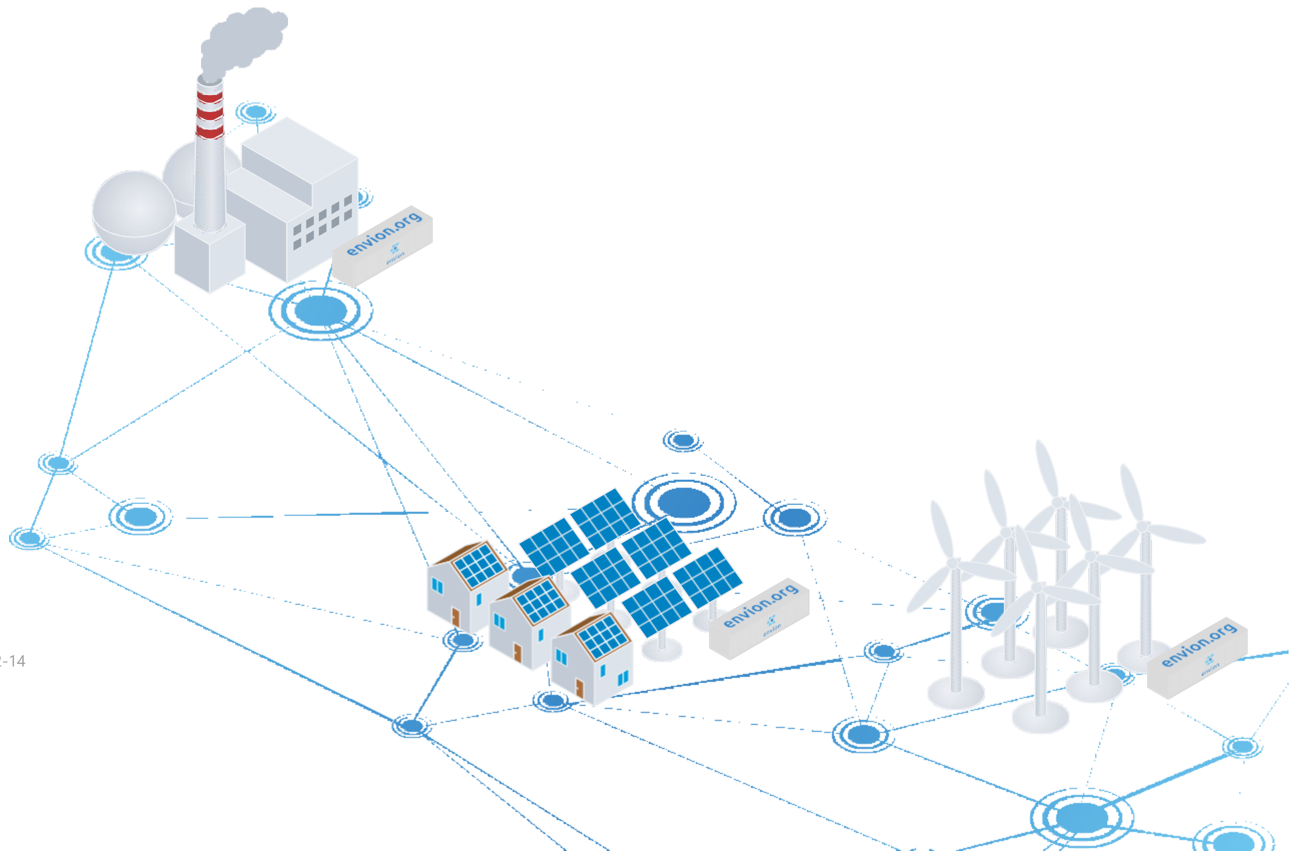
Zelos

Zelos (ZEO)

whitepaper

maximizing the value of energy worldwide



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LEGAL DISCLAIMER

The purpose of this Whitepaper is to present Zelos, its technology, business model and the ZELOS (ZEO) token to potential token holders in connection with the proposed ICO. The information set forth below may not be exhaustive and does not imply any elements of a contractual relationship. Its sole purpose is to provide relevant and reasonable information to potential token holders in order for them to determine whether to undertake a thorough analysis of the company with the intent of acquiring ZELOS (ZEO) Tokens. All relevant legal information is contained in the Token Purchase Terms and the Token Purchase Agreement.

This White Paper does not constitute an offer to sell or a solicitation of an offer to buy a security in any jurisdiction in which it is unlawful to make such an offer or solicitation. Neither the Swiss FINMA nor the United States Securities and Exchange Commission nor any other foreign regulatory authority has approved an investment in the tokens.

The ZELOS (ZEO) token can be categorized as a security as it entitles token holders to receive the profits from mining operations. The token is, as such, subjectto certain restrictions under US security laws. The Zelos ICO is compliant with these rules and restricts access for US-citizens, greencard holders and residents of the US to the category of "accredited investors", pursuant to the US Security Act Regulation D Rule 506 (4). All relevant legal information is contained in the Token Purchase Terms and the Token Purchase Agreement.

Certain statements, estimates and financial information contained herein constitute forward-looking statements or information. Such forward-looking statements or information concern known and unknown risks and uncertainties, which may cause actual events or results to differ materially from the estimates or the results implied or expressed in such forward-looking statements.

This English-language White Paper is the primary official source of information about the ZELOS (ZEO) token. The information contained herein may be translated into other languages from time to time or may be used in the course of written or verbal communications with existing and prospective community members, partners, etc. In the course of a translation or communication like this, some of the information contained in this paper may be lost, corrupted or misrepresented. The accuracy of such alternative communications cannot be guaranteed. In the event of any conflicts or inconsistencies between such translations and communications and this official English-language White Paper, the provisions of the original English-language document shall prevail

ABSTRACT

When crypto mining was still in its infancy, it was well distributed among a couple of thousand private miners, governed by transparent rules and not harmful to the climate because its energy requirements were microscopic. All that has changed: the exponential growth of cryptocurrencies has led to a dramatic increase in the sector's energy consumption and a concentration of mining activities in countries with low social and ZELOS (ZEO) iron mental standards - where electricity is produced using predominantly fossil fuels. Even worse, the concentration of mining power in the hands of a couple of large corporations is distorting the formerly democratic decision-making process in these networks: changes in protocols and hard forks are in danger of being influenced by the economic interests of a few.

Zelos has developed a system of Mobile Mining Units (MMUs) that can tap electricity directly at the source: at hydro, solar, wind and fossil power plants in every corner of the planet. Our MMUs are based on standard intermodal (sea) containers, equipped with mining hardware, communication and industry 4.0 automation features, remote control capabilities and a break-through cooling system that only makes up ~ 1% of the system's total energy consumption. Altogether it's a high-tech solution that can be seamlessly deployed globally and allows us to use the cleanest and cheapest energy mix wherever it is available.

The flexibility of the MMU system helps us to fuse two of the most important sectors of the 21st century: blockchain technology and renewable energies. Using the dynamics of exponential growth for both, we promote climate preservation and the welfare of our token holders. It is the physical incarnation of the blockchain spirit: a robust and decentralized system that can withstand disruptions in government policies, price structures and the energy supply.

The solution Zelos provides has all the necessary competitive advantages, follows a decentralized approach and provides voting rights for an experience that has been under pressure from the concentration of mining power

ICO DETAILS

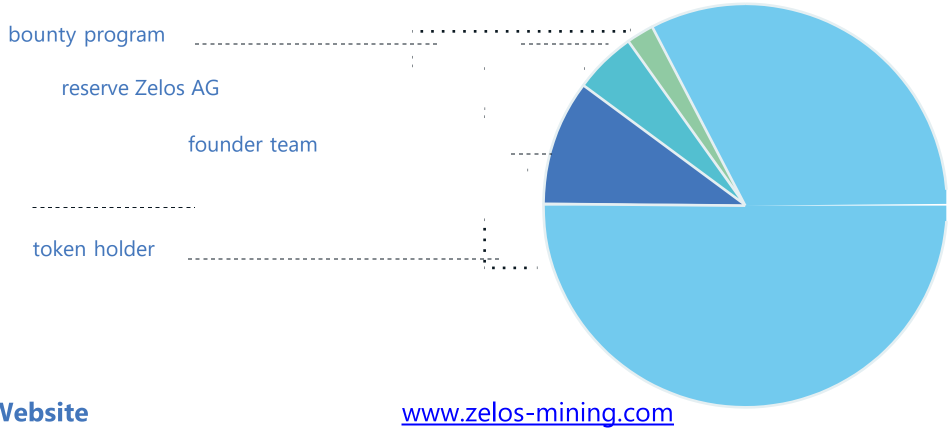
The ZELOS (ZEO) token is an ERC-20 standard-based Ethereum token. ZELOS (ZEO) tokens grant their holders the right to:

1. receive 100% of the earnings of our proprietary mining operation in two steps:
   - 75% payed out immediately
   - 25% reinvested to boost future payouts
2. receive 35% of Zelos's earnings from mining by third-party operations
3. voting and veto in important decisions of the company's strategy

Tokens will be offered for 16 days, starting on October 30th, 2020 and ending on November 15th, 2020.

Zelos (ZEO) ICO is conducted by Zelos - the first mobile mining solution in the world - targeting energy at its very source. The offering will be open to the global public. Restrictions apply for residents of Germany and US-based investors.

Token Issue Volume	max. 360 millions more tokens not distributed shall not be generated
Token Price at Issue	$ 0,34 / 0,29€ / 0.001 ETH
Distribution	50% token holders 30% founder team 15% Zelos AG as reserve 5% bounty program



Website	www.zelos-mining.com
Accepted form of payment	ETH
ICO Start Date	October 30, 2020, 12 PM GMT
ICO End Date	November 30, 2020, 11:59 PM GMT
Token Issue Date	November 31, 2020, 12 PM GMT
Use of proceeds	70% mining hardware 9% Research & Development and Administration 6% Exchange fee, App Development 15% Further Oerations

Zelos

RESTRICTIONS FOR INVESTORS

We are convinced that the global community deserves a share in the profits of crypto mining - not just a handful of anonymous players from oligopolistic cartels in authoritarian societies. We believe that crypto mining should be a decentralized, democratic, and evenly distributed operation - one that is open to everyone who is willing to support the network and benefit from it.

