A Generic Model for the Tracking of Supply Chain Transactions for Minerals, Materials, Parts and Products

(version 0.1 of this document)

The concept of merkle chains have been well commercialized in blockchain technologies such as bitcoin. However, the intrinsic benefits of such chains for supply chain instruments extends well beyond the realm of cryptocurrency. Approaches could also be quite different to effect a dramatic reduction of the resources needed per transaction record while maintaining the integrity of the transaction recording process. The method used in this paper is the proof-of-work concept known as “trusted users” which could well be a number of users well into millions, but not infinite. The scope of the “trusted users” method allows for transactions in the blockchain to be verified by signature recognition of the document using commercially available certificate technology. This ensures the integrity of each block. Sub hashes are maintained for the document, document schema, supporting data and its schema and business information and the associated schema. All previously related blockchain heights are also recorded, providing history in addition to the immutability of record because of the underlying merkle chain structure. The chain itself follows all requisites of a blockchain. Pegging of such a sidechain to any crypto-based blockchain at periodic intervals is an additional option to avoid excessive federation.

Minerals transport into the supply chain has primarily two parts to it, upstream of the smelter and downstream of the smelter/refiner, with potential for multiple recycling streams and material loss by process both in the upstream and downstream parts. In the downstream part creation of parts and assemblies results in tracking by part numbers and lot numbers. For a true mass-based flow computation, it is necessary that all of this information be captured. In reality and practicality, all this needs to be done in a manner that does not compromise the identities of the players in the supply chain beyond that needed for a supplier and his/her immediate customer. This means that all related

transactions should be available so the transactions can be followed and be verifiable, but in a manner that only persons authorized to know identities of the various players will be able to get that information. In addition, recording this information must be based on tracking all related blocks up to that point at any point in the supply chain. Records must be immutable with sufficient methodology to ensure integrity of the chain, with majority of the participants of the blockchain agreeing to the records backup, archival and synchronization method used by the federation.

The methodology followed must thus allow for a chain that is near universal in terms of how the transactions are defined. For this purpose, it is necessary to record the transaction, and the schema used in the recording the transaction, supporting data, and also the schema used in those supporting data, and finally business information and schema associated with that.

Mineral transaction: When a mineral or refined mineral (material or substance) is added or removed from the process. Upstream of the smelter/refiner, for the most part this will be as adds to the supply chain in the form. Downstream of the smelter/refiner it will be mostly as use in parts/assembly or addition by recycling or loss by process wastes.

Supporting data: They can be any piece or pieces of data to supporting the mineral transaction.

Business information: This related to the company that performed the mineral transaction. All products, parts, assemblies materials and raw materials must be identified as products or subproducts so they can have item numbers. Typical schema for this could be IPC 175x series or IEC 62474 or adaptations. The schema used itself is included in the data record.

Between each supplier and their customer(s), the transaction information would just flow as parts of the documents of bills of lading. Thus each supplier and their customer would have access to the underlying data for their transaction, and all transaction blocks are known. This means that every single transaction can be checked as needed. However, as the block hashes are only viewable data for everyone, only those authorized can see the underlying data. This also means that only points of entry of concerned minerals into the supply chain need to be focused on-i.e. the first level customers of the smelter/refiner whenever they may be in the supply chain; and also all points of recycle of minerals. This process then enables a “clean” supply chain without excessive back and forth data requests.