



**Building a Blockchain-Based
Transactions Validation Service
for Utility Vending Systems**



DISCLAIMER

MOCROW (MCW) token is developed solely to facilitate the implementation of blockchain technology in solving problems associated with revenue losses in utility companies.

This paper describes the operation of the MOCROW solution (“the project”) and its implementation as a payment validation and authentication platform for energy transactions. It aims to provide all necessary project information to parties interested in being part of the implementation phase of the MOCROW solution. The project set out in this paper has been developed, tested and is currently in deployment phase. Unless expressly specified otherwise, other innovations herein are under development and are not currently in deployment.

This is solely a technical paper; the contents herein are for information purposes only and should not be considered as investment or financial advice. Contents of this publication, or parts thereof, may be amended and/or updated without prior notice. Updated versions, if any, will be available on www.cynotrust.com.

While the project, via its parent company (“Cynotrust”) or affiliates, may make available Mocrow Tokens to potential project participants as a means of developing the Mocrow community, it should be noted that the MOCROW Token has not yet been registered as a security or financial instrument in any jurisdiction. Parties interested in the project are advised to consult all applicable laws of the jurisdiction where they are resident before participation.



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ABSTRACT

Inaccurate energy accounting and auditing is perhaps one of the biggest challenges of the energy sector in Nigeria as well as other developing regions of the world. Commercial and collection losses remain inordinately high due to leakages and inefficiencies in payment systems.

This paper provides insights into efforts made by Cynotrust to resolve the challenges associated with revenue leakages and energy audit through the implementation of a Blockchain solution, a Distributed Ledger technology with great potential in solving the inherent revenue problems of the energy sector.

Cynotrust Intelligent Systems Ltd, through its proprietary platform (MOCROW) has designed, tested and implemented an energy payment, verification and authentication solution geared towards eliminating revenue losses and associated inefficiencies (particularly related to revenue theft and leakages) in Electricity Distribution. The solution is currently deployed and in use by Jos Electricity Distribution Plc (¹), one of Nigeria's foremost Electricity Distribution Companies, under the management of TATA Power of New Delhi, India.

¹ <http://www.jedplc.com/press-release/>



BACKGROUND

Electric Energy:

Reliable power supply is vital to the attainment of Economic Growth of any country particularly in relation to the manufacturing sector. In 2014, 27% of enterprises identified inadequate electricity as the primary constraint to business growth in Nigeria².

The Nigerian economy emerged from recession in 2017 with Gross Domestic Product (GDP) growth of 0.8% and in this vein, according to the country's Economic and Recovery Growth Plan 2017-2020 ("ERGP" or "the Program"), the country aims to sustain this economic growth in several ways including the improvement of the electric power supply index of the country. Specifically it seeks to maximize its installed generation capacity alongside that of the National Grid.

The Program also seeks to encourage renewable projects with a view to increasing the total effective generation capacity of the country. One of the objectives of the plan is to enhance the delivery of a minimum of 10,000 MW of utilized capacity by the year 2020 by improving the Country's entire power infrastructure and solving the myriad of challenges being faced (gas supply and power lines insecurity). Furthermore the Program seeks to improve the profitability of Power Generation Companies (GenCos) and Electricity Distribution Companies (DisCos).³

Nigeria's national electrification rate is 55% with only 39% of rural population being electrified. In a bid to greatly improve the electrification rate by the year 2030 the country plans to connect between 500,000 to 800,000 households per year with grid extension plans as well as implementation of off-grid solutions.⁴

A notable obstacle to growth of the Nigerian electricity sector, despite the country's successful privatization of the GenCos and DisCos, is high losses. These losses - Aggregate Technical, Commercial and Collection (ATC&C) - are directly linked to low revenue collections (from end users) and lack of cost recovery tariffs. The entire value chain is affected negatively because of these losses. Low revenue collection and payment responses from end-users implies there'll be irregular and incomplete payments to GenCos, which in turn implies gas suppliers aren't paid in full, resulting in less power generation by the GenCos. This vicious cycle can be tackled immediately with immediate improvements to collection losses where every unit of

² World Bank Enterprise Surveys

³ World Bank. 2018. Nigeria - Power Sector Recovery Program (English). Washington, D.C.: World Bank Group. <http://documents.worldbank.org/curated/en/115731517496257028/Nigeria-Power-Sector-Recovery-Program>

