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| **ITU-T** | **Technical Paper** | |
| TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU | | (4 APR 2019) |
|  |  | | | |
|  | **Distributed Ledger Technology Use Cases** | | | |
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Summary

This technical paper consolidates all use cases gathered during the ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT) activities. This reflects how technologies enable applications and services by the underlying nature of the ecosystem including best practices of practical use cases and business models being used. It collects information on current initiatives and activities involved in applications and services based on DLT, and will involve developing use cases related across the world. It suggests ITU-T study items and related actions for various ITU-T study groups for example on concepts, coverage, vision and use cases of services based on DLT.

The aim is to identify and describe DLT-based use cases, specify which DLT features are required. It highlights the competitive advantage brought by DLT. It also describes how the use cases could benefit from a standardization effort. This document is going to bring relevant parties to identify issues and priorities, exchange information and best practices through peer learning and knowledge dissemination processes and identifying possible policy interventions.

\* DLT Interoperability (data portability and services)

WG3 addresses some interop aspects by abstracting a high-level architecture describing common DLT platform elements;

\* Identity Standard - people, legal entities and things

ITU-T SG17 on security and identity issues

\* Concepts and Taxonomies

WG1 does try to address the issue of common terminology

Keywords

DLT; Use cases;

Change Log

tbd

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Technical Paper ITU-T FG DLT

Distributed Ledger Technology Use Cases

Summary

This document consolidates all use cases gathered during the ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT) activities. It highlights the competitive advantage of each use case brought by DLT. It also describes how the use cases could benefit from a standardization effort.

The uses cases are classified into two domains: vertical and horizontal. Each domain has classifications and sub-classifications. Special attention is given to the relevance and applicability of use-cases presented to the attainment of the Sustainable Development Goals (SDGs).

# Scope

All use cases gathered, classified and prioritized during the ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT) activities, based on pre-determined criteria developed by WG2 (Use cases).

# References

1. ITU-T FG DLT WG2 Use Case Template

There are many references related to blockchain applications & services. It follows some of them.

1. Can Blockchain revolutionize international trade? <https://www.wto.org/english/res_e/publications_e/blockchainrev18_e.htm>
2. Blockchain’s Potential for Environmental Applications - <https://blogs.wsj.com/cio/2018/11/30/blockchains-potential-for-environmental-applications/>
3. Blockchain in Aviation White Paper - <https://www.iata.org/publications/Documents/blockchain-in-aviation-white-paper.pdf>
4. EU Blockchain Observatory and Forum - Blockchain for Government and Public Services - <https://www.eublockchainforum.eu/reports>
5. Blockchain for Social Good - <https://goodblocks.vessels.tech/>

# Terms and definitions

## Terms defined elsewhere

This Technical Paper uses DLT related terms defined in FG DLT D1.1 DLT terms and definitions.

# Disclaimers

(1) Tokens mentioned in this deliverable are only for the purpose of analysis of technical architecture and use cases. The Focus Group does not endorse any of these tokens, neither in their technical aspects nor as investments.

(2) The editors have looked at use-cases selected at random under pre-defined criteria as examples of possible good use of DLT to support the SDGs. The inclusion of use-case example does not imply any endorsement of or judgment on the quality or applicability of the mentioned use-cases.

# Abbreviations

|  |  |
| --- | --- |
| TBD | TBD |

# Introduction (ANDY)

This technical paper consolidates all use cases gathered during the ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT) activities. This reflects how technologies enable applications and services by the underlying nature of the ecosystem including best practices of real-world use cases. It collects information on current initiatives and activities involved in applications and services based on DLT, and will involve developing use cases related across the world. It suggests ITU-T study items and related actions for various ITU-T study groups for example on concepts, coverage, vision and use cases of services based on DLT. We address a wide audience through the document which includes policy makers, regulators, standards developers, the technical communities.

The examples in the document come from the exploration and innovation of blockchains by various countries and organizations. They are the cases submitted by the various agencies to the ITU since 2018. The document includes definitions and descriptions of terms related to DLT technology, and a brief introduction to the advantages and competitiveness of DLT technology in applications. Correspondingly, this document includes use cases relevant to at least one domain or subdomains in WG-2 categorization. All referenced use cases of this document were submitted by legal entities, as opposed to individuals. In addition, the use cases need to be at least at a proof of concept stage because we believe that these use cases in general have more lessons learned. In the part of the use case statement, all use cases are divided into vertical and horizontal areas. The vertical sector includes financial, health, government and public sector while the horizontal chapters cover industry, identity management, security management, IoT, data storage, etc. The document contains a description of the Sustainable Development Goals as well. The SDG refers to an agenda under the UN framework and it is a plan that seeks to build on the Millennium Development Goals and complete what these did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental. The document also mentions the significance of standardizing use cases and the tremendous efforts made by WG-2.The appendix is a summary of the use cases collected.

This paper is contributed by specialists from various industries and top research institutions. The aim is to identify and describe DLT-based use cases, specify which DLT features are required. It highlights the competitive advantage brought by DLT. It also describes how the use cases could benefit from a standardization effort. This document is going to bring relevant parties to identify issues and priorities, exchange information and best practices through peer learning and knowledge dissemination processes and identifying possible policy interventions.

# The Competitive Advantage of using DLT in Applications & Services (SHAHAR)

The benefits gained from use of DLT vary by use-case, environment, event, process and industry. While the financial sector, for example, may make use of the crypto-currency features associated with DLT, other sectors may make use of other features of the technology, such as Distribution, Disintermediation and others. This section looks at common threads that are effective in multiple use cases, as well as unique features that are more specific to certain applications.

## General benefits

Common to many use-cases is the view that DLT is a secure, cost effective technology that provides for deployment of globally scalable services. It supports a multitude of disruptive innovations that can improve existing solutions and drive the development of new products and services. DLT is considered as a tamper-proof and auditable technology that is resistent to systemic failures. It is also an effective tool to detect and mitigate fraud.

DLT can be seen as a form of general purpose technology (GPT). A GPT is a technology that on top of standing for itself – also brings gains to other technologies and sectors. It may take a long time to reach mass adoption, but once adopted it leads to productivity gains across multiple industries (Bresnahan and Trajtenberg 1995, Rosenberg and Trajtenberg 2001, Moser and Nicholas, 2004). Classic examples of GPTs include the steam engine, electricity and the internet. DLT revolutionizes the way we look at data in terms of trust, anonymity, storage, processing. Being in the information era, where “data is everything”, DLT’s innovative approach to handling information and it’s agnosticism to the types of data it handles, makes it a useful tool in many fields of business, administration, research and government – thus a GPT.

## Transparency and Trust

DLT is perceived as a canonical trusted and transparent shared resource that makes interactions and transactions understandable, traceable, certifiable and accountable.

The major beneficiaries would be use-cases that include untrusted stakeholders seeking to build a trusted infrastructure where data can be shared in a secure and accountable manner.

## Security

There are multiple aspects of security that are embedded into DLT:

1. Encryption of data. All data in a DLT is encrypted by default.
2. Access control. Albeit the fact that all records exist in many nodes of a DL, access to records can be restricted on a per-record-per-user basis.
3. Tamper-proof data. Once data is loaded into a DL, it becomes immutable.
4. Identity management. Participants in a DL can be anonymous or pseudononymous.
5. Fault tolerance. DLT includes means to mitigate the risk of incorrect/fraudulent information being loaded into a DL.

As a result of the above DLT provides secure data provenance, which is crucial for data accountability, forensics and privacy. It can detect access violations. It enhances privacy and secures consumers and businesses against theft or data manipulation, ensuring tamper-proof records. DLT plays a significant role in fighting fraud and helps detect and fix incorrect bindings. DLT provides an effective verification of identity information (without disclosing identity information itself).

## Economic Incentives

In terms of the economic incentives of DLT - Depending on the use-case it can offer Cost-Reduction, New-Revenue-Streams or both. Cost reduction is achieved through disintermediation and increased efficiency (discussed further in the coming paragraphs), while new revenue streams are generated through removal of technological and operational barriers.

DLT enables the disbursement of money, be it in the form of a FIAT or a Crypto currency, just-in-time and directly to its designated recipients. This can be of value to any industry domain that transacts money, either as part of an application (e.g. payment for goods or services) or as means to transfer value (e.g. transfer money).

DLT enables fast on-line trading and may serve to overcome regulatory and operational limitations.

DLT can add to the competitive advantage through reduction in the cost of verification and the cost of networking. (Gans, 2017)

The cost of verification relates to the ability to verify attributes of a transaction at a lower cost than existing auditing intermediaries. These costs are exacerbated when intermediaries gain market power, often as a result of the informational advantage they develop over transacting parties through their intermediation services (Stiglitz 2002).

The cost of networking refers to the ability to bootstrap and operate a marketplace without need of an intermediary. This applies both when bootstrapping a new platform and when operating it. When bootstrapping a new platform, often referred as a token sale or Initial Coin Offering (ICO), a native token is used to crowdfund the platform. When operating a platform, an incentive system is used to determine the conditions under which contributors can earn tokens, providing the resources needed for the platform’s operations (computing power, applications, storage, content and advertising, etc.).

The effects of reduction in cost of networking on market power, privacy risk and censorship risk, constitutes an architectural change to value creation and capture. Architectural innovations, by the knowledge and assets incumbents have accumulated (Henderson and Clark 1990), open opportunities for entrants to reshape market structure. Through reducing the market power of intermediaries, DLT allows platforms to operate with lower barriers to entry and innovation.

With a native token used for coordination (e.g. utility tokens), the technology allows a decentralized network of economic agents to agree, at regular intervals, on the true state of shared data which may represent a myriad of assets, including exchanges of currency, intellectual property, information or other types of contracts and digital assets. Thus, DLT can be used to trade scarce resources, digital property rights and create novel types of digital platforms.

The resulting digital ecosystem can be characterized by increased competition, lower barriers to entry and lowers privacy risk. It also challenges the existing business revenue models and open opportunities for new approaches to the provision of public goods, software protocols, data ownership, licensing, auctions and reputation systems.

## Efficiency, Reduction of complexity

It has been observed in multiple deployments (both experimental PoCs and commercial deployments) that the use of DLT serves to reduce complexity and increase efficiency. It allows for better tracking of assets and transactions. It can serve to significantly shorten timelines and automate paperwork laden manual tasks thus making processes rapid and simple. This is achieved through removal of data silos and establishing direct, trusted trackable and secure interactions between stakeholders.

DLT enables the creation of digital platforms where the benefits from network effects and shared digital infrastructure do not come at the cost of increased market power and data access by an intermediary. This reduction in the cost of networking has profound consequences for market structure, as it allows startups and open-source projects to directly compete with entrenched incumbents through the design of platforms where the rents from direct and indirect network effects are shared more widely among participants (e.g., developers, users, investors), and no single player has full control over the underlying digital assets and data.

While it may have more to do with Artificial Intelligence and Big-Data analytics, the ability to perform smart-contract operations based on data transacted in a DLT can serve to integrate functionality of multiple disparate systems into a single system. DLT thus may serve as an accelerator for automation within organizations’ IT departments, specifically in scenarios where automation of the ledger alone does not yield visible incentives. If, for example, the use of DLT allows you to shorten a certain part of a process from 24 hours to 5 minutes, but this process is part of a chain of events that took 90 days to complete, then shortening a 90 day process to a 89 day process does not yield visible gain. If, however, the use of DLT drives automation of other parts of this 90 day process and as a result it can be shortened to 7 days, then the overall gain is much more significant.

## The benefits of Disintermediation

Many supply-chain management operations rely on a centralized intermediation entity that handles the transactions across a large network of untrusting (often competing) stakeholders. Examples would be SWIFT bank transactions, SITA flight booking, Uber, AirBNB and others. Such intermediators serve a crucial role of coordination between stakeholders and customers, increase visibility of services to potential customers and enable centralized transactions. The services offered by such coordinating entity is typically associated with a fee charged to the stakeholders (e.g. Uber keeps about a third of the fare charged to the customer), and managing visibility and control between stakeholders and intermediating entity may be complex and difficult to achieve (e.g., Mobile operators may have different rate plans for roaming visitors based on their home network operator). Through the use of DLT the stakeholders can create a common interchange and enforcement mechanism without a trusted third party. Information exchange and visibility can be easily managed and anonymity can be preserved where required.

Novel digital platforms, in absence of a central ‘clearing house’ or market maker, can benefit from permissionless innovation: As long as an application is compatible with the established protocol and consensus rules, it can be deployed on the network without permission from other participants. This reduces the expropriation risk application developers face when building on top of existing digital platforms (e.g. iOS, Facebook etc.). Furthermore, since each contributor to a blockchain-based platform can theoretically shape its evolution in a way that is proportional to its stake in the platform (e.g. in terms of computing power, storage, labor or capital dedicated to it), these new platforms can democratically evolve over time to accommodate changes in market design that are beneficial to the majority of contributors.

## Identity management

The process of identity verification is central to all economic transactions. A well-functioning market (and economy), relies on robust identity verification as well as on the ability to verify the goods and services being exchanged (e.g. in terms of their provenance, how they were changed through the supply chain etc.), and the credentials of the parties involved (e.g., degrees on a curriculum vitae, professional licensing status, bad actor status, driving record, etc.).

DLT can serve a crucial role here. Scenarios may include Medical Records of patients, Credit Assessments of bank customers, Access-Management systems in secured locations and others. DLT can associate features and attributes to an individual without revealing the individual’s identity. It can be used to prevent identity theft through biometrics without risking leaks of sensitive information to prying eyes.

The same way a distributed ledger can track the attributes of financial transactions, it can also track changes to status and credentials of an individual, a firm, goods, services. An individual’s ability (or lack of it) to perform a certain action could be tracked on a blockchain and queried when needed without necessarily disclosing all underlying information (e.g., a bank could verify, after being authorized by a customer, a credit history). Similarly, access to medical records could be granted, revoked or ported between providers as needed.

Attributes of digital and physical goods can also be tracked on a distributed ledger as they move through the economy, increasing our ability to verify their integrity, provenance, manipulation and status (e.g., warranties, food safety) over time. This is particularly powerful when immutable properties of goods (e.g., the properties of a diamond, art piece or geographic coordinates of a piece of land) can be reliably recorded on a blockchain. As an example: a unique, digital fingerprint can link ownership of a blockchain token to an underlying asset it represents. In certain cases, the identity, credentials and provenance verification will require trusted intermediaries (or at least a secure IoT device or sensor) to reliably capture the status of items in the offline world and record it on a distributed ledger: Intermediaries and secure devices act as key complements to online forms of verification enabled by blockchain technology.

## Summary

DLT is not a Panacea, not a magic-cure-for-everything. It is, however, a very effective tool that can serve to facilitate, increase efficiency and accelerate applications involving data storage and exchange that span multiple categories in our day to day life. Data is everywhere, and management of data is key to success of applications and operations. DLT offers a clear advantage to data management and exchange compared to legacy database and ledger technologies in some use cases. Its ability to combine a secure data storage mechanism, security and access management with monetary transaction capabilities makes it an extremely efficient tool in a multitude of scenarios.

# Vertical Domain

The vertical domain represents different sectors of the economy. Sectors considered by FG DLT were:

– Finance;

– Healthcare;

– Industries;

– Information and Communication Technology and

– Government and public sector.

## Finance (INGRID)

* Topics:

Some of the biggest use cases of the blockchain technology have been in the financial services industry. From the obvious use in payments (e.g., Ripple) to the more complicated use in trade settlement (e.g., Digital Assets partnership with ASX) financial industry has been testing the technology since it’s very early days. While some banks have gone ahead with developing the technology in-house (e.g., JPM’s Quorum), some have made strategic investments (Goldman’s investment in Circle), while many have joined industry consortium (R3 CEV) to engage with the technology and create common standards. (Source:<https://medium.com/pennblockchain/blockchain-applications-in-capital-markets-37432d7caa0>)

* What blockchain:

In basic terms and using BCG study definition (<https://www.bcg.com/publications/2019/resolving-blockchain-paradox-transportation-logistics.aspx>), here’s how it works. A blockchain is a shared digital ledger for recording and storing transactions between multiple participants in a network. Changes made to the blockchain record must be approved by participants through an automated process. Approved updates are time-stamped, cryptographically signed, and added to the block. The new block becomes part of the blockchain. Unlike traditional ledgers, a blockchain provides an immutable record of all transactions and agreements of interest to the participants—no single party can unilaterally alter the information. Because information cannot be deleted, only appended, a blockchain provides an evidentiary trail of information back to the point of origin.

Blockchains can be public, private, or hybrid. A public blockchain (bitcoin, for example) is open, so that anyone with computing capacity can add to the network, maintain the ledger, and weigh in on issues requiring consensus. In contrast, private blockchains are run by one business, joint venture, consortium, or government entity. Although the controlling party cannot alter data, it has the ultimate say in the rules that govern the platform, including who can join and which members can view or append information in the digital ledger. Hybrid blockchains are controlled by a consortium of businesses or government entities that may give access to the public to view or append information or may restrict access to its members. A private or hybrid blockchain with permissioned access (that is, only authorized users can join and read and write data) provides the highest level of scalability and data privacy. Private or hybrid blockchains can be set up to require far less computing power than public blockchains. If effective supporting technologies are in place, blockchain’s features and benefits can potentially overcome the main obstacles to cooperation among multiple stakeholders in a complex value chain. By providing a single version of the truth for all participants, a blockchain enables trustless transactions and reduces the risk of error or fraud and the need for intermediaries. Participants gain the ability to track the movement of items in real time and verify transactions. A blockchain ledger can also be used to set up a wide range of “smart” contracts that self-execute upon the occurrence of a specified scenario (for example, peer-to-peer payment upon delivery of goods), thereby automating repetitive processes.

* Why Blockchain:

According EY estudy (<http://www.ey.com/gl/en/industries/financial-services/banking---capital-markets/ey-trust-without-it-youre-just-another-bank>) and this independent study (https://drive.google.com/file/d/1mbOtf2yLfRJgNxZz5PxgxDFH0hehFG0v/view), current financial markets systems are still largely centralized, with key central clearing and settlement players around the world - like Depository Trust & Clearing Corporation (equities), Chicago Mercantile Exchange (for commodities), CLS Group (for foreign exchange). The financial services industry has also traditionally been heavily regulated, due to the importance of it to the plumbing of the overall macro-economy, and the emotional connection people have to money and identity.

Taking stock of current financial markets systems, we note that they are plagued by the following issues (but not limited to), which blockchain could potentially alleviate:

* Inefficiency arising from information kept in silos: Information is often maintained in multiple duplicate databases, many of which are kept in-house in the systems of individual players in the ecosystem. Even within the same institution, various departments might use different data sources and maintain their own databases;
* Data center points out that systems today are “unnecessarily complex”;
* Due to this backdrop, transparency levels are low, and the result is the need for time-consuming, large and costly efforts to reconcile.
* Vulnerability to cyberattacks: Given that information is hosted on centralized legacy systems, there is a great risk of large-scale compromises due to system vulnerabilities. This should be seen in the light of rising (and more powerful, more diverse kinds of modern cyber attacks focused on the financial sector. JPMorgan for example, set aside $250 million in 2014, $500 million in 2015 and $600 million in 2016 for cybersecurity efforts;
* Not equipped for 24/7/365 processing where they should be: Today’s systems were mostly architected before the globalization of the capital markets industry. While 24 hours/7 days a week /365 day a year processing is not currently required and arguably, perhaps not advised in some asset classes, the truth remains that the capabilities of the infrastructure today simply cannot achieve that goal;
* The ability to implement atomic transactions[LTJY1] , build immutable audit trails, and simplify settlement and reconciliation across organizations, brought fast adoption and experimentation of DLT within finance and accounting. Within these fields, the technology can be used to create more open, flexible and programmable exchange platforms, substantially extending the concept of double-entry bookkeeping (e.g. examples include Chain, Digital Asset Holdings, Blockstreatm etc.).
* For the Financial Sector, beyond time, labor and cost savings, the development of more interoperable exchange platforms for digital assets substantially reduces entry cost for new players in regulated markets.

Our proposition classification for Finance Uses Casos, with the intention to simplify this understanding:

1. Onboarding and ID verification (KYC/AML) – Creatng ID databases; Identity, documentation, onboarding data verified base;
2. Financial management and Accounting – transfers, accounting, reports; Distributed audited ledger; real time accounting reports; Transparency; it can help indenpency auditor and regulatory agencies;
3. Reduction of Fraud and Risk – Creating and providing access to reputation ratings; Transparency; Providing imutability, data can not be changed, avoiding internal and external frauds;
4. Funding, Investments and Trade Finance – Digitalizing all asset classes (Funds, real state, insurances, derivatives, etc); Creating new types of markets, as equity crowdfunding second market or new stock exchanges. Smart contracts can help lawyers to verfy agreement clauses;
5. Regulatory compliance and Audit – Providng accurated and imutal reports; Provinding real time access; Changing manual work to electronic work;
6. Clearing and Settlement – keeping assets and values in a security way can reduces financial costs and services;
7. Payments and P2P transactions – Avoiding intermediaries, payments and tranfers can be faster and with low cost. More security and transparency;
8. Insurance and Credit Products – New models of funding; Smart Contracts providing real time information about liquidity events; Other types of interest.

## Healthcare (MARCELA)

Data has become the new oil, the use of data in order to analyze the behavior of clients on the platforms has become a real problem, this could be even worse with the use of wearables and the internet advance of things. The question about user responsibility and user consent for this has gained a new chapter with GDPR, requiring transparency in the use of data.

When talking about data in the health environment, this becomes even more delicate, since health data are considered sensitive data. But at the same time the data has been preserved the wrong way over time.

Within the health data we have what is spoken of silos. For various reasons these structures were created with the aim of preserving patients' data, or with a focus within the defined market structures, but silos contribute to information asymmetry, which generates an imbalance in the market competition environment and lack of information sharing, nowadays this is slow, expensive, insecure and not complete.

In order to try to solve the problem of silos and asymmetry a new concept emerges with regard to medical data, making the patient unique and exclusive owner of his medical data, allowing the reduction of the number of examinations and procedures, reducing costs, interoperability is fundamental to support the patient-centric model, it allows for greater security, decreases the lack of trust between service providers, improves scalability.

Within this new context blockchain technology shows itself as a path to application development that enables interoperability between systems by bringing more reliable information and decreasing risks on the action of the physician with the patient.

Blockchain technology would have this ability to show a good pathway over medical data, due to the key features that blockchain technology has as decentralized, secure, reliable, they are aligned with the health data interoperability needs.

In the literature some use cases are defined for the main areas within healthcare:

### Pharma

The pharmaceutical industry spends millions on patents, in addition to receiving government subsidies to produce specific drugs, such as vaccines and autoimmune diseases. Another big question is the sales of fake medicines that in the year 2010 moved 75 billion according to OMS.

Blockchain or DLT technology can help by providing better transparency and traceability for products, for example, to obtain more accurate information of which cases for Supply chain Management, mainly in the supply of medicines that must have an accurate control of environment as the ones that must be kept in cold chambers.

While the literature portrays opportunities for blockchain in the pharmaceutical industry, there is still a need to overcome some shortcomings. First, blockchain presupposes building reliable networks so that information is shared by all peers, but within the pharmaceutical environment there has been little focus on safe and trustworthy exchanges of medication histories across health institutions. Secondly, these are proof-of-concept projects.

### Biotechnology

Just as blockchain is the ideal technology for unique identity creation, it can also be used to manage biotechnology information. Biotechnology is science focused on the application of technology in biology in order to alter a living cell to make it work in a more controllable way. The biotechnology industry manages advances in genetic research to develop pharmaceuticals and other products for human diseases, conditions and crop manipulation.

As biotechnology is a science that defies traditional processes and provides innovative solutions, the use of blockchain is the key to increasing trustworthiness, particularly in the sharing of information that is characteristic of the industry chain, providing the permanent security of the data, unique patient identity management, and provenance of assets.

<http://www.thebioblock.com/about/>

<http://www.macrogen.com/en/main/index.php>

### Medicine

The issue of interoperability of medical data can improve the way a diagnosis is made or better define treatment for a patient. The focus on data management can benefit from the potential of connecting different systems and increasing the accuracy of EHRs. Blockchain Technology can be used to support drug prescriptions and supply chain management, pregnancy and any data management risk, as well as support access control, data sharing, and medical activity management.

With the shift from healthcare services that are migrating to allow a patient-centered approach. health systems, based on blockchain, could increase the safety and reliability of patient data, since it is theirs control over their health records. These systems can also help consolidate patient data by allowing the exchange of medical records at different health care institutions. The storage of medical data of patients is very important in health care, this data is very sensitive and therefore also a primary target for cyber attacks. It is important to protect all sensitive data. Blockchain technology has proven to be very robust against attacks and failures, provides different methods of access control. Therefore, blockchain provides a good framework for health data.

### Insurance

Fraud control in the healthcare industry has a major shortcoming. The numbers of frauds in the health care system have reached alarming levels in recent years, even with the implementation of routine controls, many of these cases become invisible and go through the control routines for long periods.

