Monetasa

Decentralized data marketplace based on blockchain

December 28, 2017

Data is the new oil. Every day we create 2.5 quintillion bytes of data[@keyIBM]. 90 percent of the data in the world today has been created in the last two years alone – and with new devices, sensors and technologies emerging, the data growth rate will likely accelerate even more.

Not only centralized SW giants, but also mobile and network operators and various enterprises that install huge number of devices or any electronic infrastructure are in position to put the sensors in their equipment and collect huge amount of data. Some of this data is perishable - i.e. it must be consumed instantly or it looses value. Some of this data is long-lasting. No mater what kind of data stakeholders collect, they usually have the same problem: how to draw additional profit from this data, beyond it’s immediate and obvious purpose[[1]](#footnote-21).

All this data would have value for many parties and can be further monetized. Data collectors could become data sellers, and offer collected data on the specialized data marketplace. On the other hand, data buyers would be interested to browse offered data streams and buy them, then use this data to further process it and/or build new services for their customers.

**An eBay for IoT sensor data is need. This eBay is called Monetasa**.

Table of Contents

# Introduction

Monetasa is an eBay for IoT sensor data. But beyond IoT, Monetasa marketplace can be used to sell or buy any type of data, independently of it’s type or provenance.

Monetasa is distributed and decentralized system based on blockchain. Blockchain technology is used for several important purposes in Monetasa system:

* To enable tokenization of value (i.e. provide TAS token) and token economy
* To insure data integrity (i.e. to store data hashes and guarantee that data is not tampered with)
* To enable Smart Contract capabilities
* To provide network security via PBFT consensus and immutability and make the system hack-proof

Each of these characteristics of blockchain and how they are leveraged upon in the Monetasa system will be explained in more details in the following chapters.

Monetasa market place is built with intention to be simple, easy to use and intuitive. Anyone familiar with eBay should immediately understand how to sell digital assets - in this case the data stream, or how to browse offered data streams and purchase selected data. Simplicity of use opens possibility for mass-market adoption while simplicity of the system provides high quality implementation and better secured and more performant application.

# Stakeholders

Monetasa systema is built on private, permissioned blockchain. It uses PBFT algorithm for concensus and state replication, which guarantees high transaction throughput and fast transaction finality (which as a consequence prevents blockchain forking). Because of the nature of PBFT algorithm, the whole system is run by a closed consortium with a known set of validators. Never the less, any entity can potentially request access to the consortium and run a validating node under contractual agreements.

Based on this we can identify following stakeholders of Monetasa system:

* Data buyers
* Data sellers
* Validators

## Data Buyers

Data buyers are organizations and individuals that are interested in buying the data. They log into the system and browse the data streams offered for sell, as one would browse items on eBay or Amazon marketplace.

Data streams are offered under certain price and can are purchased for TAS tokens.

Data buyer must have a sufficient ammount of TAS tokens in his wallet in order to purchase the data. Once data is purchased, data buyer obtains a proxied HTTP URL from which he can consume the data. This URL is unique and temporary - it expires after the lease period for which data was payed for.

## Data Sellers

Data sellers are organizations or individuals that offer the data for sell.

It is responsibility of data seller to provide a valid data source URL and give detailed description of the data stream an it’s format (it’s JSON schema) - so it can be easily consumed by data buyer. This URL is secret, and it is never reveled to data buyer. It is only temporary proxy URL that is given to data buyer, and it expires after time data was payed for.

Additionally, data seller can provide geolocation data of the stream source, so that it can be queried on the maps.

Data sellers should provide valid data sources. In order to guarantee the validity of the data, Monetasa employs several mechanisms - like seller reputation rating and verified IoT gateway HW provisioning, which fill be explained in dedicated chapter.

Data sellers obtain TAS tokens in their wallet when the stream that they offered is purchased.

## Validators

Validators are the entities that participate in network infrastructure, i.e. in block validation. Validators are rewarded for their work in TAS tokens.

Because in the phase 1 Monetasa is based on private PBFT blockchain, set of validators must be known up-front. Monetasa consortium will allow adherence of new members under strict contractual agreements.