⁴ Energy Access Outlook 2017, International Energy Agency, 2017



energy is financially accounted for. Total debt of energy supplied in the Power Sector is more than US\$2.5 billion as at May 2018.⁵

⁵ <http://www.nigeriaelectricityhub.com/2018/05/15/n1-trillion-power-debts-threatening-nbets-existence/>



1.0 INTRODUCTION

Cynotrust Intelligent Systems Limited (“Cynotrust” or “CIS”) has fully developed and deployed the MOCROW ecosystem, an energy payment validation system on the Blockchain, in partnership with a major Electricity Distribution Company in Nigeria, Jos Electricity Distribution (JED) Plc (“the Company”).

An overwhelming challenge to electricity distribution companies in Nigeria and other developing countries is monetary fraud and malpractices, such as forging of payment receipts, incorrect registration of payments, and other means of revenue diversion by field personnel especially at cash offices. Logs of transactions, being inherently malleable, can be doctored or tampered with for the express purpose of obfuscating audit trails and inquiries.

The blockchain, which uses Public Key Encryption Infrastructure (PKI), is a decentralized list which relies on secure cryptography to build ever-growing records of transactions, called *blocks*, in a distributed ledger that is constantly updated. Secure by design, the blockchain records transactions efficiently, and permanently remains resistant to modifications. The blockchain has witnessed exponential excitement as the next radical evolution of global financial transactions security.

The objective of the MOCROW (MCW) utility token is to introduce a new form of distributed private digital token that will aid in payment validation, and eliminate the potential fraud in energy payments on account of the very resilience of the distributed ledger as a permanent record of transactions safe from tampering. Every kilowatt-hour (kWh) of electricity traded by the Company is done on the MOCROW platform; the transactions are recorded and verified near-instantaneously before electricity units are issued to the consumer.

With extensive expertise in Energy, Information Technology and Financial Services, the team at Cynotrust initiated the development of the MOCROW Ecosystem to improve efficiencies in the electricity value chain by deploying practical technological solutions necessary to spur, sustain and increase economic growth in both developed and developing regions of the world.



