

## 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 Supply Chain (SC) 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 SC networks. It has been designed to support all the functions that the global trading system is relying upon. Its primary focus is on the 'global dynamic' SC infrastructure in support of evolving mass customization manufacturing processes.

### DLT\*ARRAY™ SCM Platform as a Competitive Business Solution – Harvesting Benefits

A Distributed Ledger Technology (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 SC syndicate. For a wide range of existing customer devices, a DLT SCM 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\*ARRAY™ R&D effort has been based on:

- ***Up-to-date 'deep from the ground up' analysis of global SC operations.*** While analyzing today's SC operations, we have concentrated on identifying B2B transactional services and specialized service niches for which DLT could provide substantive competitive advantages compared to the conventional RDBMS/DDBMS technologies.
- ***Reviewing underlining assumptions and the outcomes of recent pilots of distributed ledger and blockchain technologies.*** The goal of our comprehensive review of distributed ledger and blockchain approaches was to identify technology bottlenecks and most favorable strategies of SC implementation – thus avoiding known implementation pitfalls.
- ***Surveying regulatory and compliance regimes that often act as critical profitability/sustainability enablers for SC management and finance.*** Regretfully, regulatory and compliance factors are rarely taken into account when designing new SC platforms and initiatives.

Without such a fresh analysis, misalignment of goals and key implementation milestones is inevitable, which would make our platform less advanced, profitable and useful for the open source developers and leading industrial clients.

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 that only a coherent DLT-based platform could effectively resolve.

Today, many multinationals face a challenging objective of radically changing their global SC operations, to create an agile and dynamic infrastructure in support of profitable digital mass customization processes. ***Using legacy IT platforms, this is an expensive and risky program, typically with a price tag climbing over \$200-250M per large corporate, taking years to implement, and with a high risk of not reaching required benefits at the end of the project. Introduction of DLT\*ARRAY modular platform and our powerful and user friendly Application Development Language could reduce corporate development costs by an order of magnitude and drastically improve delivery time of highly flexible and sophisticated SCM/SCF/SCL solutions.***

As conventional revenue sources decline, ***DLT\*ARRAY™*** SCM platform also 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. ***DLT\*ARRAY™ platform might be especially valuable for mid-range and SME corporations and FIs, that are currently under intensive competitive pressure to rapidly change their business sustainability models, but do not possess large development resources of multinationals that would allow them to build their own global reach SC solutions from scratch.*** For such mid-range and small businesses, building complex proprietary solutions would be prohibitively expensive.

## **Supply Chain: From Mass Production to Mass Customization**

'Supply chain' is a relatively recent concept that has been introduced in the academic literature only since the mid-1990s, coincidentally with the emergence of Business-to-Business (B2B) ecommerce and the mass customization movement. It usually includes procurement, transportation and logistics, payments, and other activities, as well as various procedures covered by the corporate banking and trade finance.

Although there are numerous definitions of SC in the literature, in essence it relates to all actions involved in moving a product or service from the supplier to the customer, and getting paid for it. SC at each organization greatly contributes to maintaining corporate competitive advantage. It is a complex set of interdependent processes that vary in minute details for different organizations, even the ones that produce similar products. Hence, a working definition of SC is typically unique for every competitive organization and, often, for its corporate subsidiaries, departments and even individual product lines.

Radically improving profitability of the evolving B2B trading infrastructure is among the top global economic problems. For the last 50 years, numerous manufacturing operations have been reengineered and robotized, resulting in massive product cost reductions, growth in productivity and ultimate benefits to the consumers. However, high SC costs remain a substantial barrier for further improving efficiency and reducing costs of the global trade. At present, SC costs have been estimated to reach more than 12% of the global GDP, ranging from 9-10% in highly developed economies of the US or Japan to 12-13% in the EU, Korea and Singapore to 14-15% in China, India and Mexico.