Frauds are much more complex than can be seen, as in a game of chess, the pieces move in a dynamic game. Fraud schemes are thought from the existence of the filters, in order to legitimize the transaction, inserting a sophistication in the act of fraud.

There are not many studies yet on how blockchain technology can help in this fight against fraud if you have the idea that technology plus a few steps of control can bring a gain for fraud detection faster. But it is necessary to develop a lot with adoption in order to have a real definition of the best use of technology, due to the complexity of the theme.

Health Insurance Claim Adjudication Automation to Surface Error and Fraud

### Conclusion

The research and creation of applications in blockchain in the area of ​​health has been consolidating and is increasing. The focus on application development has mostly been on data sharing, health records and access control, another area that has been explored as a supply chain or management of prescriptions and vaccines. Other areas such as Insurance, Biotechnology still need a greater focus on studies and development.

Therefore, the potential of blockchain use for health is still unexplored. Most surveys feature a new framework, architecture, or model using blockchain health technology.

Another issue raised is the use of smart contracts, and whether some types of consensus algorithms are better for the healthcare environment. We have identified that intelligent contracts can be more widely used because they allow the automation of processes within a blockchain platform.

Future research should bring better structure to applications that are already under development, blockchain is still a new technology, especially in the field of health and new ways of employing it can still be found and researched.

## Information and Communication Technology (SHAHAR)

While traditional centralized management of data may be a good, fast and efficient fit for many scenarios, there are certain cases where DLT offers features that may be of benefit in the ICT industry.

Current DLT deployments in ICT can be broadly divided into two main categories:

1. Retail services
2. Wholesale services

While services from both categories may involve multiple ICT providers, the differentiating factors are related to the users of the services, the types of services and the beneficiaries from the use of DLT.

### Retail services

Retail services are such where the end-user (mobile or fixed-line subscriber) would be the main beneficiary of the service. DLT is used to enable new services and service features that were not available prior to its deployment. Examples may include **mobile top-up, touch/scan-to-pay**. Those may not be new services and are already offered by most mobile operators to their own customers.

However - DLT now enables such services to be offered to visiting/roaming customers from other networks, and for its own customers when they visit/roam other networks. Both can be broadly categorized as opening up mobile-operator services that were previously available only to its own subscribers while on their home network, to visiting users from other networks, and to its own users roaming to other networks.

Another popular use case is establishing a marketplace where vendors (or government offices) sign up with ICT provides to allow selling and buying of goods (or payment for services) through applications installed on their ICT devices.

Looking into the future – **IoT** will heavily depend on efficient, fast and low cost data transfer and processing.

The inherent ability of DLT to handle both data and payments reduces the complexity of data exchange and monetary transactions that involve multiple players. It does so by reducing the number of systems involved, removing data silos, and establishing trust between stakeholders.

### Wholesale services

ICT operators live in a state of *mutual-suspicion* and in an environment of “*coopetition*” where ICT **providers both compete and cooperate with each other**. On one hand ICT operators compete with each other by trying to win the consumer business. On the other hand – ICT operators often rely on complementing their own portfolio with certain elements of service that they acquire from their competitors. This could be geographical coverage of a certain territory, compute or storage resources or specific applications or security features not available on the ICT provider’s own resources.

Management of such supply chain in an environment of mutual-suspicion and coopetition eliminates the option of using a centralized intermediator. It is unlikely that ICT provides will be willing to offer a third-party visibility and management of their resources.

Thus – the wholesale ICT industry is based on a mesh of bilateral agreements between ICT operators transacting in an equal-level playing field.

Being a distributed and non-hierarchical ledger, DLT is a good fit for wholesale ICT supply chain scenarios even when the ultimate beneficiary is an individual subscriber and the supply chain includes operators, cloud, application developers, on-line stores, POS and banks. DLT allows all stakeholders to be linked together to ensure trusted transactions take place and information is correctly stored and retrieved by all parties.

Let us review a few wholesale ICT examples:

Consider number porting as an example where DLT can offer benefits over a traditional centralized database.

Today it’s quite common for a mobile subscriber to have switched from their original operator to a second or even a third operator - while still keeping the telephone number that they were originally allocated. If their number is 054-123-4567 (where 054 represents the dialing prefix of the original operator) the whole number is required to be ported to the new operator.

When someone dials that number, the 054 prefix automatically routes to the original service provider. The original service provider needs to somehow verify whether that number is still on their network before routing it to the correct new service provider, typically for at least some cost.

For efficiency, it makes sense for all operators to keep a database of ported numbers so that when one of their subscribers dials 054-123-4567, they will route the call directly to the new operator. But how is such a database managed and kept up-to-date?

One option would be to use a traditional database, managed centrally. But hold on – who will manage that database? Which operator? Or should a neutral third party be used? Who will pay the cost of operating and administering this database?

The fact of the matter is that today each mobile operator pays a monthly check to one of several third-party companies that manage and administer such databases. In return, the mobile operator is able to query that database prior to routing each call. If the dialled number is found to be ported – the operator is able to route the call to the correct operator.

However, if we were to use DLT as a number porting database technology, then each mobile operator would be able to run their own identical “node” of a distributed ported number database. Within a set of pre-defined rules, each operator would have access to update the DLT with the ported numbers on its network. Through the automatic replication of data across all nodes, this information, as well as information updates from other mobile operators reflecting the ported numbers on their respective networks, would rapidly be available at each DLT instance on each mobile operator’s own systems.

The end result would not be different than using a centralised database, except that the information would now be available locally and would not require a monthly check to be paid to any third-party database operator.

This example demonstrates two major benefits for the use of DLT: *Disintermediation* and *Decentralisation*.

Disintermediation yields simplification and possible cost reductions, while decentralisation fits well in situations where entities operate in an equal-level playing field (such as mobile operators that simultaneously compete and cooperate with each other).

DLT has the ability to remove the complexity of information management in such scenarios where the data is no longer managed by a specific entity at a specific hierarchical level, but is now able to be managed by everyone and located everywhere.

Of course, any advantages DLT technology has to offer hinges on the effective security, data integrity and fraud prevention of the information contained across different independent nodes. To handle these subjects in any depth requires far more extensive comment than is available in this article. However, in general, DLT technologies do have effective mechanisms to identify fraudulent transactions and to ensure the integrity of stored information.

Overall, rather than having to put your faith in the hands of a third party and having to trust their numbers completely without any transparency or visibility, with DLT all involved parties have the ability to manage their own node and use trusted transactions that ensure the integrity of the information that is generated and consumed.

Of course, using DLT for number porting in the telecoms sector is just one example where the technology has the ability to yield significant cost-saving and efficiency benefits. The number porting example could easily ignite your own imagination to identify other areas in the industry where blockchain could be of benefit.

In another example, a group of ICT partners successfully demonstrated a proof of concept that makes use of DLT, artificial intelligence and machine learning, with the potential to disrupt the international wholesale voice minute settlement process and dramatically reduce inter-carrier dispute settlement times.

The initiative demonstrated a significant reduction in the time and effort required to identify discrepancies, resolve disputes and generate undisputed invoices for financial settlements - analysing and settling a whole month’s worth of wholesale voice traffic between two major European carriers within less than 4 minutes.

Put into perspective, this process is currently performed manually and typically requires 6-weeks of work from as many as 30 employees at each operator to complete!

Another example could be the maintenance of a global repository of network resources through a distributed federated catalog. This DLT database could be used to speed up the process of inquiry, ordering, maintaining, invoicing and settlement of network resources, including connectivity, compute and storage, on-demand across two or more ICT operators’ networks.

In October, 2018, a team of eight ICT operators and two technology partners joined forces to demonstrate the ability to perform an inquiry, quote and an order across a chain of multiple interconnected ICT operators - all within less than one minute. In addition, the proof of concept demonstrated the ability to invoice, reconcile SLAs and settle, including financial transactions, across the same chain of ICT operators, within less than two minutes. Both of these processes typically take weeks of work using manual processes.

So while cryptocurrencies like Bitcoin steal the daily headlines, it’s the more workaday practical implications of DLT that are impacting other industries, including ICT.

## Arts, Culture and Entertainment (LISA)

Include DENISA PROJECT, IP rights

### eSports (LISA)

To gamers, DLT and digital currencies are not new. Virtual money has played a huge role in games, where huge sums of real money was exchanged in return for the in-game currency, to buy items within the game that would otherwise take hours and hours of gaming time to earn. Hence, when it comes to the adoption of DLT, there is less resistance in the eSports industry.

Advantages of using blockchain in eSports:

* Gamers do not need special incentive mechanisms to be part of the ecosystem and participate.
* True ownership of in-game items that players can buy and sell freely, enabling robust in-game economies.
* Provable and auditable item scarcity and fairness in drop rates.
* Infinite modability — games can be built that allow developers to build and upload their own alternate game modes for all players to use. Developers can modify and extend server-side logic, allowing for infinitely expandable game worlds driven entirely by community development.

Blockchain Application Categories

* Decentralised Tournaments: players to test their skills and to bet on games without being dependent on traditional money transfers, financial regulations and middleman corruption
* Reputation Management: users may also serve as active clients who can participate in the verification process and earn tokens as a result
* Community Involvement: Enabling decentralised ranking of favourite games, renting spare hardware and bandwidth
* Facilitate betting: create a trustless, secure ecosystem for low fee betting outside the control of a central party, allowing amateur players to host tournament rounds that was once inaccessible to amateur players
* Reduce forgery: increase trust and reliability when it comes to making money out of the time and effort spent playing a game

Sources:

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## Industries - except from ICT (HUI DING)

Traditional industry can be broadly categorized into agriculture, energy, manufacturing, construction, sales, transport, entertainment, information and telecommunication, finance, real estate, technology and science, etc. The products and services can vary across different sectors, but many of them have similar features such as multi-party data exchange, lack of trust, layers of intermediaries, etc., which cost individual enterprises extra money for informational and operational management. Note that ICT, finance and healthcare sectors that are left out of this section will be reviewed in other sections of this report.

### Supply Chain Management

Supply chain management involves the creation and distribution of goods, which is extremely complex process. For different products, the process can span hundreds of stages, multiple geographical locations (some cross borders), multiple payments, various individuals and entities, extended to several months of time. Low efficiency costs all participates extra operational expenses, and it will only be deteriorated as the supply chain grows.

The key requirements in supply chain are reliability and integrity, which can be provided by blockchain. Blockchain can also provide dispute resolution since all entities on the chain have the same version of the ledger. Everyone on the blockchain can see the chain of ownership for an asset on the blockchain. Records on the blockchain cannot be erased. With these advanced features of blockchain, some pilot projects are deployed in logistics and supply chain in manufacturing, agriculture, e-commerce, etc.

* Food industry: IBM Food Trust Initiative, FarmShare, Provenance, Chaincomp
* Manufacturing industry,
* E-Commerce

### Asset Management

* Intellectual Properties Asset: novels, photos, videos
* Real Estate

### Climate Industry (Leonardo)

In the last few decades the world society has been confronted with warnings from the scientific community about the perils from an accelerated change in the climate. To cope with this event, we should adjust and rethink our current market and growth economy. From that we have been observing a significant transition, not only in the global market but also in the means of production. This new logic determines that growth and development cannot be detached from environmental concerns and sustainability.

Against this backdrop emerged a new logic of production that have been responding the need for climate solutions. This emerging green economy have settled the foundations for a new ‘Climate Industry’ – which could be understood as the incorporation, in certain productive segments, of elements connected to sustainability and efforts to cope with climate change, generally through mitigation or adaptation action.

Mainly fueled by climate-related investments, this new industry first focused in few sectors and activities, such as renewable energy, production efficiency, ecological services, etc. Nonetheless, recently, a new call from the scientific community has indicated that the “traditional” climate approach would not be enough. It would sneed a new collective effort and considerable technological breakthroughs to achieve the necessary levels of reduction of Greenhouse Gases and limit the impact on the environment. To address these new calls, the nascent ‘Climate Industry’ took a turn to a technological intensive and innovative business models.

Currently is possible to identify many climate related initiatives relying in emerging and disruptive technologies, such as Artificial Intelligence, Internet of Things and Blockchain. This technological turn taken by the Climate Industry enabled a greater decentralization of the climate solutions, since in its early days, Climate Industry enterprises were generally capital intensive and restricted to only few actors. Now there are a number of startups and other small and medium actors that are revolutionizing the Climate Industry and the Green Economy.

## Government and Public Sector (HUI DING, Yihui)

Incomplete data makes effective decision making extremely difficult, especially in government. The lack of digitization aggravates the problem. With many records existing only in paper form, people need to appear in person to update their information. Even in governments with high level of digitalization, blockchain can be used to prevent forgery and counterfeit and present trusted data.

Governments also regularly work with individual private agencies, all of which have their own collection of data and information management protocols. These non-transparent, fragmented systems create mis-information and scattered data that is difficult to weave together. Governments are also not allowed to access sensitive information from individual private agencies. Government services, therefore, require duplication. Evaluation of successful programs becomes difficult, tax dollars got uncollected, infrastructure maintenance is inefficient, and even health care dollars often go to waste. Even when the government implements data analytics to help make better decisions, the analytics are only as good as the data itself.

### Advantages in blockchain2 for government and public sector

Blockchain technology could simplify the management of trusted information, making it easier for government agencies to access and use critical public-sector data while maintaining the security of this information[[1]](#footnote-1).Over the last couple of years, governments started experimenting with DLT for the purpose of increase accountability, transparency and efficiency for government affairs. DLT is an asset record keeping system supported by decentralized participates. There are a number of blockchain tools and technologies that government agencies can implement today to protect critical data and improve the management of records associated with property ownership and incorporation. In the long term, as blockchain matures, governments may also use it to enable networked public services.

Currently, applications of blockchain in government and public sector can be generally categorized into:

1. Regulation compliance
2. Government data management

### Regulation compliance

Regulation compliance is a promising direction where governments using the blockchain to boost efficiency by eliminating some of the intermediaries. Regulation compliance usually involves several intermediaries and steps.

**Case 1: Blockchain invoice in China**

For example, tax collection goes through several intermediaries including different business activities, contracts and complex tax system. Chinese internet giant Tencent has partnered with the tax authority of the city of Shenzhen to use blockchain in the fight against tax evasion. The first blockchain invoice was issued on August 10, 2018. It is the only such pilot to have received the official approval of the State Administration of Taxation, and has been designed for comprehensive use by consumers, merchants and tax authorities, according to EEO. The system allowed for a consumer payment via WeChat to generate an invoice that would be eligible for inspection and management by tax authorities. Cai Yunge, general manager of blockchain at Tencent, is quoted by EEO as saying that the new system achieves a frictionless link between consumer scenarios and tax services.

<https://cointelegraph.com/news/china-issues-first-tax-authority-approved-invoice-on-blockchain>

**Case 2: Blockchain stored digital evidence**

Supreme Court of China recently announced that internet courts in the country shall recognize the legality of blockchain as a method for storing and authenticating digital evidence. “Internet courts shall recognize digital data that are submitted as evidence if relevant parties collected and stored these data via blockchain with digital signatures, reliable timestamps and hash value verification or via a digital deposition platform, and can prove the authenticity of such technology used,”

<https://www.coindesk.com/chinas-supreme-court-recognizes-blockchain-evidence-as-legally-binding>

### Government data management

**Improving the data management process**

Many governments recognize the importance of having an efficient method of collecting data. With big data analytics, governments can modernize existing government services and aid their economies. While problems concerning data collection range from error-filled data input, to untrained workers, and problems with data collected by private sector contracts, the largest issue is the original, centralized databases. In certain government sectors, systems are so inefficient that workers stopped inputting information altogether simply because it was too time-consuming for them to do their jobs. Not only are governments furthering inefficiencies, they miss out on huge growth opportunities. The blockchain is an example of a transparent, decentralized, digital network that could help governments effectively collect and store data[[2]](#footnote-2).

**More trust in government through blockchain technology**

A more secure infrastructure like the blockchain network can decrease inefficiencies from the older system and gain greater trust and adoption by the wider public. Over time, with a blockchain network, the government can create rules and algorithms that automatically share data with third parties once the parties fulfill the smart contract’s terms. These smart contracts remove the need for additional human resources as well, which can be costly and time consumptive.

**Case 1: Keyless Signature Infrastructure (KSI), Estonia**

The nation of Estonia, for example, is rolling out a technology called Keyless Signature Infrastructure (KSI) to safeguard all public-sector data. KSI creates hash values, which uniquely represent large amounts of data as much smaller numeric values. The hash values can be used to identify records but cannot be used to reconstruct the information in the file itself. The hash values are stored in a blockchain and distributed across a private network of government computers. Whenever an underlying file changes, a new hash value is appended to the chain, and this information can no longer be changed. The history of each record is fully transparent, and unauthorized tampering from within or without the system can be detected and prevented. KSI allows government officials to monitor changes within various databases—who changes a record, what changes are implemented, and when they are made. The electronic health records of all Estonian citizens are managed using KSI technology, and the country is planning to make KSI available to all government agencies and private-sector companies in the country.[[3]](#footnote-3)

**Case 2: The government of New Zealand**

The government of New Zealand will participate in the pilot of a blockchain data management system developed by software firm Nyriad and hosted on a cloud platform operated by Revera, a company that already houses some government data.

Various unnamed departments are expected to take part in the trial, which will test a system designed to store sensitive information in a more secure and streamlined manner than has historically been possible with traditional digital database systems[[4]](#footnote-4).

**Case 3: The government of US**

Blockchain is not a silver bullet for the U.S. government as society transitions to a state in which digital record-keeping becomes nearly universally accepted. However, as blockchain-related technology is more widely implemented, it could represent the future of legally-binding “smart” contracts, and shape how entire industries conduct their business in a transparent and streamlined manner, in partnership with the U.S. government. There are several working groups and pilot projects (in all stages of work ranging from proposed, to under development, to deployed) focused on applying blockchains within the U.S. government. The most common trends evaluated by federal agencies include: financial management, procurement, supply chain management, smart contracts, government-issued credentials, Federal personnel workforce data, Federal assistance programs, foreign aid delivery, health records and biometric data.

**Case 4: The government of South Korea**

Last month, Mayor Park said that the government will develop a citizen’s card using the distributed ledger which will be used to process payments, store mileage, and carry out a variety of daily tasks. The government selected ICONLOOP as the official operator of the Seoul Blockchain Demonstration Project and the ICON team is expected to be involved in the development of most distributed ledger-based applications of Seoul in the years to come.

**Case 5: Smart Dubai with Blockchain**

The government of the United Arab Emirates (UAE) has also taken steps of establishing a Global Blockchain Council to promote the use of blockchain among its services, such as e-democracy, e-residency or land registration, while other projects are focused on the broader use of this technology in solutions for national and international identity management and national data centers. Dubai Blockchain Strategy project is a new technology project which aims to position the UAE as a global distribution that includes all aspects from e-democracy to smart tourism.

### Challenges in blockchain

First, there are no widely accepted standards for blockchain technologies or the networks that operate them. Government IT organizations—like everyone else—may therefore have a hard time assessing the quality of available solutions and determining how best to integrate them within their existing IT landscapes. Second, because many blockchain providers are small start-ups, it may be difficult for IT and procurement departments to identify partners with staying power—that is, companies that can offer cutting-edge products but are stable enough to see projects through to implementation.

At the same time, privacy risks will require constant attention. Even if governments could deploy blockchains that share data across public networks (as in the “networked services” scenario described earlier), they would still need to ensure that current and future encryption methods are strong enough to ensure user privacy. Leaders in government agencies will need to understand the legal and regulatory implications of blockchain, among them: To what degree will smart contracts be binding? Can blockchain audit trails be used as evidence in court? Should the use of blockchain be mandatory in certain fields? [[5]](#footnote-5)

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13. <https://www.ibm.com/blogs/blockchain/2018/10/how-the-uae-is-empowering-its-citizens-through-blockchain/>
14. “Blockchain for government and public services”, the European union blockchain Observatory & forum, <https://www.eublockchainforum.eu/sites/default/files/reports/eu_observatory_blockchain_in_government_services_v1_2018-12-07.pdf>

# Horizontal Domain (Yihui)

As an emerging technology, blockchain has the potential to be applied in many areas, not only for vertical use cases, but also for horizontal use cases. Apart from its unique trust-building mechanism, blockchain is basically a decentralized and distributed database, which is jointly maintained by multiple parties, using cryptography to ensure the security of transmission and access, to achieve data storage consistency, data tamper-proof, and prevention of repudiation. The horizontal use cases focus on the technical features of the database itself, rather than vertical sector segmentation.

Considering the actual landing scenario of the current blockchain in the horizontal domains and the collection of use cases, some typical and potential sectors such as identity management, security management and data management have been chosen for representing this domain.

The horizontal domain represents use cases that are applicable across multiple sectors of the economy, including

– Identity management;

– Security management; and

– Data management.

## Identity management

Everyone uses identity document on a regular basis, which gets shared with third-parties without their explicit consent and stored at an unknown location. Even if corporations manage to keep our data safe, we still lose ownership over our identity. Despite the internet becoming an intrinsic part of human daily life, there is no adequate way of sharing our data without it being misused.

A blockchain-based digital identity solution could focus on three key challenges: security, privacy and usability. Blockchain technology may offer a way to solve this problem without the need for a trusted, central authority. More specifically, individuals and businesses could store and authenticate their identity on the blockchain, giving them greater control over who has their personal information and how they access it. By using a decentralized, open-source blockchain and combining it with an identity management, we could create a digital ID, which would act as an incorruptible watermark. This watermark could be used to verify an identity for any transaction in real time. Once such a digital ID has been created, it could be used to verify an identity for any service, dispensing with the need for clumsy and unreliable password/email combinations[[6]](#footnote-6).

**Case1: Civic**

Civic, a digital identity management platform works by collecting various user identifying information and passes them through a government agency or third party identity verification service depending on the country the user is located or hails. The system then collect a cryptographic hash and stores in the blockchain while erasing other personal data from the servers. Users can utilize the hashed information to authenticate in order to use another service. In other words, they can share whatever information they need to. The authenticated service will no longer need to store user information. Once the hashed data is stored, even hackers or intruders cannot get the data unless if there was a way to decrypt the data[[7]](#footnote-7).

**Case2: Shocard**

Shocard provides the ShoBadge platform that avails blockchain-based digital identity verification and authentication process. Users such as banks and businesses can use the platform to extend security and privacy to their systems and to secure user data when required, for instance to secure data against breaches. Individual users can also use the system to share any personally identifiable information (PII) with any organization they wish. It secures data, which is also independently verified with one way digital signatures of hashes of their data on the blockchain[[8]](#footnote-8).

**Case3: Netki**

IBM is running a project to help accelerate growth of networks on Hyperledger Fabric. With Nekti, users not only create digital identity but they can carry that digital identity seamlessly across multiple blockchain to share their identity with whomever they choose. This improves user privacy compared to common practices today. And on May last year, the company launched the highly-anticipated Digital ID smartphone app to help people control their identities better. In other words, it gives everyone who needs a government-approved identification a feature-rich, blockchain-based, free solution that can be used anywhere.[[9]](#footnote-9)

## Security management

Security management is the identification of an organization's assets (including people, buildings, machines, systems and information assets), followed by the development, documentation, and implementation of policies and procedures for protecting these assets.

An organization uses such security management procedures as asset and information classification, threat assessment, risk assessment, and risk analysis to identify threats, categories assets, and rate system vulnerabilities so that they can implement effective controls

Blockchain has the potential to improve everything from improving data integrity and digital identities to enabling safer IoT devices to prevent DDoS attacks. Indeed, blockchain might play across the ‘CIA triad’ of confidentiality, integrity and availability, offering improved resilience, encryption, auditing and transparency.

**Case1: Xage**

The Xage Security Suite is the first and only blockchain-protected security platform for the Industrial Internet of Things (IIOT). Xage includes Blockchain technology, which elegantly satisfies the challenging security environment of Industry 4.0. By enforcing immutable records and distributing and sharing identical security data across the nodes in its network, Blockchain is tamper proof, redundant and self-healing.

Through a process of continual reconciliation, consensus between devices secures the network when new or intermittently connected devices join it. Through the Xage security fabric, devices establish consensus to identify and isolate bad devices and applications infected with malware like Mirai. This self-healing capability delivers the data integrity and redundancy that Industry 4.0 needs to thrive. Blockchain also integrates well with redundant, thresholdbased technologies like Shamir’s Secret Sharing to flexibly secure operational data.[[10]](#footnote-10)

**Case2: Blockstack**

Blockstack is the first naming system, which operates directly on top of the Bitcoin blockchain. Formerly it was Onename and built on top of Namecoin. After a security crisis of Namecoin, the development team decided to migrate the whole system to the Bitcoin blockchain. Therefore, the ability to migrate across different blockchains became one of their design philosophies and the name is also changed to Blockstack which reflects the concept of layered blockchains. Blockstack combines a DNS system with PKI (public key infrastructure). Blockstack is built on top of the Bitcoin blockchain which cannot accommodate large data such as name-value pair information. Not only can Blockstack increase the data storage capacity considerably, but allows the logical layer to improve and extend independently[[11]](#footnote-11).