Cynotrust Timeline of Activities & Achievements





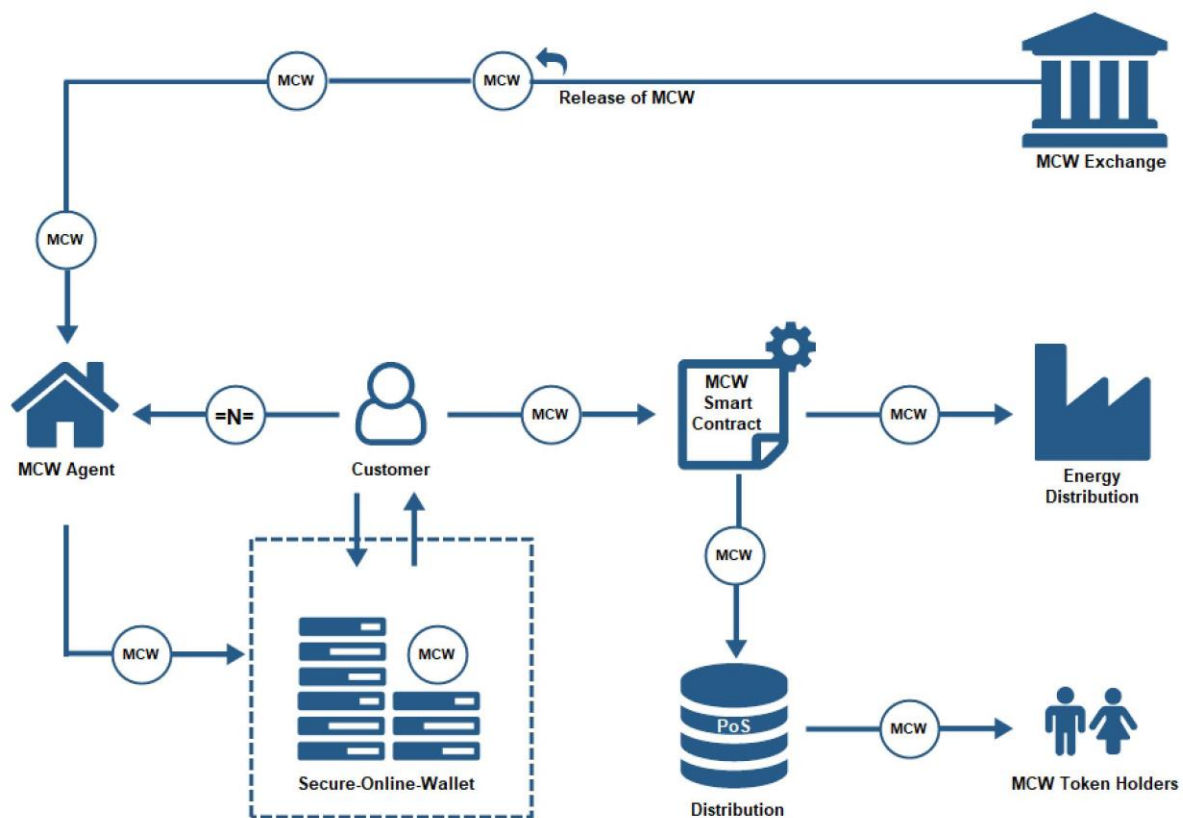
2.0 THE TOKEN

2.1 The MOCROW Token

The MOCROW ecosystem is the application host that allows the electricity consumers of JED Plc to gain access to a discounted supply of energy by using the MOCROW utility token as a means of energy payment validation on the blockchain.

MCW will be used to validate payments for electricity via a smart contract application service that will forward the MCW to the Energy Distributor and to the Proof of Stake Distribution Smart Contract.

The MCW Exchange will keep a proportion of the issued tokens, ensuring distribution to the local population. These tokens will be used to further develop the ecosystem and build renewable energy solutions, where the green power plants will agree to accept MCW as a payment validation mechanism.





USE CASE IMPLEMENTATION

3.0 MOCROW PLATFORM INTEGRATION WITH ELECTRIC UTILITY

JED Plc.'s prepay metering platform conforms to the Standard Transfer Specification (STS) Protocol, the industry standard for utility prepayment systems. The protocol, which implements IEC 62055-41 Certification, ensures interoperability between system components from different manufacturers of prepayment meter systems, and allows seamless integration with utility vending systems.⁶

As an electricity distribution company, JED Plc's customers fall under two categories:

- Prepayment-Meter (PPM) Customers: Electricity consumers with STS-compliant electricity meters who pay for energy *before* consumption.
- Postpaid or Credit Customers: Electricity consumers with non-PPM meters who pay for energy *after* consumption.

The electric energy value chain, as applies to JED Plc, consists primarily of the following market participants on whom successful integration depends:

- a) Energy consumers;
- b) Energy Sales Channels ("vendors" or "aggregators");
- c) Utility Distribution Company (JED Plc)
- d) MOCROW platform: Allocates tokens to JED for energy trading and payment verification purposes;
- e) Utility Vending System (UVS): Naira-kWh exchange system serving as interface between JED Plc and Energy Sales Channels.

Primary commodities to be exchanged by participants above:

- a) Fiat (Naira) [₦]
- b) MOCROW Token [MCW]
- c) KWh (units of energy) [KWH]

⁶ STS Association Brochure STS 1800-1-2 Edition 5.1 2014
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Platforms built to facilitate the exchange of commodities between all parties:

- a) Cloud-based Utility Vending System (UVS)
- b) Third party Sales Channels Portals (integrated with UVS)
- c) MOCROW platform

Upon full implementation JED Plc will no longer accept fiat as a valid form of payment; ONLY MCW will be accepted. This implies fiat must first be converted to MCW before it can be accepted by JED Plc.