Based on these principles we have created the ZELOS (ZEO) token. This grants investors the right to receive the full pay-out of our proprietary mining operation. As a consequence, the ZELOS (ZEO) token can be classified as a security in most jurisdictions. In compliance US security laws, holding a token is strictly limited to three categories of investors:

- **Investors** who
  - do not hold a US passport;
  - are not in possession of a US Greencard;
  - have no residence in the United States.
- **accredited investors** under the US Securities Act, Regulation D, Rule 506, i.e. investors with a networth of more than $1m, excluding their primary residence, or with a net income of more than $200.000 (if married a combined income of $300.000).
- **investors whose residency lies in Germany** are limited to investments above 250.000€.

SEC guidelines concerning Regulation D, Rule 506(c) demand that the issuer undertakes „reasonable steps" to secure that investors meet the above mentioned criteria. In the Zelos ICO we apply the SEC safe harbour verification: investors have to submit a scanned confirmation by a securities attorney or certified public accountant that the investor is indeed verified as accredited. If such confirmation is not submitted funds already transferred shall be remitted to the investors wallet or bank account.

These restrictions on holding tokens contradict our idea of giving everyone a fair chance to participate in our crypto-mining operation and the competitive advantages of the Mobile Mining Unit (MMU) system. However, we have to comply with security laws and regulations. In order to reconcile these regulations with our concept of fairness, we are already working hard to turn the token into a publicly tradable asset. Right after the ICO, Zelos will begin preparing a prospectus, register with the SEC and apply for a listing as a security token on regulated exchanges. Afterward, the ZELOS (ZEO) token will finally be accessible for everyone - provided the SEC gives the green light.

TOKENS

ZELOS (ZEO) Tokens are based on the ERC20 protocol, which determines that 360 million tokens will be issued with a nominal price of 0,29 € or 0.001 ETH. The final allocation is set up as follows:

Zelos

Any tokens not allocated to investors, founders or the company shall not be created. In other words the maximum token number can never exceed 360 million, where as investors participate with 50% or a maximum of 180,000,000 tokens, founders participate with 30% or a maximum of 108,000,000 tokens and the Zelos company holds 15% or a maximum of 54,000,000 tokens (e.g. for the remuneration of advisors).

The tokens carry voting rights. From time to time, when Zelos has to take strategic decisions regarding mining operations, the company will bring these decisions to a vote with token holders who have the right to veto the company's proposals. A voting process will be installed based on the ZELOS (ZEO) token's smart contract.

The tokens carry the right to receive dividends from the mining operation. Dividends are calculated solely on the basis of the net profit of the mining operation. They are not based on Zelos's profit and loss statement (P&L), which might carry risks not related to the mining business. The Zelos business model for mining has two components:

1. **Proprietary Operations (PO)** where Zelos invests in, owns and operates the MMUs. Token holders are the 100% beneficiary of the earnings of proprietary operations.
2. **Third-Party Operations (TPO)** where an independent company, such as a utility or an investment fund, acquires the MMUs while Zelos operates them. For this operation, Zelos will be rewarded with a share of the mining revenues. 35% of the earnings of this business model will be distributed to token holders.

Earnings in Proprietary Operations are comprised of the total rewards minus operation costs: such as, but not limited to, costs for electricity, rent/land lease for containers, hardware replacements to ensure the continuity of Zelos's mining operation (stabilize the MMU's performance and counter e.g. difficulty increases or other efficiency losses directly connected to the mining process), depreciation and a handling fee for the company's overhead). The calculation of earnings in Third-Party Operations depends on the agreement with the third party, but will exclude depreciation.

100% of PO and 35% of TPO will make up the fund that is ready for distribution to token holders. But that's not enough in our eyes. In order to accelerate earnings growth, we have decided to invest one quarter of the annual earnings fund to build new MMUs and lay the foundation for more earnings - and for exponential growth.

Three quarters of the earnings will be distributed immediately - and that means on a weekly basis

USE OF PROCEEDS

We have calculated the cost of the ICO (legal advice, production of promotion materials, staff for marketing and communication, direct marketing expenses such as social media space, banners, paid articles, etc.) to be $33m at hard cap. Around 6% of this amount was raised before we even launched our website and official pre-sale began. We expect to fully cover the cost of the final product launch early in January 2020. Therefore, contributions raised during the core ICO will be used entirely for investments and for building the company.

70% of the core ICO funds will be used for mining hardware, the construction of MMUs by contractors and their deployment at locations with low energy prices. Investment per MMU is estimated to be between $100,000 and 150,000 at present. However, this could change due to changes in hardware prices and market conditions. For every $10m of capital raised during the core ICO, $7m will be invested in mining hardware.

During the first couple of months of the roll-out, overhead and administrative expenses will not be fully covered by mining revenues. As such, we will reserve 9% of the capital raised from the ICO for the roll-out phase (administration, research & development, legal proceedings for token status as a publicly available security) and as a general reserve.

It is a goal of Zelos to stay ahead of the competition and develop new potential ways of mining, increase efficiency and detect pockets of low-cost energy worldwide; to explore the possibility of using MMUs as an energy sink at places and in times where renewable energies produce overcapacities; to integrate the MMU system into smart grids; and finally to transform the purely mining-oriented MMU technology into a data-center technology with much broader applications in a developing blockchain market. To achieve these strategic goals, Zelos has started a research and development (R&D) cooperation with the renowned German Fraunhofer Institute for Solar Energy Systems. The focal point of this cooperation is to assess to what extent overcapacities of solar grids can and will be used for MMUs, and to analyze the economic viability of relocation of MMUs. The budget for R&D is part of the administrative budget.

For the benefit of our investors, we plan to make the ZELOS (ZEO) token available beyond accredited and qualified investors for a broader public. This requires developing a prospectus and involves a complicated regulatory process with financial authorities in various jurisdictions. Our priority jurisdictions are Switzerland, the US and potentially the European Union. We will allocate funds from the administrative budget for this process as well.

SUMMARY OF FUNDS USAGE

Pre-Sale $7m	100%	ICO budget
ICO	70%	Investment in Mobile Mining Hardware (MMH)
	30%	Administration, Research & Development, Legal proceeding Advertising Employees

In the event the ICO raises the entire Pre-Sale amount of $7m, the use of proceeds will gradually shift from investment in our mining farm towards administration and marketing. In this case, Zelos will focus on company value (with an asset portfolio) of constantly generating digital Assets with a location with low price spikes for cheap energy in tax beneficiary regions.

The use of proceeds as put forward in this White Paper is set according to a schedule we feel committed to. Nevertheless, circumstances, legal proceedings, and disruptions in crypto markets, rewards and exchange rates might arise that could force Zelos to deviate from its original schedule

THE CHALLENGE

The crypto mining business model is highly dependent on the energy supply. The price and availability of electric power are the two most important factors for mining companies.

On a macro level, the hunt for cheap energy has lead to a concentration of mining operations in countries with low socio-economic and ZELOS (ZEO) iron mental standards, and therefore cheap fossil electricity. As a negative consequences of this low-cost, “dirty” energy, the mining of cryptocurrencies significantly contributes to climate change. The concentration of mining operations in a few authoritarian countries meanwhile, undermines the distributed ledger system and increases the risk of manipulations.

On a micro level, miners have become vulnerable to energy price fluctuations and regulatory changes. The competitive advantage of many companies in this sector depends on the willingness of a handful of regimes to tolerate cryptocurrencies, keep energy prices low and maintain friendly regulations. That is, obviously, the business model of an industry in its early stages.

Next generation mining operations will be climate friendly, more resilient against local price fluctuations and regulatory changes, more profitable and more decentralized. Consequently Zelos’s technology-driven business model, which combines green energy sources with economic viability on a global scale, is part of this next generation.

DIGITAL ENERGY CONSUMPTION

The IT ecosystem is one of the largest consumers of electricity worldwide. It consumes about 1,500 TWh per year of electricity – enough to equal the power generated by Germany and Japan combined - or almost 10% of the electricity generated worldwide[1]. Within the sector, cloud computing alone accounts for 416 TWh[2,3], roughly equivalent to the carbon footprint of the entire aviation industry, and it is growing fast: cloud computing doubles its energy consumption every four years. By 2020, it will grow to 1,400 TWh annually and could surpass China and the US, the world’s biggest electricity consumers, by 2030. Within the next decade, electricity might become a scarce resource, putting upward pressure on prices, if not globally then in certain places at certain times. The source of this bottleneck is the grid rather than power generation[4].

The fastest growing application in cloud computing is cryptocurrency mining. The amount of energy consumed by Bitcoin and Ethereum exploded within ten years from virtually zero in 2010 to 19.2 TWh in 2020 – matching the energy produced by Iceland or Puerto Rico [5]. The energy efficiency of ASICs and GPUs has risen quickly, but it has been outpaced by the increase in transactions and market cap. While this exponential growth provides excellent opportunities for miners to earn rewards, the power consumed by the information technology ecosystem also increases competition for energy. Only those with safe access to affordable electricity can put their chips to work.

GLOBAL ELECTRICITY MARKET

Unlike coal, oil and LNG, which can all be shipped around the world, there is no global market for electricity. The electricity market is highly fragmented, consisting of thousands of regional subsystems in various jurisdictions where overcapacities alternate with shortages. While global energy demand continues to grow dramatically, huge differences remain between industrialized countries and the rest of the world. In its International Energy Outlook 2016 the US Energy Information Agency (EIA) projects an increase of global electricity consumption by 69% within three decades, from 21.6 trillion kWh in 2012 to 36.5 trillion kWh in 2040. While the demand for electricity in OECD countries will increase by a total of 38%, demand in non-OECD countries will double – reflecting the difference in GDP growth of 2.0% for OECD and 4.2% for non-OECD countries.[6]

Some of this growth in demand will be met by electricity generated from fossil fuels, but renewables will increase their share of the energy mix from 25% to 33% between 2012 and 2040 and double their output in absolute terms. Viewed over a period of 28 years, this does not appear to be disruptive. Disruption, however, is happening within the sector. On a global scale, 90% of all renewable energy is hydropower, which will – due to natural limitations – grow only marginally. That implies that all of the remaining growth will be contained in thenon-hydrosector, i.e. wind andsolar. The amount of photovoltaic electricity generated - private and utility scale - has grown exponentially from 100.000 MWp in 2012 to 390.000 in 2020. In other words, the fastest growing source of the global electricity supply over the next two decades will be the most unreliable and volatile source - and will depend onweather conditions that even supercomputers cannot predict. This will have far- reaching repercussions: governments trying to stabilize energy markets will impose more regulations, and electricity prices will become distorted with large deviations between countries, energy sources and customer categories. In consequence, price volatility is growing as a result of both the laws of nature and government intervention.