## Data management

Blockchain contains what everyone in data management, from data scientist to chief data officer (CDO), wants: Information that comes with complete provenance. That is data showing who did what, when and with full history from day one. Verified by all parties participating in the network, transparent, with complete reconciliation, and secured by the latest in cryptography.

Blockchains are authenticated records of the history of a network’s activity distributed among the users of the blockchain all around the globe. A blockchain enables secure storage of arbitrary information – in some cases, a token balance; in other systems more complex information – within the network simply by securing a set of private keys. After some years of evolution, blockchains are now capable of storing arbitrary data and establishing permissions to modify that data through self-administering and self-executing scripts, which are performed by a distributed virtual machine. These scripts are known as smart contracts, and they allow platform operators to define complex and fully customisable rules, which govern the blockchain’s interaction with its users. [[12]](#footnote-12)

Three reasons blockchain technology is exciting for data management:

1. The potential cost savings: On a very practical note, distributed storage is much cheaper than maintaining servers to store your own data or popular cloud storage solutions such as AWS.
2. A harder-to-hack system: To be clear, storage on the blockchain isn’t inherently safer than centralized cloud storage, but techniques such as sharding, in addition to the decentralized nature of distributed storage, make it harder for bad actors to access or steal your data.
3. Automation through smart contracts: One of the most exciting implications of blockchain technology is the ability for businesses and individuals to cut out the middlemen in terms of data oversight.

**Case1: Camelot**

German Camelot Consulting Group has developed a Blockchain-based solution for the management of sensitive medical data, Cointelegraph reported Monday, April 9. With its Hypertrust X-Chain data management system, the company aims to offer the healthcare industry a secure digital platform for the exchange of patient data. It aims to provide all actors that are authorized to participate in the therapy process with decentralized data storage based on Blockchain technology. All data transactions are encrypted and stored on an unchangeable Blockchain and will be carried out directly between the authorized participants, the company says. It will also allow the “integration of partner systems”, “real-time temperature, location and quality control as well as reliable proof of origin”.[[13]](#footnote-13)

# Barriers to DLT adoptions (Lisa)

Specific

Ecosystem

# Significance of DLT in the attainment of the Sustainable Development Goals (SDGs) (INON. MICHAEL, RICK, HUI, MARTIN, SUZANA).

In September 2015, 193 members of the United Nations endorsed 17 Sustainable Development Goals (SDGs) to be attained by 2030. The SDGs are a key reference point for all development actions and, particularly, those undertaken by the United Nations and its specialized agencies. Totaling to over 160 different measurable targets, the goals cover a broad range of social and economic development issues including poverty, hunger, health, education, gender equality, clean water, sanitation, energy, environment, and social justice. They also lay great emphasis on the role that trade, tele- communication and innovation can play in support of sustainable development, as well as for the provision of effective government services that support more inclusive economic and social progress.

The SDGs are perhaps the most ambitious and far-reaching initiative in human history to address major economic, social, and environmental problems confronting our planet. The SDGs are predicated on the notion that efforts to alleviate poverty have to go hand-in-hand with endeavors that simultaneously seek to build economic growth, while addressing a range of social needs including education, health, and employment opportunities, while tackling climate change and environmental protection. Connectivity, Internet, digital solutions, are essential for successfully achieving nearly all of the SDGs.[[14]](#footnote-14)

One of the obvious challenges of the SDGs is the funding gap between all of the multilateral funding organizations and the financial requirement needed to fund the SDGs. Initial estimates suggest that achieving the SDG targets would require annual incremental investments of between $5 to $7 trillion.[[15]](#footnote-15) Additionally the UN currently does not possess all of the Key Performance Indicators (KPIs), dashboards, tools and mechanisms to provide transparent measurement of the SDGs progress, which arguably, leads to the challenge of how to ensure that the SDGs can be credible, verifiable and ultimately successful.

As highlighted earlier in this report, distributed ledger technologies, blockchain and immutable records, provide both transparency and security simultaneously and can be a critical tool in enabling and eventually scaling progress toward the SDGs.



Originally, the technology’s primary use was to store and track cryptocurrency transactions (e.g. Bitcoin). However, other uses and implementations have emerged in recent years. Some blockchain applications which are already being used to support the SDGs include: the establishment of identities (for example for refugees), the tracking of information linked to identities (related to health, social benefits), the distribution of resources, the tracing of goods and their content or original source, transparency in donor funding as well as banking unbanked populations.

Recently, several internal UN initiatives emerged with the objective of increasing agencies and other UN bodies understanding of DLT, information sharing and tools. The UN Innovations Network is spearheading such an effort out of New York and in Geneva, a first Inter-Agency meeting on the matter was held on 26th March 2019, co-chaired by UNECE and SDG Lab.

The Blockchain Commission for Sustainable Development released a white paper entitled: ‘The Future is Decentralized: Block chains, distributed ledgers, and the future of sustainable development’, which examined “six areas of application — development aid effectiveness, digital identity, remittances, supply chain management, energy and property rights.”[[16]](#footnote-16)

Here are some examples:

**Logistics**

A key to improving delivery to the World Food Program, which is part of which is the world’s largest humanitarian organization, and a branch of the United Nations, is to improve logistics, tracking and payment. There is a blockchain trial, which seeks, “...to deliver aid efficiently to refugees and slashing the cost up to 98% in comparison to the traditional methods. World Food Program is one of those rare examples that has delivered tangible results for the society through its blockchain experiments.”[[17]](#footnote-17)

**Cash**

The have been a number of events that have focused on blockchain and sustainable and inclusive finance.[[18]](#footnote-18)

There are a number of examples such as “Coins.ph in the Philippines, Kenya’s BitPesa, Mexico’s Bitso, India’s Unocoin and others are using blockchain to expedite cross-border payments, establish new types of digital wallets and allow peer-to-peer payments with digital currencies for previously unconnected people and markets.”[[19]](#footnote-19)

As part of the World Food Program Building Blocks pilot they are “... trialling blockchain as a means of making cash transfers more efficient, transparent and secure. Cash assistance and emerging digital opportunities empowers vulnerable households to meet their essential needs according to their priorities. WFP assistance is increasingly being delivered in the form of cash transfers, which are likely to reach close to USD1.6 billion in 2018.”[[20]](#footnote-20)

**Biometric/Cash**

“Everest, the first platform to combine biometric identity with a digital wallet, announced today that it is partnering with Indonesia’s TNP2K (National Team for the Acceleration of Poverty Reduction) to conduct a pilot in selected regions to enhance the efficiency, accountability, transparency, and gender inclusivity of the National LPG (Liquefied Petroleum Gas) Subsidy Program. By leveraging blockchain technologies, the Everest platform helps deliver subsidies to digital wallets, enabling those who meet the requirements to realize this important benefit, even users without a mobile device. The LPG subsidy program was developed to provide 41 million Indonesian households with liquefied petroleum gas as cooking fuel instead of dangerous and costly kerosene.”[[21]](#footnote-21)

Other areas of possible blockchain usage include:

* UNFCCC Secretariat created the Climate Chain Coalition, which uses DLT to strengthen monitoring, reporting and verification (MRV) of climate actions;
* The UN Office for Project Services (UNOPS) and the UN Department of Management’s Office of Information and Communications Technology (UN-OICT) to use blockchain to combat child trafficking in Moldova
* UN Secretary-General António Guterres highlighted the use of blockchain in nuclear safeguards or machine learning in multilateral disarmament verification, as examples of ways for new technologies to support disarmament and non-proliferation[[22]](#footnote-22)

Connectivity and digital solutions can help deliver the most ambitious and far-reaching economic and social initiative in human history. More information “dashboards” are required to move countries toward achieving the goals by the year 2030.

In the work of the focus group, we have used the following criteria to assess the use cases submitted on their potential to contribute to the SDG attainment:

* Use case addresses at least one of the 17 Sustainable Development Goals

Explanation: to be included, it is sufficient that a use-case addresses any one of the 17 SDGs. No preference is given to use-cases which address many or all SDGs

* Use Case is not owned by an individual and submitted by a recognized (e.g. registered corporate) legal entity

Explanation: use-case scalability may require at minimum an organizational structure.

* A group of reviewers agreed that this use case contribute to the SDG Attainment.

Explanation: Team work is emphasized principle in FG DLT

Using these criteria, we have identified the following use cases as particular relevant to the SDG Attainment.

**Use case 1 – Vaccine Supply Chain (include reference to the generic use case in this document)**

SDG 3. Indicator 3.2 and 3.8

The application aligns to SDG 3 indicator 3.2 and 3.8 by ending preventable deaths to children under five and access to quality essential health-care services such as vaccines.

SDG 9. Indicator 9.1

The blockchain application aligns with SDG 9. Indicator 9.1 in that it will provide a reliable and resilient infrastructure that will support human well-being by enabling access to vaccines.

SDG 17. Indicator 17.18

The blockchain application aligns with SDG 17. Indicator 17.18 by increasing significantly the availability of high-quality, timely and reliable data disaggregated by gender, age, geographic location and other characteristics relevant in national contexts concerning immunization.

**Use case 2 – Reverse Logistics for waste management**

**Use case 3**

**Use case 4**

**Use case 5**

**[to be completed]**

# Standardization Efforts (SHAHAR)

*“Standards facilitate interoperability: this is important for competition. Furthermore, by setting ground rules, a common terminology, development methods and measurement techniques, standards enable the development of follow-up innovations and the diffusion of innovations.*

*Standardization may also help create critical mass in the formative stages of a given market. However, setting standards can also pose risks: they may lead to undesirable lock-in into sub-optimal technologies and allow incumbents to create barriers to market entry with negative implications for innovation.”*   
(Source: <https://www.innovationpolicyplatform.org/content/markets-competition-and-standards>)

Standardization can provide economies of scale benefits and ensure effective interoperability between different systems and platforms. It also provides the conditions to avoid anticompetitive behaviors and to conduct the market to an efficient operation. Nevertheless there are concerns regarding a very prescriptive approach that could prevent innovation at this very early stage of DLT roadmap.

Taking an abstract approach, a DLT use case can be broken down to two abstract layers the ledger layer and the applications layers. The ledger layer is based on either OpenSource ledgers, downloadable from public repositories such as github.com, or on proprietary lodgers developed by individual developers/vendors. One may ask if standardization is actually required on the ledger level. Multiple ledger types exist for a reason, as they vary one from another by features such as consensus mechanism, smart-contract coding language, resource requirements and more. They also vary one from another by their suitability to specific use cases – be that a permissioned or permissionless ledger, be that a public or private ledger. It is technically impossible, at least at the time this document is written, for ledgers of different types to use the same chain (this is written with the caveat that there are certain groups of ledgers, e.g. the eight variants of Ethereum, that can use the same chain. These variants were built with this purpose in mind). Thus standardization of the ledger layer should not focus on reducing all variants of ledgers down to one common ledger type, or to one common chain type, but rather on a standard method to link or refer to records that exist on different chains created by different ledgers.

Standardization at the application level is where the industry should probably focus. One must keep in mind that to-date all applications are proprietary developments. While DLT may disintermediate hierarchical top-level repositories, the applications remain the IP of the developers, creating a vendor-lock-in. When the application is developed in-house and serves a single organization – this may not pose a problem. But in instances where the application serves multiple (sometimes competing) entities, vendor lock-in is a situation to be avoided. Vendor lock-in creates dependency, reduces diversity and increases operational risks. This is where standardization can bring real benefit. To begin with – there are certain functions, such as identity and payment, which are common to the vast majority of use cases. Those functions would be the first candidates for standardization. Other functions may be more use-case specific, and it may make sense to dissect them to what one may define as an MVP (Minimum Viable Product) and VAF (Value Added Features). Standardization of MVPs would then allow developers to compete on the VAFs, differentiating their offering from that of others. A common approach towards standardization would be to build an abstract RA (Reference Architecture) that defines the basic building blocks, and their relations/information-exchange points. Then one would build a common IM (Information Model) and DMs (Data Models) that are derived from the IM and define the structure of the information flows between the building blocks (through the information-exchange points). The next phase would be to look at the functionality of each building block and define it using state-machines or flow-diagrams for all lifecycle operations of the entire application which then constitute the standard operation of such block that developers should built to. It is not uncommon that when use cases (MVPs) are being added – commonalities are being discovered, making certain blocks in one MVP reusable in another.

Another important aspect of standardization is portability of applications between ledger types. Clearly each ledger has a somewhat different northbound (ledger to application) interface that requires, as a minimum, different APIs (AKA “2nd layer”). However – with the use of different coding languages for the smart-contracts by each ledger, such portability may require rewriting the contracts, which to-date is a manual task. It would be of benefit to develop a standard, abstract, smart-contract template that can then be automatically compiled to the ledger of choice. Though it may look far fetched – by combining application portability between ledger types, and standardizing linking or referring records between chains – we allow interoperability of applications that run on any type of ledger.

Looking at the different use cases presented to DLT FG, it would be safe to state that most of them will benefit from the adoption of a standardized approach to application development. It is not recommended, at this stage, to enforce the choice of ledger type (e.g. Ethereum, HyperLedger, Neo, a proprietary ledger or any other ledger available for use) per use-case type, but it is recommended that the industry develops guidelines highlighting the benefits and disadvantages of different ledgers and thus their level of suitability for use cases of different natures. Standardization is discussed to a greater detail in the ITU-T FG-DLT WG3 document….[link].

From electronic mortgage to pharmaceutical supply chain, from distributed energy generation to public sector loans, all applications can take advantage of scale costs reduction and interoperability inherent to standardized interfaces. Another benefit considered with standard interfaces is the portability of solutions between alternative service providers.

# Recommendations

[TBD]

# Appendix – Use cases

## Finance

### Financial management & accounting: Custodian accounting of electronic mortgage

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Vertical |
| Submission Date: | 28.12.2018 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | [Custodian accounting](https://www.multitran.ru/c/m.exe?t=5344233_1_2&s1=%E4%E5%EF%EE%E7%E8%F2%E0%F0%ED%FB%E9%20%F3%F7%B8%F2) of electronic mortgage | Domain: | List 8  Appendix 2 |
| Status of Case | Pilot | Sub-Domain | 1. Finance    1. Financial management & accounting    2. interbank payments    3. Reduction of Fraud    4. Financial messaging    5. Asset lifecycles and history |
| Contact information of person submitting/  managing the use-case | Full Name: Dergachev Ivan  Job Title: Project manager, Fintech Association  E-mail address: ivan.dergachev@fintechru.org  Telephone number: +7 926 773 77 74  Full Name: Alexander Chuburkov  Job Title: Expert GOST R \* Russian TC 26 Cryptography and security mechanisms \* ISO TC 307 Blockchain & DLT \* Fintech Association (RUS) \* Chair WG4 FG DLT ITU-T  E-mail address: chuburkovalex@gmail.com  Telephone number: +7 965 336 62 92 | | |
| Proposing Organization | Fintech Association  Address: 4 Shlyuzovaya Embankment, Moscow, 115114, Russia  Web site: http://fintechru.org/ | | |
| Short Description | Masterchain is a P2P-network with access control. The communications between the nodes of this network are based on the modified Ethereum protocol. Masterchain provides for safe record of information in a distributed ledger. The copies of this ledger are kept at each node of the network.  Here you can see the white paper of the Masterchain:  <http://fintechru.org/documents/Masterchain_whitepaper_v1.1_en.pdf> | | |
| Long description | **Masterchain is:**   * System using blockchain, hierarchical, with a restriction on the addition of information; * Ledger type is replicated; * Financial organization included in the Masterchain-authorized user of the information system, which can be both a user-validator (confirming the creation of a new block) or a user-controller, and as a result of the consensus procedure - user-registrar of the information system; * Conventional unit (token) - technological units of account/ specialized units of account; * User-registrar’s resource - the computing power of the node (pool) of the user-registrar, expressed in the number of calculations of the hash function per second. * Type of consensus procedure - PoW.   Decentralized Depository system is a platform implemented in the Masterchain.   * Decentralized Depository system including electronic mortgages aims to combine the accounting systems of the depositories of the Russian Federation in the unified ledger . The DDS application is part of the initiative, which aims to translate the entire process of buying property from the selection of the object to the registration of mortgages and obtaining rights to real estate in the "online" and to make maximum transparency at all stages. * DDS provides depositaries with the ability to perform the functions of storage and (or) accounting and confirmation of rights to electronic mortgagees to owners of mortgages or other persons exercising rights to electronic mortgages, conducting Depository operations, ensuring the accounting of mortgage parameters, as well as receiving reports on the status of mortgage registration in the Depository at any time. * DDS allows exchanging information messages between depositories, including orders, keeping records of electronic mortgages on accounts provided by the Bank of Russia acts, storing files of electronic mortgages, as well as documents that can be created/issued in pursuance of electronic mortgages. * Is necessary for conducting Depository accounting of electronic mortgages in connection with changes in the legislation of Russia, which introduces the concept of electronic mortgages - a non-documentary security, the rights of which are fixed in the form of an electronic document signed by an enhanced qualified electronic signature, which is stored in the Depository, in accordance with article 13.2 of the Federal law of 25.11.2018 No. 328-FL.   **General principles of Depository accounting in DDS:**   * Depository accounting of mortgage certificates is in pieces. * Mortgages on Deposit accounts are accounted for on a double entry basis (in accordance with clause 5.1. Bank of Russia Regulation No. 503-P). Each mortgage in the Depository account must be recorded twice: once in the passive account and once in the active account for mortgages recorded in the Depository, the balance must be kept: the total number of mortgages recorded in the passive accounts of the depot must be equal to the total number of mortgages recorded in the active accounts. * Depository operations are carried out on the principle of "two hands": the operator (it is possible to use the "technical user" in the system) and the controller. * It is not allowed to have a negative balance of mortgages recorded on the depot account.   **Document accounting system:**   * A system of accounting for documents related to Depository accounting, as well as documents related to the storage, recording and transfer of rights to electronic mortgages should be organized within the framework of the DDS. Records of documents that have been received (incoming documents) or sent (outgoing documents) by the Depositary shall be accessible. * Document accounting system may include software hardware designed to generate, send and receive electronic documents. | | |
| SDG in Focus (when applicable) |  | | |
| Value Transfer: | Reduce of the mortgage business process costs by 30% | Number of Users: | *10* |
| Types of Users: | **Business roles of DDS users:**   * Record-keeping Depository - the Depository carries out the storage of the mortgage, that is, performs the function of storage information contained in the electronic mortgage and agreements to the electronic mortgage, as well as interaction with Rosreestr during registration, amendments in the mortgage, cancelling the mortgage. * Record-entry Depository - depositary carrying out accounting and transfer of mortgage rights. Does not store the mortgage, provides services for the accounting and transfer of rights for the mortgage. * Role combining the roles of the Depositary of storage and Depository of accounting rights. | | |
| Stakeholders | Fintech Association, Banks. | | |
| Data: | There are two different kinds of data stored in Masterchain. The first is open data, that is stored in ledger and is available for all users in network. The second type is confidential data. It is stored in special storage. Access rights to confidential data are configured in smart-contract called “Role Model”. | | |
| Identification: | Addresses in network are calculated using certified cryptographic methods. These addresses within roles and access rights of users are stored in special smart-contract called “Whitelist”. Each operation in network should pass an authorization using this contract. | | |
| Predicted Outcomes: | * Elimination of the risks inherent in a paper mortgage: the risks of loss of the mortgage and the need for a procedure for the mortification of rights under the lost mortgage. * Increasing transparency of interaction between mortgage market participants and regulators. * Acceleration of securitization: the process of portfolio valuation and sale of the fixed volume of mortgages. | | |

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| --- |
| Overview of the Business Problem or Opportunity |
| The objectives of the project:   * Switching from paper documents to digital form due to Russian law * Optimization of the business process by dint of DLT * Simplification of the procedure of securitization   For all participants of the business process it means a significant reduction of time (in 3-5 times). Process reduces the risk of falsification of the document. For Depository, it means a reduction of operating costs by 30% and simplification of furnishing of documents for the Regulator.The process of document verification is simplified for the Regulator. |
| Why Distributed Ledger Technology? |
| The Blockchain and smart-contracts make this interaction trustworthy, transparent and understandable. The implementation of DLT solution, which allows tracking electronic mortgages, can eliminate paperwork and shorten the time of transaction. |

### Financial management & accounting: Digital Letter of Credit

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Vertical |
| Submission Date: | *28.12.2018* | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Digital Letter of Credit | Domain: | List 8 Appendix 2 |
| Status of Case | *Pilot* | Sub-Domain | 1. Finance    1. Financial management & accounting    2. International & interbank payments    3. Reduction of Fraud    4. Financial messaging    5. Asset lifecycles and history    6. Trade finance    7. AML/KYC |
| Contact information of person submitting/  managing the use-case | Full Name: Dergachev Ivan  Job Title: Project manager, Fintech Association  E-mail address: ivan.dergachev@fintechru.org  Telephone number: +7 926 773 77 74  Full Name: Alexander Chuburkov  Job Title: Expert GOST R \* Russian TC 26 Cryptography and security mechanisms \* ISO TC 307 Blockchain & DLT \* Fintech Association (RUS) \* FOCUS GROUP DLT ITU-T  E-mail address: chuburkovalex@gmail.com  Telephone number: +7 965 336 62 92 | | |
| Proposing Organization | Fintech Association  Address: 4 Shlyuzovaya Embankment, Moscow, 115114, Russia  http://fintechru.org/ | | |
| Short Description | Development and implementation of a software package to opening and implementation of a digital letter of credit based on a distributed ledger platform. | | |
| Long Description | **The goals of the project** are the creation and implementation of the application, improvement of legal regulation of digital letter of credit.  **The objectives of the project are:**   * *the formation of requirements and hypotheses for testing* ( business requirements, functional requirements, hypothesis for testing on the prototype of the system, the target scheme of the system node and integration requirements); * *the development of a prototype system* (the prototype system, the test system prototype, the testing protocols of the prototype system); * *the* development of the pilot system and its integration with external systems (the pilot system, the script /test reports of the pilot system, reports on the testing of hypotheses, the program of activities/reports on the readiness of the transition to experimental-industrial exploitation system); * the introduction of the system/launch of the pilot (reports on the results of the commercial operation system, acts of transition to the commercial operation system, plan / report on the distribution of the system); * *the identification of obstacles/opportunities to improve the base of the*  *regulatory legal act for digital letter of credit, the preparation of proposals and the organization of their adoption* (a list of regulatory legal act in digital credit for development/change, proposals in digital credit for the enactment of the PPA digital credit enacted).   **Projected effect:**  - reduction the duration of information exchange processes from 4 days to 0.5 days;  - reduction of labor costs of the Bank's involved employees - up to 20%; | | |
| SDG in Focus (when applicable) |  | | |
| Value Transfer: |  | Number of Users: | 10 |
| Users: | Exporters, Importers, Banks, Shipping companies | | |
| Types of Users: | Buyer, Buyer's Bank, Supplier's Bank, Supplier. | | |
| Stakeholders | Exporters, Importers, banks | | |
| Data: | Electronic documents, accounts in DLT | | |
| Identification: | Full identification of participants required | | |
| Predicted Outcomes: | Automation of document and supply tracks involved into a Letter of Credit implementation. Reduction in the term of implementation of a letter of credit with a 15 days' cover. | | |

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| Overview of the Business Problem or Opportunity |
| The letter of credit transaction may involve a large number of participants of the business process that do not know and do not trust each other.  The first stage of project addresses the issue of eliminating paper work, by shifting it into digital form. At the second stage, it is expected to transfer payments between the counterparties using digital currency (CBDC).  The objectives of the project-automation of document flow, which are involved in the design of the letter of credit; eliminate paperwork and related time delays in the application of transactions.  Paper work elimination could be possible solution to problem of distributed data storage.  For customers it means significantly reduced time for registration and processing of documents (from 10 days to 4 hours). For Banks it means that they will be able to reduce transaction costs for processing transactions.  **Project boundary:**  Start: the buyer forms a business documents for issuance of the letter of credit (the condition of the contract for a bargain).  End: the buyer and the supplier are notified of the payment of the transaction. |
| Why Distributed Ledger Technology? |
| The Blockchain and smart-contracts make this interaction trustworthy, transparent and understandable for each one of them. The implementation of DLT solution, which allows tracking paid LoC issuance, can eliminate paperwork and shorten the time of transaction. |