In the second phase of development, Monetasa validation will be opened to public via novel *Proof-of-Verified-Source* and *Proof-of-Stake* on the Cosmos[@cos] network.

# System Architecture

Monetasa is a decentralized application based on the blockchain network with native token of value.

Monetasa blockchain is provided via novel BigchainDB technology, which provides several benefits to the system:

* Native token, in a form of divisible digital asset
* Digital asset queries
* Fast transaction throughput and finalization

In order to secure the system and make it resistant to Byzantine General attack[@bft], Monetasa replaces the underlying BigchainDB default BCA consensus algorithm[@bcdb] with Tendermint PBFT conensus engine[@tendr].

Tendermint is very performant PBFT consensus algorithm - it supports thousands of transaction per second at 1000ms latencies. Not only that Monetasa benefits from this consensus algorithm in security in performance, but this mechanism opens the possibility to connect Monetasa system to incoming Cosmos network. Announced as “Internet of Blockchains”, Cosmos hub will give to Monetasa system 2 very important features: interoperability and additional scalability.

Interoperability is extremely important, as it will enable TAS token to natively flow from Monetasa private blockchain into other blockchains connected to the Cosmos hub, thus opening potential for TAS exchange to other crypto-currencies, and vice versa. This will influence token economy and rise the value of the TAS token. Additionally, developed token economy would allow *Proof-of-Stake* consensus to be applied on the top of the Monetasa-Tendermint system and allow opening Monetasa validator set participation to the wide public.

Scalability is also important, although, as a consequence of the wise technology choices, Monetasa system is already very performant. But “Interent of Blockchains” will enable additional scalaing od Monetasa chains through sharding[@shard] using Cosmos zones.

As mentioned before, blockchain technology is used for several important purposes in Monetasa system:

* **TAS token**: TAS token is native token of value in Monetasa system and is necessary for system operation and functioning. It will be explained in details in a dedicated chapter.
* **Data integrity**: Leveraging on BigchainDB digital asset features, as well as native digital asset querying, Monetasa implements mechanism that insures integrity of the data that flows through the system by taking it’s digital fingerprint (cryptographic hash) and stores it in to the immutable blockchain database. This way system assures that critical data has not be tampered with. In the context of OTA firmware updates of safety-critical IoT devices or tamper-proof checking of already running software on such a systems (for example a braking system of a self-driving vehicule) this form of data security becomes quintessential.
* **Smart Contract**: Smart Contracts define a complex set of conditions under which data is exchanged. They are important part of Monetasa system, and will be explained in detail in a dedicated chapter.
* **Network security (via PBFT consensus)**: In order to protect valuable digital assets and network infrastructure in the era of ever-increasing security threats[[2]](#footnote-28), Monetasa builds a decentralized network based on Byzantine fault-tolerant state and data replication algorithm. This way system can tolerate up to 1/3 malicious-acting nodes and assure network functioning under cyber-attack. Additionally, blockchain-structured data assure immutability and anti-tampering characteristics. Applying *Proof-of-Validated-Source* and *Proof-of-Stake* consensus, network is adding an additional layer of protection, incentivizing nodes to behave honestly and punishing badly behaving nodes. Based on these important features and technologies, Monetasa builds high-security network that is capable to fully protect digital assets and insure secure protection of value exchanged through Monetasa marketplace.
* **Auditing (via record immutability)**: Monetasa enables monetary transactions, which are often subject to various regulations and can be examined by regulatory bodies. Thanks to the immutability feature of blockchain systems, Monetasa system allows every organization participating in Monetasa data market to have a proven track of records of all executed transactions. To make system usable for the wide public, Monetasa implements secure centralized walled, similar to Coinbase[@cbase]. Wallet, however, can be implemented also in decentralized fashion, as users can create accounts and transfer their funds to wallet of their choice.

# Data Verification

Monetasa has unique-on-the-market solution for verifying the source of the IoT data. Based on the fact that Monetasa and it’s partners play one of the crucial roles in telecom equipment industry, an IoT gateways and edge computers were designed and connected with big number of sensors to serve as a verified and known IoT sensor data source.