These volatile conditions will prevail throughout the transitional period from a world powered by fossil fuels and centralized energy production to one where decentralized, renewable sources prevail. Over the long term, the global electricity market will be governed by new technologies to balance, store and trade energy between multiple intelligent - probably blockchain-driven - actors that can create a much better equilibrium than regulation could ever achieve.

With this in mind, flexible players will be able to cope best with this new energy world.

PRICE DISTORTIONS & OPPORTUNITIES

Photovoltaic (PV) is the fastest-growing renewable energy source, a reflection of the decline of module prices – from $76 USD per Watt peak (Wp) in 1977 to $0.35 USD in 2020. This collapse in prices was initially driven by technological improvements and then accelerated as a result of attractive feed-in tariffs, economies of scale and Chinese competition. Meanwhile, feed-in tariffs followed the drop in module prices: 1 kWh of PV energy generated earned $0.40 USD in 2005, while it currently earns $0.08 USD/kWh in most OECD countries. Beginning in the planet's sun belt, country after country reached grid parity in the last couple of years, i.e. solar power became as cheap as power from the grid (production cost + transport and levies). This process has gone even further. In India, Chile and the Middle East, PV plants get paid as little as $0.03 to $0.04 Cents (USD) per kWh generated, which is only a slightly more than the price of dirty coal power.

While the average price of PV power is already low, certain conditions in the spot market can drive them even lower, sometimes into negative territory. The very nature of wind and solar power, the drivers of renewable growth, puts pressure on the existing power infrastructure and has severe consequences for national grids and price structures. Power input fluctuates with the weather and sunlight and leads to overcapacities on sunny afternoons or scarcities during calm nights. In other words, the massive expansion of wind and solar creates opportunities for extremely low prices per kWh.

EXAMPLES

- **California.** On a sunny spring day, the state produces so much solar energy that utility companies have to give away gigawatts of solar power, even paying neighboring states to accept it[7].
- **Germany.** A similar overcapacity occurs when a storm hits Germany's northern shores and on- and off-shore windfarms go into overdrive, producing excess capacity for Poland and France.
- **Chile.** Here, power prices have not been hit by forces of nature, but by the economic cycle. In Chile's Atacama desert, the place with the highest intake of solar energy per square meter on earth, the government promoted PV plants to provide electricity for the large mining industry in the north. When the commodity supercycle petered out after 2012 due to a slowdown in Chinese demand, electricity prices collapsed and PV plants with a break-even of $0.14 USD/kWh are selling at $0.04 USD now
- **India.** PPV capacity increased tenfold from 300 MWp in 2010 to 3000 MWp in 2020, creating excess capacities at certain times and a collapse in electricity prices[8]. This collapse applies to renewable as well as fossil fuels. Meanwhile, 1 kWh is on the market for $0.03 to $0.04 USD, and sometimes falls to $0.00 USD, especially in remote areas where energy demand is low.

While electricity prices in non-OECD countries are under pressure, the picture is much more diverse in the OECD. European OECD countries introduced a range of taxes and levies on electricity prices – partly to finance legacy PV-projects that earn $0.20 to $0.40 Euro USD/kWh for the next 10 to 15 years and partly to develop the grid and finance new power lines for renewable energies. Consumers in Denmark and Germany pay up to $0.30 and $0.40 USD/kWh, while power production at the source costs $0.03 USD for coal or gas and $0.08 USD for the latest PV parks. Simultaneously, governments have introduced large exemption schemes in order to preserve the competitiveness of their industries so that smelters or car manufacturers can still purchase low-cost energy.

The regulatory regime of legacy feed-in tariffs, subsidies and exemptions has distorted the market and is highly vulnerable to policy changes. The European Commission, for example, has targeted Germany's exemption system as a violation of European competition regulations and could even force the government to change it. Furthermore, social institutions are putting pressure on a system that favors the interests of large companies over those of small consumers with lower incomes. Price changes could therefore come overnight - in both directions.

The European Union, India, Chile and the Middle East are only some examples of the distortions, risks and opportunities that affect the global electricity landscape. Our survey demonstrates that these markets are undergoing a deep change that will force energy consumers to adapt within relatively short time frames.

SUMMARY

The exponential growth of energy consumption in the IT ecosystem is hitting an energy market in transition. The growth of renewables in the energy mix is creating imbalances in the grid – an uneven distribution of power in time and space. At certain times and in certain places, there is an abundance of electricity straining the grid to its limits, while scarcity might prevail at other times. These imbalances trigger large fluctuations in spot market energy prices, regulatory responses, and price differences between sectors, regions, time and climate zones.

As data centers are long term investments in infrastructure, they have a limited capability to adapt to changes in the price structure of energy markets. Once built, they are tied to their location and might lose competitiveness to other locations if price structures change. While new market conditions might be lethal for traditional data centers, they offer vast opportunities for the global, flexible and smart mining operation that Zelos is launching now.

THE ZELOS APPROACH

OUR VISION

We believe that system innovation is imperative in order for cryptocurrencies to gain mass acceptance. We believe that future mining operations need to be decentralized to reduce their dependency on regulations from single governments, powerful individuals, and fossil or nuclear energy.

Future crypto-mining operations need to reduce the systemic risks that result from being bound to certain coins or mining pools. Thus, Zelos strives to hand the decisive power back to the crypto-community. It must be possible for individuals to take part in crypto-mining without tremendous investments in hardware and technology. Besides broad ownership of mining operations, Zelos strives to involve the community in making decisions about key mining decisions. We therefore strive to reduce the hurdles for larger audiences to take part in the crypto-community.

By offering anyone the ability to take part in securing the future of the blockchain technology, Zelos is laying the foundation for the future of crypto mining by designing highly mobile low-maintenance mining units and by offering our community the right to vote for mining locations and for coin choices.

OUR APPROACH

The technology that Zelos has developed represents the next generation of data centers — modular, mobile, flexible, low-maintenance, data-driven and therefore designed for the challenges of the future.

Our flexibility strategy is based on three technologies:

- **Our decentralized Mobile Mining Units (MMUs)** offer industry 4.0 automation with little maintenance, are completely modular and have a scalable design. They manage a variety of electricity sources and are able to adapt to different climate zones. Built in a 20ft standard intermodal container, they have a proprietary, highly efficient and failsafe cooling system, an intake of more than 100 KW (depending on configuration) and can turn energy into cryptocurrencies or alternative data applications (for details see The Mobile Mining Unit, page 18).
- **Our central hub or Unified Mining Cloud (UMC)** manages the automated, decentralized operation of mobile mining units worldwide. It supports our Mobile Mining Units (MMUs) in finding the optimal mining strategy depending on the traded price of the cryptocurrency, mining difficulty, real-time energy price at location, hardware generation and many more factors. Besides data aggregation, control and optimization of MMUs, our UMC is also handling and supervising all service & maintenance operations throughout the Zelos network.
- **Our global Smart Energy Sourcing (SES)** identifies and secures locations with low energy prices. It is a database that we develop in a continuous process in cooperation with one of the most renowned scientific institutions for renewable

energies in Germany. It combines knowledge of price structures for industrial users, feed-in tariffs for renewables, discounts for on-site consumption, grid fees, taxes, levies and exemptions - a proprietary, multidimensional system that helps us to identify the most efficient locations for processing data and mining cryptocurrencies. Together, MMUs, UMC and SES build a complementary system: SES software helps us to identify the most efficient renewable energy sources around the globe, while the MMU technology allows us to direct computing power to exactly these spots in order to build a decentralized and robust system that turns geographical flexibility into global cost leadership. The global cost leadership of Zelos relies on an exceptional data-based capability: with the help of SES we don't just identify attractive energy ZELOS (ZEO)ironments by country. We zoom into the micro level to find the most efficient grid locations - directly at a transformer, a wind farm or a PV park. Furthermore, we know exactly whether the jurisdiction allows this on-site approach to avoid grid fees, levies and taxes on energy transportation. This surgical precision exploits the imbalances of the existing energy system

UNIQUE SELLING PROPOSITION

Zelos has developed a fully automatized ("industry 4.0"), mobile mining unit inside CSC-certified intermodal (sea) containers that can be shipped to any location around the world within days (most transport routes) or weeks (transport between continents).

Lowest price for energy on the market. Our mining units use low-priced green energy directly at the source - near the shore, in the desert or in other remote locations. This allows us to always strategically position our Mobile Minings Units (MMUs) in regions with a competitive supply of energy and provides us with leverage when negotiating with energy providers.

Maximum energy efficiency. Our mobility concept allows targeted placement of our mobile mining units at sites where thermal energy is required - for heating buildings, greenhouses or warehouses. This way, we "recycle" the energy used for mining. With this strategy, we achieve revolutionary, low electricity prices.

Cutting-edge cooling technology. We have designed, developed and tested a radically new, self-regulating cooling system specifically designed for the blockchain mining industry. This patent-pending cooling system achieves a best-in-class energy efficiency with a consumption of only ~1% of the system's total energy consumption.

True scalability. Mass production & scalability has been deeply embedded into Zelos's DNA from day one. Next to custom components developed by Zelos (e.g. circuit boards for management or cooling systems), our Mobile Mining Units use a wide range of standardized components that facilitate the mass production. Our investment in software is safeguarding our growth trajectory by providing the necessary means to operate a large fleet of MMUs. Through our network of partner firms, we have been able to secure a prioritized access to components such as GPUs in large quantities.