### Financial management & accounting: Digital Bank Guarantee

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| Use Case Summary | | | |
| Use Case ID: | V-F-EBG | Use Case Type: | Vertical |
| Submission Date: | 05.12.2018 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Digital Bank Guarantee | Domain: | List 6  Appendix 2 |
| Status of Case | Pilot | Sub-Domain | Financial |
| Contact information of person submitting/  managing the use-case | Full Name: Dergachev Ivan  Job Title: project manager  E-mail address: ivan.dergachev@fintechru.org  Telephone number: +7 926 773 77 74  Full Name: Alexander Chuburkov  Job Title: Expert GOST R \* Russian TC 26 Cryptography and security mechanisms \* ISO TC 307 Blockchain & DLT \* Fintech Association (RUS) \* FOCUS GROUP DLT ITU-T  E-mail address: chuburkovalex@gmail.com  Telephone number: +7 965 336 62 92 | | |
| Proposing Organization | FinTech Association  Address: 4 Shlyuzovaya Embankment, Moscow, 115114, Russia  http://fintechru.org/ | | |
| Short Description | Development and implementation of a software package for the organization of work with Digital Bank guarantees (DBG) based on the distributed ledger platform (blockchain platform "Masterchain"). | | |
| Long description | The market is ready to move from paper bank guarantees to digital ones, and it has already come to the realization that the digitization of paper documents and further work with digital copies of paper documents is a non-optimal approach and it is necessary to move to a system where the digital document will be primary;  The potential availability of CBG solutions currently being developed by individual Banks is limited to the clients of the respective Bank, which reduces the possible effect of their implementation (the Buyer and the Seller, as residents of the Russian Federation, are not always clients of the same Bank). The System (solution, set of services) developed in the project is an interbank platform that is not tied to one Bank and, therefore, is devoid of the mentioned restriction.  **Project goals:**   * Creation and implementation of the System * Improvement of legal regulation of CBG   **Project objective:**   * Generation of requirements and hypothesis to test * Development of a prototype System and test the hypothesis * System pilot development and integration with "external" systems * System implementation/Start-up of pilot   **Key assumption:**   * the technological platform for the project implementation is the infrastructure of the distributed Masterchain network, which includes the functionality for its administration and support of the role model of the system participants, * technological implementation of the system involves two stages: 1) creation of a prototype System and 2) creation of a pilot System, * openID Connect 1.0 is proposed as a technology for authorization of users of the developed system (user ID is signed by the authorization center, and can also be signed by the client in the browser through the EDS plug-in), * to store scans of documents (accompanying release, entry into force, change of conditions, termination of the warranty, etc.), it is planned to use a local document Storage integrated with the node of the distributed Masterchain network.   **Beyond the scope of the project**  • Approval by the Principal and the Bank of the conditions for issuing a Bank guarantee,  • Verification of the conditions for the entry into force of the Bank guarantee (except for the agreed date),  • Check the conditions of termination of the Bank guarantee (except for the expiry of the guarantee),  • Payment by the Principal of the Commission to the Bank for the issuance of a Bank guarantee,  • Transfer of funds to the Beneficiary of the Bank guarantee when paying for it,  • Integration with government agencies for the exchange of information on transactions with Bank guarantees. | | |
| SDG in Focus (when applicable) |  | | |
| Value Transfer: | Stage 1: no value transfer;  Stage 2: payments in DLT allowed (CBDC) | Number of Users: | 10 |
| Types of Users: | Principal, G[uarantor bank](https://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/by+a+guarantor+bank), B[eneficiary](https://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/beneficiary). | | |
| Stakeholders | Principal, Beneficiary, Bank. Central Bank as observer | | |
| Data: | Electronic documents, such as BG and contract, accounts in DLT | | |
| Identification: | Full identification of participants required | | |
| Predicted Outcomes: | * Reduction of terms and reduction of costs to ensure document flow under Bank guarantees (According to Bain&Company, 2016, more than 50% of operating costs of banks to conduct transactions of Bank guarantees goes to the implementation of paper document flow). * Reducing the cost of storage and risks of loss of information on paper (Distributed ledger guarantees the technical safety of information on the documents). * Increasing the availability/reducing the time for obtaining information on the Bank guarantee and its status for all stakeholders through the use of a single information environment, in the future integrated with national electronic trading platforms. | | |

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| Overview of the Business Problem or Opportunity |
| The objectives of the project:   * Switching from paper documents to digital form * Protection of confidential data by limiting the visibility of the issued document   For all participants of the business process it means a significant reduction of time (1-2 days). Process reduces the risk of falsification of the document, for economy that means increase of origin BG market. For banks, it means a reduction of operating costs by 10-15%. For Beneficiary, there is no reason to waste time on letters to Bank to verify authenticity of the issued bank guarantees. The process of document verification is simplified for the Regulator. |
| Why Distributed Ledger Technology? |
| The Blockchain and smart-contracts make this interaction trustworthy, transparent and understandable for each one of them. The implementation of DLT solution, which allows tracking paid bank guarantees, can eliminate paperwork and shorten the time of transaction. |

### International & interbank payments

### Clearing and settlement

### Reduction of Fraud

### Financial messaging

### Asset lifecycles and history

### Trade finance

### Regulatory compliance & audit

### AML/KYC

### Insurance

### Peer-to-peer transactions

## Healthcare

### Pharma: Supply Chain Finance in Pharmaceutical Industry with DLT

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Vertical |
| Submission Date: | Oct.30, 2018 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Supply Chain Finance in Pharmaceutical Industry with DLT | Domain: | Industries |
| Status of Case | Pilot | Sub-Domain | Pharmacy |
| Contact information of person submitting/  managing the use-case | Full Name: Michael Dong Job Title: CEO  E-mail address: dongning@chainnova.com  Telephone number:+86 13511068330  Social media: WeChat Account: immdong  Web site: [www.chainnova.com](http://www.chainnova.com) | | |
| Proposing Organization | ChainNova Data Technology (Nantong) Co. LTD, PRC. | | |
| Short Description | This use case is a proposal to trace the logistics of medicines and provide lower-cost financial support for the trader on pharmaceutical industry chain. | | |
| Long description | This use case is a proposal to trace the logistics of medicines and provide lower-cost financial support for the trader on pharmaceutical industry chain. In traditional pharmaceutical supply chain, we see the issues like fake medicines, fragmented medical logistics, untransparency of trading processes and restriction of credit grantees for SMEs. In this use case, ChainNova built a pharmaceutical supply chain financial platform based on DLT technology which can make the whole trading process traceable and increase trust among the participants on the supply chain. | | |
| SDG in Focus (when applicable) | 3: Good Health and Well-Being | | |
| Value Transfer: | No | Number of Users: |  |
| Types of Users: | Pharmaceutical companies, medicine distribution companies, banks, hospitals | | |
| Stakeholders | Government, Pharmaceutical companies, medicine distribution companies, banks, hospitals doctors, patients | | |
| Data: | The medicine data, logistics data, sales date | | |
| Identification: | Full identification of all the participants | | |
| Predicted Outcomes: | The predicted outcomes are:   * Increase the transparency of the trading processes * Integrate the pharmaceutical industry deeper with finance * Increase the transaction efficiency on the supply chain * Strengthen the credit of medicine distribution companies and lower the cost of financial due diligence for banks * Facilitate the development of medicine distribution companies with greater support from financial institutions * Prevent fake medicine circulation | | |

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| Overview of the Business Problem or Opportunity |
| * In traditional supply chain finance area, there are restrictions of credit grantees for medicine distribution companies * Since the national credit information systems is not complete, there is information asymmetry for medicine distribution companies in the supply chain and banks can’t directly grant credits to them. The bank credit is based on the credit of core companies. * Limitations of information integration on the supply chain * The core enterprises own IT system is difficult to integrate the upstream and downstream companies’ transaction information on the supply chain, the authenticity of the transaction information is hard to verify and tell if the transaction information has been tampered. * The transaction information is untransparent in the trading process * Supply chain finance integrates business flow, logistics and cash flow. If the online business flow and offline logistics cannot achieve information transparency and full visibility, the bank’s right to control the collateral may create risk and directly affect the business development. |
| Why Distributed Ledger Technology? |
| The DLT technology can ensure all the information on the supply chain transparent and reliable as they can’t be tampered. This will help the financial institutions to access and grant credit to the medicine distribution companies which can lower the cost for their credit investigation and stimulate the development of medicine distribution companies in return. In addition, the smart contract of DLT can automate the trading process with efficiency greatly improved. |
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### Pharma: Blockchain Web/Mobile application for vaccine supply chain

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Vertical* |
| Submission Date: | January 9, 2019 | Is Use Case supporting SDGs | *yes* |
| Use Case Title: | Blockchain Web/Mobile application for vaccine supply chain | Domain: | *Healthcare* |
| Status of Case | *Pilot Implementation* | Sub-Domain | *immunization* |
| Contact information of person submitting/  managing the use-case | *Dr. Agnes Naliaka Mindila Principal Investigator on “*Blockchain Web/Mobile application for vaccine supply chain” project funded by Bill and Melinda Gates Foundation  *amindila@icsit.jkuat.ac.ke*  *+254 713478642* | | |
| Proposing Organization | *Jomo Kenyatta University of Agriculture and Technology* | | |
| Short Description | The application seeks to achieve visibility, transparency and traceability of the vaccines along the supply chain and ensures that each vaccine can be isolated, analyzed and all activities associated with it identified. | | |
| Long description | Developing countries face challenges in the vaccine supply chain. The Challenges threaten vaccine access, availability, and quality. As countries adopt newer and more expensive vaccines and attempt to reach people at different ages and in new settings, the supply chain must be optimized. Information about demand, stock-levels and timely use of vaccines is poorly kept affecting timely supply leading to expirees and/or lack of needed vaccines. There is also the risk of poor product quality and counterfeiting that countries face and avoidable wastage. Accurate data collection, secure data storage and a flow of trusted information between parties is required.  Development of a Permissioned Blockchain-based web/mobile application will enable incorporation of Identity Management technologies, achieve end to end visibility with the incorporation of BLE iBeacon technologies, GS 1 data matrix codes and map the physical to the digital. The application will improve transparency and traceability within the vaccine supply chain through the use of immutable record of data and transactions, distributed storage, rules enforcement, and controlled user accesses. This will ensure every vaccine in the supply chain can be isolated, analysed and all activities associated with it identified. Data analytics and creation of dashboards for decision makers will be possible. | | |
| SDG in Focus (when applicable) | SDG 3. Indicator 3.2 and 3.8  The application aligns to SDG 3 indicator 3.2 and 3.8 by ending preventable deaths to children under five and access to quality essential health-care services such as vaccines.  SDG 9. Indicator 9.1  The blockchain application aligns with SDG 9. Indicator 9.1 in that it will provide a reliable and resilient infrastructure that will support human well-being by enabling access to vaccines.  SDG 17. Indicator 17.18  The blockchain application aligns with SDG 17. Indicator 17.18 by increasing significantly the availability of high-quality, timely and reliable data disaggregated by gender, age, geographic location and other characteristics relevant in national contexts concerning immunization. | | |
| Value Transfer: | The Application will generate assets for transactions on the blockchain. The proof of concept involves three counties in Kenya | Number of Users: | 30 |
| Types of Users: | Manufacturers of vaccines, Manufacturers of cold chain equipment, UNICEF Supply Division, National Vaccine and immunization Programme (NVIP), MoH Head, National Logistician, Logisticians, National Primary Store Managers, Regional Store Managers, Sub-County store managers, hospitals, health centres, Cold chain equipment technical officers, community health workers and Mothers/care givers, Kenya Regulatory Board | | |
| Stakeholders | Donors, Government of Kenya specifically Ministry of Health (MoH), the citizens who need the vaccines, NVIP, UNICEF, Manufacturers of Vaccines, Manufacturers of cold chain equipment, Kenya Regulatory Board | | |
| Data: | *What data are expected to be stored in distributed ledger in terms of types, record structure, privacy*  The application has both human actors and what we call IoT actors. Both actors have different data sets.   1. IoT actors include data from the (a) ibeacons that have temperature sensors that send temperature readings for vaccines in storage and those on transit (b) ibeacons that send location data for vaccines on transit and storage (c) identification data that uniquely identifies the different devices involved (ibeacons, smart phones, coldchain equipment, gateways 2. GS 1 data matrix codes data scanned from the vaccines and hold each vaccine details 3. Human actor’s data that includes (a) identification data of participants in the blockchain network since it’s a permissioned blockchain (b) assets in the form of messages that are exchanged between the participants (c) Transactions performed along the supply chain (d) Mother-child data for last mile monitoring   Privacy is ensured by the blockchain structure of creation of different channels, where one needs authorisation to access any specific channel in the blockchain network achieved through the Certification Authority(CA) of the blockchain architecture.  The NVIP plans to set up its own data centre but meanwhile the data will be stored in the DHIS2.  Interaction with external data and other systems will be though authorization through the CA of the blockchain architecture in what can be termed as Personal health trains (PHT) that ‘knock’ and are given access after necessary vetting by the CA according to the rules. | | |
| Identification: | *Identification mechanism and rules; ability of participants to be anonymous, etc.*  Identification Mechanism is achieved by the Certification Authority that is implemented as a chain from the root CA to Intermediary CA to the normal users according to allowable rules for authorization. Participants in a specific channel are known because it’s a permissioned blockchain. | | |
| Predicted Outcomes: | 1. Every vaccine is visible from the time it comes to the country to the last step when it is used on a child. 2. Every vaccines potency is known from the time it comes to the country to the time it is used on a child 3. Every transaction done receives consensus from the participants permissioned hence ensuring transparency and accountability 4. Every transaction is immutable and so traceability is achieved. 5. Provision of high-quality reliable data 6. Every vaccine can be accounted for. 7. Data on who was vaccinated, how many, by region, by gender is made available. 8. Creation of dashboards and maps to decision makers made possible. | | |

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| Overview of the Business Problem or Opportunity |
| Existing systems are unable to cope with the changing landscapes of national immunization programme and as a result they experience:   * Stock-outs * Potential administration of ineffective vaccines * Avoidable wastage * Expirees * Inadequate cold-chain capacity * Risk of poor product quality and counterfeiting |
| Why Distributed Ledger Technology? |
| The DLT solution will improve data capture by introducing automatic data capture through GS 1 data matrix codes and ibeacons. It will provide dashboards allowing stakeholders to see a country wide view of the stock levels. It will enable stakeholders to transact in a secure manner and offer consensus seamlessly to transactions they are required to with all stakeholders in the picture hence offering transparency. It will enable stakeholders in every process have the same data at the same time. It will enable immutability of records that concern vaccines from the time it comes to the country to the time its administered and hence every step is verifiable. It will enable stakeholders to accurately ensure potency of vaccines administered. It will offer guidance on redistribution of vaccines in cases of shortages. |

### Pharma: Drugs Distribution Ledger

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| Use Case Summary | | | |
| Use Case ID: | V-H-DDL-01 | Use Case Type: | Vertical |
| Submission Date: | 28 May 2018 | Is Use Case supporting SDGs | No |
| Use Case Title: | Drugs Distribution Ledger | Domain: | Healthcare |
| Status of Case | PoC | Sub-Domain | Medicine |
| Contact information of person submitting/  managing the use-case | *Full Name*  Vadim Likholetov *Job Title CTO*  *E-mail address:*  vadikas@setere.com *Telephone number:*+7-921-417-99-55  *Social media: none Web site: http://www.setere.com* | | |
| Proposing Organization | *Limited Liability Company “Tech Medical Group”, INN 7841019901* | | |
| Short Description | Drug distribution ledger based on DLT can make the distribution process trustworthy and transparent. | | |
| Long description | Main conditions of success scenario:   * All the medical centers and pharmacies are connected to DDL * Patients can get treatment reports via the internet * All the necessary drugs distribution reports are being provided by DDL   The implementation of DLT solution, which allows tracking medical treatments and provides the necessary reports can reduce paperwork and increase common efficiency. | | |
| SDG in Focus (when applicable) | NA | | |
| Value Transfer: | No value transfer | Number of Users: | 1000+ |
| Types of Users: | Medical centers, Patients, Federal and Local Government (as auditors) | | |
| Stakeholders | Medical centers, Patients, Federal and Local Government | | |
| Data: | Information about treatment sheets, prescriptions and associated with them drugs distribution should be stored in DLT. | | |
| Identification: | Identification for inserting data to DLT is required. Reports can be provided to anonymous users depending on report type. | | |
| Predicted Outcomes: | Implementation of open DLT for collecting transactions connected with drugs distribution processes will provide transparency of the process. Also every patient can get possibility of tracking their treatment. | | |

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| Overview of the Business Problem or Opportunity |
| There is no information system for collecting all the treatment sheets, prescriptions and connected with them drugs distribution. Every medical centre makes own reports and then send it to government institutions. Patients cannot track their treatment. |
| Why Distributed Ledger Technology? |
| The Blockchain and smart-contracts make this process trustworthy and transparent. The implementation of DLT solution, which allows tracking medical treatments and provides the necessary reports can reduce paperwork and increase common efficiency. |

### Biotechnology

### Medicine: DLT for pay for success contracts

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Horizontal* |
| Submission Date: | 1/3/2019 | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | DLT for Pay for Success contracts | Domain: | *List 1 Appendix 1* |
| Status of Case | *Concept,* | Sub-Domain |  |
| Contact information of person submitting/  managing the use-case | *Full Name Jesse Medina Job Title: Impact Investing Consultant*  *E-mail address: jesse@socialfinance.org.il*  *Telephone number:+972545781987*  *Linked-in:* [*https://www.linkedin.com/in/jesse-medina-24703769/*](https://www.linkedin.com/in/jesse-medina-24703769/)  *Website:* [*www.social-finance.org.il*](http://www.social-finance.org.il) | | |
| Proposing Organization | ***Social Finance Israel, Israel,*  514916618** | | |
| Short Description | Social Impact Bonds (or pay for success contracts) powered by distributed ledger technology (Smart PFS) to create transparency between government and non-government outcome payers, providers of social and/or environmental services and solutions, and investors. DLT has the power to enhance performance management and automate impact measurement processes through smart contract powered data processing, triangulation and validation – ultimately reducing the transaction costs associated with performance management, dispute resolution, and value transfer. | | |
| Long description | Established in 2013, Social Finance Israel is a social enterprise that promotes the flow of capital towards solving social issues in Israel, through the use of innovative financing tools. As the first and only social investment intermediary in Israel, SFI is developing the Impact Investing sector with the ultimate goal to positively impact the lives of citizens nationwide.  SFI is the sole developer of Social Impact Bonds in Israel, having launched Israel´s first two SIBs. The first reduces the dropout rate among Computer Science students in higher education, and the second aims to prevent the onset of type 2 diabetes among pre-diabetics.  Behind a team of excellent professionals from a variety of social and professional backgrounds, SFI is bolstered by a Board of Directors comprised of vastly experienced public leaders, purpose-driven investors, foundations, entrepreneurs, and industry experts. SFI partners with organizations in Israel and abroad which strive to achieve measurable, positive social outcomes alongside financial returns. SFI also works closely with the Israeli National Advisory Board, which consists of senior executives from the public, financial and social sectors.  In addition, SFI provides impact advisory services, to support the creation and management of Impact Investment products, such as impact private equity or venture capital funds. We design Impact Investment strategies tailored for the unique needs of a range of clients, including investors, institutions, foundations, enterprise and NGOs. | | |
| SDG in Focus (when applicable) | *PFS mechanisms span a range of social issues that contribute to the UN SDGs*  *This particular use case contributes to goal 3.4*  *See* [*https://www.un.org/sustainabledevelopment/sustainable-development-goals/*](https://www.un.org/sustainabledevelopment/sustainable-development-goals/) | | |
| Value Transfer: | *Yes – working capital to service providers and outcome payments to investors* | Number of Users: | *Potentially innumerable* |
| Types of Users: | Service providers and case managers (data upload from employees of the service providers)  Beneficiaries (data upload from participants in social service delivery programs)  Independent evaluators (data verification or statistical analysis by 3rd party measurement providers) | | |
| Stakeholders | *Health maintenance organizations, World Health Organization*  World Diabetes Foundation, Pre-diabetics around the world, Impact Investors | | |
| Data: | Participant and service provider (case managers, trainers, nutritionist) identifiers (DIDs, zero knowledge proofs to protect personal information)  Health intervention program attendance (IoT, QR or biomarker “sign in”, and “sign out”)  Physical activity within and outside of the confines of program delivery (heart rate over a dedicated time period, GPS for distance travelled)  The DLT solution will use JSON-RPC to make requests to client APIs. There is a challenge to make healthcare databases interoperable – fortunately, there are existing ventures working on PoCs. | | |
| Identification: | *Following the Decentralized Identifiers data model:*  *Decentralized Identifiers (DIDs) are a new type of identifier for verifiable, "self-sovereign" digital identity. DIDs are fully under the control of the DID subject, independent from any centralized registry, identity provider, or certificate authority. DIDs are URLs that relate a DID subject to means for trustable interactions with that subject.*  *Each participant will be indistinguishable from others in the herd to enable privacy. The client technologies and human interfaces should default to preserving anonymity and pseudonymity, by sharing common settings across implementations, encrypted transport layers, and pad messages at standard length.* | | |
| Predicted Outcomes: | Vastly higher investment in preventive health intervention services  Less incidence of type 2 diabetes, a preventable, behavioral-based condition | | |

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| Overview of the Business Problem or Opportunity |
| A Pay-for-Success (PFS) contract (originally known as a Social Impact Bond), is an innovative model for financing social interventions and programs. PFS contracts are performance-based funding agreements between social service providers, investors, and governments (and/or other stakeholders). These contracts stipulate that investor capital used to fund a specific social service program will generate financial returns paid by governments or other stakeholders, when the social outcomes defined in the contract are achieved. Effectively, these contracts generate financial returns that are linked to social improvements. This requires a financial intermediary such as Social Finance Israel and the other contracting parties to come to a consensus regarding the economic value of achieving specific outcomes, based on current or historical costs to the stakeholders who are bearing the cost burden of that social need. The stakeholder works with the intermediary to study and define how the positive outcomes of the social intervention program that is to be financed will be measured, and ultimately must agree to make Outcome Payments in the event of effective intervention. Often, these Outcome Payments represent a portion of cashable savings or increased revenue to the stakeholder, resulting from resolution or mitigation of the social issue. Ultimately, these Outcome Payments generate returns for investors, in proportion to the rate at which the service program achieves the outcomes, with respect to the terms of the contract.  Diabetes is a global health epidemic, affecting hundreds of millions of people worldwide. The World Health Organization projects that diabetes will be the 7th leading cause of death by 2030. The disease often brings with it health complications including limb amputation, blindness, and heart disease.  Most health systems around the world are designed to guarantee treatment to patients with disease, and cannot dedicate enough resources to preventative measures. As a result, patients often receive treatment only after the onset of the disease or related complications. As the single most effective form of preventing type 2 diabetes is to implement lifestyle modifications, the opportunity to raise investment and generate economic value through behavioral modification and improved health outcomes is apparent. |
| Why Distributed Ledger Technology? |
| PFS initiatives span a wide variety of social issues, including homelessness, chronic health conditions, access to education and more. For the purpose of this application, the use-case will focus on our SIB that finances an intervention to prevent the onset of type 2 diabetes.  Like many other PFS initiatives, the underlying economic value of this SIB is created through behavioral change that results in better outcomes. In this context, the economic driver is a reduction in future medical costs to stakeholders (health maintenance organizations). For this reason, ongoing program data that reflects the participants’ adherence to a behavioral modification plan contain key performance indicators on the projected success of the project. In order to maximize the achievement of key performance objectives, service providers and participants are incentivized to reach service delivery and adherence targets. At various points in time, portions of this data are siloed from the intermediary (SFI), outcome payers and investors in the PFS initiative, until which time the contract stipulates that these actors gain access. Unfortunately, manual data entry and transfer, and even single factor technological applications used by the participants (wearables, etc.) create trust concerns that there are perverse incentives to exaggerate participation, attendance or progress. In addition, when the beneficiary is not in the presence of the service provider (trainer/nutritionist), the ability to collect behavioral information is limited and easily manipulated – for instance, wearables and “step” collecting apps that can be placed on an animal.  Currently, the diabetes program data such as attendance at individual or group nutrition and/or exercise sessions and bodyweight, are collected manually at touchpoints between service provider (case managers) and participants in the program. This data can be manipulated to reach performance targets, and the manual process lends itself to human error. While centralized server systems can be built for direct, simultaneous data entry from the beneficiaries and service providers (trainers/nutritionists) that will limit the segmentation of data control from various actors to one – such as dedicated IoT sensors to verify attendance, or QR codes to provide time stamps of service delivery – this would still not solve the predicament of any one actor having control over the performance data, and the potential for perverse incentives to alter it.  We propose building a distributed ledger that will contain service delivery and behavioral adherence information for complete transparency between all the stakeholders in this PFS initiative, with smart contract powered dispute resolution mechanisms between the service provider, performance manager and the outcome payer. This use-case would be the first instance of a social-financial intermediary ensuring immutability of program data that is uploaded, enabling a more robust data entry process that triggers automated value transfers from stakeholders to investors.  In addition, with the recruitment of more Health Maintenance Organizations around the world, a distributed ledger can enable investment from all corners of the globe (barring regulation constraints) and identification and onboarding of additional beneficiaries and service providers in various locations, affording the PFS initiative the ability to scale and deliver much needed services while remaining bound by the rules of the original smart contract. Long term, the ability to “tokenize” the investment shares through a smart contract coincides with true price discovery (through transparency of program performance data) and allow for greater capital flows, liquidity and a secondary market for PFS contracts. |

