Next, we present the architectural design of our system, describe various system components (Section III) and the implementation notes (Section IV). Finally, we describe the experimental setup used for evaluation of the proposed system along with the performance of different types of transactions (Section V) and summarize our contributions (Section VI).