Risk mitigation by design. According to recent benchmarking studies, the centralization of hashing power in the hands of a few is a risk universally perceived as high by large- and small-scale miners[9]. However since Zelos is able to "mine" a broad set of cryptocurrencies, our mobile mining units reduce this concentration of power, as well as the dependency on a single government (e.g. regulatory changes), single energy providers (e.g. energy shortages or rapid price increases) and single cryptocurrencies (e.g. crash of single cryptocurrency).

Supporting the smart grid. Our mobile mining units are designed and built to operate at remote locations (”industry 4.0”) near energy sources such as solar plants, wind turbines or hydropower plants. Our mobile mining units can be integrated into a smart grid and flexibly take the load off of energy grids.

The pivotal parameter for cryptomining is the electricity price, where rewards and the depreciation of hardware are similar for every market participant. For commercial miners, the cost of data center infrastructure is equally important. We at Zelos have addressed both of these cost drivers with our concept of Mobile Mining Units: it is a modular, simple, robust and highly cost-efficient framework for any data center operation with the flexibility and standardized size required for a global deployment strategy.

OPERATING MODELS

We apply the combination of our Smart Energy Sourcing (SES) and our Mobile Mining Units (MMUs) in two business models: Proprietary Mining Operations (PMO) and Third- Party Operations (TPO):

PROPRIETARY MINING OPERATIONS (PMO)

We produce, own and operate a fleet of proprietary MMUs. Our margin is the margin after rewards, depreciation and energy prices. CAPEX is on Zelos’s shoulders, financed by our ICO investors. In turn, token holders are entitled to 100% of the earnings - of which Zelos re-invests 25% in order to increase Zelos’s future market share and maximize future earnings growth.

Distribution of these dividends will occur on a weekly basis whereas 75% of profits will be emitted and 25% will be used to reinvest directly in MMUs in order to deliver growing dividends to the Zelos community. MMUs will remain active as long as the operation is profitable.

In an MMU setup with a combination of 50% ASIC- and 50% GPU miners, the total ROI of Zelos’s proprietary mining operations is 181% (calculated on Jun. 24th 2020). A detailed overview of the underlying assumptions as well as profit and cost drivers on can be found in the appendix.

While Proprietary Operations are highly profitable in itself, they also serve as a proof of concept that should help turn utilities (e.g. power plant operators) into clients. At this point, we are currently already engaged in discussions with planners & operators of power plants that have approached Zelos. Their interest lies in the operation of Zelos’s Mobile Mining Units (MMUs) as part of a downstream vertical integration to safeguard their profitability in a difficult energy market ZELOS (ZEO)ironment.

THIRD-PARTY OPERATIONS (TPO)

In Third-Party-Operations, MMUs are manufactured and maintained by Zelos, but the investment is carried by external partners, the “third parties”. A third party can be an investment fund or a corporation seeking an upgrade in its profitability. By refining electricity, a mere commodity, into sophisticated crypto-mining services the corporation moves up the value chain and multiplies its revenues per kWh. With TPO, we offer our expertise in mobile crypto mining to a sector in need of revenues, leverage our own capital base and increase returns for token holders. A percentage of the total mining revenues of the third party will be claimed by Zelos for operating the MMUs and Zelos will pay 8.4% anually of the resulting earnings to token holders.

CHALLENGES IN THE BLOCKCHAIN COMMUNITY

The ecological footprint of traditional mining operations is enormous – the total amount of energy consumed in mining Ethereum and Bitcoin is as large as Nigeria's consumption, a country with 180 million inhabitants, about 2% of the entire population on earth. *The Guardian* stated back in July that a single Bitcoin transaction "devours as much energy as what powers 1.57 US households for a day – roughly 5,000 times more energy- hungry than a typical credit card payment"[10]. Traditional large- and small-scale mining operations get their power from regular grids - based on a traditional energy mix. On a global level, that energy mix is still dominated by fossil fuels contributing to pollution and climate change. For blockchain to fulfill its own vision and become the infrastructure for transactions in the future, the technology needs to improve its energy consumption profile while maintaining its core principles: the distributed ledger and a redundancy of capacities. That is a big challenge for the entire industry. However we - the Zelos team
- are convinced that we can help make the world a better place with our mobile and flexible system which taps unused resources in the renewable space.

Besides our ZELOS (ZEO)ironmental ambitions we want to strengthen the original idea of blockchain and crypto currencies: a distributed structure in the hands of many as opposed to oligopolistic clusters of computing power in intransparent jurisdictions under authoritarian rule. The very nature of our mobile fleet of MMUs allows for a widely distributed system and the voting rights we give to the community of token holders ensure that important decisions in mining are taken by the community and not by tycoons

LONG TERM VISION

We believe that next generation energy grids need to be intelligent, dynamic systems connecting legacy power stations with large scale renewables and networks of distributed producers and consumers of energy. On the last mile, such a system relies on Advanced Metering Infrastructure (AMI) with smart meters as energy managers and intelligent machines as agents that buy and sell energy via smart contracts, using household's solar roofs as power stations and car batteries as storage. In the energy world 4.0, the formerly uninvolved consumer of the 20th century becomes an active player in a breathing and flexible energy organism, managed by smart contracts, paid in cryptocurrencies[11].

In such a world, the analysis of energy prices on a global scale is key for efficient crypto mining and data center operations[9]. With Smart Energy Sourcing (SES), we are now laying the foundations for the software infrastructure necessary to manage our crypto mining operation and maximize the potential and flexibility of our Mobile Mining Units

Figure 1. Scalability. Containers can be stacked in arrays to allow the best usage of available space and maintain an outstandingly small footprint for a comparable data center.

SCALABILITY

According to a recent Cambridge study, many large miners are highly concerned with issues regarding the scalability of their operations. We designed our processes with this issue in mind, resulting in an all-around highly scalable concept. We deploy a modified, ISO-certified sea container that is adapted to suit Zelos's needs right from the beginning. In partnership with well-established Chinese steel factories, all of the container's units are thoroughly prepared and equipped with most of the required hardware, including Zelos's proprietary sensor array, remote control mechanisms and Zelos's hardware stacking system. At this point, Zelos's units can be filled with the computing hardware. Currently this step is undertaken in the EU, however we have plans for passing it on to production sites in the future as well. After this final step, which is facilitated by Zelos's simple hardware stacking system, the unit can be connected and can start working anywhere in the world, be it in a remote power plant, rural industrial area or even a container ship, using the ship's onboard wifi and power supply. Our team of international energy experts has furthermore helped us to create a power hub that allows Zelos's modular data centers to be connected to virtually any high-power electricity in the world. Accepting the industrial standard of 380-400 VAC via a set of adjustable connectors, Zelos's fleet remains flexible, can be used in any imaginable setting and can be dynamically adjusted to meet the required needs. In the post-deduction phase, a unit can even be economically used to solely transform excess energy such as excess power potentials from (off-grid) renewable energy sources.

Given the low prices of standardized grid-tied inverters, PV farms often use these standard modules in an array, creating an ideal low-voltage AC network for off-grid usage of PV power. After the primary amortization phase, where units are in use 24-7, a 100% off-grid use case becomes profitable.

DEVELOPMENT PRINCIPLES

The Zelos team has developed the core technology ranging from circuit boards to middleware to application software layers for the MMU based upon a clear set of development principles and guidelines:

- **Mobility.** The Zelos vision can only be realized by ensuring that each and every component is compatible with, and supports, our ruggedized mobility concept (e.g. protection of hardware components against vibrations and transport-related issues). This is largely realized by using components designed and revised in-house. See “Scalability” , page 17 for details.

- **Modularity.** For the sake of scalability, modularity is one of Zelos’s fundamental design strategies. The modularization of functional units and the creation of a completely modular ZELOS (ZEO)ironment are essential contributors to the sUUCess of our Mobile Mining Unit (MMU). See “Zelos Mining Rack” , page 24 for details.

- **Cost-efficiency.** The highest-performance device does not always provide the best value when energy cost is a factor. Our goal is to create devices with the greatest ROI at the lowest overall risk. The core technology of the MMU has been developed to only include carefully chosen, well-engineered solutions with a clear focus on improved ROI over the life of the device.

- **Maintainability.** Keeping operational costs low is the key to sUUCess. Industry 4.0-driven automation approaches are therefore preferred over using human resources for maintenance. See “Smart Maintenance Concept”, page 46 for details.

- **Plug‘n‘play.** Replacing, removing, adding, or moving units and devices should not affect the operability of the system or any parts of it. To this end, a sophisticated plug‘n‘play system should be designed to track and balance connected components.

- **Plug‘n‘mine.** A fundamental development concept is that deployment of the MMU to full-scale mining should only take a few minutes once energy and network have been connected. Simply plug in the device and mining will rapidly commence following the sequential startup sequence.

- **Expandability.** Simple, straightforward, function-based engineering allows for exponential scalability, allowing for virtually unlimited expansion of our system. This ensures easy-to-control mass production and a short time-to-market.

- **Cooling optimization.** Cooling is an essential factor for any data-center and is the greatest component in determining its efficiency. A maintainable and error-proof system is the key to an autonomous mining operation. Therefore, we have created a largely passive, highly-efficient cooling system that keeps the unit running even at outside temperatures above 40 °C. For special purposes, like hot climates, this system will be scalable without additional adaption (see chapter “Automated Cooling System”, page 27).

SYSTEM OVERVIEW

Based on a fully ISO-certified 20ft intermodal (sea) container, our mining unit represents a highly mobile crypto-miner that universally fits into internationally standardized transportation systems. Our design and engineering experts have made every effort to maintain the unit's flexibility with regard to stacking and arranging multiple units to create an easily-accessible data center array. The sea container design assures cost-effective logistics by giving access to standardized international transportation and storage systems. Our strictly modular design allows for physical stacking and parallel connection of several units.