### Medicine: Bone marrow, blood, and organ donation

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| Use Case Summary | | | |
| Use Case ID: | LifeBlocs | Use Case Type: | Vertical |
| Submission Date: | 3 January 2019 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | LifeBlocs | Domain: | Healthcare |
| Status of Case | PoC | Sub-Domain | Bone marrow, blood, and organ donation |
| Contact information of person submitting/  managing the use-case | *Full Name: Job Title:* Cathy Chen Co-Founder & CMO & Head of   Government Relations  *E-mail address: Telephone number:* [cathy.chen@lifeblocs.com](mailto:cathy.chen@lifeblocs.com) +1 805 304 5849  *Social media: Web site:* N/A www.lifeblocs.com | | |
| Proposing Organization | LifeBlocs | | |
| Short Description | LifeBlocs endeavors to reinvent the donation value chain for bone marrow, blood, and organs globally by utilizing the blockchain technology. In doing so, it aims to reduce the number of lives lost as a result of inefficiencies in the donation and matching processes. Moreover, LifeBlocs strives to increase the number of donations amongst the population.  Our first use case and current primary focus is bone marrow data storage and matching. | | |
| Long description | LifeBlocs is a start-up that aims to increase blood, bone marrow, and organ donations, and optimize the matching process between donors and receivers. Powered by the Ethereum blockchain, LifeBlocs hopes to optimize supply chain efficiency by equipping each actor in the donation supply chain with a data storage and matching process, from donors and donor organizations to hospitals and patients. It hopes to give patients their much-needed access to healthcare essentials by offering a secure data storage and higher rate of match compatibility, thereby enabling timely availability of life-saving material.  In executing its mission, LifeBlocs aims to save human lives by providing the following solutions: 1. An easy-to-integrate, decentralized data storage and matching platform that enables greater access for patients, and fosters collaboration between organizations and nations; 2. An incentive system that rewards blood and bone marrow donors through a non-monetary incentive, and through which donors can visualize the impact of their donation; 3. Spreading awareness and increasing the participation of donors worldwide.  Finally, through the implementation of LifeBlocs’ system in multiple smart cities and the learnings gathered in this process, it also plans to provide its system in countries where existing donor systems do not exist. | | |
| SDG in Focus (when applicable) | SDG 3, indicator 3.8.  LifeBlocs aligns with SDG 3, indicator 3.8, in that it seeks to achieve universal access to a quality essential healthcare services and access to safe, effective, quality and affordable essential bone marrow, blood, and organs for all. | | |
| Value Transfer: | LifeBlocs will not generate a token or an asset for transactions on the blockchain. | Number of Users: | N/A |
| Types of Users: | Donors, Donor organizations, Hospitals | | |
| Stakeholders | Individual donors, donor organizations, hospitals, patients. | | |
| Data: | *What data are expected to be stored in distributed ledger in terms of types, record structure, privacy, etc.*   * The method of storage can be adjusted to comply with specific countries’ privacy and health data storage laws. Outlined below is a general description of the default structure.   PII (Personally Identifiable Information)   * PII will be stored separately on a conventional, secure database.   Medical Data   * Medical Data, specifically HLA (Human-Leukocyte Antigen) types, will be stored on IPFS (Inter-Planetary File System).   Links to PII and Medical Data   * The links that provide access to the two sub-sets of data will be stored on the blockchain. Given increased computing power and storage capacity prove to be quite expensive on the blockchain, we aim to utilize blockchain as the technology for the facilitation of storage and matching of health data.   *How DLT solution would interact with external data and other systems.*   * The DLT solution interacts with bone marrow registries, IPFS (Inter-Planetary File System), and a conventional, secure database. The DLT stores the separate links to the PII and the Medical data and facilitates cross-border matching. | | |
| Identification: | When bone marrow registries register new donors, PII and HLA lab results are stored. Bone marrow registries only have access to the PII of individuals that they have registered themselves. | | |
| Predicted Outcomes: | Donors: Individual donors will be able to visualize their individual impact as the LifeBlocs system provides a transparent and up-to-date overview of where their donation has been located along the supply chain. Moreover, those who are not donors yet will be encouraged to donate through the non-monetary incentive system.  Donor organizations: Organizations that manage donations along the supply chain will become visible and traceable. Furthermore, the data storage and matching process will become more secure.  Hospitals: Hospitals will benefit from increased success rates of match compatibility, and face lower administrative costs as a result of the system.  Patients: Personal and health data will be stored securely on the system, and patients will have timely availability of life-saving material. | | |

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| Overview of the Business Problem or Opportunity |
| * Technological advancements are lacking in the current tissue and organ donation systems, and lives are lost as a result of inefficiencies in the value chain. As of today, major issues prevent universal access to essential blood, bone marrow, and organs for patients. For example, issues include individuals that are not incentivized to donate, donation registries that are not integrated seamlessly, and large, centralized players in the donor value chain that prevent transparency and traceability. |
| Why Distributed Ledger Technology? |
| * DLT will seamlessly integrate data siloes across countries without centralizing and harbouring all data in one centralized location. This is essential as many bone marrow registries would be hesitant to share and centralize all of their data into one location. Each of the features listed above (immutability, security, verifiability, transparency) are valuable for our use case of blockchain. For example, having a verifiable source of truth for tracking blood transfusions can be invaluable in countries such as India where, in the past 10 years, 20,000 cases of HIV transmission from blood transfusions have occurred. |

### Medicine: Health Data

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Vertical* |
| Submission Date: |  | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | My Health Data | Domain: | ***2***  Healthcare |
| Status of Case | *Concept* | Sub-Domain | *a – Pharma*  b – Biotechnology  c – Medicine |
| Contact information of person submitting/  managing the use-case | *Valeria Queiroz Idealizer*  *E-mail address:*  *valfqueiroz@gmail.com*  *Telephone number:55 21 99327-5080*  *Social media: https://myhealthdata.github.io/*  *Web site:* | | |
| Proposing Organization | *My Health Data, Brazil* | | |
| Short Description | *My Health Data is born, with the purpose of constructing a system where patient is the sole detector of his/ her data, a system which enables not only unified repository, but, above all, ease of access and portability, once the information holder is the user and not the third party.* | | |
| Long description | *My Health Data using the Blockchain technology, we invite everyone, through our interactions, to create a health data network, in which we will be the agents capable of generating solutions, which bases should be:*   1. *Empowerment of people, where the individual is not the patient, but the agent, the generator and the owner of their information;* 2. *User centralized data generation capable of providing the network with reliable and faithful information;* 3. *Generation and transmission of consistent information, capable of assisting in medical, pharmaceutical and wellness research and remunerating the parties involved;* 4. *Creation of an "anti-fragile" system, supported by multiple nodes of the network, encryption, anonymity and database not corruptible and, at the same time, generic capable of adapting to multiple situations, people and cultures easily;* 5. *User-focused solution, in which the Individuals will always be at the forefront of institutions, whether they are governments or for-profit entities.* | | |
| SDG in Focus (when applicable) | *1 – No Poverty*  *3 – Good Health and Well-being*  *5 – Gender Equality*  *8 – Decente work and Economic Growth*  *9 – Industry, innovation and infrastructure*  *17 – Partnership for the goals* | | |
| Value Transfer: | *Data, tokens* | Number of Users: | *0* |
| Types of Users: | *Patients, Partners (hospitals, clinics, doctor office, laboratories)* | | |
| Stakeholders | *Government, Researchers, …* | | |
| Data: | In My Health Data the information is always stored under this primary key and with the permission of the key owner. The system, based on the patient's permissions, controls access to medical records, permits the inclusion, removal and reading of medical records by the patient or third parties, makes the sale of such data available to third parties, where negotiation is done directly between interested parties, but always preserving the identity and anonymity of those who make them available. | | |
| Identification: | *Identification mechanism and rules; ability of participants to be anonymous, etc.* | | |
| Predicted Outcomes: |  | | |

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| Overview of the Business Problem or Opportunity |
| *The platform that consists of a smart contract that not only validates operations, but also stores and creates a patient-centered health data network that can be used in a variety of applications such as academics surveys, hospitals, laboratories and the pharmaceutical industry.* |
| Why Distributed Ledger Technology? |
| *Due to the characteristics of the DLT, such as immutability, transparency, security, distribution, verifiable, technology can take these characteristics to medical data ensuring safety, ensuring that the patient knows who is accessing their data and ensuring universal access from anywhere in the world, anytime.* |

## Information and Communication Technology

### Global market place for mobile operators and service providers

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| **Use Case Summary** | | | |
| **Use Case ID:** |  | **Use Case Type:** | Vertical |
| **Submission Date:** | 11-October 2018 | **Is Use Case supporting SDGs** | No |
| **Use Case Title:** | Global market place for mobile operators and service providers | **Domain:** | IT & Telco |
| **Status of Case** | PoC | **Sub-Domain** | Mobile roaming  Digital Services |
| **Contact information of person submitting/**  **managing the use-case** | Full Name: Alexander Yakovenko  Job Title: Project Director  E-mail address: ayakovenko@clementvale.com  Telephone number: +7-985-991-2048  Social media: https://www.linkedin.com/in/alexander-yakovenko  Web site: https://www.blockchaintele.com | | |
| **Proposing Organization** | Clementvale Baltic OU, Estonia | | |
| **Short Description** | This use case is a proposal to create global market place for mobile operators and service providers with the use of private Blockchain ecosystem by changing traditional roaming rules and creating new sales channels, using a stable coin for immediate payments. | | |
| **Long description** | This use case is a proposal to create global market place for mobile operators and service providers with the use of private Blockchain ecosystem. The main goal is to enable mobile operators and service providers to interact directly and securely without any agreements, intermediators and complex integration via smart contracts. This solution significantly simplifies all processes, eliminates old-fashioned roaming technology, shifts principles of interaction, reduces costs on all levels, gives an easy and quick access to global market for all players in a short period of time with almost zero investment, gives a good opportunity for mobile subscribers to use services at reasonable rates worldwide, changes principles of settlements, making them in real time in stable coin. Our company has created one of the stable token that equals 1 SDR used in telecommunications, which is tied to the basket of five world currencies. We named it SDRt (SDR Token). It's the unit of payment given to providers for their services, i.e., the price of services is measured in these units. | | |
| **SDG in Focus (when applicable)** |  | | |
| **Value Transfer:** | SDR tokens representing fiat money | Number of Users: | 100+ |
| **Types of Users:** | Any MNO/MVNO and/or service provider, mobile subscribers | | |
| **Stakeholders** | Any MNO/MVNO and/or service provider | | |
| **Data:** | Offers on mobile and non-telecom services published by operators and service providers, Requests on services, User ID, Service provider’s digital code, SDR tokens flow, Other transactions related to rendering services | | |
| **Identification:** | Nodes verify all transactions via consensus algorithm | | |
| **Predicted Outcomes:** | * Elimination of any agreements, intermediators and complex integration * Change of traditional roaming rules * Reduction of mobile services costs * Secure and direct interaction between mobile operators or operators and service providers via smart contracts * Quick access to global market for small and medium-sized mobile operators and service providers * Provision of own subscribers with local rates around the world in a short period of time with almost zero investments * New sales channels for service providers | | |

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| Overview of the Business Problem or Opportunity |
| Current problems:   * Long and complicated process to implement mobile services in roaming, requiring negotiation between operators, signing a lot of roaming agreements, physical interconnection of networks, different tests and other integration processes; * High rates for mobile subscribers in roaming, which increase cost of this service and cause big inconvenience for end users; * Low consumption of services, which effects on decreasing of mobile operator’s revenue due to huge amount of “silent roamers”; * Huge expenditures on infrastructure support; * Necessity for mobile operators to have a large staff to maintain commercial, legal and technical processes of mobile roaming services; * Marketing expenditures for service providers to promote their services   Blockchain technology is a platform to construct a global trusted marketplace, where mobile operators and service providers can interact directly with each other without agreements, intermediators and costly integration.  Opportunities:  For mobile operators:  - Simple and low-cost access to global rooming market.  - Provision of own mobile services to subscribers of other operators worldwide.  - Possibility to resell mobile and non-telecom services from global providers to own subscribers.  For service providers (content providers, software vendors, insurance, transportation, etc):  - New sales channels to subscribers of mobile operators.  For subscribers:  - To get high quality mobile and non-telecom services worldwide at affordable prices.  For all participants:   * Elimination of intermediators in sales chains. * Reduced time and costs for mutual settlements between participants. * Significantly reduced costs on technical, legal and commercial levels |
| Why Distributed Ledger Technology? |
| * Community-controlled DLT system ensures participants that the system operates according to the strictly defined software-driving rules. * Unlike classical centralized approach, there is no party or organization that could change rules on its own. Therefore, there are minimal risks for participants and their investments. * Minimal investments into hardware and software infrastructure. * Exceptional reliability of the system because of inherent security, redundancy and self-restoring capability of DLT platform. |

### Automatic Discovery, Quote, Ordering and Settlement in a Mesh of Interconnected ICT Service Providers

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Vertical* |
| Submission Date: | December 18, 2018 | Is Use Case supporting SDGs | *no* |
| Use Case Title: | Automatic Discovery, Quote, Ordering and Settlement in a Mesh of Interconnected ICT Service Providers | Domain: | 1-c  3-f |
| Status of Case | PoC | Sub-Domain | *If necessary* |
| Contact information of person submitting/  managing the use-case | Shahar Steiff AVP New Technology  E-mail address: ssteiff@pccwglobal.com  Telephone number:+85263888875  Social media:  Web site: [www.pccwglobal.com](http://www.pccwglobal.com) | | |
| Proposing Organization | PCCW Global Limited. Hong Kong | | |
| Short Description | Describe PoC conducted at MEF18 event that demonstrated Automatic Discovery, Quote, Ordering and Settlement in a Mesh of Interconnected ICT Service Providers resulting in a significant decrease in time compared to legacy manual processes. | | |
| Long description | On October 2018 a team of 7 Carriers (PCCW Global, Infonas, Liquid Telecom, Singtel, Sparkle, and Tata Communications) together with two technology partners (Cataworx and Clear Blockchain Technologies) has presented a PoC where the process of obtaining a quote, ordering of a service, invoicing for such service, invoice reconciliation and final settlement for service delivered through a partial mesh of interconnected carrier networks were conducted through an automated system.  Each carrier network was operating a catalogue of available services and upon receiving an inquiry from its customer through an eNNI it would search the catalogue for a matching entry and return a price if found. If no matching entry was found, the catalogue would then initiate an inquiry to its neighbour eNNI connected carriers that will then repeat this process until a matching entry is found in one of the catalogues (or until a pre-defined threshold has been reached, either time, or number of hops). If a price is returned by an downstream catalogue, the originating catalogue would then mark the price up according to defined commercial rules, and provide a quote to the upstream catalogue. This cascade of inquiries and quotes eventually provides the ultimate customer a quote for an end-to-end service that may span across multiple carrier networks.  Once the ultimate customer places an order – a cascade of orders is placed downstream with all participating carriers.  Once service is terminated – invoices are being generated by each carrier based on their measured utilization (a combination of time, throughput and SLA metrics) and is then being reconciled with the measurement of the neighbour eNNI carriers.  Once reconciliation is complete – the invoices are settled.  The above proceeds, when handled manually on Carriers’ legacy OSS/BSS platforms, may take weeks to complete.  The PoC has demonstrated that the inquiry, quote and ordering take less than 30 seconds, and invoicing and reconciliation takes less than two minutes.  This may result in a significant reduction in both time and HR, as not only that the process is accelerated, it is also automated.  The information is exchanged through private permissioned ledgers between each pair of carriers and this is a flat-hierarchy architecture with no top-level orchestrator. Reflecting the commercial environment of the wholesale ICT market. There is complete isolation of information and visibility and no one has end-to-end visibility and control. | | |
| SDG in Focus (when applicable) | N/A | | |
| Value Transfer: | The solution includes financial settlement between each pair of entities. | Number of Users: | Millions |
| Types of Users: | End users: Private, Enterprise and Wholesale ICT SPs.  ICT SPs: Connectivity SPs (carriers), Compute and Storage SPs (Public and Private Cloud). | | |
| Stakeholders | End users: Ability to buy on-demand services. Ability to pay per-use.  ICT SPs: Ability to deliver on-demand services and Yield new revenue from existing infrastructure.  IoT SPs: Ability to use managed-services on-demand. | | |
| Data: | Inquiry details, Quote details, Order details, Utilization records, SLA performance, Invoice details, Settled amount.  The respective data models are service-type specific (connectivity DM differs from Compute DM that differs from Storage DM). The information is shared between the two eNNI partners only.  Catalogue interaction will be through an API.  End user interaction is expected to be through an intent-based interface. | | |
| Identification: | This is a permissioned ledger. Only pre-accepted members can participate. Governance is managed through a board consisting of representatives of members of the ledger. | | |
| Predicted Outcomes: | As demonstrated in the PoC – Manual processes replaced by automation significantly accelerate enabling a host of new applications that are currently dependent on best-effort, unmanaged, resources. | | |

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| Overview of the Business Problem or Opportunity |
| Problem:  Most ICT services traverse more than one network domain. Each such network domain (a carrier network, a data centre, a radio link, an enterprise LAN) is typically operated by a different administration and is using different methods to transport, process and manage the flows of information.  It is very seldom that all administrations along the information flow path use a common language/process to define and manage their portion of the end to end path. Furthermore – it is very seldom that true end-to-end visibility and management is available across all administrations.  The typical process-flow is such that each two consecutive administrations along the end-to-end path have bilateral commercial and operational relations with each other that have overcome some of the differences in language/process. These relations are heavily dependent on manual processing of requests, manual provisioning of services, manual management, semi-manual invoicing and manual settlement. Such manual laden process-flow is time consuming and does not allow services to be activated on-demand but rather requires orders to be placed in advance, then be subject to delivery lead-times of weeks or months. For services that span across multiple administrations – the problem is further amplified as the service related information now flows through a cascade/chain of bilateral agreements. Timelines stretch even further and management of the end to end service characteristics becomes very difficult.  Today’s applications require resources to become available within minutes/seconds. Waiting months before establishing a video connection is not an option. While compute and storage resources are already available for on-demand consumption, and can be made ready for use within minutes or even seconds of notice, managed connectivity between the user and the compute/storage resources can not be delivered instantly due to the reasons stated above. As a result – if managed connectivity was not made available in advance, the applications resort to the use of the public internet, which on one hand offers always-on any-to-any connectivity, but on the other hand offers no effective measures to manage the connectivity and guarantee performance.  Opportunity:  If we were able to guarantee quality of the end-to-end service, through management if each individual segment in the overall path, we could create an eco-system where all parties involved could benefit: The user will experience better quality services for which they will be willing (or forced) to pay. The ICT service providers will be able to charge for the use of their segments, provided that they manage and guaranty the quality and performance of their respective segment. |
| Why Distributed Ledger Technology? |
| ICT SPs operate in an equal-level playing field. There is no top-level administration that controls other administrations. Each ICT SP (administration) manages its own platforms as a “silo” using its own management system. No one will be willing to allow other administrations to administer their resources and services.  This creates a challenge when it comes to managing information flows across a chain of distributed administrations that have no hierarchy. That is where blockchain can play a role as a trusted mechanism to convey and manage information in a distributed environment. The fact that the information is owned by everyone and all nodes are at an equal hierarchical level makes it possible for administrations to exchange information related to services, and blockchain can then ensure integrity of the information across those multiple administrations.  The PoC has demonstrated how Quote, Order, Invoice, Reconciliation and Settlement information is exchanged across a chain of ICT SPs with timelines down to seconds on a per-pair of SPs basis, and minutes on a multi-SP environment. |

### Distributed Ledger based Online Trading System for DDoS Mitigation Services

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| Use Case Summary | | | |
| Use Case ID: | Xxx | Use Case Type: | Vertical |
| Submission Date: | Xxx | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Distributed Ledger based Online Trading System for DDoS Mitigation Services | Domain: | Industries |
| Status of Case | Concept | Sub-Domain | IT and telco |
| Contact information of person submitting/  managing the use-case | *Xinpeng Wei* [*wexinpeng@huawei.com*](mailto:wexinpeng@huawei.com)  *Bingyang Liu* [*liubingyang@huawei.com*](mailto:liubingyang@huawei.com) | | |
| Proposing Organization | *Huawei* | | |
| Short Description | This use case is a proposal for utilizing DLT-based online trading system for DDoS mitigation services, which enables a victim network to on-demand purchase DDoS mitigation services close to the attack sources. | | |
| Long description | This use case describes how DLT is used in DDoS mitigation service. Distributed Denial of Service (DDoS) attacks combine multiple distributed attack sources to attack a single victim, thereby amplify the attack power and downgrade the services of the victim network. DDoS mitigation service aims at mitigating DDoS attacks for the victim network. By using DLT, it’s much easier to mitigate attack at the point of attack sources, and prevents the attack traffic from consuming bandwidth resources of the intermediate networks. | | |
| SDG in Focus (when applicable) | Goal 9: Industry, Innovation and Infrastructure  9.3 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. | | |
| Value Transfer: | Tokens which is used to pay for DDoS Mitigation service | Number of Users: | thousands |
| Types of Users: | Network operators, OTT (Over The Top), Internet users, enterprise, residential customer network | | |
| Stakeholders | Network operators, OTT, Internet users, enterprise, residential customer network | | |
| Data: | Token balance to each account.  Service smart contract: Each DDoS mitigation service provider has a service smart contract to accept service requests from DDoS victim. Service smart contract include information about the service and price that DDoS mitigation service provider can provide.  IP prefix-related information: The DLT records information about IP prefix and AS (Autonomous System) numbers, so given an IP prefix the corresponding AS number can be retrieved. By using these information, the DDoS victim can find the DDoS mitigation service provider when the IP address of attack source is identified. | | |
| Identification: | Full identification of each entity is required. | | |
| Predicted Outcomes: | 1. Minimize time to negotiate DDoS mitigation service.  2. Eliminate the need of pre-sign SLAs between customer and service providers. | | |

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| Overview of the Business Problem or Opportunity |
| Distributed Denial of Service (DDoS) attacks combine multiple distributed attack sources to attack a single victim, thereby amplify the attack power and downgrade the services of the victim network. DDoS can exhaust not only the resources of victim networks but also of the uplinks. Mitigation near attack sources is better than near attack targets, because it prevents the attack traffic from consuming bandwidth resources of the intermediate networks. Besides, the burden of DDoS mitigation is shared, so the required service capacity of single provider will not be so challenging.    Figure 1: Overview of DDoS Protection System  However, near-source DDoS mitigation requires a business model that the victim network to purchase mitigation services from multiple providers close to the multiple source networks, which can be any of the tens of thousands of autonomous systems (ASes). There are two challenges:  First, the victim network has to set up business relationship with the remote providers, who may be unknown to the victim;  Second, different attacks have different sources, and thus require setting up business relationship with different providers. Due to the challenges, existing mitigation services are typically provided closed to the victim networks. |
| Why Distributed Ledger Technology? |
| DLT is to build a trust infrastructure, which helps the victim network to set up trust relationship with the remote providers, and enables fast on-line trading between them to start DDoS mitigation as soon as possible. |

### Distributed Ledger based Online Trading System for Cross-domain VPN Provision

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| Use Case Summary | | | |
| Use Case ID: | Xxx | Use Case Type: | Vertical |
| Submission Date: | Xxx | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Distributed Ledger based Online Trading System for Cross-domain VPN Provision | Domain: | Industries |
| Status of Case | Concept | Sub-Domain | IT and telco |
| Contact information of person submitting/  managing the use-case | *Xinpeng Wei* [*wexinpeng@huawei.com*](mailto:wexinpeng@huawei.com)  *Bingyang Liu* [*liubingyang@huawei.com*](mailto:liubingyang@huawei.com) | | |
| Proposing Organization | *Huawei* | | |
| Short Description | This use case is a proposal for utilizing DLT-based online trading system for cross-domain VPN (Virtual Private Network) provision services, which enables a custom to purchase cross-domain VPN service on-demand and flexibly. | | |
| Long description | A virtual private network (VPN) extends a private network across a public network, and enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network. Usually the VPN connection will cross one or more networks operated by different operators, and the operators should have SLAs between each other to setup of end-to-end VPN connection for customers, the process of setup VPN could take a very long time both due to technology issues and SLA issues between operators, but because the VPNs are usually static provisioned and once setup it will maintained for a very long time, so the time taken for VPN setup is acceptable.  But as the new cases that VPN should be setup in a more flexible and on-demand way, the existing solution for VPN setup is no longer acceptable, because it is usually unknown which operator’s network to traverse and whether the en-route operators has SLAs between each other.  This document provides a use case that DLT is used for on-demand VPN connection setup across different domains. | | |
| SDG in Focus (when applicable) | Goal 9: Industry, Innovation and Infrastructure  9.3 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. | | |
| Value Transfer: | Token which is used to pay for VPN service. | Number of Users: | thousands |
| Types of Users: | enterprise, residential customer network, network operator | | |
| Stakeholders | enterprise, residential customer network, network operator | | |
| Data: | 1. The data that VPN user sends to network operator for VPN provision.  2. The Service Level Agreement signed between different network operators. | | |
| Identification: | Full identification of each entity is required. | | |
| Predicted Outcomes: | 1. Minimize time to negotiate VPN provision process.  2. Eliminate the need of pre-sign SLAs between customer and service providers. | | |