These country averages, however, conceal a substantial disparity for various business process segments. Whereas SC costs are relatively low for well-established commodity manufacturing operations, such costs for many novel ecommerce-driven business processes might be prohibitively high. Despite

substantial computerization, SC overhead in many new corporations often reaches 70-80% of corporate sales, of which the SCM component might range from 4 to 30%, depending on the steadiness of the manufacturing process and the level of product customization. The final bill includes costs of purchasing, logistics, finance and of expensive exception management.

Supply chain implementation strategies range from more stable *mass production* processes, first introduced at the onset of the 19th century industrial revolution, to the modern trend of *mass customization*, which has only recently evolved as a viable commercial option. By changing assembly, logistics, payment and outsourcing processes, mass customization supports manufacturing of individualized products.

As a SC strategy, mass customization has been introduced in 1980s through the creation of high commonality modular components as a new product design approach. Modularization permits configuring of wide variety of end products while maintaining lower inventory levels, thus reducing risks and costs of obsolete inventories.

In contrast, more novel mass customization practices involve flexible manufacturing, which is based on smart robots and 3D printers, artificial intelligence and innovative ecommerce approaches. Their principal adding value is realized through the 'made to order' custom-made personalization, which, in turn, is based on the better knowledge of individual customers' needs. Direct interaction with each customer could result in shorter life cycles and better response to rapid market changes.

More important, it could also result in lower product costs which, in many cases, could be comparable with the commodity-level costs of mass manufactured products. Although at present the total revenues of new mass customization enterprises are less than 1/10<sup>th</sup> of that for the mass production businesses, it is likely to significantly increase in the future. Still, it is doubtful to exceed soon the high revenues of the well established mass produced commodity products, like softwood lumber, toilet paper or laundry detergents.

Centrally controlled proprietary B2B sales and procurement platforms (e.g., Ariba Network, GTNexus, Basware), have been developed 20-30 years back and optimized for the use in than prevailing mass production. However large, such B2B legacy platforms could be effectively serviced by RDBMS databases and legacy ERP systems, and are likely to cost-effectively support mass production environment for the years to come.

However, for a number of technical, security and business reasons, legacy databases and software would be unable to evolve into powerful and smart SCM platforms that are necessary for supporting transactional applications of numerous customized product lines. Based on mass customization requirements, such highly specialized product lines must each maintain their own constantly advancing robotics, IT and payments infrastructures. Unlike '*corporate static*' SC solutions sufficient for mass production environments, only a '*global dynamic*' SC infrastructure could support novel mass customization manufacturing processes.

SCF covers liquidity management and payment activities among the collaborating business partners. Its objective is to monetize the working capital tied up in the global SC by using various financial instruments, practices, technologies and liquidity management optimization methods. For mass customization systems, the role of supply chain finance also substantially differs from that of mass production. In that, it could disproportionately affect the development of a viable supply chain management platform.

To comprehensively manage complex SC processes, a SC support platform has to be tightly integrated with the worldwide financial, regulatory, governance, and logistics infrastructure that includes banks, insurance companies, payment institutions, legal firms, taxation agencies, customs brokers and transportation organizations, and government agencies.

## Supply Chain Management – The Need for Radical Action

Radically improving efficiency and yield value of the worldwide business-to-business (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, SCM overhead for novel mass customization manufacturing processes is still far too high. Thus, SCM is becoming a huge obstacle for improving the profitability of industrial and trading communities in the rapidly evolving new economic paradigm.

SCM ensures a coordination of SCL, SCF with other corporate operations for countless independent business entities. *With today's radical change from mass production, with its inflexible legacy manufacturing and IT platforms, to mass customization, which necessitates the use of agile robotics and smart AI applications, this business practice 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, 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 SCF and SCL solutions. However, most DLT/blockchain platforms being developed up to date are too crude, outdated, 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 operating system;
- 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.