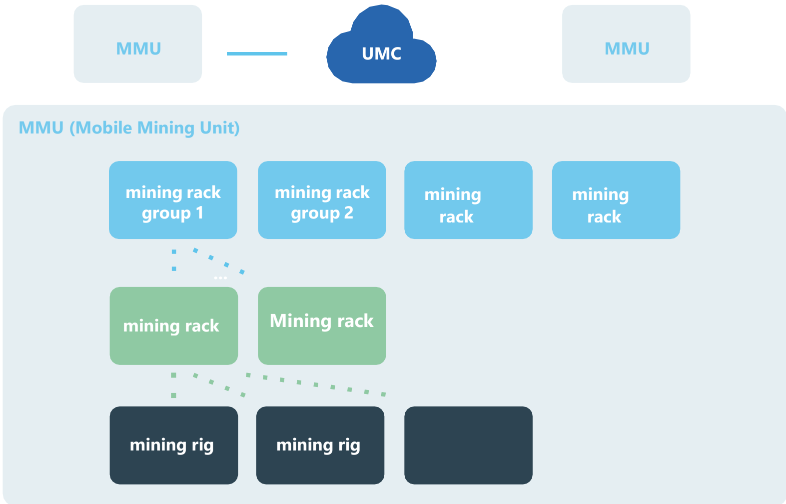


Figure 2. System Overview. Zoom in from Unified Mining Cloud connecting the MMUs to smallest entities.

Even at the container's maximum gross weight, our units can be moved and stacked freely by means of simple fork-lift trucks that are capable of lifting 3 tons of weight.

The Mobile Mining Unit (MMU) is contained within and includes the sea container, along with the complete system of racks, doorman, satellite-communication, relays, energy measurement & safety devices, mining optimization and central management system (UUC), remote control units and networking infrastructure for secure communication & uplink.

Based on industry 4.0 standards, our goal for the first generation of the MMU was that it can work autonomously and therefore can be placed anywhere in the world. The only requirement for the MMU to begin operation is energy.

Upon connection to a suitable power source (see below), the MMU automatically searches for an internet connection via multiple failover data links including WIFI, LTE or satellite connections (including automatic unfolding, scanning & bearing of the satellite antenna to locate and connect to the appropriate satellite) with the help of the Automated Internet Connection (AIC). Once found, the available internet connection can initialize any attached Zelos workers (rigs and ASICs) and brings the whole MMU, its IP addresses, and its status monitoring of controlling system units (temperature, power, fan speed) online. When the workers are fully-initialized, they quickly start to mine and report to the Zelos ZELOS (ZEO).

The MMU is completely automated and does not require manual interaction for daily routines. All of this is achieved by modular control systems, which are connected and supervised by the UUC (Unified Unit Control). The UUC is the brain of the MMU: it receives the information of all associated and connected IoT devices, brings them together, and controls them at various levels.
Supervised by the UUC (Unified Unit Control). The UUC is the brain of the MMU: it receives the information of all associated and connected IoT devices, brings them together, and controls them at various levels.

ZELOS MINING WORKER

he smallest element in Zelos's ecosystem is the mining worker. This can be an ASIC, a GPU-based mining rig or other possible future mining or cloud-computing engines.

MINING HARDWARE

The first generation of the Zelos MMU contains the Zelos rig, which is an optimized mining device configured for optimal ROI efficiency. With this goal in mind, we over- or underclock GPUs, test dual-mining strategies, and reduce overhead by the operating system. New mining configurations based on this hardware can be published to all running instances worldwide by our Zelos UMC (Unified Mining Cloud) automatically.

More detailed information with relation to hardware optimization can be found in chapter Mining Excellence (page 45).

HARDWARE MAINTENANCE

One central asset of our Mobile Mining Units is that they keep maintenance costs and efforts minimal. There are fully automated systems in place which detect defective rigs, based on IP address and rig denotations, so that any maintenance worker is able to locate defective hardware within a very limited amount of time. Zelos is already able to instantly detect defective GPUs on a software basis when they stop performing their intended tasks at the desired performance rate. Now, we have taken a further step by altering BIOS names of GPUs (unique identifiers) and equipping GPUs with LEDs that translate software-based issue detection into physical signals, allowing even uninstructed maintenance workers gain the ability to quickly and reliably detect and replace defective hardware.

These mechanics are merely a fragment of the efforts that Zelos has undertaken in order to ensure minimal maintenance; the entire MMU has been designed so that anyone with a basic understanding of hardware and software processes can operate them with little guidance. For instance, all mining units are configured in a plug'n'play style, indicating that they start up as soon as electricity and internet connection are available. Furthermore, all rigs are equipped with LED strips, so that it is clearly visible when one particular section of an MMU loses electricity, networking or other functionality, simplifying repairs.

Generally speaking, a certain number of GPUs will stop mining after a certain amount of time, but there's a simple fix for that: every MMU has a randomized reboot schedule which reboots the mining rigs in order to safeguard performance, minimize maintenance operations, reduce the load on GPUs and improve heat management. This approach is highly favourable in contrast to the sole remaining viable solution, which is to not bring the hardware to its limits, but that could lead to much lower performance, which in turn would lead to a lower ROI for the Zelos community.

On the process side, the declared goal of Zelos is to highly standardize all maintenance operations. This means that maintenance operations are guided and controlled by our software infrastructure that provides clear prioritization, visual guidance, effective control & benchmarking and escalation of all maintenance operations.

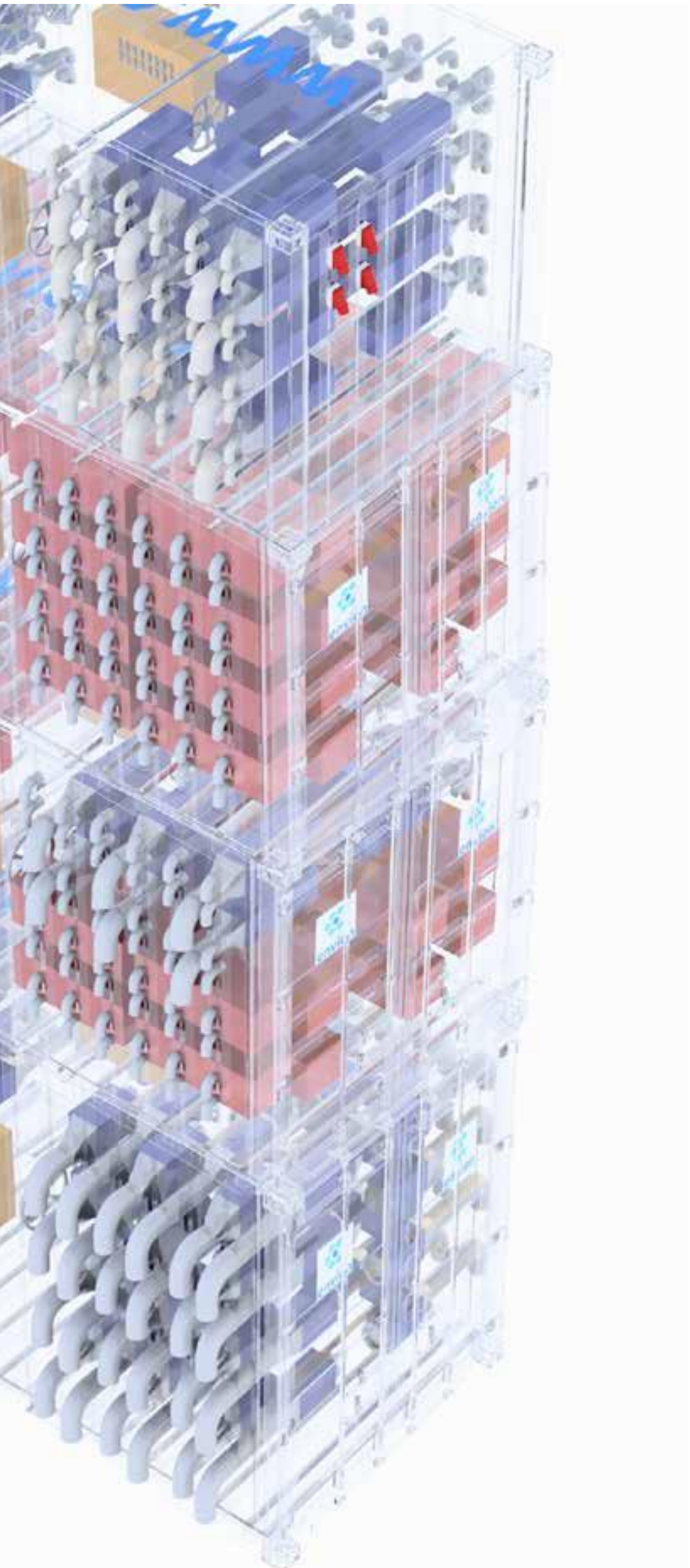
MMU CONFIGURATIONS

MMUs can be configured either with traditional ASIC workers or with our proprietary GPU-based rigs. The patent-pending cooling system includes specific options for both, ASIC- and GPU-based workers, which can be installed at fixed or yet to be determined ratios. The main configurations are depicted below in table 1 and figure 3, where an ASIC worker-fraction of 0, 50, or 100 % is depicted. Due to the nature of an air-cooled system, we have created a "medium (power) density" (< 50 KW), a "high density" (60-85 KW) and an ultra-high density (137 KW; ASIC-only) MMU version for each configuration. The implementation of a medium-density MMU version allows deployment of our containers even to regions with outstandingly high ambient air temperatures. Our prototype is of high-power density (figure 1).

	MD*			HD**				UHD***
	100% GPU	100% ASIC	50%/50%	100% ASIC	100% GPU	50%/50%	Prototype	100% ASIC
No. GPU Workers (pcs)	48	0	24	0	64	32	48	0
P/GPU Worker (W)	960	960	960	960	960	960	960	960
No. ASIC Workers (pcs)	0	32	16	64	0	24	10	96
P/ASIC Worker (W)	1430	1430	1430	1430	1430	1430	1430	1430
P total GPU (W)	46080	0	23040	0	61440	30720	46080	0
P total ASICS (W)	0	45760	22880	91520	0	34320	14300	137280
P aux. Eq. (W)	800	800	800	800	800	800	800	800
P TOTAL (W)	**46880**	**46560**	**46720**	**92320**	**62240**	**65840**	**61181**	**138080**
No. CEE 32A Power Lines	3	3	3	5	4	4	4	7

*MD = Medium Power Density version.
**HD = High Power Density version.
***UHD = Ultra High Density version. 100 % ASIC workers.