Implementation

Step A: Purchase of MCW

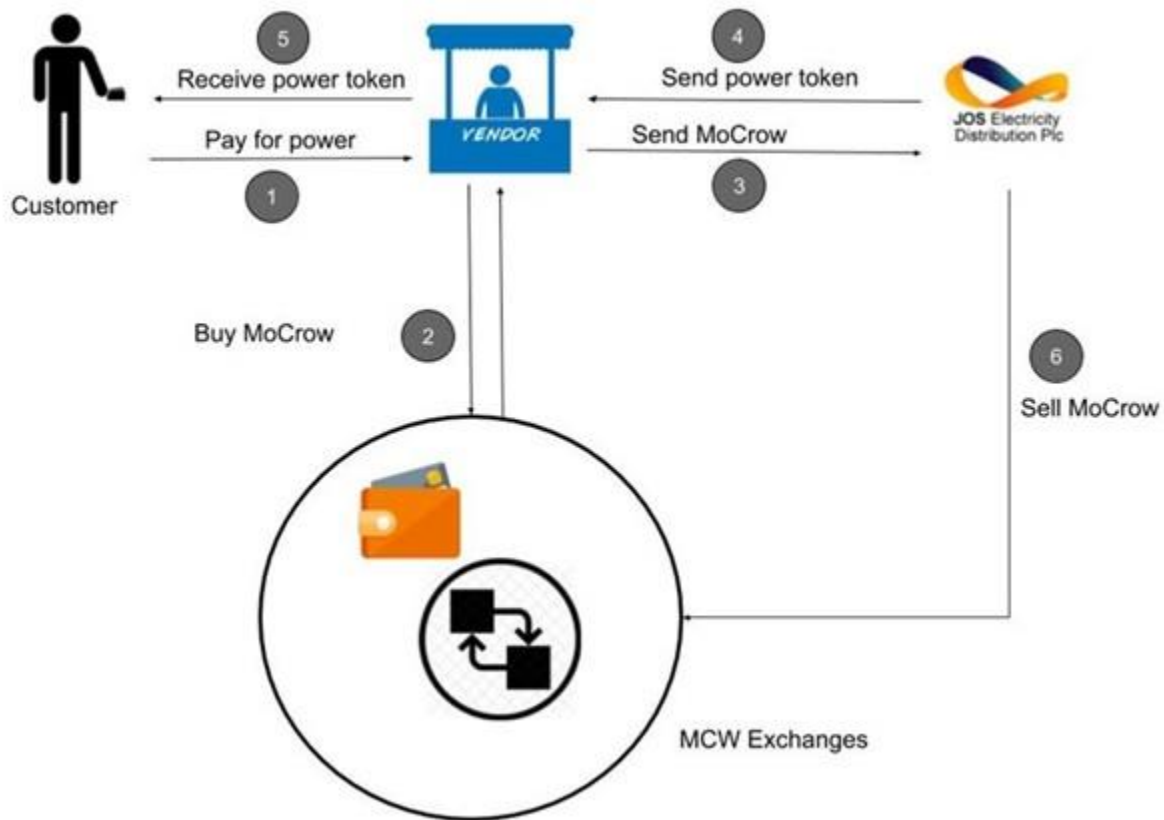
1. Customer makes fiat payment to vendors/sales agents/aggregators
2. Vendors/sales agents/aggregators send payment to JED Plc
3. Based on applicable transaction rules (every utility will have a separate business rule which will require a different smart contract to be built) JED Plc releases equivalent amount of MCW (for the customer) to the vendor in exchange for fiat.
4. Vendors/sales agents/aggregators send MCW to customer.
5. Customer (automatically assigned a permanent MCW wallet on first instance of payment) is credited with MCW from steps 3&4 with every payment made. The customer has invariably bought MCW with fiat. This blockchain transaction has its own transaction info i.e. transaction hash, wallet address, equivalent kWh, transaction timestamp data etc.
6. The transaction hash is proof of payment and also acts as One Time Password (OTP) as it cannot be forged.

Step B: Payment to JED/verification of payment

1. Entering the transaction hash from step 6 into the OTP interface (domiciled on the Vendors'/sales agents'/aggregators' interface) executes the transfer of MCW from the customer wallet to JED Plc wallet. This transaction is payment for kWh. The transaction hash will be the second proof of payment. Two proofs of payment are required:
 - Payment for MCW
 - Payment for kWh



2. JED Plc upon receiving the MCW generates the meter-specific numeric code for the equivalent amount of kWh paid for by customer in step 1.
3. Customer receives (via email, sms, paper print-out) the following information in one go
 - Energy vending code (numeric)
 - Proof of payment 1 (alphanumeric) from item 3, Step A above
 - Proof of OTP usage (alphanumeric) from item 6, Step A above



Electric Energy sales and smart contacts



Each utility company will have its own predefined set of rules for user/customer identification or classification. For JED Plc the smart contract has been structured such that there will be fourteen (14) different classes of users. Each user class will have a specified discount for all purchases made with MCW. These classes of users (for JED Plc i.e.) and their applicable discounts are listed below.