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| Overview of the Business Problem or Opportunity |
| Currently in order to establish VPN connection across more than one operators’ network, because the QoS of VPN connection needs to be provided along the whole connection path, so operators should have SLAs between each other and each operator makes its own provisions for the VPN connection. The process of setup VPN could take a very long time both due to technology issues and SLA issues between operators, but because the VPNs are usually static provisioned and once setup it will maintained for a very long time, so the time taken for VPN setup is acceptable.    Figure 1: VPN connection across different operators’ network  But for the new use case of on-demand VPN connection, the existing solution is hard to satisfy the requirements for the following reasons:  1. The on-demand VPN is very dynamic, and it is hard to predict with network it will traverse.  2. The on-demand VPN could only exist for a short time, e.g. only a few days, so the time cost of establishing such as connection should be low enough. |
| Why Distributed Ledger Technology? |
| DLT is to build a trust infrastructure, which helps the private network to set up trust relationship with the network providers for establishing VPN connection, and enables fast on-line trading between them to realize automatic VPN provision. |

## Industries

### Ambiental?: Nori carbon removal marketplace

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Agriculture, Finance, Data Validation |
| Submission Date: | March 19, 2019 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Nori carbon removal marketplace | Domain: | Finance |
| Status of Case | Pilot | Sub-Domain | P2P transactions |
| Contact information of person submitting/  managing the use-case | Ross Kenyon  Lead Strategist  [ross@nori.com](mailto:ross@nori.com)  +1-602-809-0448  https://nori.com | | |
| Proposing Organization | Nori LLC, Washington, United States | | |
| Short Description | Nori is building a new marketplace to incentivize the removal of carbon dioxide from the atmosphere. | | |
| Long description | Nori is the world’s first carbon removal marketplace. We focus exclusively on helping carbon removal practitioners get paid for removing CO2 from the atmosphere. Existing carbon markets primarily focus on avoided emissions. We have learned a lot from their experience but have made a number of design choices that we believe improves credibility, efficiency, and deservedly treats carbon removal as a discrete activity. Our technology and carbon removal methodologies are open source, and we have open our first pilot project for farmers engaging in regenerative agriculture. As a result of carbon removal’s mechanics and the transparency of blockchain accounting, we can far more credibly guarantee that a tonne of carbon dioxide removed and represented by a Carbon Removal Certificate is actually removed. Our NORI token trades at a ratio of 1:1 against the CRC, which will effectively create a market-driven price on carbon for the first time in history, something we very much hope will be akin to the Brent Crude or West Texas Intermediate prices used for forecasting in petroleum. A simple and scalable system that allows even small carbon removers to monetize their activity could see the emergence of a trillion dollar carbon removal industry. | | |
| SDG in Focus (when applicable) | #13.1, 13.2, 13.3, 13.A, 13.B | | |
| Value Transfer: | NORI is a token acting as a medium of exchange that will be traded representing the global price for a metric tonne of carbon dioxide removed from the atmosphere. It is traded 1-to-1 for a non-fungible token called a Carbon Removal Certificate (CRC) that is immediately retired upon purchase. | Number of Users: | Including employees, those in the pilot, and those at companies we collaborate with, <100. Our ultimate goal is to be “The API for reversing climate change” with billions of users interacting with the system in the backend of everyday transactions. |
| Types of Users: | Supplier, Buyer, Verifier, Baseline generator, Peer reviewer, Data platform provider, Data manager, CRC aggregator. | | |
| Stakeholders | There are two broad groups of stakeholders: those benefitting from less climate change (or a fully pre-Industrial Revolution climate), and those being paid for carbon removal behaviors. As a result of there being a single market-driven price for carbon removal, this could proportionally benefit the Global South more than those more-developed countries. | | |
| Data: | Carbon Removal Certificates will include metadata about who removed the CO2, where it was removed, how it was removed, who verified it, what standards it was verified against, who purchased the CRC, how much they paid. | | |
| Identification: | CRCs will be transparent, so the sellers and buyers will be public. Certain data about the carbon removal, such as farming practice data, will be kept confidential. | | |
| Predicted Outcomes: | Our goal is to provide the market mechanism for the future trillion dollar carbon removal industry. With a market-driven price on carbon dioxide, and a credible marketplace that is software-driven and scalable, we think this could cause a gold rush into carbon removal technology.  At a more basic level, an outcome we expect is that carbon removal will be treated as discrete from offsets, which is crucial for carbon removal to grow into its own dedicated financial infrastructure. | | |

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| Overview of the Business Problem or Opportunity |
| There is no marketplace that treats carbon removal as discrete from avoided emissions credit. But they are not the same and should not be treated as such. Additionally, we are past the point where emissions reductions, cap and trade allocations, avoided deforestation credits, and RECs can prevent climate change. With the trajectory we are currently on, we need carbon removal and we need it immediately. By building financial infrastructure that is simple and scalable, and assets that are trustworthy and make a credible impact on climate change, there is a huge opportunity to defuse political fighting over the environment vs. the economy. If people can become wealthy by practicing carbon removal, then we can grow the economy while also reversing climate change. Our approach to this financial infrastructure is software-driven and should be as easy to use as we have come to expect from ecommerce giants like Amazon. Our technology cuts out the large number of middlemen in legacy carbon markets, and can plug into the backend of many other applications through an API. |
| Why Distributed Ledger Technology? |
| **Trust:** The main reason blockchain is needed is for verification of who owns the Carbon Removal Certificate at what time. Public databases can provide transparency, but when you combine the transparency of the public ledger with the verifiability of records that cannot be tampered, corrupted, or bribed via the blockchain, you have something truly unique and valuable.  **Provenance:**  In carbon markets today, there is rampant double-counting and fraud. Companies routinely count emissions reductions against their carbon emissions after someone in their supply chain has done the same thing.  In the Nori market, there can only ever be one owner at a time of a Carbon Removal Certificate (CRC). Once the supplier sells it to a buyer, it becomes non-transferable, and can never be sold again. No longer can buyers of these certificates claim emissions reductions that were paid for by someone else. Whoever owns the CRC is the entity who can claim publicly that they’ve been responsible for removing a tonne of CO2.  The same goes for suppliers. It is often the case that suppliers count their projects that reduced carbon emissions for themselves, and then sell offset credit to a buyer who also counts the emissions. In the Nori market, after a supplier sells a CRC, they no longer own it, and cannot claim that they have removed CO2 in their own emissions report.  It would be possible to do this in a centralized database. But that’s exactly what the current carbon registries use, and yet somehow the double-counting continues. By building this application on a blockchain, everyone involved can completely trust that there is only one owner of the CRC.  **Insurance pooling:** Of the 500 million NORI tokens which we plan to mint, they will belong to different categories of stakeholders. The most relevant category here is the insurance pool. In legacy carbon markets, if someone buys certificates that turn out to have released the carbon they attempted to remove or avoid emitting, the buyer would be on the hook for replacing those. We take that risk ourselves. We have an insurance pool set aside of 100 million tokens to replace any invalid CRCs for the benefit of buyers. We are able to build this mechanism into our market because of our control over token supply and its mechanics for the benefit of our users.  **Operating, not Brokering:** By using smart contracts, Nori is able to take a role whereby we never actually take ownership of the CRCs. We have developed our own open-source framework for an atomic swap marketplace. This enables the seamless transfer of the CRC for a NORI token between buyer and seller. All without Nori ever touching either asset.  This is partially useful to Nori so that we avoid any regulatory requirements that exist for brokering in a commodity like the CRC. But this is also a benefit to the users of the platform. They can trust—because of the open-source nature of the smart contract—that the exchange of NORI for CRC is truly a bilateral agreement solely between the buyer and supplier.  Immutability, verifiability, and transparency are cornerstone values of what Nori is building. |

### Arts?: Lithopia: engaging stakeholders in blockchain and satellite futures

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Horizontal |
| Submission Date: | 14.3.2019 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Lithopia: engaging stakeholders in blockchain and satellite futures | Domain: | Internet of Things |
| Status of Case | PoC | Sub-Domain | Land Registries |
| The contact information of the person submitting/  managing the use-case | Full Name Denisa Reshef Kera  Job Title Marie Curie Fellow  E-mail address: [denisa.kera@usal.es](mailto:denisa.kera@usal.es) Telephone number: +34622631271  Social media: <https://linkedin.com/in/denisakera/>  <https://usal.academia.edu/DenisaKera>  Web site: <http://anonette.net> | | |
| Proposing Organization | BISITE, University of Salamanca, Spain | | |
| Short Description | Template of Hyperledger Fabric based service (chaincode) that uses satellite data as a trigger and explores stakeholder engagements in blockchain futures. The contract is featured in a design fiction parody of a “smart village,” but it can be utilized by activists reclaiming symbolic ownership of various resources on an NGOs operated ledger for mobilization through land-art performances. | | |
| Long description | Lithopia <https://github.com/anonette/lithopia> is a parody of a “smart” blockchain-managed village that uses open satellite data to trigger smart contracts on the Hyperledger Composer/Fabric. It reflects the current search for national cryptocurrencies and speculative investments in mining, such as ICOs or Lithium reserves in the Czech Republic. It is a functional prototype of a Node-RED interface/dashboard connected to the blockchain smart contracts on Hyperldger over a REST API service. It uses open data from Sentinel 2A Copernicus to change ownership of a location or a resource when covered by 10 x 10 m textile creating a pixel of data for the satellite. The project supports inclusive and democratic “future-making” (anticipatory governance) against the current misuses of emerging technologies in the so-called predictive, anticipatory and frictionless design. The villagers in Lithopia govern their affairs in an extremely transparent, but also aesthetic manner. Special long gestures and large LiCoins, but also acts of covering spaces in a land-art, Christo manner trigger the transactions. Lithopian DLT is inspired by Micronesian island of Yap that uses large stone coins to preserve their oral memory of ownership, marriages, and important events. Lithopians deploy smart contracts as a form of oral culture timestamping emphasizing genealogy over exchange and stewardship over ownership. The project is currently installed at the Milan design Triennial until September 2019. | | |
| SDG in Focus (when applicable) | Goal 1: end of poverty ( 1.4 supports ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services)  Goal 9: resilient infrastructure (9.1, 9.3, 9a -c)  Goal 11: inclusive and safe settlements and safeguarding of cultural and natural heritage (11.1, 11.3, 11.4, 11a)  Goal 13: combat climate change (13.b)  Goal 15: sustainable use of terrestrial ecosystems(15.6, 15.9)  Goal 16: effective, accountable institutions (16.6, 16.7) | | |
| Value Transfer: | Assets changing ownership | Number of Users: | Users registered on the permissioned Hypereldger Fabric blockchain network (unknown limitations) |
| Types of Users: | Citizens, artists, activists | | |
| Stakeholders | Investors, owners of a property, tenants, property management teams, public administration workers, indigenous groups | | |
| Data: | The contract includes human actors and external data from Sentinel 2A satellites and online services (Twitter, Weather, Cryptocurrency exchanges).   1. Sentinel 2A data shared over an API service developed for the project ( <http://anonette.net:8000/summary/> ). It updates on when is the satellite available in a given GPS location. It includes custom made visual recognition/tracking system searching for 1 pixel (10 x 10m) of red color data in a given location. 2. Human actor’s data include identification data of participants in the blockchain network and assets. The Hyperledger Composer BNA (business network archive) includes cto file defining the users (participants), assets and the transactions (adding data from satellites and changing the ownership of an asset) in the JS script file. The ACL file them defines access control rules. The BNA data are available through a REST API (<http://anonette.net:3000/explorer/> - only authorized users).   Privacy is ensured by the Hyperledger Fabric blockchain structure of creation of different channels, where one needs the authorization to access any specific channel in the blockchain network achieved through the Certification Authority(CA) of the blockchain architecture.  The interface to interact with the blockchain is Node-RED dashboard. Currently, you can add and see participants, properties and also types of partnerships. The DLT solution interacts with Twitter and external data over the dashboard (following weather data over open API and cryptocurrency exchanges influencing the decision to trigger the contracts).  This PoC connecting satellite API with Hyperledger Composer REST API and Node-RED interface is currently stored only on one server with limited privacy and access for the developers and workshop participants. | | |
|  | The PoC is used in a design fiction project with fake participants and assets for testing purposes and as a tool to engage stakeholders in workshops. We plan to use identification mechanism offered by Hyperledger Composer Certification Authority and their channel tool. The participants are not anonymous. | | |
| Predicted Outcomes: | 1. Properties registered on the ledger symbolically change ownership through land-art mobilization and performance by individuals or group of citizens in front of the satellites at a given time. 2. The dashboard informs the participants about the right time and weather condition to cover a given area and trigger the transaction. It also keeps a record of participants interested in a specific cause and the type of properties they try to own symbolically. It gives them tools (sentiment analysis of Twitter feeds and cryptocurrency exchange) to make the decisions. | | |
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| Overview of the Business Problem or Opportunity |
| The tool is an opportunity for various stakeholders to understand and test the possibilities of Hyperledger based blockchain systems through a real near future scenario. It can also be used by NGOs and indigenous groups to reclaim symbolic ownership of natural resources or property by supporting an alternative ledger and a type of a ritual in front of the satellites. It is a tool to mobilize citizens to manage various resources which need stewardship by the commons or that have cultural and other value for a given group. |
| Why Distributed Ledger Technology? |
| Anticipatory governance of emerging DLT infrastructure is possible only if we involve a diversity of stakeholders to be part of the early development of a given technology. DLT, in this case, is a tool for stakeholder engagement over design fiction scenario with real prototypes. It has a potential to be used as a tool for public participation in the management of natural and other resources on a ledger operated by NGOs and various organizations interested in such land uses or to support the plea of indigenous population for symbolic ownership of their ancestral land etc. The solution offers a tool to understand and be part of the decision making about future infrastructure and to support the diversity of users. It also provides a dashboard allowing stakeholders to follow the use of such a tool in a design fiction or real scenario. It can enable immutability of records that concern ownership of property of natural resources and land and enable stakeholders to start important conversations about commons, climate exchange, and other pressing issues. |

### Manufacturing

### Energy: Energy distribution with the use of smart contracts

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Vertical* |
| Submission Date: | October 17, 2018 | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | Energy distribution with the use of smart contracts | Domain: | *Industry* |
| Status of Case | PoC | Sub-Domain | *Energy* |
| Contact information of person submitting/  managing the use-case | Ioannis Kounelis,  ioannis.kounelis@ec.europa.eu  Joint Research Centre (JRC), European Commission  Via E. Fermi 2749, TP 580  21027 Ispra(VA), Italy  Telephone number: +39 0332 78 3653  Social media: https://twitter.com/EU\_ScienceHub  Web site: https://ec.europa.eu/jrc/en | | |
| Proposing Organization | European Commission | | |
| Short Description | In this use case, taking advantage of the potentialities of blockchain technologies, we propose a solar energy production and distribution architecture using smart contracts, a particular distributed ledger paradigm, to support automatic energy exchanges and auctions, potentially enabling a new, open and more fruitful, under an end-user perspective, energy micro-generation market. | | |
| Long description | In our model, we assume a local grid where energy is produced and consumed in a limited geographical area, such as a local neighbourhood. Energy produced by a prosumer may be saved in the user’s local battery for later use or may be immediately injected in the local grid. An additional possibility is to have a common, central to the neighbourhood, battery shared as a temporary energy buffer. The model is divided in three layers: (a) the energy grid, (b) the middleware controller, and (c) the smart contract.  When energy is injected in the grid a smart meter linked to each producer continuously measures how much energy has been injected in total. These smart meters, along with the software that handles their output, i.e. a middleware controller, are the input source for our smart contracts. After a predefined amount of energy has been injected to the grid, an Helios Coin (HEC) is awarded to the corresponding prosumer.  The middleware controller interconnects the grid with the smart contract since these systems cannot communicate directly with each other. As a result, the controller plays the role of invoking the smart contract on one end, and on the other receiving the readings from the grid, thus facilitating communication between the two entities. | | |
| SDG in Focus (when applicable) | Goal 7: Affordable and clean energy | | |
| Value Transfer: | Tokens | Number of Users: |  |
| Types of Users: | energy producer, energy consumer, smart meter | | |
| Stakeholders | energy producer, energy consumer, electricity grid | | |
| Data: | *energy data* | | |
| Identification: | energy producer (anonymous), energy consumer (anonymous), smart meter | | |
| Predicted Outcomes: | The main aim of our model is to enable micro-grid prosumers to produce, consume and trade energy. In particular, they would be able to:   * Release excess energy to the grid and receive virtual coins in return * Transfer/Exchange the virtual coins * Redeem the virtual coins in exchange with energy * Enable prosumers to access the energy market | | |

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| Overview of the Business Problem or Opportunity |
| Business Problem:  Micro-generation is the capacity for consumers to produce electrical energy in-house or in a local community. The concept of “market” indicates the possibility of trading the electricity that has been micro-generated among producers and consumers, where a user acting both as a producer and consumer is called a “prosumer”. Traditionally, this market has been served by pre-defined bilateral agreements between prosumers and retail energy suppliers. This means that until now, electricity-generating prosumers have not had real access to the energy market, which remains a privileged playing field for the institutionalised energy suppliers. This fact has, so far, heavily impacted on the real diffusion at large scale of micro-generation due to the limited economic advantages this energy generation approach would bring to the prosumers.  Opportunity:  The main options considered so far by the technical literature, were completely centralised and their viability (under a prosumer perspective) was in general challenged as they introduce additional management fees and costs and assume the intervention of a trusted third party reducing once again the potential gains of end-users. New approaches should be developed enabling end-users to have free access to the energy market. In this context the advent of distributed ledgers, i.e., blockchains, can be considered beneficial. |
| Why Distributed Ledger Technology? |
| Blockchain enable users to access the energy market and exchange energy directly with other entities without trusted centralized third party.  The DLT features required are verifiability, security, resilience, transparency. |

### Energy: P2P Energy Trading

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| **Use Case Summary** | | | |
| **Use Case ID:** |  | **Use Case Type:** | *Vertical* |
| **Submission Date:** | 17th of December 2018 | **Is Use Case supporting SDGs** |  |
| **Use Case Title:** | P2P Energy Trading | **Domain:** | *Industry* |
| **Status of Case** | *Concept* | **Sub-Domain** | *Energy* |
| **Contact information of person submitting/**  **managing the use-case** | *Igor Ferreira [FOHAT] Chief Executive Officer*  *igor.ferreira@fohat.co +55 41 9 9101-9222*  [*https://www.linkedin.com/in/figor*](https://www.linkedin.com/in/figor) | | |
| **Proposing Organization** | *FOHAT Corporation* | | |
| **Short Description** | *Consumer token (NRJ TOKEN) for energy trading of the Distributed Energy Resources (DERs) inside Blockchain Microgrids.* | | |
| **Long description** | *By tokenizing the Energy Trading platform we will allow Prosumers to trade the energy from their Distributed Energy Resources (DERs) like solar panels, batteries and electrical vehicles in a peer-to-peer transactive network. That will allow people to Bring Your Own Devices (BYOD) into the Microgrids, which allow Grid expansion and improves reliability of the grid network.* | | |
| **SDG in Focus (when applicable)** | *7-11* | | |
| **Value Transfer:** | *Tokens* | **Number of Users:** |  |
| **Types of Users:** | *Energy Traders, Prosumers* | | |
| **Stakeholders** | *Development Bank, Utility Companies* | | |
| **Data:** | *=> Shared Data (DLT)*   * *Transaction history for audit purposes;*     *=> Use case specific DLT data:*   * *Account;* * *Token Balance;* * *Forecasting;*   *=> External Data (not stored in DLT):*   * *Energy usage inside Microgrid;* | | |
| **Identification:** | *KYC (Know Your Customer) for Energy Traders and Prosumers* | | |
| **Predicted Outcomes:** | The predicted outcomes are:   * Expansion of the Distributed Energy Resources inside Microgrids; * Transparency of the investments done by Development Bank in the Energy Sector; * Improved participation of Prosumers in a Free Energy Market; | | |

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| **Overview of the Business Problem or Opportunity** |
| *The Energy Sector is key for the development of the society and to secure access to a comfortable life for everyone, is a key product/service that support people’s life and the country growth.*    *The world is moving from a Centralized energy generation - based in big power plants - to a more Decentralized energy generation system which improves costs since the energy is produced and consumed closer. A lot of new energy generation is being deployed on solar rooftops, that needs to be integrated in a technology arrange called Microgrid, which allows a better way to improve the energy flow and secure a more reliable system that can work both connected or disconnected of the main Grid..* |
| **Why Distributed Ledger Technology?** |
| *In the Energy Sector a movement around Decentralization is already happening for power generation, but it’s also needed to secure that the Grid is also Distributed when it comes to Operation and Accountability of the energy trading, DLT technology can scale the energy trading to be performed inside every Microgrid and in between Microgrids, it also allows a new layer of protection against cyber attacks in a infrastructure that is becoming more and more digitized.* |

### Chemical

### Retail

### Real estate

### Supply chain management: Reverse Logistics Credits

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| **Use Case Summary** | | | |
| **Use Case ID:** |  | **Use Case Type:** | *Vertical* |
| **Submission Date:** | **04/01/2019** | **Is Use Case supporting SDGs** | *Yes* |
| **Use Case Title:** | Reverse Logistics Credits | **Domain:** | *3* |
| **Status of Case** | *Pilot* | **Sub-Domain** | *g* |
| **Contact information of person submitting/**  **managing the use-case** | *Full Name: Lucas Farias de Moraes Sarmento*  *Job Title: COO*  *E-mail address: lucas.sarmento@brpolen.com.br*  *Telephone number:+55 21 991686899*  *Social media:* [*https://www.linkedin.com/in/lucas-farias-de-moraes-sarmento-82206490/*](https://www.linkedin.com/in/lucas-farias-de-moraes-sarmento-82206490/)    *Web site:*[***www.brpolen.com.br***](http://www.brpolen.com.br) | | |
| **Proposing Organization** | *Legal Name: POLEN CONSULTORIA E INTERMEDIACAO DE NEGOCIOS EM SUSTENTABILIDADE LTDA ­ EPP*  Country: Brazil  CNPJ: 28.038.406/0001-82 | | |
| **Short Description** | *Post-consumption waste Reverse logistics compensation scheme using DLT as infrastructure to issue Reverse Logistics Credits, which can be used by companies wishing to offset and incentivise the recycling of the waste generated by the consumption of the products they sell to the public.* | | |
| **Long description** | Companies in Brazil that manufacture packaged goods are required by law to provide proof that a percentage of said packaging is recycled, post-consumption. Also, in Brazil, a crucial part of the reverse logistics chain lies on street waste pickers associations, they collect, sort and sell post-consumption urban solid waste to the recycling industry. In short, waste pickers do the job that these manufacturers were supposed to do. Regulators, auditors and legislators are aware of this scheme and allow for companies to finance the operations of waste pickers associations (proportionally to the amount of waste the association collects and sell) as a way to prove that the packaging of the products they sell to the public is returned to recycling industry, what constitutes basically a credit or offsetting scheme. Currently the scheme works as follows:   * Waste Pickers collect, sort and sell post-consumption waste to recycling industry * Packaged goods manufacturers ‘buy’ the invoices from the transactions described above from the association paying in the form of improvements in the association’s infrastructure and machinery. * Packaged goods manufacturers use these invoices to prove to authorities that they were financially responsible for the recycling of the post-consumption waste.   The main concern about the current process is that companies are paying for duplicate credits, Reverse Logistics Operators (waste pickers associations and similar organizations) have been selling invoices of the same commercial transaction for more than one packaged goods manufacturer, effectively incurring in ‘double-spending’ of the Reverse Logistic Credit they generated.  Another concern about the current process is that to rule out any chance of an employment bond between the associations and the manufacturers the waste pickers associations can only receive the payments from the manufacturers in the form of improvements in the association’s infrastructure and machinery. Being that most of these waste pickers live in extreme conditions of poverty, their, totally fair, claim is to be able to receive these payments in actual sound money instead of improvements and machinery.  Using a DLT to record, issue and transact those credits solve both above mentioned problems. Double spending is made impossible by the very characteristics of the system and employment bonds between associations and manufacturers will be never be formed because manufacturers will only buy the fungible tokens issued by the smart contract not knowing which association was responsible for the actual process of returning the post-consumption waste to the recycling industry. | | |
| **SDG in Focus (when applicable)** | GOAL 8: DECENT WORK AND ECONOMIC GROWTH  GOAL 9: INDUSTRY, INNOVATION AND INFRASTRUCTURE  GOAL 12: RESPONSIBLE PRODUCTION AND CONSUMPTION  GOAL 14: LIFE BELOW WATER | | |
| **Value Transfer:** | *Users transact tokens that represent the collection and recycling of 1 ton of post-consumption packaging waste* | **Number of Users:** | *TBA* |
| **Types of Users:** | ***Reverse Logistics******Operator*** *(company or association that is responsible for collecting and selling post-consumption packaging waste to the recycling industry)*  ***Packaged Goods Manufacturers*** *(company that sells packaged goods to the general public and is required by law to provide proof that a percentage of said packaging was recycled)*  ***Auditors*** *(Brazilian Government body that is responsible for overseeing the compliance of such legislation)*  ***System Operator*** *(company that develops and maintain the online platform and infrastructure where tokens are issued, bought and sold)* | | |
| **Stakeholders** | ***General society****: is benefited by the increase in recycling rates and the environmental consequences that come from said increase.*  ***Waste Pickers Associations:*** *is benefited by the extra income earned due to the selling of the Reverse Logistics Credits.*  ***Packaged Goods Manufacturers:*** *are provided with a simple and secure mechanism to comply with legislation and offset environmental impact of their activities.*  ***Government bodies responsible for overseeing compliance of such legislations:*** *are provided with an easy and secure way to audit the compliance of such legislation* | | |
| **Data:** | The DLT will store data about commercial transactions that complete the reverse logistics process (Reverse Logistics Operator selling post-consumption waste to Recycling Industry).  Invoices of such transactions officially issued by the Brazilian fiscal authorities will be parsed and tokenized if adherent to the requisites above.  The information to be stored is: Seller’s CNPJ, Buyer’s CNPJ, NCM Code (MERCOSUL common denomination code), amount, type of material transacted, date of issuance. | | |
| **Identification:** | *Identity of participants will be available only for the marketplace provider and government authorities* | | |
| **Predicted Outcomes:** | Increase in packaging recycling rates; increase in Waste Pickers income and overall work conditions; increase in compliance by packaged goods manufacturers; decrease in the amount of landfilled recyclable material; decrease in the amount of waste mishandled and wrongly disposed in the environment. | | |