Table 1: MMU configurations. Different configurations of our MMUs with ASIC and GPU workers are presented. Representative configurations of 100% GPU workers, 100% ASIC workers and a 50/50 mix (based on power consumption) were chosen and are compared in the above table.



A)
100% ASIC

B)
100% GPU

C)
ASIC/GPU

D)
ASIC UHD

Figure 3. MMU configurations. Representative drawings of our different MMU configurations demonstrating configurations with A) 100 % ASIC workers, B) 100 % GPU workers, C) a combination of ASIC and GPU workers. D) 100 % ASIC workers in UHD configuration.

SOFTWARE

To ensure unprecedented performance, we created our own Zelos operating system (EOS) to run on our mining rigs. EOS is Linux-based and optimized for low overhead, high performance, scalability, and stability.

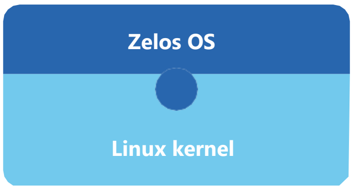
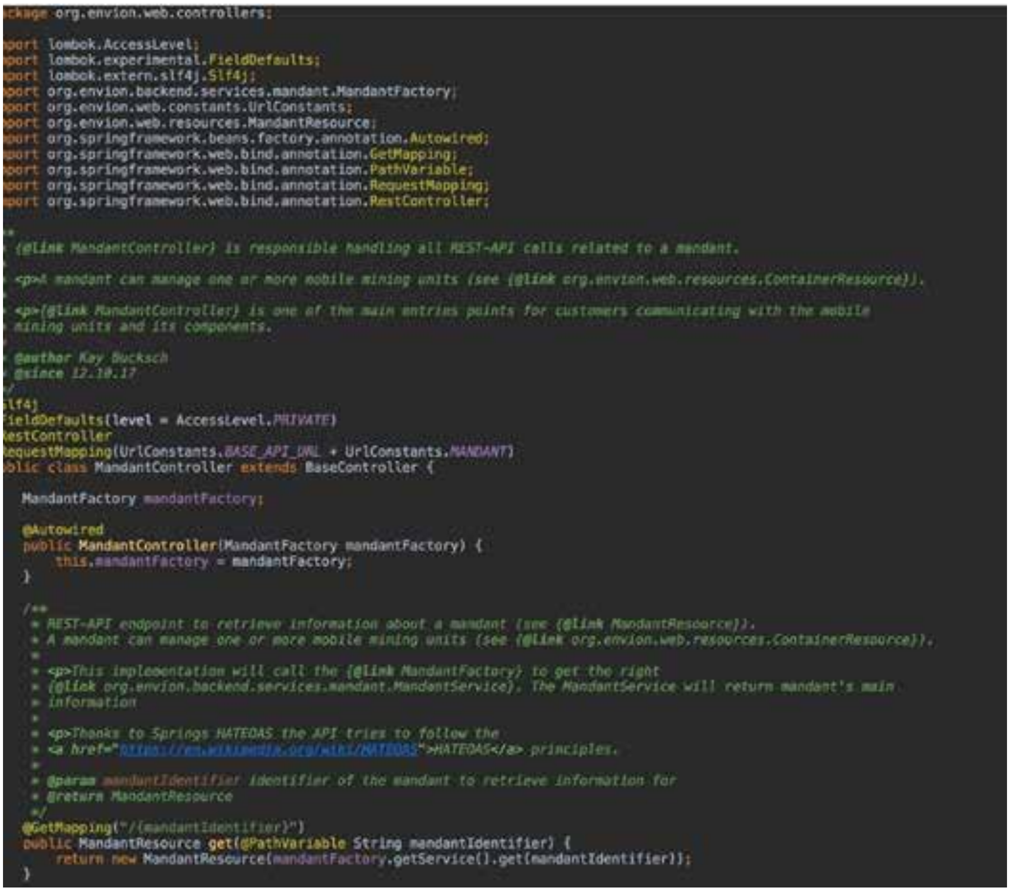


Figure 4. Zelos operating system (EOS)

Whenever a system is brought online, it initially receives an IP address from the network. Based on a configurable URL, it sends initial status information on startup which registers the Zelos rig in the ecosystem (see UUC - Unified Unit Control, page 32). EOS updates the ecosystem in frequent intervals. The operating system is furthermore able to recognize GPU failures and can set LED indicators to support maintenance work. If a GPU fails, EOS instantly pushes messages to the network in the standardized Zelos communication format (ECF). With the help of an integrated, secured REST-API, the mining rig is able to receive additional information and instructions.



```
ckage org.envion.web.controllers;

port lombok.AccessLevel;
port lombok.experimental.FieldDefaults;
port lombok.extern.slf4j.Slf4j;
port org.envion.backend.services.mandant.MandantFactory;
port org.envion.web.constants.UrlConstants;
port org.envion.web.resources.MandantResource;
port org.springframework.beans.factory.annotation.Autowired;
port org.springframework.web.bind.annotation.GetMapping;
port org.springframework.web.bind.annotation.PathVariable;
port org.springframework.web.bind.annotation.RequestMapping;
port org.springframework.web.bind.annotation.RestController;

*
 {@link MandantController} is responsible handling all REST-API calls related to a mandant.

 <p>A mandant can manage one or more mobile mining units (see {@link org.envion.web.resources.ContainerResource}).

 <p>{@link MandantController} is one of the main entries points for customers communicating with the mobile
 mining units and its components.

 @author Kay Bucksch
 @since 12.10.17
/
lf4j
ieldDefaults(level = AccessLevel.PRIVATE)
estController
equestMapping(UrlConstants.BASE_API_URL + UrlConstants.MANDANT)
blic class MandantController extends BaseController {

  MandantFactory mandantFactory;

  @Autowired
  public MandantController(MandantFactory mandantFactory) {
      this.mandantFactory = mandantFactory;
  }

  /**
   * REST-API endpoint to retrieve information about a mandant (see {@link MandantResource}).
   * A mandant can manage one or more mobile mining units (see {@link org.envion.web.resources.ContainerResource}).
   *
   * <p>This implementation will call the {@link MandantFactory} to get the right
   * {@link org.envion.backend.services.mandant.MandantService}. The MandantService will return mandant's main
   * information
   *
   * <p>Thanks to Springs HATEOAS the API tries to follow the
   * <a href="https://en.wikipedia.org/wiki/HATEOAS">HATEOAS</a> principles.
   *
   * @param mandantIdentifier identifier of the mandant to retrieve information for
   * @return MandantResource
   */
  @GetMapping("/{mandantIdentifier}")
  public MandantResource get(@PathVariable String mandantIdentifier) {
      return new MandantResource(mandantFactory.getService().get(mandantIdentifier));
  }
```

Figure 5. Zelos RIG REST API

These details ensure that an Zelos rig is completely modular, including its EOS. This means that wherever an Zelos rig is installed, it will start connecting to the network, send information and statuses, and begin to take up the work.

The Zelos rig receives frequent software updates, ensuring that it adheres to the best performing mining strategies by default. Of course, this can be interrupted and changed on each rig as defined and requested by the UMC (see Unified Mining Cloud, page 34).

The process of flashing the EOS onto the new SSDs used for the Zelos rig is done during the build-pipeline. This semi-automated process can be massively scaled to meet the requirements of any particular application of the mining system. When the EOS is started, it automatically sends requests to the UMC cloud for newer versions of EOS and will begin updating.

ZELOS MINING RACK

All racks are designed to meet the central goal of maximizing the gross energy efficiency of the whole unit. This involves optimizing arrangement of the different components at defined heights inside the racks, allowing for optimal airflow through the air ducts to reach all components that require cooling.

MODULARITY

Each Zelos rack has its own power supplies, relays, network switches, and mining workers which make each rack completely independent and interchangeable. This way the rack can be assembled independently of its location which ensures a high level of modularity and safety.

Racks in a Mobile Mining Unit can furthermore be readily exchanged or replaced. This ensures a scalable-build pipeline and that only minimal knowledge is required for physical installation, as only network and energy need to be connected to the rack to allow the mining process to begin.

EXPANDABILITY

The layers of the rack are highly expandable to match the needs of this rapidly evolving market. This means that the rack can be expanded for ASICs, mining rigs, or any other kind of hardware, such as traditional hard drives, in order for the unit to remain adaptable to multiple applications and use-cases. Our Zelos racks are designed and tested in our laboratory to optimize them towards maximum versatility in the field. To this end, we also maintain ongoing research and development to ensure continuous improvements in design and performance for future and already-deployed racks.

COOLING OPTIMIZATION

Based on aerodynamic simulations, field testing in various ZELOS (ZEO)ironments, and proof- of-concept testing under thermal-imaging control, the racks and the placement of the GPUs have been optimized for ideal convective conditions. This specific placement ensures our superior cooling performance, allowing the racks to be placed next to each other without losing performance to heat.

MAINTAINABILITY

To ensure maximum flexibility and maintainability, all racks are placed on rails that have been welded into the container during initial production. This enables precision movement of the racks along the short horizontal axis of the container, allowing for a optimal adjustment of rack-to-rack distances as well as ideal positioning for maintenance

.

Due to the modular design of each rack, modifications to the layout will trigger the Zelos operating system to execute automatic connection routing that ensure a seamless connection of the modular rack with the Zelos network upon connection to the power line.

The end result is an easily maintainable, cost-efficient, expandable rack which can be deployed into a Mobile Mining Unit without any on-site configuration.