### **DLT\*ARRAY™ Value Proposition**

- ***DLT\*ARRAY™ platform's value proposition is in its potential for exponential scaling and traffic growth of a global dynamic SC distribution network.*** Improving networking potential of currently patchy and unreliable global SCM infrastructure could provide lower innovation costs and rapid time to market, due to our agile delivery model and seamless involvement of outside developers. In turn, it could be able to support the introduction of a multitude of disruptive startups and facilitate 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.

- Among the most important and distinctive traits of *DLT\*ARRAY™* platform is that it transcends conventional software management technology. Because mass customization digital economy necessitates dynamic analytics of critical financial attributes for each independent SC transaction (such as product cost; shipping costs; payment conditions and discounts; expiry dates; various kinds of risk mitigation/insurance costs and conditions; custom duties; taxes; brokerage fees; dynamic lending linked to the invoice; to name just a few), and because most of financial processes and institutions are tightly regulated, we believe that ***innovation in SCF is usually a prerequisite for innovation in supply chain management and logistics***. Hence, to comprehensively manage complex SCM/SCF/SCL processes, 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***.
- A wide-ranging and rapidly evolving ***global SCM/SCL/SCF network could not be centrally imposed and hierarchically managed***. Rather, it necessitates a new peer-to-peer (P2P) 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*** that is both agile and smart. 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, based on decentralized and transactional data sharing across a large network of untrusted participants, which is computationally difficult or uneconomical to achieve using RDBMS or conventional DDBMS-based platforms. 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.
- Alternatively, 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/Infor multi-corporate solutions, IFRS-GAAP, XML, XBRL, various governments’ large procurement/IT systems), have low success rate in improving global exchange of data, execution of SCM transactions and reducing overhead costs, even though some of them might be successful for implementing large corporate or multi-corporate applications, especially with mass production based systems.

### ***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 platform only occasionally.
- Could 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™* platform exhibits the following fundamental properties, some of which have been substantially modified compared to other DLT systems or conventional DDBMS models:

- *Immutable*: Even though Blockchain and Ethereum systems promote themselves as ensuring immutability (data records can't be altered after being posted), their history proves otherwise. In cases of gross security breaches that caused multi million dollars losses, certain transactions in these systems have been reversed by the administrators in charge of their respective core system code maintenance. This is especially ironic, as these systems by definition are not supposed to have effective defenses in cases of failed software security; in essence they come with the implicit guaranty that their security defenses are conceptually unbreakable; which is indeed a tall order to satisfy 'forever'. In contrast, *DLT\*ARRAY™* platform uses more pragmatic definition of immutability, which has been proven for many years in the well established accounting systems, both in applications and by independent audits.
- *Non-repudiation*
- *Data Integrity*.
- *Transparency*
- *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 anonymous 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!). Looking at it differently, the Bitcoin network requires at least 11,000 times more computing power than top 500 supercomputers combined (7x10<sup>6</sup> vs. 642 petaFLOPS in November 2015!), whereas its output is evidently not as meaningful. 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 an alternative 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 need for mined block chains, with consensus generated by an original validation algorithm.
- *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 application today (like a stock exchange) typically runs 100k to 1M transactions/s. Bitcoin's 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 scaled 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 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.
- *Authentication for authorization*: Authorization specifies secure access policies that define which user can access which resources, while authentication confirms the user's identity that enables authorization. For conventional distributed databases, authorization and authentication protocols of their management systems are optimized for a central authority that must authorize all changes in the identically structured database segments. However, such conventional protocols are ineffective in the highly fluid and collaborative DLT environment. With every network node typically having its own unique control of secure internal access, it is necessary to introduce a supplementary protocol, to effectively control external access to all independent DLT nodes. Hence, user authorization in *DLT\*ARRAY™* platform is performed with an additional security layer, which imposes effective external access control. Public key cryptography that is used to support this supplementary external protocol, ensures security decentralization, thus reducing the chance that the request approval by the central authority could cause performance problems; eliminating a single point of failure inherent to centralized databases; and also improving transparency for SC transaction's stakeholders.
- *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.

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