Monetasa installs these sensors in cooperation with network and telecom partners, or sends the certified equipment to various other partners for installation. Because these edge computers, IoT gateways and sensors contain known and certified hardware and firmware, often coupled with embedded GPS modules, system can be assured that data coming from these sensors is:

* Real-world data and not modified or generated “fake” data
* Coming from precise geographical location

Monetasa partners that install and deploy this equipment will have an advantage on the marketplace, as their data sources will be marked as “trusted and verified”.

Moreover, since these partners made an economic investment and also entered in partnership with Monetasa through various legal contractual agreements, they are allowed to run a validating node and participate in *Proof-of-Verified-Source* network consensus. Validators are rewarded for their work with TAS tokens.

# TAS Token

TAS token is utility token of Monetasa system. It is used to assure fair and secure functioning of the system, as well as to enable token economy on the Monetasa data market.

Primary purpose of the token will be to fuel the system - it will be used to tokenize the value of digital assets (i.e. data) and facilitate their exchange. Equally, once the token economy is developed, TAS token will have a purpose in enabling the consensus mechanism based on *Proof-of-Stake*.

Data sellers will use TAS token as a representation of value of their digital data streams that are offered on the marketplace. Buyers will use TAS token to exchange it for selected data - they will transfer their TAS tokens to data sellers and obtain their digital assets in return.

# Proof-of-Verified-Source and Proof-of-Stake

In order to secure the network, Monetasa system provides an original an unique approach called *Proof-of-Verified-Source*. This approach represents validator (miner) selection algorithm based on a proof of monetary investment in sensing hardware and networking equipment.

Due to the unique position on the market Monetasa produces and delivers to the companies and network operators a specialized networking and sensing equipment - often an IoT edge gateway inter-connected with a lot of sensors. Since this hardware (and internal secure firmware) comes from known source (Monetasa company), and since all equipment purchase and installation is done according to contractual agreements, everybody can be assured that this given data source is valid.

Because a company or an operator that purchases the equipment has to invest money, and also respect the written legal contracts, system can stay assured with high possibility that they are incentivised to make fair decision, because it is in their best of interest to keep the network secure and functional (otherwise their investment will be useless and they will suffer legal penalties).

Moreover, possibility to have *Verified Data Source* badge listed next to the data sources offered by these companies is an additional incentive for them to purchase the specialized sensors and other equipment.

Further more, once TAS token economy is developed, a *Proof-of-Stake* consensus algorithm will be applied in order to additionally incentivise companies and individuals that run validator nodes and help secure the network.

# Smart Contracts

A Smart Contract is a computer protocol intended to facilitate, verify, or enforce the negotiation or performance of a contract. The aim with Smart Contracts is to provide security that is superior to traditional contract law and to reduce other transaction costs associated with contracting.

Monetasa platform provides possibility for users to define and deploy Smart Contracts that automate processes and formalize contractual agreements regarding various features of the system. One important feature, for example, is revenue sharing - every data seller can define a Smart Contract that will be signed by his partners and himself. Earnings obtained by selling this data stream will then be automatically divided between the parties, without further intervention from the seller and his partners.

Moreover, Smart Contracts enable fine-grained per-user and per-datastream conditions to be formalized. For example, new GDPR (*General Data Protection Regulation*)[@gdpr] laws by which by which the European Parliament, the Council of the European Union and the European Commission intend to strengthen and unify data protection of individuals, regulate the way that telecom operators or other companies can share user data. Since this data and it’s sharing and monetization represent a core business of many companies (especially of those who’s business model is based on advertising), a strict new relation between company and it’s users is imposed and can be formalized and automated via Smart Contracts.

Monetasa UI will enable defining these Smart Contracts in a simple manner though well-defined forms. Moreover, Monetasa API will provide possibilities for these contracts to be definied and deployed programtically.

# Data Integrity Through Anchoring

It is very well known feature of blockchains to offer immutable data storage. Once data is written in the blockchain it can not be changed (tampered with). This feature can be used to prove integrity of the data, which is especially important for OTA (*Over-the-Air*) firmware updates of safety-critical IoT devices or tamper-proof checking of already running software on various robots, machines, vehicules and similar.