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| **Overview of the Business Problem or Opportunity** |
| *Business opportunities lies on the intermediation of the buying and selling of the token, collecting transaction fees for every transaction made on the platform.* |
| **Why Distributed Ledger Technology?** |
| Using a DLT to record, issue and transact Reverse Logistics solve the two more sensible problems of this compensation scheme. Double spending is made impossible by the very characteristics of the system and employment bonds between associations and manufacturers will be never be formed because manufacturers will only buy the fungible tokens issued by the smart contract not knowing which association was responsible for the actual process of returning the post-consumption waste to the recycling industry. Also, auditing the system becomes extremely easy due to the immutability and traceability of the transactions recorded on the ledger. |

### Supply chain management: Polo Multimodal Pecém

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Industry/3 and 4* |
| Submission Date: | 04 Jan 19 | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | Polo Multimodal Pecem – Supply Chan application | Domain: | *List 1 Appendix 1* |
| Status of Case | *Concept* | Sub-Domain | *Supply chain management* |
| Contact information of person submitting/  managing the use-case | *Ingrid Barth Chief Blockchain Officer*  *E-mail address:ingrid@cosmosblockchain.co*  *Telephone number: 11 983615309*  *Social media:https://www.linkedin.com/in/ingrid-barth-48a17b19/ Web site: http://www.polomultimodal.com/* | | |
| Proposing Organization | *Polo Multimodal Pecem*  Fotaleza (Ceará) – Brazil | | |
| Short Description | Polo Multimodal Pecem is a project with over 20 million square meters located in the logistic corridor of Port of Pecém, in the municipality of São Gonçalo do Amarante, State of Ceará, that will create a Blockchain Lab with the intention to create Blockchain and DLT solutions to help industries inside the Polo to solve problems. The first solution will be use blockchain time stamp and immutability to track goods into the Porto do Pecem. | | |
| Long description | Polo Multimodal Pecem is a project with over 20 million square meters located in the logistic corridor of Port of Pecém, in the municipality of São Gonçalo do Amarante, State of Ceará. Conceived to house both national and international companies from different sectors, the POLO MULTIMODAL PECEM was designed within the most modern and rigorous criteria of infrastructure, technology and sustainability; promoting innovation to contribute to the progress of a new industrial age. The idea is also having a Blockchain Lab inside de Polo, with the intention to create blockchain and DLT solutions for all opportunities there. The first idea, based on problems that companies are having in all Ports around the world, is create a solution in a public Blockchain to help companies register in blockchain, in a permanent way and using the time stamp, all tracking about goods, process, containers, flows, in order to bring more security, avoid losses and create new solutions for the flow. Also, other benefits as hold all data and use it for further works – provide data for insurance companies to have a best score and price. | | |
| SDG in Focus (when applicable) | *8 – Decent Work and Economic Growth*  *8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services* | | |
| Value Transfer: | *Security in shipping and transportation processes, possibility to reduce costs and security for the goods.* | Number of Users: | *All companies and people involved. The Pecem Port is growing about 34% year.* |
| Types of Users: | *Companies, society, employees, Pecem port* | | |
| Stakeholders | *Companies, society, employees, Pecem port* | | |
| Data: | *Data will be basically all data involved in shipping processes: Company name, shipping documents, type of goods, date, locations, destination, serial numbers, container number, seals, employees that input data, receivers.* | | |
| Identification: | *Full identification of all participants, like company, employees, location, destination, goods to be transported.* | | |
| Predicted Outcomes: | *The predicted outcomes of the adopting the new process are to:*  *- increase transparency in all supply chain scheme*  *- Avoid losses and frauds during the shipping and transportation*  *- More control about shipping process*  *- More security in shipping process*  *- Higher efficiency and consequently better companie’s reputation*  *- Less bureaucracy once they can certify the veracity in all infos* | | |

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| Overview of the Business Problem or Opportunity |
| *After the Panama Canal expansion, the port of Pecém began to gain a growing importance in the international logistics scenario.*  *With its 18 metres natural depth, it is on the list of the main ports in the world capable to dock large containers ships (post-panamax) and it has been attracting relevant overseas investments to the region in the last few years. Pecem port is growing about 34% per year, and the region is lacking in resources.*  *Because of that, is important to consider solutions that use 4.0 technologies, as DLT/ Blockchain, that can improve process and transform the port and the region in a model abroad, showing concerns with security, losses with frauds, efficiency in shipping process, that cause millions dollar in losses.*  *Supply chain is today the most important and efficiently uses cases in DLT/ Blockchain because the possibility of traceability and immutability, creating a huge transformation in supply chain process.* |
| Why Distributed Ledger Technology? |
| *DLT/ Blockchain is today one of the most exponent and sophisticated technological constructions. This is because in addition to being a decentralized and distributed database, the information once inserted and validated is immutable and with the time stamp, which creates a chain of trust in the processes where Blockchain is inserted and avoid problems with frauds and security of data. Another important point is that it allows the level of governance to be high since each new information registered will be validated and will only continue if most of the participants in that chain validate it.* |

### Transportation

### Agriculture: Livestock farm data monitoring & tracing system

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Vertical |
| Submission Date: | 11-October -2018 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Livestock farm data monitoring & traceability | Domain: | Agriculture |
| Status of Case | Pilot | Sub-Domain | Food traceability |
| Contact information of person submitting/  managing the use-case | Full Name: Hui Ding (Chaincomp)  Job Title: Standard Engineer  E-mail address: hui.ding@chaincomp.net  Telephone number: 86-18311280681  Web site: chaincomp.io | | |
| Proposing Organization | Chaincomp Technologies Co., Ltd., China  Shenqiao Technologies Co., Ltd., Henan, China | | |
| Short Description | Blockchain-based trusted data storage and dissemination among stakeholders in the meat industry, combined with IoT-based effective and complete livestock farming monitoring and data collection enables efficient data sharing and promote food safety. | | |
| Long description | Current large-scale livestock farming industry in China cannot provide trusted data collection and traceability, which gives chances to food safety hazards that happened in recent years. Our use case realizes: 1) IoT-based effective and complete livestock farming monitoring and data collection; 2) Blockchain-based data storage and dissemination. The system can automatically record the environmental, physiological and feeding data and enables efficient and trusted data storage and sharing among stakeholders.  After deployment of such system, 1) government inspector can access tamper-proof data to evaluate the farm and the quality of the livestock; 2) consumers will be able to access the details of his/her purchase and be assured of food safety and quality; 3) furthermore, it enables lower cost meat feeding business operation: farms, feed/drug sellers, insurance providers can share information via DLT to perform transactions in lower cost. | | |
| SDG in Focus (when applicable) | 9 – Industry, Innovation and Infrastructure  9-1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all | | |
| Value Transfer: | NA | Number of Users: | Tens of thousands+ |
| Types of Users: | farm owner, feed/veterinary drugs seller, insurance provider, government inspector, retailor, etc. | | |
| Stakeholders | farm owner, feed/veterinary drugs seller, insurance provider, government inspector, retailor, consumer, etc. | | |
| Data: | Massive amount of data is collected via sensors and devices every day from every animal in the farm, which makes it inefficient to store on DLT. In our system, such data are encrypted and stored in distributed file system, only the hash of a data unit is stored in DLT. The data unit is decided by data types and sampling frequency, e.g. the feeding data and environmental data in 24 hours. | | |
| Identification: | Each livestock, feeding device, sensor, farm site is uniquely identified and related data are collected and recorded. Anonymity is not required. | | |
| Predicted Outcomes: | * Safe and high-quality meat production; * Efficient livestock farming business by sharing livestock data with feed/drug sellers, insurance providers. | | |

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| Overview of the Business Problem or Opportunity |
| Chinese people consume nearly 70 million pigs every year, which constitutes over half of the pig meat consumption of the world. However, current large-scale livestock farming industry cannot provide trusted data collection and traceability in different stages of the process including farming, inspection, transportation, distribution to consumer. Hence, the safety and quality of pig meat is one of the most important unresolved food issues in China.  Business Problem:   * Safe and high-quality meat product is highly demanded; * Efficient livestock farming business by sharing livestock data with feed/drug sellers, insurance providers.   Opportunities:   * IoT-based effective and complete livestock farming monitoring and data collection can automatically record the environmental, physiological and feeding data; * Blockchain-based trusted data storage and dissemination among stakeholders; * Data close to livestock has great value in ensuring food safety and preventing fraud in logistics and sales process. Lack of such data will result in the lack of the most important source data for farm-oriented monitoring. |
| Why Distributed Ledger Technology? |
| * The distributed ledger technology will enable trusted data storage and dissemination among untrusted stakeholders and reduce the chance of data manipulation.   + Inspector can access tamper-proof data to evaluate the farm and the quality of the livestock;   + Consumers will be able to access the details of his purchase be assured of food safety and quality.   + Lower cost meat feeding business operation: farms, feed/drug sellers, insurance providers can share information via DLT to perform transactions in lower cost. |

### Other: Space Data

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Core is horizon (data) 4a. Covering a number of verticals |
| Submission Date: |  | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Celestialdata.io | Domain: | Horizontal 4a, covering Vertical 2a,b,c and 3c,d,i as a starter |
| Status of Case | Concept just about to start with PoC | Sub-Domain | If necessary |
| Contact information of person submitting/  managing the use-case | Full Name Harumi Urata-Thompson  Job Title co-founder and CEO  E-mail address: Harumi.thompson@celestialdata.io  Telephone number: 6462710003  Social media: <https://www.linkedin.com/in/harumiuratathompson/> and @harumiurata for Twitter. I also use a number of messenger apps  Web site: celestialdata.io  (I am based out of New York, but my partner is in Sao Paolo) | | |
| Proposing Organization | Celestialdata.io | | |
| Short Description | We are democratizing the space data for the people on earth, involved in pharma, healthcare, agriculture, food & beverages, academia, and biotech to name a few | | |
| Long description | Agencies like NASA and a number of private entities (since the list is long, happy to provide separate list as needed) have been conducting experiments to improve human lives for decades in microgravity and harsh environment. The data has been accumulating, but thus far, with some exceptions (dried food, super swimsuit, certain types of cosmetics to name a few) the result of all these experiments have not been felt by human race on the earth yet because most of us do not have an access to what we have found out so far, so no scientists, engineers, academia and anyone else who have a possibility of developing our findings into the real earth solutions do not even have the chance to find out what is available for us. Celestialdata is trying to democratize this process and close the gap of those who haves and have nots in order to better the human lives holistically. | | |
| SDG in Focus (when applicable) | 2 – between microgravity and harsh environment, we are already seeing how the seeds react, how vegetables grow, etc. If we can leverage all this data successfully, we can alleviate hunger issues down the line potentially  3 – There are a number of healthcare related experiments that are happening in the microgravity environment. For example, osteoporosis progresses much faster in the environment which means the drug testing can occur in much shorter period of time and this is one just one example. Further R&D obviously a necessary, but if we can leverage what we already found out, we could release critical drugs in much shorter period of time than we currently are doing  6 – a number of bacteria experiments are being conducted. For example, what really triggers salmonella and what might be a solution for it? Again, the data that can be leveraged on the earth if properly found and used  11- slightly different focus from the responses that I have given for other goals, but if we are seriously looking into humanity to open up the additional areas to live, whether it is the “inhabitable” places on the earth or different planet, we need to know what it means to sustain life out there and we are accumulating data in this field as well  13- monitoring the weather and air change is something that we can’t conduct without proper data. We are bringing this down from the space  15 – This goes hand in hand for what I wrote for #2 and #6 goals and more. Without knowing exactly how living organisms, both “good” and “bad” grow, sustained, get wiped out etc, we will never fully unlock the value of life on the earth. We already have a number of experiments that have been conducted in the “clean” environment in the space that can be leveraged on the earth | | |
| Value Transfer: | We will be initially acting more like a data exchange place but we will eventually be allowing simulation using the data which is highly valuable solution – therefore, we will be using tokens to distribute our solution | Number of Users: |  |
| Types of Users: | Pharma R&D, Healthcare professionals, Academia, Agriculture industry, biotech doctors and engineers, food and beverage researchers as a starter | | |
| Stakeholders | Type of users (and their organizations) mentioned above and any individuals that take any services or goods from the industries (which means everyone on the planet earth, I believe I can safely say) will be a stakeholder of some level | | |
| Data: | Nothing will be stored on the main chain – at best it will be the side chain where we will be seeing any kind of data storage because we will be working with a number of agencies and private entities around the world and we have petabytes of petabytes of data that will be utilized throughout this solution.  I believe above addresses how our solution interacts with “outside data” because we will be interacting with outside data from the get go and all the way | | |
| Identification: | Knowing (or programming) who is consuming whose data becomes critical for any data providers to be guaranteed of staying clear of industry spies or international incidents. Therefore, for us to onboard clients, it will be critical that each participant uses professional email address and knowing the extension (which country?) in order to make sure that the smart contract properly functions. | | |
| Predicted Outcomes: | There are somewhat similar science solutions (only for earth science and citation only) like Web of Science or Skopus. My aim is we will take a similar business model to them but market this as (not in this exact words of course) “Web of Science but you can get both data and citation that are coming from all space experiments that are relevant to your field”. So we should be able to onboard very similar client types as these products and anyone who utilize their services/goods (food, drugs, healthcare service, research, etc) should be, as the end customers, able to take advantage of this progress | | |

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| Overview of the Business Problem or Opportunity |
| Business problem – nobody has leveraged the data coming from the space yet except for the pixel (as in satellite images) data that are beginning to be utilized although we have wealth of findings that can be leveraged into the earth business immediately. This provides our opportunity. |
| Why Distributed Ledger Technology? |
| The space data world is extremely fragmented. If DLT didn’t exist, I assume I would have figured out a way to study each and every single database from around the world and write API into every one of them and build a data center of our own. However, with DLT, it is much simpler to “stich” all these fragmented sources. In addition, because of our aim to provide simulation in the future and the nature of the data that we have, we want as much security and verifiability we can have built into the technology. For this, DLT is ideal. |

### Other: Animal Data on the Blockchain

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| Use Case Summary | | | |
| Use Case ID: | **Cecil Alliance Foundation** | Use Case Type: | 1,3,4/1,3,4 |
| Submission Date: | 05.02.2019 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | **Animal Data on the Blockchain** | Domain: |  |
| Status of Case | Concept (seed funding) | Sub-Domain |  |
| Contact information of person submitting/  managing the use-case | Dennis Nagel  Business Development Manager  Cecil Alliance Foundation  d.nagel@cecilalliance.com  Cecilalliance.com  https://www.linkedin.com/in/dennis-nagel-a3737a96/ | | |
| Proposing Organization | Cecil Alliance Pte Ltd / Cecil Alliance Foundation  10 Anson Road #23-05A International plaza 079903 Singapore | | |
| Short Description | IoT blockchain for animal welfare and species conservation | | |
| Long description | Information has a value. Utilizing the idle resource of animal data makes this value available for animal welfare and species conservation. We aim to create a global standard in collecting, tracking and transacting animal data in order to bring transparency, data accessibility, traceability, interoperability and verifiability to animal based industries. Animal ID and documentation on the blockchain prevents illegal wildlife trade enabled by document falsifications. Blockchain opens up innovative fundraising channels. And much more – Cecil Alliance has solutions to solve issues in data collection, data management and data sharing for wildlife, zoos, pets, livestock and sports. | | |
| SDG in Focus (when applicable) | 2,3,9,12,13,14,**15**,17 | | |
| Value Transfer: | CECIL token (crypto currency) | Number of Users: | *-* |
| Types of Users: | Everyone. Private users, authorities, animal enthusiasts, pet owners, animal businesses, veterinaries, researchers, scientists, crypto traders… | | |
| Stakeholders | Animal related industries; wildlife, zoos, pet industry, livestock, sports, research, education, private persons, crypto related businesses, tech suppliers, media… | | |
| Data: | Many different types of animal data, manually or collected by IoT devices automatically. Many other different systems will be interconnected too. Privacy solutions included. | | |
| Identification: | Different approaches for different use cases. Privacy solutions included | | |
| Predicted Outcomes: | Setting a new standard for animal data and creating a platform with significant global impact for animal welfare and species conservation | | |

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| Overview of the Business Problem or Opportunity |
| Data issues cause diminished animal welfare/species conservation, and a lack of efficiency in the multi trillion dollar animal sector, economically. The core issues in data handling affect data collection, data management and data sharing and lead to inaccurate or falsified animal data, unnecessary animal suffering, hindering of scientific advancement and a lack of efficient regulatory oversight, which enables fraudulent activities. Illegal wildlife trade is the fourth most lucrative crime in the world with 7-23 billion USD annually and large parts are enabled by document falsifications. 55 elephants are poached every day. Charity campaigns don’t reach the next generation and are subject to misappropriations. There is a lack of trust, a lack of involvement, a lack of attractivity. Pet and equine frauds go into the billions too. There are more than 10,000 zoos in the world with over 700 million visitors per year, which could make use of IoT blockchain technology just like a smart city. Animal transports can be traced just like a supply chain. 20% of all livestock are culled due to diseases, which is not only a ethical tragedy, but also adds up to 300 billion USD annually. Food scandals are frequent. In the US, 1.5 million shelter dogs are euthanized every year, while 25 million are bred. Animals lack a platform. They are left behind in a world full of technological advancement – for no reason. |
| Why Distributed Ledger Technology? |
| DLT is a gamechanger for the animal sector, because it provides exactly what is currently missing: transparency, traceability, verifiability and accountability. By putting the animal ID and documentation on the blockchain as an immutable data asset, document forgery can be prevented (described in section 2). Donations can become transparent, traceable, more direct and require less administration cost. The crypto community is a new audience of donors who can be attracted by innovative ways of fundraising, like an online collectible token game, microdonations and online animal adoptions with certificates on the blockchain, which can be presented in social media channels, just to name a few examples. It’s not only possible to trace the supply chain of livestock related foodstuff, but also to include the living conditions by monitoring the animals with IoT devices, which write data on the blockchain automatically. This way, premium labels can be provided (easy to scan for the users by mobile phone) and food safety can be enhanced. Moreover, mass cullings can be prevented by advanced health monitoring. |

## Government and public sector

### Taxes

### Government and non-profit transparency: Public sector lending transparency

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | Vertical |
| Submission Date: | 28-may 2018 | Is Use Case supporting SDGs | Yes |
| Use Case Title: | Public sector lending transparency | Domain: | Government and public sector |
| Status of Case | PoC | Sub-Domain | Government and non-profit transparency |
| Contact information of person submitting/  managing the use-case | Full Name: Suzana Mesquita de Borba Maranhão Moreno (BNDES)  Job Title: Software Engineer  E-mail address: suzana@bndes.gov.br  Telephone number: 55-21-993056325  Social media: <https://www.linkedin.com/in/suzana-moreno/>  Web site: <https://www.bndes.gov.br> | | |
| Proposing Organization | BNDES, Brazil | | |
| Short Description | This use case is a proposal for changing the process of lending projects in The Brazilian Development Bank using a stable coin with DLT technology. The main goal is achieve more transparency of the public money allocation. However, the new proposal achieve other benefits like operational costs reduction and the generation of data to support aggregate analysis of the benefits arising from the bank's loans. | | |
| Long description | This use case is a proposal for changing the process of lending projects in The Brazilian Development Bank using a stable coin with DLT technology. The stable coin is used when disbursing money from BNDES to the client and from the client to contractors. Then, the contractor can redeem to get its fiat money. It is a closed ecosystem between BNDES, clients and contractors in order to avoid regulatory risks. In order to achieve the desired transparency, it is necessary to identify everyone who do transactions using the stablecoin. In future view, there is also important to identify services and products offered from contractors to clients. The main goal is achieve more transparency of the public money allocation. However, the new proposal achieve other benefits like operational costs reduction and the generation of data to support aggregate analysis of the benefits arising from the bank's loans. | | |
| SDG in Focus (when applicable) | 8 – Decent Work and Economic Growth  8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services | | |
| Value Transfer: | Tokens representing fiat money | Number of Users: | 20+ |
| Types of Users: | Development bank, Lender, Contractor, Society | | |
| Stakeholders | Government, Development bank (or Public agency), Commercial banks, Lender, Contractor, Society, Auditor | | |
| Data: | => Use case shared data (ideally stored in DLT):  - Entity identification (link between DLT account and real world entity identification)  - Product or service type identification (Future Vision only)  => Use case specific DLT data:  - Account  - Token balance to each account  - Project identification  - Instances of use case shared data identification  => External data - not stored in DLT:  - Entity additional information (number of employees, revenue, geographic region, industry, sector etc.)  => All public information (see Security and privacy section). | | |
| Identification: | Full identification of Lenders and Contractors required by the development bank | | |
| Predicted Outcomes: | The predicted outcomes of the adopting the new process are to:  - increase transparency of public money allocation  - make clients’ proofing of their spending simpler  - reduce audit and compliance costs  - improve public money allocation by postponing fiat money lending  - minimize time to publish lending information  - produce data to do aggregate analysis of the benefits arising from the development bank's loan | | |

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| **Overview of the Business Problem or Opportunity** |
| - In general, society demands more transparency in the use of public money.  - The development bank uses public money to finance projects that adhere to government development policies priorities.  - The society does not trust the development bank.  - The development bank needs to verify that the public money is being used as planned.  - Periodically, lenders need to prove each money spending, including transfer to contractors.  - The development bank needs to verify that lenders’ proof correctly demonstrates that the public money was used as planned.  - Auditors verify that the development bank indeed has assessed lenders’ money spending.  - Maximizing process automation would increase processes efficiency, while reducing the development bank’s verification and audit costs.  - The process information of lending is fragmented.  - The development bank owns the projects and disbursements data. Each lender or contractor has its transfer data.  - Transfer data is protected by commercial banks - financial privacy.  - The development bank has to collect transfer data in order to publish lending information to society.  - The development bank does not have contractor’s registry.  - The development bank has to collect and group data to demonstrate benefits arising from the development bank's loans.  - Integrating data would improve the process efficiency, while minimizing cost.  - In order to minimize paperwork, the development bank disburses to lenders large amounts of money.  - Lenders take some time to spend all the money so they have to invest the funds. If the value of investment interest rate is bigger than the value of the lending interest rate, lenders may have an incentive to postpone the project schedule.  - To make disbursement date and money spending date closer would improve the process efficiency and improve fiat money allocation. |
| **Why Distributed Ledger Technology?** |
| DLT would improve the current solution because it is possible to achieve public money loans transparency without trusting the development bank. Transfer data become easily accessible and can be used to make the underlying processes of lender’s proof of money spending and the process of collecting and publishing loans benefits simpler and more efficient.  In addition, the use of DLT token enables the development bank to disburse fiat money just-in-time. Many times the money can flow to contractors directly. |

