DLT ARRAY™ (Advanced distributed OS and smart business applications development language)

DLT*ARRAY™: Development of a Distributed Ledger Technology Supply Chain Management Platform

Executive Summary

*DLT*ARRAY* is a new business and technology platform that is currently being developed by DLT*ARRAY Inc. startup. *DLT*ARRAY* platform enables easy implementation of various supply chain operations and their critical functionality, such as Supply Chain Management (SCM), Supply Chain Logistics (SCL), and Supply Chain Finance (SCF). It is designed to be secure, scalable, transparent, highly extensible and customizable, robust and durable, efficient and fast. It can be deployed between as few as two counterparties anywhere in the world, but it can also scale globally to support a large number and a wide variety of disparate counterparties who wish to transact continuously or intermittently with one another. It does not replace existing SCL technologies that trading counterparties might be currently using.   Instead, *DLT*ARRAY* extends and seamlessly connects private and public technology infrastructures, making it easier for these systems to become interoperable, thus dramatically reducing existing inconsistencies and errors in global supply chain networks. It has been designed to support all the functions that the global trading system is relying upon.

Supply Chain Management – The Need for Radical Action

Radically improving efficiency and yield value of the worldwide B2B wholesale trading infrastructure has been listed among the top global economic problems. For the last 50 years, manufacturing has been considerably reengineered and robotized, which resulted in massive cost reductions. In contrast, despite its substantial computerization, Supply Chain Management (SCM) overhead often reaches 15-20% of corporate revenues. Thus, SCM is becoming a huge obstacle for improving the profitability of industrial and trading communities in the rapidly evolving new economic paradigm.

SCM is a market that is ripe for disruptive innovation on a worldwide scale. Done right, such innovation will enhance global trade, and increase our society's economic growth and prosperity.

Distributed Ledger Technology (DLT), advanced and customized to the evolving SCM requirements, is capable of enabling a new and highly efficient worldwide B2B trading management infrastructure. This infrastructure should be able to support and radically improve a wide range of specific trade, payment and procurement Supply Chain Finance (SCF) and Supply Chain Logistic (SCL) solutions. However, most DLT/blockchain platforms being developed up to date are too crude, specialized for different business segments (i.e., cryptocurrency or large banks) or just unsuitable for such a huge task.

***DLT*ARRAY™** is an original SCM platform comprised of:

- Advanced distributed OS;
- Execution engine;
- Smart business applications development language;
- Communication and security layer;
- Data storage; and
- Applications execution.

It is based on the evolving Distributed Ledger Technology. Its principal use is to support implementation of numerous advanced SCF and SCL digitization solutions, which, in turn, could result in massive cost savings for the new global economy and, ultimately, the customer.

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Value Proposition

- Among the most important and distinctive traits of *DLT*ARRAY™* platform is that it transcends conventional software management technology. We believe that innovation in SCF is a prerequisite for innovation in SCM and SCL. Hence, to manage SCL/SCF, the platform has to be tightly integrated with the worldwide financial, regulatory, governance, and logistics infrastructure, such as banks, insurance companies, payment institutions, legal firms, taxation agencies, customs brokers and transportation organizations, and government agencies, to name just a few. *DLT*ARRAY™* platform is capable of *intelligently incorporating compliance with copious regulatory and enforcement requirements* – international, national and local – that are exceedingly complex, often contradictory, and are *normally outside of the purely technical OS and networking software design approaches*.

- Corporate sales and procurement platforms, however large, could be effectively serviced by RDBMS databases and legacy ERP systems. However, a wide-ranging and rapidly evolving *global SCM/SCL/SCF network could not be centrally imposed and hierarchically managed*. Rather, it necessitates a new data management and business integration approach that only a DLT engine could effectively support. *Only Distributed Ledger Technology, advanced and customized to the evolving SCM requirements, is capable of enabling a worldwide B2B trading management infrastructure*. In turn, once the SCM platform has been appropriately scaled, it could support the introduction of a multitude of disruptive innovation solutions for radically improving SCM/SCL/SCF network. Not less important, the existence of the global SCM infrastructure would undoubtedly facilitate critical involvement of committed lead users and of SCF partners in solution financing.

- It does not look promising to create yet another '*one size fits all hierarchical global solution*' to overhaul SCM. So far, introduction of numerous global and country-wide trade/payment/procurement-facilitating initiatives and standards (like ISO20022, SAP/Oracle/Peoplesoft multi-corporate solutions, IFRS-GAAP, XML, XBRL, various governments' large procurement/IT systems), have low success rate in improving SCM and reducing overhead costs.