	Class	Discount on every MCW purchased %
1	JEDUser_R1	91.60369437448%
2	JEDUser_R2	35.07556675063%
3	JEDUser_R3	0.00000000000%
4	JEDUser_R4	0.00000000000%
5	JEDUser_C1	7.07388748950%
6	JEDUser_C2	0.73467674223%
7	JEDUser_C3	0.73467674223%
8	JEDUser_D1	7.32577665827%
9	JEDUser_D2	9.21494542401%
10	JEDUser_D3	13.83291351805%
11	JEDUser_A1	2.95969773300%
12	JEDUser_A2	2.95969773300%
13	JEDUser_A3	2.95969773300%
14	JEDUser_S1	2.24601175483%

Figure 1 user classes and applicable discounts



JED Plc Transaction rules

At the initial stages of implementation the following rules are the underlying conditions built into the smart contract:

- **Rule 1:** Based on prevailing exchange rate 1 MCW is equivalent to μ units of energy (i.e. 1MCW = μ kWh). Where μ depends on N/\$ exchange rate and market price of MCW i.e.

$$\begin{aligned} \mu &= \frac{\text{Naira Cost of MCW}}{\text{Normalised cost of kWh (in Naira)}} \\ &= \frac{\beta}{\emptyset} \\ \mu &= \frac{\text{USD Cost of MCW} \times \text{Exchange rate (Naira per USD)}}{\text{Normalised cost of kWh (in Naira)}} \\ &= \frac{\gamma \times \infty}{\emptyset} \end{aligned}$$

$$\beta_0 = \text{N}186.9869999988, \text{ Initial cost of MCW } \gamma_0 = \$0.51940833333$$

$$\emptyset_0 = \text{N}47.64, \text{ Initial Exchange rate } \infty_0 = \text{N}360/\$, \mu_0 = 3.92499999974811$$

- **Rule 2:** Users are identified by their user classes and the respective discounts are applied to their purchases/payments.

If a user is identified as JEDUser_X and the user pays \$y, **discount for JEDUser_X** is applied to the purchase hence they get:

$$\text{Units of electricity} = 3.92499999974811 \times \frac{\text{payment}}{\text{price per MCW} \times (100\% - \text{JEDUser_X_discount})}$$

Scenario A: If a user is identified as JEDUser_R4 and the user pays \$1.00, zero discount is applied to the purchase, hence the user gets:

$$\begin{aligned} \text{Units of electricity} &= 3.92499999974811 \times \frac{\$1}{\$0.51940833333 \times (100\% - 0\%)} \\ &= 7.556675063 \text{ kWh} \end{aligned}$$



Scenario B: If a user is identified as JEDUser_R1 and the user pays \$1.00, a 91.60369437448% discount is applied to the purchase, hence they get:

$$\begin{aligned} \text{Units of electricity} &= 3.92499999974811 \times \frac{\$1}{\$0.51940833333 \times (100\% - 91.60369437448\%)} \\ &= 90.00 \text{ kWh} \end{aligned}$$

TxHash	Block	Age	From	To	Value	[TxFee]
0xf232622327b300...	6099069	19 hrs 49 mins ago	0x2f7e7407399b7dd...	IN 0xea6c8aefdd26c88...	0 Ether	0.000122768
0x60554fad90a3051...	6099054	19 hrs 53 mins ago	0x2f7e7407399b7dd...	IN Contract Creation	0 Ether	0.014611132

Figure 2 Screenshot (7th Aug. 2018) of JED Plc smart contract creation viewed in www.etherscan.io



4.0 TOKEN ACQUISITION AND DISTRIBUTION

MOCROW tokens will be available for initial acquisition to the public through cryptocurrency exchanges and via direct transfer from another token owner. Listing of MCW on cryptocurrency exchanges will be carried whilst the company considers a crowd-sale event in the form of an ICO to further provide avenues for interested stakeholders to acquire the MOCROW token. In the event that the company decides to conduct a crowd-sale event, the sale will strictly be for the purpose of expanding the spread and growth of MCW by offering the public the opportunity to be a part of the project and not for project funding purposes.