### Government and non-profit transparency: Trubudget for the Amazon Fund

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| **Use Case Summary** | | | |
| **Use Case ID:** | TRUBUDGETAMAZONFUND | **Use Case Type:** | *Vertical* |
| **Submission Date:** | 22/03/2019 | **Is Use Case supporting SDGs** | *Yes* |
| **Use Case Title:** | Trubudget for the Amazon Fund | **Domain:** | *4. Government and public sector* |
| **Status of Case** | *Pilot* | **Sub-Domain** | *b. Government and non-profit transparency* |
| **Contact information of person submitting/**  **managing the use-case** | *José Nogueira D’Almeida Jr.*  *Software Engineer*  [*nogueiradalmeida@gmail.com*](mailto:nogueiradalmeida@gmail.com)  *+55 (21) 97189-2811*  [*https://www.linkedin.com/in/nogueiradalmeida/*](https://www.linkedin.com/in/nogueiradalmeida/)  [***www.bndes.gov.br***](http://www.bndes.gov.br/) | | |
| **Proposing Organization** | *BNDES – Brazilian Development Bank* | | |
| **Short Description** | *Trubudget for the Amazon Fund is a blockchain system that improves the reliability of the information providing the money tracking for the investments of Amazon Fund in Brazil.* | | |
| **Long description** | *The Amazon Fund is a REDD+ mechanism created to raise donations for non-reimbursable investments in efforts to prevent, monitor and combat deforestation, as well as to promote the preservation and sustainable use in the Brazilian Amazon.*  *The Amazon Fund is managed by BNDES, the Brazilian Development Bank, which is responsible for raising and investing funds, monitoring the projects supported, rendering accounts and communicating results obtained.*  *Germany is one of the main donors of Amazon Fund. The Germany's Development Bank KfW and BNDES are cooperating to use the blockchain technology to record how funding is spent. The Trubudget is a generic blockchain system that allows to register workflows. The Trubudget for the Amazon Fund is a use case that registers the money flow. It started in 2017, it had a Proof-of-Concept Phase in 2018 which consisted in simulations with real clients and in 2019 is evolving to a Pilot Phase, which consists in real disbursement monitored and controlled by the blockchain. The payments process from BNDES to its Clients was the choice to be recorded on Trubudget blockchain in the Pilot Phase. Future developments can include other payments processes, e.g., the NGO payments to the supported individuals.* | | |
| **SDG in Focus (when applicable)** | *Goal 6 – Clean Water and Sanitation*  *Goal 13 – Climate Action*  *Goal 15 – Life on Land*  *Goal 16 – Peace, Justice and Strong Institutions*  *Goal 17 – Revitalize the global partnership for sustainable development*  *All these objectives are related to the Amazon Fund and the Trubudget aims to improve the management of it.* | | |
| **Value Transfer:** | *There is no value transfer in the blockchain solution described.*  *This is a declarative ledger.* | **Number of Users:** | *30+* |
| **Types of Users:** | *BNDES Business Analyst*  *BNDES-Clients Business Analyst*  *Auditors (donors, government agencies, etc)* | | |
| **Stakeholders** | *BNDES, KfW, TCU (government agency), Norway* | | |
| **Data:** | *Users*  *Projects*  *Subprojects*  *Workflow items*  *There is a communication between Trubudget and the ERP System, which every disbursement that occurs in the ERP, it makes a new record in the respective Trubudget Subproject.* | | |
| **Identification:** | *Every user has credentials (login and password) to use the system. Some users have admin power, which means that they can create other credentials.*  *Projects, Subprojects and Workflows items need permission of its owner to read/write.* | | |
| **Predicted Outcomes:** | Trubudget aims to be an additional source of information in a blockchain for the stakeholders monitor the Amazon Fund projects.  The system is able to provide the Client’s, BNDES and Donors access to the same data at any time. This is similar to the Circularization technique commonly used by Audit companies, when the auditor sends a letter directly to a third party to confirm a information about the audited organization.  In a future phase, it can replace some process/report that are currently made offchain. | | |

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| **Overview of the Business Problem or Opportunity** |
| *The donors of Amazon Fund and BNDES could be concerned about the correct use of the disbursements for the projects executed by their clients, generally NGOs. This system can improve the timing of the information and the reliability of it.* |
| **Why Distributed Ledger Technology?** |
| *Every stakeholder (Donor, BNDES, Clients/NGOs) has its system and provide the information of money expenditure using the traditional ways (emails, documents, spreadsheets, receipts, etc).*  The Trubudget for the Amazon Fund integrates this information in one blockchain system, where the data is immutable, secure, verifiable and transparent. |

### Legislation, compliance & regulatory oversight: Mudamos

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| Use Case Summary | | | |
| Use Case ID: |  | Use Case Type: | *Vertical* |
| Submission Date: |  | Is Use Case supporting SDGs | *No* |
| Use Case Title: | Mudamos | Domain: | *List 1 Appendix 1*  *d* |
| Status of Case | *Implementation* | Sub-Domain | *If necessary* |
| Contact information of person submitting/  managing the use-case | *Marco Konopacki*  *Project Coordinator*  [*marco@itsrio.org*](mailto:marco@itsrio.org)  *+55 21 999278090*  [*marco@itsrio.org*](mailto:marco@itsrio.org)  *@marcoamarelo*  [*http://itsrio.org*](http://itsrio.org/)  [*http://mudamos.org*](http://mudamos.org/) | | |
| Proposing Organization | *Institute for Technology and Society* | | |
| Short Description | *Mudamos is a mobile application that enables Brazil’s citizens to participate in lawmaking by proposing their own bills and signing onto one another’s proposals using verified electronic signatures.* | | |
| Long description | *Mudamos is a mobile application that enables Brazil’s citizens to participate in lawmaking by proposing their own bills and signing onto one another’s proposals using verified electronic signatures. Any citizen with a smartphone (Android or iOS) can download the app and register with his or her electoral ID, name and address, information which Mudamos keeps secure and verifies with Brazil’s Electoral Court. The app issues what is known as a cryptographic key pair, a small piece of code used for verification. One half of the key is stored on the user’s phone and the other with Mudamos, which makes it possible to authenticate a person’s signature. In this way, members of the public can draft and sign petitions in a way that is verifiable and secure.* | | |
| SDG in Focus (when applicable) | *Enter one or more number (1-17) and specific corresponding indicator/s as applicable*  *See* [*https://www.un.org/sustainabledevelopment/sustainable-development-goals/*](https://www.un.org/sustainabledevelopment/sustainable-development-goals/)  *Goal 16: Promote just, peaceful and inclusive societies* | | |
| Value Transfer: | *If potential solution allows to transfer any value (e.g. assets, tokens, etc.)* | Number of Users: | *350.000* |
| Types of Users: | *Voters regular registered to vote.* | | |
| Stakeholders | *Citizens (engaged citizens in support for law making), Legislative Houses (representatives and public servants).* | | |
| Data: | *In order to make the whole process auditable, Mudamos publishes the signatures list periodically by registering the files in public blockchain networks, where they can be publicly scrutinized. This ensures that signature lists are immutable, and if an interested agent wants to audit the entire signing process, from the first signature collected, they have the capability to do it without relying on Mudamos or any other agent.* | | |
| Identification: | *Auto geranted Private key / Electoral data* | | |
| Predicted Outcomes: | Signature lists in support of citizens’ initiative draft bills. | | |

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| Overview of the Business Problem or Opportunity |
| *Brazil’s Constitution provides several direct democratic mechanisms, including the referendum, plebiscite, and citizens' initiatives. The initiative mechanism allows any citizen to propose a draft bill to the lower house of municipal, state or federal legislatures. If the proposal gets the requisite number of signatures from registered voters in support then the campaign organizators present the bill before the House. Once the signatures are verified, the Speaker assigns a House committee to start bill discussion that could lead (or not) to the bill becoming a law. At the federal level, the minimum amount of signatures is 1.5 million, which is problematical to organize using paper-based petitions. Popular initiatives to collect signatures are often paper-based which, apart from being costly, also present problems of transparency and integrity. In fact, no citizen bill has ever been approved at the national level due to the verification barrier and participation costs.*  *Thus Institute for Technology and Society (ITS Rio) created Mudamos in 2017 to reduce the high costs of creating paper-based petitions by offering a verifiable online mechanism for the creation and signing of citizen petitions and offer a robust means of participation that, in turn, should help to raise citizens’ degree of trust in political institutions and contribute to the construction of participatory rules and norms.* |
| Why Distributed Ledger Technology? |
| *The uniqueness of the signatures is guaranteed by the association of unique electoral ID number combined with the signature timestamp and the user’s private key. The private key generates a unique hash based on the data reported for signature. Verifiability is guaranteed by publishing the user’s public key along with the data given for signature and the signature hash. In order to make the whole process auditable, Mudamos publishes the signatures list periodically by registering the files in public blockchain networks.* |

### Voting

### Taxation and customs

### Intellectual property management

### Land Registries

## Identity Management

### AlastriaID

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| Use Case Summary | | | |
| Use Case ID: | Identity Management | Use Case Type: | *Horizontal* |
| Submission Date: | 4th January 2019 | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | “AlastriaID” | Domain: | *1.* |
| Status of Case | *MvP already tested and various uses cases in PoC .* | Sub-Domain | *Not applicable.* |
| Contact information of person submitting/  managing the use-case | *Full Name: Ismael Arribas*  *Web site:* [*https://alastria.io/index\_en.html*](https://alastria.io/index_en.html) | | |
| Proposing Organization | **ASOCIACIÓN CONSORCIO RED ALASTRIA**, Kingdom of Spain.  G-87936159 | | |
| Short Description | Alastria is the first multisectorial Association promoted by organizations and institutions for the establishment of a semi-public Blockchain/DLT infrastructure, supporting services with legal effectiveness in the Spanish scope and according with the European regulation.  The Consortium is open to any organization that wishes to have available a fundamental tool for the development of its own blockchain/DLT strategy with the aim of distributing and organizing products and services.  Alastria can be summarized as a semi-public, independent, permissioned and neutral Blockchain/DLT framework for networks. | | |
| Long description | *Thanks to the diversity of its stakeholders and associates, Alastria is granted an infrastructure for Self-Sovereign Identity management. As a network is dully authenticated in the Spanish market and European Union however the partnership with LaC countries which is a fact of the SDG 17 scope for Alastria is the consequence for being a framework of networks.* | | |
| SDG in Focus (when applicable) | *SDG3, SDG4, SDG5, SDG6, SDG7, SDG8, SDG 13, SDG16, SDG17.* | | |
| Value Transfer: | We will transfer claims off-chain with on-chain proofs. Ponderation of attributes by causality. Verified authority to attest and authenticate an attribute. | Number of Users: | First PoC will happen in Spain (>45MM) but this solution aims to establish a global Identity system as an interplanetary badge.  European Population and LAC. |
| Types of Users: | People, Organizations, Public Administration & Objects (IoT) and process. | | |
| Stakeholders | *As we are proposing a Self-Sovereign Identity based interconnected Blockchain Platform(s), with the right Governance, all type of users are also stakeholders* | | |
| Data: | [*https://github.com/alastria/alastria-identity/wiki*](https://github.com/alastria/alastria-identity/wiki)  *Privacy by design: unlinkable actions.* | | |
| Identification: | *Identification mechanism and rules; ability of participants to be anonymous, etc.*  Non-interactive Zero-Knowledge Proof, in essential it refers to a proof construction where one can prove possession of certain information, e.g. a secret key, without revealing that information which needs to be kept confidential, and without any interaction between prover and verifier.  <https://snark.network/> | | |
| Predicted Outcomes: | MAIN NET | | |

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| Overview of the Business Problem or Opportunity |
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| Why Distributed Ledger Technology? |
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### Digital identity as a service

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| **Use Case Summary** | | | |
| **Use Case ID:** |  | **Use Case Type:** | Horizontal |
| **Submission Date:** | 11-October 2018 | **Is Use Case supporting SDGs** | No |
| **Use Case Title:** | Digital Identity as a service | **Domain:** | Cybersecurity |
| **Status of Case** | PoC | **Sub-Domain** | Mobile roaming  Digital Services |
| **Contact information of person submitting/**  **managing the use-case** | Full Name: Alexander Yakovenko  Job Title: Project Director  E-mail address: ayakovenko@clementvale.com  Telephone number: +7-985-991-2048  Social media: https://www.linkedin.com/in/alexander-yakovenko  Web site: https://www.blockchaintele.com | | |
| **Proposing Organization** | Clementvale Baltic OU, Estonia | | |
| **Short Description** | This use case is a proposal to implement Digital identity with the use of DLT and use it as a service | | |
| **Long description** | This use case is a proposal to implement Digital identity with the use of DLT and use it as a service | | |
| **SDG in Focus (when applicable)** |  | | |
| **Value Transfer:** |  | Number of Users: | 100+ |
| **Types of Users:** | Private users who need to supply personal data to get services, service providers. | | |
| **Stakeholders** | Any service provider identifying their customers.  Mobile operators validating their customers. | | |
| **Data:** | Hashes of validated personal data | | |
| **Identification:** | Mobile operator verifies personal data by request of their customer and publishes its hash in blockchain | | |
| **Predicted Outcomes:** | Decentralized approach, which allows exchanging of personal data, compliant with “General Data Protection Regulation” (GDPR) | | |

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| Overview of the Business Problem or Opportunity |
| *It is critical for mobile operators and mobile service providers to know with whom they are interacting. Growing IoT market and IoT services make this problem even more prominent. Traditionally a person who needs to identify himself must visit office of organization and present his passport and other documents. For private person this is inconvenient and time-consuming procedure. For organizations this is significant item of expenditure.*  *Usually mobile operators possess all information necessary to identify their customers. They can use blockchain to effectively assist customers to identify themselves to other participants by supplying identity verification services. The approach is developed to be fully compatible with “General Data Protection Regulation”.* ***No actual transfer of personal information is expected between organizations.*** |
| Why Distributed Ledger Technology? |
| *Distributed Ledger is an optimal solution for this use case because:*   * *Verification of identity information (without disclosing identity information itself) can be shared across all participants of decentralized platform.* * *Different mobile operators as well as other authorized organizations can provide digital identity services in similar standardized way.* * *Identity services are immediately available to multiple service providers and consumers through the same Distributed Ledger platform for telecom.* |

## Security Management

### Public Key Infrastructure: DLT for Public Keys Infrastructure

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| Use Case summary | | | |
| Use Case ID: | V-H-DDL-01 | Use Case Type: | Horizontal |
| Use Case Title: | DLT for Public Keys Infrastructure | Domain: | Cybersecurity |
| Subdomain | Information Security Governance |
| Stakeholder: | Any web-service operating through TLS sessions | | |
| Value Transfer: | No value transfer | N. of participants: | Nodes, web-service, client |
| Data: | Mappings between a common name (e.g. [www.example.com](http://www.example.com)) and a public key are stored in DLT | | |
| Users: | Certificate Authorities (nodes), TLS Clients | | |
| Identification: | Nodes verify domains public keys via consensus algorithm | | |
| Predicted Outcomes: | Decentralization of certificate issuing authorities (CAs) will mitigate risks of reliance on few entities, which are responsible for the security of the whole Internet. | | |

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| Overview of the Business Problem or Opportunity |
| When client connects to web-service through Transport Layer Security protocol (TLS), trusted third parties also known as certificate authorities (CAs) provide client with correct public key of the server.  The security of the entire Internet depends on CAs doing their job right. While this has largely been the case, certain violations of trust have happened. As a trusted CA can issue certificates for any website or digital asset around the world, poor management or takeover of a single CA threatens the security of the entire WWW.  The case can be extended to any kind of digital assets beyond domains. |
| Why Distributed Ledger Technology? |
| The reliance on few entities for the security of the Internet may not be a good idea. As a certificate is nothing but a mapping between a common name (ww.example.com) and a public key, we believe that distributed ledger technology can be used to provide this service.   * Distributed nodes need to form consensus on the domain name and the correct public-key * Instead of relying on a single CA, domains may provide economic incentives to participants of decentralized network to do that job for them * Public distributed ledger can provide certificate transparency and help to detect and fix incorrect bindings * X.509 is an ITU standard and therefore it makes sense to continue research in this field |

### Public Key Infrastructure: DLT based Decentralized Public Key Infrastructure System

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| Use Case Summary | | | |
| Use Case ID: | Xxx | Use Case Type: | Horizontal |
| Submission Date: | Xxx | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | DLT based Decentralized Public Key Infrastructure System | Domain: | Security Management |
| Status of Case | Concept | Sub-Domain | Public Key Infrastructure |
| Contact information of person submitting/  managing the use-case | *Xinpeng Wei* [*wexinpeng@huawei.com*](mailto:wexinpeng@huawei.com)  *Bingyang Liu* [*liubingyang@huawei.com*](mailto:liubingyang@huawei.com) | | |
| Proposing Organization | *Huawei* | | |
| Short Description | PKI, Public Key Infrastructure, acts as the trust foundation in many scenarios, but the current hierarchical PKI system faces the problem of single point of failure. This document describes how to build a decentralized PKI system. | | |
| Long description | A public key infrastructure (PKI) is a set of roles, policies, and procedures needed to create, manage, distribute, use, store & revoke digital certificates and manage public-key encryption. The purpose of a PKI is to facilitate the secure electronic transfer of information for a range of network activities such as e-commerce, internet banking and confidential email.  Currently the PKI system is built in a hierarchical mode, one root CA exist at the top of the system and several intermediate CAs at lower level. The security of the whole system based on the security of root CA, if root CA is corrupted or misbehavior then the whole system fails.  By using DLT, a decentralized PKI system can be built without highly centralized root CA, and avoid the single point of failure problem. | | |
| SDG in Focus (when applicable) | Goal 9: Industry, Innovation and Infrastructure  9.3 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. | | |
| Value Transfer: | Token | Number of Users: | Tens of thousands |
| Types of Users: | ISP, OTT, web user, enterprise, bank, government… | | |
| Stakeholders | certificate authority, anyone needs a certificate | | |
| Data: | 1. Token account  2. Digital certificate related information (e.g. Identity, application specific information, cryptographic-related information etc.)  3. Smart contract, including running code for PKI-related operations | | |
| Identification: | Both anonymous Identification and identifiable identification should be supported. | | |
| Predicted Outcomes: | A decentralized PKI system based on DLT. | | |

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| Overview of the Business Problem or Opportunity |
| Currently the PKI system is built in a hierarchical mode, one root CA exist at the top of the system and several intermediate CAs at lower level. The security of the whole system based on the security of root CA, if root CA is corrupted or misbehavior then the whole system fails.    Figure 1: Centralized and Hierarchical Public Key Infrastructure |
| Why Distributed Ledger Technology? |
| The distributed and unaltered features of DLT make it easy to build a decentralized system on it, and especially its support of smart contract makes it possible to issue the digital certificate fully automated. |

## Data Management

### Smart contracts for data accountability and provenance tracking

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| Use Case summary | | | |
| Use Case ID: | V-H-DDL-01 | Use Case Type: | Horizontal |
| Use Case Title: | DLT for Data Provenance | Domain: | Data Management |
| Subdomain |  |
| Stakeholder: |  | | |
| Value Transfer: | No value transfer | N. of participants: | 3+ |
| Data: | Digital trail of data for extended auditability is stored in DLT | | |
| Users: | Service providers, data vendors, consumers, cybersecurity solutions | | |
| Identification: | Smart contracts on a blockchain VM will be used as an identification mechanism | | |
| Predicted Outcomes: | DLT data provenance will keep tamper-proof, detailed picture of how the data was collected, where it was stored and how it was used. These records essentially form an audit trail for the data itself. | | |

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| Overview of the Business Problem or Opportunity |
| Today, sensitive data is held on many disparate systems and affects multiple workflows (i.e. applications, processes, and services) without associated properties of trust, integrity and provenances. Without these properties, data held by a company quickly becomes hard to manage efficiently, impeding company performance and more worryingly leading to data inconsistency, with opportunities for data tampering and manipulation to go completely undetected.  Hence, there is a need to secure not only the cloud data but also ensure integrity and trustworthiness of provenance data.  New data protection requirements on data controllers and processors imposed by GDPR is a prominent example of the business problem and opportunity for DLT technologies. |
| Why Distributed Ledger Technology? |
| Data provenance is metadata that records the history of the creation and operations performed on a data object. Secure data provenance is crucial for data accountability, forensics and privacy as it can help detect access violations within the cloud computing infrastructure. Besides, provenance data may contain sensitive information about the original data and the data owners.    Blockchain-based data provenance can provide tamper-proof records, enable the transparency of data accountability, and help to enhance the privacy and availability of the provenance data.  This approach relies on the use of publicly auditable smart contracts deployed in a blockchain that increase the transparency with respect to the access and usage of data. Smart contracts can be used to encode data usage policies and provenance tracking information in a privacy-friendly way. |

### Smart contracts for data accountability and provenance tracking

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| Use Case ID: |  | Use Case Type: | *Horizontal* |
| Submission Date: | *December 14th 2018* | Is Use Case supporting SDGs | *Yes* |
| Use Case Title: | *Smart contracts for data accountability and provenance tracking* | Domain: | *Data management* |
| Status of Case | *Proof-of-concept* | Sub-Domain |  |
| Contact information of person submitting/  managing the use-case | *Full Name: Ricardo Neisse*  *Job Title: Scientific Project Officer*  *E-mail address: ricardo.neisse@ec.europa.eu*  *Telephone number: +39*  *0332 78 9592*  *Social media:* *https://twitter.com/EU\_ScienceHub*  *Web site:*  <https://ec.europa.eu/jrc/en> | | |
| Proposing Organization | *European Commission Joint Research Center, Ispra, Italy* | | |
| Short Description | *Smart contracts can be used to track data provenance and encode usage control policies regulating the access and usage (e.g., redistribution) of subject’s data by controller and processors.* | | |
| Long description | *The recent approval of the General Data Protection Regulation (GDPR) imposes new data protection requirements on data controllers and processors with respect to the processing of European Union (EU) residents’ data. These requirements consist of a single set of rules that have binding legal status and should be enforced in all EU member states. In light of these requirements, this use case propose the use of a blockchain-based approach to support data accountability and provenance tracking. This approach relies on the use of publicly auditable smart contracts deployed in a blockchain that increase the transparency with respect to the access and usage of data. Smart contracts can be used to encode data usage policies and provenance tracking information in a privacy-friendly way.* | | |
| SDG in Focus (when applicable) | *Goal 16: Promote just, peaceful and inclusive societies* | | |
| Value Transfer: | *Fingerprints of digital identity and personal data items* | Number of Users: | *Large scale including citizens of many EU countries* |
| Types of Users: | *Data Subjects, Data Controllers, and Data Processors* | | |
| Stakeholders | *Citizens, enterprises handling digital identity and personal data items, government institutions auditing privacy practices of enterprises.* | | |
| Data: | *Fingerprints of pairs of data type and values exchanged between a data subject and data controller, including an obfuscated usage control policy regulating how the data should be used by the controller/processor.* | | |
| Identification: | *The use case proposes a privacy-friendly way of encoding identities, data and policies in a way that is still meaningful for auditability purposes. The only thing that can be learned is the structure of the policy specified by data subjects and no details about the data or restricted activities that can be performed by data processors and controllers.* | | |
| Predicted Outcomes: |  | | |

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| Overview of the Business Problem or Opportunity |
| *Subjects provide data to controllers and processors and have no auditable way of verifying how their data is being processed, stored, and redistributed. In case of privacy violations reported by subjects controllers and processors should be able to prove the data is stored and processed according to the subjects’ privacy requirements.*  *Smart contracts can be used as an auditable way of encoding data provenance information and privacy requirements to enable subjects to evaluate who has accessed their data and the conditions for storage, processing, and redistribution of the data. In case subjects believe their privacy requirements are not being fulfilled they can revoke data access and usage rights using the blockchain. This provides a mechanism for legal compliance in the face of the new EU General Data Protection Regulation (GDPR). Since in public blockchains the smart contracts are readable by anyone the data provenance and accountability information should be encoded in a privacy friendly way.* |
| Why Distributed Ledger Technology? |
| *In traditional centralized ledgers data subjects have no way of auditing and verifying (1) the set of data accessed by data controllers and processors and (2) how the provided data is being used. The use case relies on the immutability, verifiability, and transparency of DLT.* |

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3. https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/using-blockchain-to-improve-data-management-in-the-public-sector [↑](#footnote-ref-3)
4. <https://www.ethnews.com/nz-govt-begins-pilot-of-blockchain-data-management-platform> [↑](#footnote-ref-4)
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7. http://www.cryptomorrow.com/2018/01/17/10-projects-in-blockchain-based-identity-management/ [↑](#footnote-ref-7)
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16. SDG Knowledge Weekly: Blockchain in Practice, <http://sdg.iisd.org/commentary/policy-briefs/sdg-knowledge-weekly-blockchain-in-practice> [↑](#footnote-ref-16)
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18. SDG Knowledge Weekly: Blockchain in Practice, <http://sdg.iisd.org/commentary/policy-briefs/sdg-knowledge-weekly-blockchain-in-practice> [↑](#footnote-ref-18)
19. Realizing blockchain's potential for social impact From helping those with limited access to bank accounts to tracking tuna – the applications are broad, <https://www.undp.org/content/undp/en/home/blog/2018/realizing-the-potential-of-blockchain-for-social-impact.html> [↑](#footnote-ref-19)
20. Blockchain for Zero Hunger BUILDING BLOCKS, <https://innovation.wfp.org/project/building-blocks> [↑](#footnote-ref-20)
21. “Everest, ID2020 and the Government of Indonesia (TNP2K Secretariat) Announce Innovative Identity and Blockchain Pilot Solution to Enhance the National LPG Subsidy Program,” <https://www.globenewswire.com/news-release/2018/09/14/1571269/0/en/Everest-ID2020-and-the-Government-of-Indonesia-TNP2K-Secretariat-Announce-Innovative-Identity-and-Blockchain-Pilot-Solution-to-Enhance-the-National-LPG-Subsidy-Program.html> [↑](#footnote-ref-21)
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