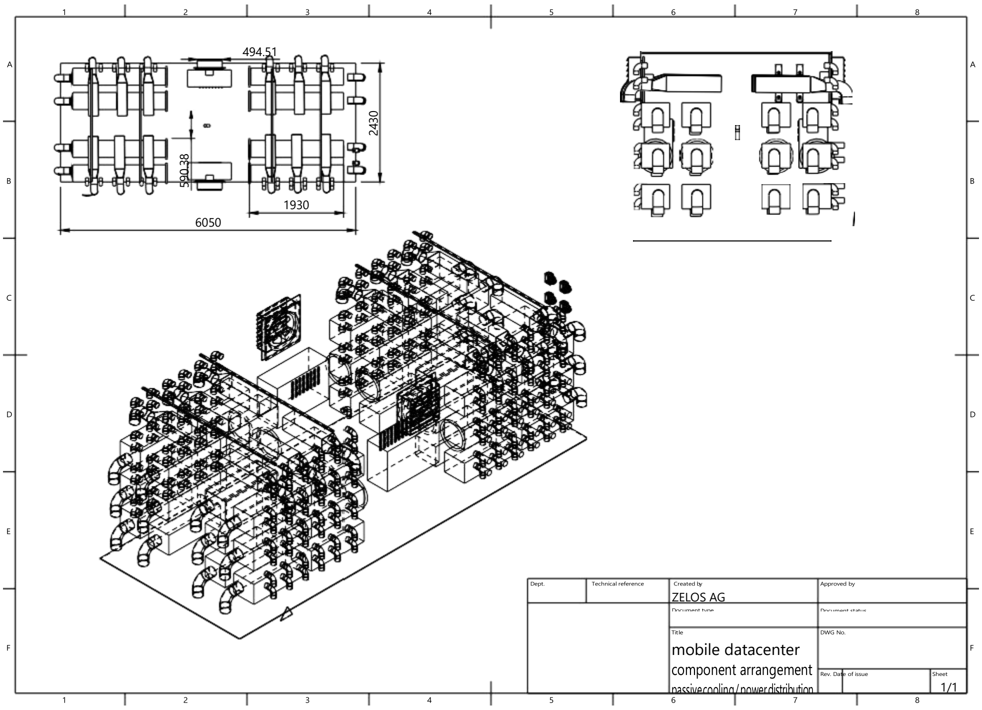


Figure 6. Cooling system & arrangement of hardware. Two large diameter fans decrease pressure inside the container, resulting in directional inflow of cool air through ventilation ducts. Archive racks on rails are used to host the hardware.

COOLING SYSTEM & HEAT MANAGEMENT

Our first and foremost objective is to keep our data centers as fail-safe as possible. Our strategy toward achieving this goal is to keep things simple, limiting the unnecessary introduction of error-prone components. While competitors have experimented with fully-liquid cooled systems, battery-backed arrangements and even water-immersed electronic components, we at Zelos have decided to design a simple yet unique air-based cooling system. The main feature, and the competitive advantage of this cooling system, is its efficiency in terms of the opex (energy required) and capex cost (initial investment) required to remove excess heat from inside the container. This is achieved by its directed air-flow design, which is routed directly to the sources of heat, and the redundancy that is guaranteed by the use of its twin-engine system, with one engine being capable of compensating a complete failure of the other.

Using a state-of-the-art temperature probe array and a fail-safe stack of independent PID-controllers, both fan drives are simultaneously and continuously governed to run at the most efficient rate, determined in real time by the relative temperature and pressure difference between the inside and outside of the container. Humidity and water sensors allow identification of various weather conditions. If a container is deployed outdoors, severe storms or rain can be detected and the ventilation system will be adjusted so that no water can enter the interior of the container. As mentioned above, pressure and temperature sensors are able to control ambient outside and inside air temperatures, allowing foradjustments oftheconvertedenergyandcooling powertotherequired (preset) temperatures. In certain cases, it may be desirable to increase the operating temperature of the unit for external purposes, e.g. heating of a swimming pool, where water can be heated by running through the heated container cells. The sensors allow for such adjustments to be set and monitored remotely. In total, the efficiency of our mobile data center reaches a still unprecedented power usage effectiveness of less than 1.02.

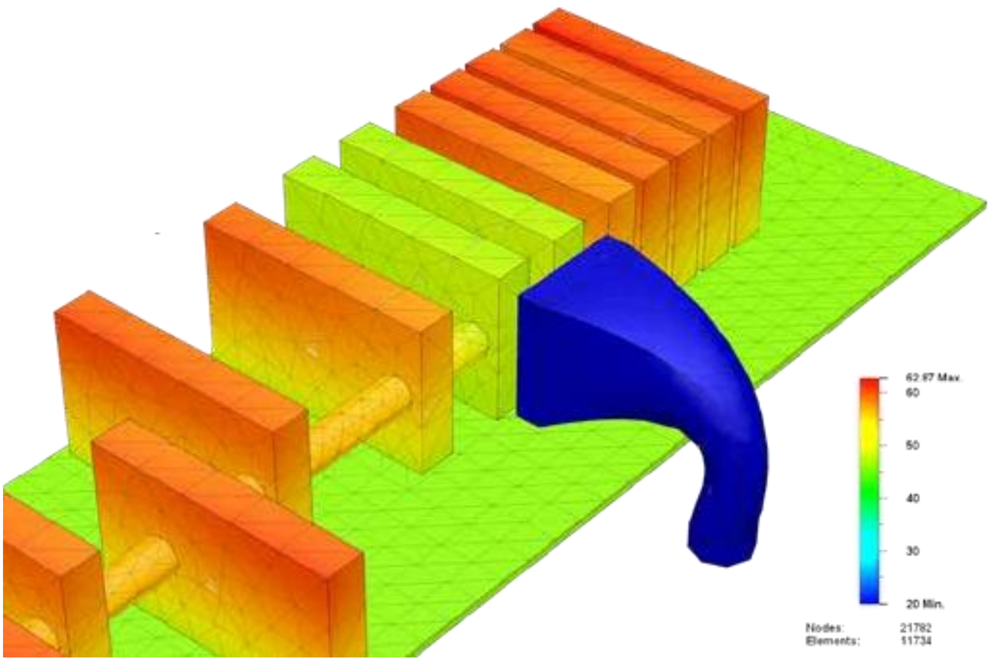


Figure 7. Simulation of heat dissipation by convection and thermography.
A: GPU arrays have been optimized for heat dissipation by passive ventilation.
B: Thermal images of a representative GPU and an ASIC miner were taken at thermal equilibrium after 60 min of runtime at outside ambient temperature of 24 °C

Since our Mobile Mining Units, just like all data centers, convert the largest part of their electrical energy consumption into heat, this, otherwise useless, thermal energy can directly be used in the settings depicted in table 2:

	BEFORE MMU DEPLOYMENT	AFTER MMU DEPLOYMENT
Industrial Hall	Cheap industrial electricity rate Spare transformer station(s) available = unused capacity Heating with fossil fuels or electricity	MMU connected to spare transformer station now delivers up to more than 100 KW of thermal energy per unitt Fossil fuel heating can be reduced accordingly
Warehouse, Shopping Centers, Office	Moderate electricity (flat) rates Spare capacity often available in the order of 50-500 KVA Heating with fossil fuels or electricity	MMUs deliver heat directly to the building Fossil fuel heating can be reduced
Greenhouses, vertical	Cheap industrial electricity / PV-derived electricity Heating via "heat boxes" (e.g. 2-10kW Units)	MMU connected to central power connection Waste heat used to heat greenhouse Same power consumption as before, but massive revenues from MMU mining

Table 2: Examples for specific "energy recycling" use cases. Use of Zelos's MMU as an electrical heating system in various settings, whenever constant heating of a building is required to a significant extent. About 90% of the energy input of one MMU is directly released as clean, hot air.

Converting our MMU's waste heat into a system where thermal energy is useful provides savings which are directly proportional to the amount of electrical energy being converted by the MMU. Heating expenses, before and after installation of a MMU inside a heated warehouse or greenhouse, can thus be easily assessed and the savings on heating the building can be directly deducted from the MMU's electricity bill. This creates another unique competitive advantage for the Zelos MMU over conventional mining farms, which are typically installed in remote areas and thus unable to recycle their massive amounts of thermal energy.

AUTOMATED SUPPORTIVE COMPONENTS

AUTOMATED INTERNET CONNECTION (AIC)

Automatic establishment of an internet connection via satellite, LTE and/or WIFI is realized upon power connection. Governed by an embedded system, equipped with automatic startup procedures and an RSSI-guided antenna control algorithm, our satellite communication system supports an automatic positioning of the antenna towards the respective satellite position. This procedure takes under two minutes, in total. Additionally, a diversity antenna-equipped LTE/UMTS access point is enabled and results in connection of the unit, via LTE or Satellite links, to the preferred connection type according to the data plan presets (supporting automatic failover).

AUTOMATED COOLING SYSTEM (ACS)

The ACS represents the governance mechanisms of our patent-pending cooling system which has been described above. The ACS runs independently of the UUC. In case of a controller failure, the relay-circuits are opened, resulting in the cooling system being set to an “on”-state, which ensures proper cooling even in the event of a controller failure, additionally, a hardware override to directly control the fans is installed, allowing for direct control of the cooling system.

AUTOMATED DOORMAN SYSTEM (ADS)

The physical access door of the MMU is secured by an electrical doorman. The ADS is a separated system which can work without the UUC, but it does inform the UUC of its status and can be controlled by it. This means that the UUC can set timeframes with dedicated codes or one-time passcodes to open the door for a certain amount of time. This can be useful for timed access controls, such as to allow for maintenance by external maintenance workers. The system supports pass codes and RFID transponder cards.

AUTOMATED SECURITY MODULE (ASM)

Wide-angle cameras monitor all angles of the exterior and interior of the MMU and their control system is known as the ASM.