MOCROW ecosystem is designed to be a self-enhancing system. Value is created and maintained by the number and frequency of transactions/payment verifications carried out. JED Plc currently carries out approx 5,000 Transactions per day (TPD). The distributor plans to increase this to over 15,000 TPD. Plans to increase vendors and aggregator coverage within communities are ongoing. Transactions on Etherscan are currently approximately 5,000 TPD (in sync with the Energy Company transactions). This implies number of TPD on MCW will increase to approx 15,000 TPD in line with projections of the Energy Company.

Distribution of tokens to cryptocurrency-exchanges will be implemented as required at point of listing. 24.34%⁷ of all tokens will be distributed to the public at a discount in a Discounted Sale event. 22.80% allocation of MCW tokens is assigned to the Founding team, Promoters and Foundation.

A total of 27.69% of all MCW tokens will be available on crypto-exchanges while Cynotrust's operation (i.e. payment verification for utilities as well as PV power plant development) will be supported by an allocation of 12.77%.

Continuous Research in energy/utilities sector as well as further use-case development and implementation of the platform and technology has been allocated 1.31% of all MCW tokens. An additional 1.31% has been assigned to Cynotrust for its operating expenses. 1.09% allocation is assigned to project investors as ROI and equity repayment. Tests have been carried out for the implementation of international remittances using MCW and plans have been instituted for the acquisition of a Regional Blockchain banking licensing and expansion of same. 8.7% of all MCW tokens have been duly allocated for this purpose.

⁷ All allocation percentages indicated are relative to total mined MCW token: 884,705,884
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5.0 TEAM MEMBERS



ABUBAKAR UMAR BSc (Hons), CobiT, ITIL – MD-CEO/CO-FOUNDER

An enthusiastic, award winning Computer Science Graduate with excellent proven experience of the Power & Energy sector, Retail Industry, Financial Markets, Software Development and Implementation, and working experience within the Aviation Industry.

Involved with Strategic & Tactical level business development in Information Technology Services, Aviation, Oil & Gas, Energy and Facilities Management Services.

Involved with development of modern Agile software applications deployed using Microsoft Azure Cloud Technology. Virtualization: Virtual Machines and Virtual Networks, Platform as a Service (PaaS) implementation for leading Companies, including using PowerShell for automation and management, using Active Directory, migrating from on-premises to cloud infrastructure. A pioneer blockchain enthusiast developing real life PoC for adoption and implementation in many African economic sectors.



DR. MOHAN GUNARATNAM B.Eng. (Hons), MSc, PhD, MBA, CEng, MIChemE – Chief Operations Officer (COO)

Dr Mohan is a business head with a proven ability to develop and implement strategies that deliver financial goals. His recognized ability to lead key business initiatives to generate income and enhance service value is second to none. An industry expert with recognized proficiency to commercialize solutions and services as well as develop and execute astute business operations strategies. Ability to build teams focused on achieving revenue goals.

Specific Areas of Expertise

- Energy distribution
- Water Utility and Process Integration
- Process Plant Operation and Business Performance Optimization
- Technology Centric Service Delivery
- Analytics and Big Data Driven Business Values
- Asset Management and Delivery of Investment Programmes
- Design, Build and Operation of Water and Energy Utility Infrastructure



DAVID LLOYD – CHIEF FINANCIAL OFFICER (CFO)

A P&L experienced & sales-driven Senior Business Leader with a successful background in B2B, B2C, banking, financial, automotive, commercial & corporate sectors. Commercially-aware, with a broad range of business development experience. David has previous experiences heading different departments with the Royal Bank of Scotland and Barclays where he has driven several innovative business solutions and financial strategies.

An alumnus of the University of Wolverhampton, David has been involved with new startups as well as managing his own established business interests.



DR. PETER OWOTOKI BSc (Hons), MSc, PhD, MBA – Chief Technology Officer (CTO)

A significant independent consulting expertise across different functions for two of the global top five Pharma and a leading German Dax Pharma company, Dr. Peter is an accomplished technologist of the highest standards. A graduate of Computer Science from St. Petersburg, Russia, Dr. Peter has an MSc in Information and Communications System, as well as a PhD in Artificial Intelligence from the Technische Universitaet (TU) Hamburg, Germany. He has an MBA from the Northern Institute of Technology (NIT) Hamburg, Germany and a Post Doctorate Research Fellowship – Harvard, USA.