In order to enable this feature as a service, Monetasa implements an API on the top of its system that allows “anchoring” the data timestamp and cryptographic hash into the blockchain. This cryptographic hash essentially represents digital fingerprint of the data. Data hash can be recalculated and compared to immutable record in the blockchain at any later point, thus proving that the data has not be tampered with.

# Future Work - Computing and Storage Tokenization

Besides data, a marketplace based on the blockchain can allow economy of at least two important resources:

* Storage
* Comuputing

## Storage

Companies like **Storj**[@storj] or **Sia**[@sia] announced projects that strive to enable decentralized cloud. With low prices that would be a consequence of tokenized storage capacity offered by the various users in exchange of tokens, these companies can become a real competitiors of SW giants in the cloud bussiness space - like Amazon or Google.

Monetasa plans to integrate and maintain permissioned distributed file-system through wich Monetasa users will be capable to offer and rent their storage space in exchange for TAS tokens.

## Computing

Projects like **Golem**[@golem] or **SONM**[@sonm] are working on decentralizing the computing power.

Based this ideas, but also on the ideas presented by **Blue Horizon** project from IBM [@bhz], Monetasa plans to enable Docker container based decentralized platform for deploying arbitrary software on the computing infrastructure offered and rented by Monetasa users in exchange of TAS tokens.

# Conclusion

IDC says that worldwide revenues for big data and business analytics will grow from $130.1 billion in 2016 to more than $203 billion in 2020, at a compound annual growth rate (CAGR) of 11.7%[@idc]. In addition to being the industry with the largest investment in big data and business analytics solutions (nearly $17 billion in 2016), banking will see the fastest spending growth. A a new report from McKinsey & Company’s Global Institute is trying to put a real dollar amount to the global IoT market. In the report’s estimation, IoT has the potential to be worth between $3.9 and $11.1 trillion by 2025[@mck].

Based on many and many reports, we can be sure of one thing: there is gold in these mountains of data. A way is needed to mine all this gold - a platform is needed to monetize all this data. Monetasa is a an enabler that will unlock this huge potential.

Monetasa builds decentrlized marketplace based on blockchain, that is secure and scalable. It enables new token economy - TAS token will be used as an utility token of Monetasa system, and will be used to enable fair and secure functionining of the system as well to enable trading facilities.

Monetasa builds whole environment needed for quick adoption of the system: UI, wallet, API and SDKs. This will lower adoption barriers and lead to the higher popularity of the system, which will in turn incentivise the economy based on TAS token.

Due to unique positioning, Monetasa provides specialized senor hardware, and employing various patent-pending techniques assures that data sources are verified. Moreover, throght specific AI and machine learning algorithms, Monetasa system assures that all data streams can be unified in format and prepared for easy consumation. This brings clear advantage of Monetasa comparing to all existing competition.

Monetasa will be go-to marketplace for data monetization - any data, anywhere.

# Team

Monetasa team is composed of expirienced industry professionals, that together bring over 100 years of expertise in designing, building, deploying and maintaining large-scale industry networks.

**Drasko DRASKOVIC** - Drasko is a an IoT expert with over 15 years of professional experience. He hacked embedded Linux SW and HW device drivers, designing complex wireless systems in telecom industry. Drasko earned his reputation in open-source community as an author of numerous projects - like WeIO[[3]](#footnote-39) or Mainflux. He is one of the main contributors of the Linux Foundation’s EdgeX Foundry[[4]](#footnote-41) project. Drasko is also author of the book “Scalable Architectures for the Internet of Things” published by O’Reilly and a vivid conference speaker. He holds a MSc in Electrical Engineering from Belgrade University.

**George SALEH** -

**Rastko BLAGOJEVIC** -

**Nikola MARCETIC** - Nikola is software developer with over 10 years of expertise in Web development and connected things over IP, delivering a complex and scalable Web apps. He enjoys in cutting edge technologies and projects with Linux OS & related open source tools with technical barriers and complex challenges. Nikola holds MSc in Economy from Novi Sad University.