DLT*ARRAY™ Platform – Advantages and Challenges

- *DLT*ARRAY™* SCM platform has SCF/SCL application focus and is dedicated to servicing SMEs, mid-range enterprises and multinationals, allowing them to remain competitive in the new business environment. *DLT*ARRAY™* system's fundamental properties are based on high functionality of its services, its governance and payment requirements, and on the needs of key vertical industries that it intends to serve, such as manufacturing, transportation, banking, agri-food, pharma, fashion industry, etc.

- It is highly flexible, easy to manage, inexpensive to grow and maintain, has high profit potential and could support evolving regulatory frameworks. It could provide SCF/SCL trading partners and Financial Institutions (FIs) with substantial competitive advantages and high profit potential. For its principal user categories, the service could efficiently scale up while satisfying enhanced speed, security and authentication requirements. It could be further customized for working with each participant's back office systems and for supporting development of new revenue streams.

- Could be used by SCF/SCL trading partners and FIs to *conduct high value, complex, multi-step B2B transactional services, thus attracting premium business clients.* We believe that it is where good margins are, as opposed to low value B2C commodity operations. Overall, our platform has potential to make B2B trading faster and more cost efficient, optimize money flows between partners in the industry value chain, enhance customer experience, and support introduction of

numerous new value added services.

- Recognizes that in *global, non-uniform, highly complex SCM/SCF/SCL networks*, each trading partner and FIs core management system has somewhat different architecture and implementation, diverse language, currency, payment, legal and taxation profiles and financial messaging blocks regimes, and a variety of security/privacy requirements, including their unique authentication, authorization, compliance and KYC/AML/fraud detection. An effective SCM/SCF/SCL network must cover numerous vertical applications, as well as access to participants' third party intermediaries and business clients who might use our SCM platform only occasionally.

- *C*ould be customized for individualized connections to each corporate or bank's SCM/SCF/SCL systems, both for instant payments and batch processing, thus supporting development of new revenue streams.

- Could help your company or FI to monetize SCF/SCL operations and manage international cash, liquidity and lines of credit, thus remaining competitive in the new business environment.

- *Has the disruptive potential to improve quality of data* necessary to support profitable and sustainable B2B trading flows. With the growth in complexity of supporting information, use of our SCM platform instead of conventional databases for comprehensive data sharing, reconciliation and analysis might be very beneficial. Interoperability between mutually trading organizations that lever the singular character of *DLT*ARRAY™* records could result in enhanced efficiencies in transaction processing and invoicing, and drastically reduce the cost of reconciliation and exception management in frequent cases of disagreements between trading parties.

- Uses smart contracts to enable all parties to update their parts of the SCF/SCL transaction on a single shared ledger, thus improving efficiency, high level of trust and transparency on a permanent ledger record. Immutable (unchanging) trusted records ensure transaction visibility, accountability and auditability, process optimization, and demand management. Hence, *corporates and banks could increase control, speed and reliability of their supply chain at a fraction of the cost of their current infrastructure*.

- Payments could be monitored by all parties, thus empowering suppliers in the buying process, while they wait for transaction processing.

- Benefits for importers and exporters include increased sales in foreign markets by offering competitive terms and enhanced borrowing potential; alleviation of the time-consuming administrative, credit and collection burden often created by international businesses; accelerated cash flow through faster collections due to substantial reduction in the time required from initiation to payment, for loan approval, and in bank fees (due to higher bank automation); as well as substantially reduced risk of fraud and credit losses on foreign customers. Also, with the increased transactional security, the platform could support dynamic loans from the vendors or banks that could offer different payment plans, tailored to their products and customer's unique requirements, such as predictable monthly installments. Transactional orders can be placed swiftly without Letters of Credit (LoC) opening charges, high negotiation expenses and incurring delays.

- Allows 'privacy by design', so that individual unit records can be securely encrypted (unlike in the conventional RDBMS database where it is practical to encrypt the whole set of data), so that a compromise of one record is unlikely to lead to the penetration of all of them. At the same time, it eliminates the exclusive need for a single authority to conduct or approve all transactions, as just two players could use *DLT*ARRAY™* to conduct secure transactions among themselves.

- Supports ISO20022/SEPA, messaging for payment initiation, cash and account management. Includes XBRL call reports according to the financial reporting taxonomies.
- Satisfies enhanced security, authentication and privacy requirements of evolving regulations for high-value complex transactions and for IoT network components.