Dr. Peter has several years technology consulting experience with McKinsey in the Middle East, Africa and Brazil. He also has more than 5yrs independent technology consulting experience in Germany and Switzerland. He holds the professional position as Director, KBR Finance Frankfurt, as well as various researcher positions (Harvard University, TU Hamburg, Airbus, Panasonic, DaimlerChrysler).



ANATOLY SOKOLNIKOV – Blockchain Architect/Developer

Anatoly has more than 6 years' experience developing scalable blockchain solutions and is a highly qualified developer with hands-on experience within the banking & finance sector. Apart from software development, Anatoly has worked on systems improvement and architecture design for top tier banking IT systems.

A blockchain enthusiast, Anatoly has been worked on some exciting blockchain projects over the last 3 years. He started from development of simple smart contracts, but very fast was able to work with, develop and even design complex smart contracts which further solidified his blockchain development experience. He has worked with some blockchain projects for existing blockchains improvements, developed blockchains from scratch, as well as developing both private and extremely secured blockchains.

Anatoly is considered as a blockchain expert that can take a blockchain project of any complexity and bring it to life.



MAXIM PRISHCHEVO – Blockchain Software Engineer

Starting from the middle of 2016, Maxim has been proactively working on Ethereum related projects as a Blockchain software engineer.

He has over 15 years background experience in Fintech and security of financial information systems spheres, which is very helpful in blockchain projects.

Moreover, Maxim has contributed significantly to the progressive evolution of decentralized applications development from Feb 2017 to date, the results of which has undoubtedly initiated a new era of Internet - Web 3.0 evolution.



REON PARK – Legal

Reon is a senior corporate affairs and commercial lawyer with extensive experience in business facilitation and commercial contracts negotiation. She also holds a senior position as the company director for a blockchain consultancy.

Reon studied Politics and East Asian Studies at Newcastle University, and as well as her legal qualifications, she also earned a diploma at Sotheby's Institute of Art and School of Oriental and African studies. Prior to law, Reon was the director of a Japanese theatre production company based in London. She is fluent in both English and Japanese, and has working proficiency in Korean.



SHALOM LLOYD BSc, MSc, MBA - ADVISOR

Shalom is an experienced Strategic Leader with over twenty years in the pharmaceutical industry who has built a strong reputation for excellent professional service, relationship management and customer focus. A TEDx speaker, Shalom is a highly motivated leader, who combines influencing, cultural awareness and results in order to build high performing teams to thrive in a challenging environment. A proven strategic advisor with the ability to lead global organizations to achieve and deliver strategic goals, initiatives and results.



NANCY MEYERSON-HESS – QA/COMPLIANCE/REGULATORY

Nancy has over 30 years' experience in leading global quality assurance, compliance and regulatory practices. She has focused over the past recent years on providing best practices and regulatory compliance frameworks for organizations in emerging regions.

Nancy is also an Associate Partner at Admedicum Business, where she also consults for organizations on research, and also outsourcing through quality and process improvements.



PAUL RINGER – ADVISOR

Paul is a pioneer hybrid management consultant, management training, bid, business transformation and project delivery consultant. He has worked across sectors including: Construction, Utilities, Facilities Management, Information Technology, Communications, Advertising, Media, Insurance, Banking, Manufacturing and Government.



MARIA PALOMBINI MBA - ADVISOR

Maria is a technology enthusiast with focus on Blockchain applications in the energy, agriculture, pharmaceutical and finance sectors. Convergence of technologies including IoT, AI, ML and Blockchain. Digital inclusion through Trust and Agency.

As a serving director with the IEEE Standards Association, she was the creator, advocate, and project leader for the Pharma Blockchain Initiative - seeking to educate and advance adoption of blockchain for viable applications in the pharmaceutical framework.

As Project Leader - Digital Inclusion through Trust and Agency, she worked with a global network of technologists, policy experts, academia and advocacy groups to develop a standardized low-cost solution to bring the remaining 50% of the world's population online.



ADAMA IBRAHIM BSc (Hons), EMBA - ADVISOR

Adama is an award winning professional with passion for technology and innovation. She has received the Development Sciences Innovation Award 2014 for developing a new endpoint for remyelinating, was awarded outstanding achievement in marketing with excellent presentation skills in 2000, Women Innovation Network UK Co-Lead 2016 Honorary Mention for Diversity and Inclusion Award and more recently the Sunday Times and Telegraph Rising Stars of London Award.