**Janko ISIDOROVIC** - Janko is the co-founder of Mainflux IoT open source project. He is also chair of the Application Work Group of Linux Foundation EdgeX Foundry project. Janko has a background in Project Management, IT and Software integrations. He holds MSc in Telecommunications from Belgrade University and brings more than 15 years of extensive industry experience to Monetasa project.

**Darko DRASKOVIC** - Darko holds a PhD thesis on AI from UNIL, Switzerland. His special fields of interest include web development, graphics programming and data science. Darko is also philosopher with a special interest in contemporary science and cutting edge IT technology. Darko has been hacking mathematically complex software solutions for over 10 years.

**Manuel IMPERIALE** - Manuel holds M.Sc. form University Pierre and Marie Curie in Paris. He has specialized in industrial informatics and both software and hardware technologies. Manuel was working in The Institute for Intelligent Systems and Robotics (ISIR), and various hi-tech companies, like 3D Sound Labs and Devialet.

**Sasa KLOPANOVIC** - Recently engaged in the biggest real estate project in South-East Europe master-planned by world renowned architects, Sasa gained significant working experience within the international environment where communication with international companies, eminent consultancies, and government institutions was a major part of his daily tasks. Additionally, he is the founder of first Serbian Branding Association and part of the team responsible for the development of National Brand of Serbia visual identity and slogan. He holds MSc degree in Philosophy from Belgrade University.

# Contact

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## Social Networks

Twitter: @monetasa

LinkedIn:

Facebook:

# Acknowledgments

This work is the cumulative effort of multiple individuals within the Monetasa team, and would not have been possible without the help, comments, and review of the collaborators and advisors of Monetasa. Drasko Draskovic ad George Saleh wrote the original Monetasa whitepaper in 2017, laying the groundwork for this work. Nikola Marcetic developed ideas related to the Monetasa decentralized protocol and implemented original temporary proxying scheme. Janko Isidorovic contributed ideas related to TAS token economy and integration with Mainflux IoT platform. Manuel imperiale, Darko Draskovic and Sasa Klopanovic improved the protocol, designed TAS token wallet and added geofencing capabilities. We also thank all of our collaborators and advisors for useful conversations; in particular Ilia Zelenikin and Dejan Novakovic.

# References

1. Take for example a mobile telephony operator. Company like this already owns huge number of network base-stations, gateways and antennas which make the deployed network infrastructure. These network devices are already equipped with big number of telemetry sensors that provide the operating state insights and are used for management and maintenance. Data coming in for this sensors is useful for the operator to keep the network healthy and functional. But beyond this primary purpose, collected data can be extremely useful for other parties - like Smart City municipalities, health institutions or various other businesses. Moreover, because of the density of mobile base-stations and antennas, operators are in unique position to offer for example extremely precise environmental data, which is hard to achieve to even specialized services as it demands significantly expensive HW sensor installation. Similarly, a company that does smart signage could turn public signs into sensing stations with marginal additional costs. With further cost drop of the sensors and appearance of smart dust, even individuals or small enterprises will be capable to collect significant amount of IoT data. [↑](#footnote-ref-21)
2. The number of records compromised grew a historic 566 percent in 2016 from 600 million to more than 4 billion. These leaked records include data cybercriminals have traditionally targeted like credit cards, passwords and personal health information, but IBM study[@ibmSaf] also shows a shift in cybercriminal strategies. In 2016, a number of significant breaches related to unstructured data such as email archives, business documents, intellectual property and source code were also compromised. [↑](#footnote-ref-28)
3. WeIO is an innovative open source hardware and software platform for rapid prototyping and creation of wirelessly connected interactive objects using only popular web languages such as HTML5 or Python. More informaition can be obtained at project website: <http://we-io.net>. [↑](#footnote-ref-39)
4. EdgeX Foundry is a vendor-neutral open source project building a common open framework for IoT edge computing. At the heart of the project is an interoperability framework hosted within a full hardware- and OS-agnostic reference software platform to enable an ecosystem of plug-and-play components that unifies the marketplace and accelerates the deployment of IoT solutions. More information can be obtained at project’s web address: <https://www.edgexfoundry.org/>. [↑](#footnote-ref-41)