*DLT*ARRAY™ SCM* Platform Architecture – Basic Principles and Rich Functionality

DLT is an emerging technology for decentralized and transactional data sharing across a large network of untrusted participants. It is a subset of DDBMS that provides a decentralized concurrency control of the read/write access by using encryption, whereas non DLT types of DDBMS are logically centralized and primarily use encryption to enforce auditability between trading participants. Decentralized DLT means that no single entity controls the network. The SCM platform could be customized for individualized connections to each participant's core system and for processing SCL and SCF transactions and analytics.

DLT*ARRAY™ rich functionality is accomplished with the system architecture consisting of four layers:

1. *Execution engine. DLT*ARRAY™* execution engine consists of five key interacting components that could be deployed in a single host or run across many hosts. They include a switch that connects the input and output of all the nodes; compute, decision and clock nodes; and custom agents that take values from the switch to run distributed OS processes.
2. *DLT*ARRAY™ Application Development Language* (*ADL*) that has been developed to execute directly on the execution engine and to fully control it. Because *DLT*ARRAY™* system supports a 'distributed' IT network, traditional programming approaches could not efficiently function with it. Distributed Ledger is a concurrent system; therefore *DLT*ARRAY™* platform has been optimized to model concurrent systems.
3. *Communications and infrastructure layer. ADL* leverages this layer to communicate with other systems on the corporate premises or on the cloud.
4. *Third party components*: *Drivers and dynamic interfaces* to third party components and applications must be written in *DLT*ARRAY™* ADL. All applications written in ADL can be directly deployed on the execution engine, and they should be able to support the entire functionality that the execution engine offers.

- Ensure that access by the third party has indeed been authorized by a network partner, DLT*ARRAY™ APIs use tokenization or secure delegated access method.
- Ensure fault-tolerant communication identity, which is critical for real-time SCF/SCL applications.
- Federation protocols allow single sign-on without passwords both on premises and on the cloud.
- Enforce Internet of Things (IoT) security. SCM/SCF/SCL applications typically interact with countless IoT objects that have to be traced around the globe.

*DLT*ARRAY™* Fundamental Properties

To accommodate specific SCM/SCF/SCL network support requirements, *DLT*ARRAY™* SCM platform exhibits the following fundamental properties, some of which have been substantially modified compared to other DLT systems or conventional DDBMS models:

- *Immutable*
- *Non-repudiation and authentication*
- *Data Integrity*.
- *Transparency*

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- *Rights*
- *Data privacy*
- *Consensus mechanism and energy consumption*: Blockchain spreads anonymous validating power among clients who are wishing to participate. To allow anyone to validate yet remain anonymous, it must be 'Sybil tolerant', i.e., able to prevent an 'attack of the clones', or the 'UNESCO attack', where some malicious entity makes numerous copies of itself and takes over voting control. Blockchain and current Ethereum solve this by making a validating entity vote/pay with the real fiat money, by purchasing electricity necessary for validating computing power (i.e., the Bitcoin system harnesses-approximately 70,000 tera hashes/second, which, depending on the hardware efficiency, consumes ~150-250 kW on each specialized and efficient ASIC mining computer system! Most of this energy is irreversibly wasted with the mining of the next data block). Hence, the Bitcoin mining has huge electricity consumption (same as entire Ireland!). This is not an oversight on the part of developers that could somehow be improved with time. Rather, its wasteful character is the key blockchain enabler that can't be wishfully discarded or substituted without introducing some other validating mechanism that is equally expensive and hence environmentally wasteful and perhaps even more complex to manage and control. In contrast, in *DLT*ARRAY™* there are no mined block chains.
- *Scalability*: The bottleneck in any distributed computing is the system's latency. To have high performance applications, the network should be used smartly and the system should leverage network improvement caches as much as possible. I.e., all Blockchain and Ethereum implementations cannot scale well. The Bitcoin network has a theoretical maximum of 7 transactions/s, whereas a midrange customer today (like a stock exchange) typically runs 100k to 1M transactions/s. Bitcoin fastest limit ever achieved in practice is 3 transactions/s. As its capacity is limited, Bitcoin users worry about their server's 'bloat' despite holding just 70 GB of data. With its current implementation, the congestion is so bad that even minor spikes in volume create dramatic changes in network conditions, with waiting time to confirm a transaction between 60 min and 14 hours! Ethereum's corresponding transaction speed numbers are theoretically 4 times higher but in practice only twice as high (7 transactions/s). The current 'on-chain' latency for Ethereum's block chain is around 3 min. Bitcoin's worldwide scale applications are not stable or robust partly due to the need to validate each transaction with electricity consumption (which causes technical difficulties and must incur high electricity costs), and partly because each node must store all the data, i.e., it has a replication factor of n. If the network has to hold 1 PB, it means that each full node needs to hold 1 PB, i.e., each full node user has to run their own datacenter. Hence, according to many developers, even though a proof-of-concept pilot for a Blockchain or Ethereum application might be relatively easy to implement, it's all but impossible to follow it up with building a production system on the enterprise or worldwide scale. *DLT*ARRAY™* original validation algorithm is able to overcome this limitation and hence could scale well.
- *Trust*
- *Governance*: *DLT*ARRAY™* is designed for semi-private networks in which admission requires obtaining an identity signed by a root authority.
- *Data format*: In DLT implementations, such as Blockchain, transactions have a single, rigid data format and can hold very little data apart from quantities of Bitcoin and associated spending rules (script). Work arounds can't provide a robust solution. By contrast, *DLT*ARRAY™* can include arbitrary typed data.
- *Cryptocurrency*: At present, mainly for regulatory and economic reasons, the system does not

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contemplate a native cryptocurrency but rather use regulated fiat currencies to ensure global AML compliance.

- *Smart contracts*
- *Potential for cost savings*: DLT*ARRAY™ platform could potentially enable savings by lowering back-office reconciliation costs in SCF applications. Its biggest net benefits would likely come from the interaction of a SCF payments system with broader Supply Chain Management, Supply and Demand Chain Logistics, product traceability, third party hardware/software components and fiat and cryptocurrency payments infrastructures that could settle multiple assets on the same ledger.
- *Authorization*: DLT*ARRAY™ ensures that people entering transactions into the system possess the authority to make transactions at the appropriate level.
- *Data completeness*
- *Table integrity*
- *Edit checks*
- *Transaction verification*
- *Data input integrity*

*DLT*ARRAY™* Application Development Language

Different ADL features that make *DLT*ARRAY™* distributed execution engine possible are listed below:
- ADL has a simple and friendly interface for a business person to use it.
- Integrated Development Environment (IDE) with integrated editor, syntax checking, testing, debugging and deployment
- ADL has facilities to model workflows + relationships (i.e., business rules) across different entities.
- ADL is able to conduct complex business interaction sequences, as specified in smart contracts.
- The language supports non repudiation, ensures data integrity, and it has facilities to notify users about data changes.
- ADL ensures confidentiality, by providing a way to control information visibility and transparency.
- The language has facilities to ensure that information processing is compatible with standard network security products and measures, like encryption, perimeter defense and firewall.

*DLT*ARRAY™ SCM* Platform as a Competitive Business Solution

A DLT platform, advanced and customized to the evolving SCM requirements, has a potential to become a mainstream business solution that enables co-creation, enhancing, sharing, reusing and monetizing customer value among the multiple cooperating parties that form on the fly a virtual transactional syndicate. For a wide range of existing customer devices, the DLT SMC platform could support complex transactional interactions among corporate, banks and insurance agencies legacy systems (including SOA and EDI), third-party proprietary services and in-cloud SaaS on-demand distributed resources.

DLT SCM platform's value proposition is in its potential for exponential scaling, traffic growth and a wider distribution network. The global SCM infrastructure could provide lower innovation costs and rapid time to market, due to its agile delivery model and seamless involvement of the outside developers, thus supporting the introduction of a multitude of disruptive startups and facilitating critical involvement of committed lead users and SCF partners in solution financing. Transaction costs and profits are typically distributed between the members of countless virtual SCM/SCF/SCL consortia, who, in turn, would provide distinct value components for each individual transaction.

The underlining DLT SCM/SCF/SCL microeconomic model is highly dynamic. This is in contrast to the far more slowly operated old 'formal partnership/service level agreements' procurement paradigm, which was in essence operating in the predefined multi-year batch mode. The new model has introduced numerous regulatory, governance, legal, compliance, risk management and indemnity dependencies.

As conventional revenue sources decline, *DLT*ARRAY™* SCM platform introduces an unparalleled opening for the corporates and FIs to create new profit opportunities through innovation – by instituting novel value-add services and attracting premium clients.

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