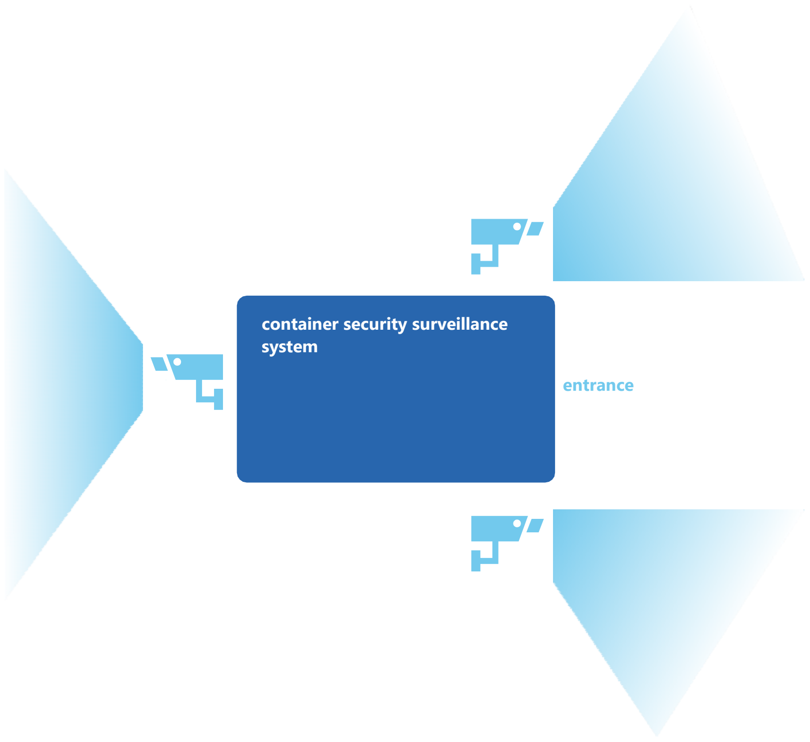


Figure 8. MMU Security Surveillance System. Broad camera angles for secure surveillance of the MMU.

The cameras store their information on Network Attached Storage (NAS). This makes the ASM, just like all the other systems, independent of the UUC. The UUC is able, however, to retrieve the information, evaluate it, and report it to other systems. In this way, cameras can be turned into smart monitors, allowing for video footage of the movements of people within and around the MMU to be monitored, transferred, and stored. Together with the Automated Doorman System (ADS), physical access to the MMU by maintenance workers can be monitored, reviewed, and controlled remotely.

SURVEILLANCE & AUTOMATION

At Zelos, our design premise is focused on keeping the device operator's workload as small as possible, resulting in minimal operational requirements related to manpower and user education. Tasks related to the operation of the decentralized network have been distributed in a simple and sensible way by pursuing a strategy of maximum automation of the hardware. The remaining tasks for on-site personnel are therefore limited to

a) connecting the power supply, b) typing in the network authentication keys, and c) exchanging broken hardware modules upon automatic email notification.

All processes inside the unit are fully remote-monitored, leaving critical tasks such as the maintenance of computing units and identification of faulty components to Zelos's specialists and computing experts.

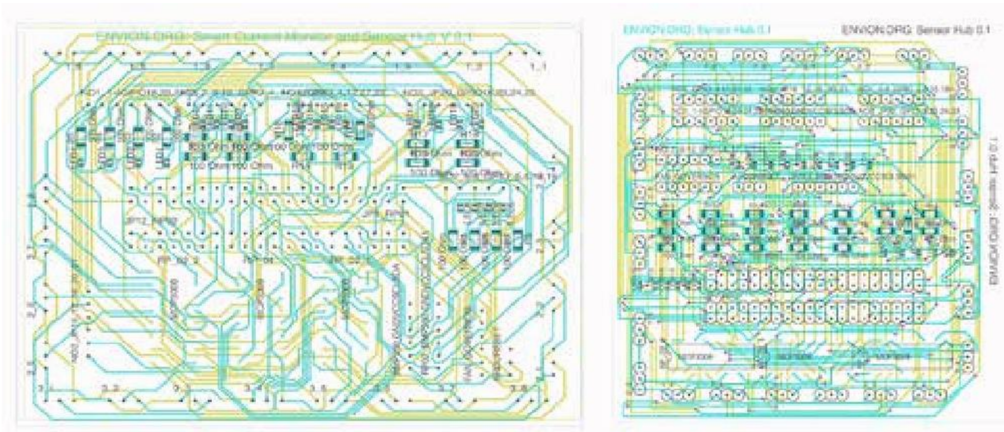


Figure 9: Custom-designed sensor hub. Custom PCBs inside the central power distribution units allow preci- se and safe integration of sensor data into the MMU's automated workflow.

ZELOS SENSORS AND REMOTE MONITORING CAPABILITIES

Zelos

ENERGY MONITORING

	POWER / ENERGY UPTAKE			COMPUTING RIG PERFORMANCE		
TASK	**Incoming Gross Power Moni- toring**	**Single Unit Power Monito**	**Single Unit wer**	**Single Unit Hard- Computing Performance**	**Single Unit Core Temperatures**	**Single Unit and Software modifications**
SENSORS	3-phase AC current integ- rator, certified, calibrated	ACS 724 analog current sensor	LAMP-server triggered Optopcouple r relais-array	Hardware- integrated	Hardware- integrated	Hardware- integrated
DATA ACCESS	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)	RESTful API secured by VLAN and optional SSL/ VPNI	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)	Remote controlled via VPN/SSL- secured PHP-based remote control
PURPOSE	Internal verification/ external billing, accounting	Performance/ Efficiency calculations and optimizations	Hardware restart	Micro level optimization/ early failure diagnostics	Micro level optimization/ early failure diagnostics	Micro level optimization/ early failure diagnostics

Table 3: Energy Monitoring. Power and Rig Performance Monitoring

CLIMATE MONITORING

CLIMATE-RELATED DATA

TASK	Outside temperature	Outside air pressure	Inside temperature gradient (bottom to ceiling)	Inside air pressure	Inside humidity and metal body tempe- rature
SENSORS	Bosch BMP 280 temperature sensor	Bosch BMP 280 barometric sensor	DALLAS DS180 1- wire array	Bosch BMP 280 temperature sensor	DHT11 and MAX6675 humidity and temperature sensors
DATA ACCESS	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)
PURPOSE	Climate and performance monitoring	Climate monitoring/ calculation of air flow	Estimation of cooling efficiencies	Climate monitoring/ calculation of air flow	Dewpoint calculation/ condensation avoidance

Table 4. Climate Monitoring. Monitoring of inside and outside temperature, humidity and air pressure of the MMU.

SECURITY AND SURVEILLANCE

SECURITY SENSORS/ACTUATORS

TASK	Outside Cameras: 3x	Inside Cameras: 3x	Chemical Burglary defense	Electronic Transponder-based access	UPS Battery
SENSORS	IP Cameras, waterproof IP44	IP Cameras	confidential	confidential	confidential
DATA ACCESS	Real time data upload to secure unified unit control (UUC)	Real time data upload to secure unified unit control (UUC)	Automatically deployed; Remote controlled via VPN/ SSL-secured control panel	Real time data upload to secure unified unit control (UUC)	n/a
PURPOSE	Outside surveillance	Internal surveillance	Theft protection	Remote-administerable Access Control	Aux. power unit for non-mining hardware

Table 5. Security & Surveillance. Sensors and actuators for security and surveillance purposes of the MMU

Zelos

OUR SOFTWARE INFRASTRUCTURE

SYSTEM OVERVIEW

Our main goals for the Zelos software are reliability, modularity, maintainability and security. Due to the physical separation of the different hardware components, the system is split into various software components running on numerous devices. Therefore we have software components for the mining workers and the automated supportive components. We have furthermore built software running on a server system inside the MMU, called Unified Unit Control (UUC). The UUC is aggregating and controlling all information from control systems and workers inside the MMU. On top of the UUC is a cloud-based application called Unified Mining Cloud (UMC). The UMC aggregates information from UUCs and allows access to the system via multiple frontends. Frontends can be web-based applications or, in the future, mobile applications. To meet these requirements, all communication between the system is based on RESTful APIs

These fine degrees of software component separation allow us to scale quickly and to be able to effectively divide development between software teams. Each code base is handled separately and will be merged and assembled during an automated build pipeline. The

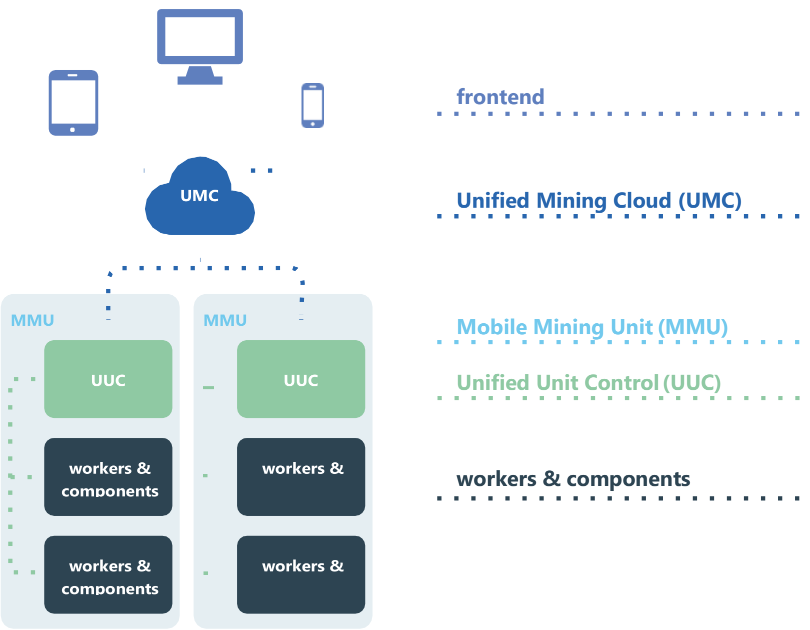


Figure 10. Overview of system architecture.

source code is reviewed before it is accepted to increase code quality and follow modern development methods.

This yields high-quality source code builds which can automatically be rolled out for production, resulting in a very rapid time to market.

UNIFIED UNIT CONTROL (UUC)

We have created a central system that manages all IoT devices, control systems, and workers (both rigs and ASICs) in the MMUs which we call Zelos's UUC.

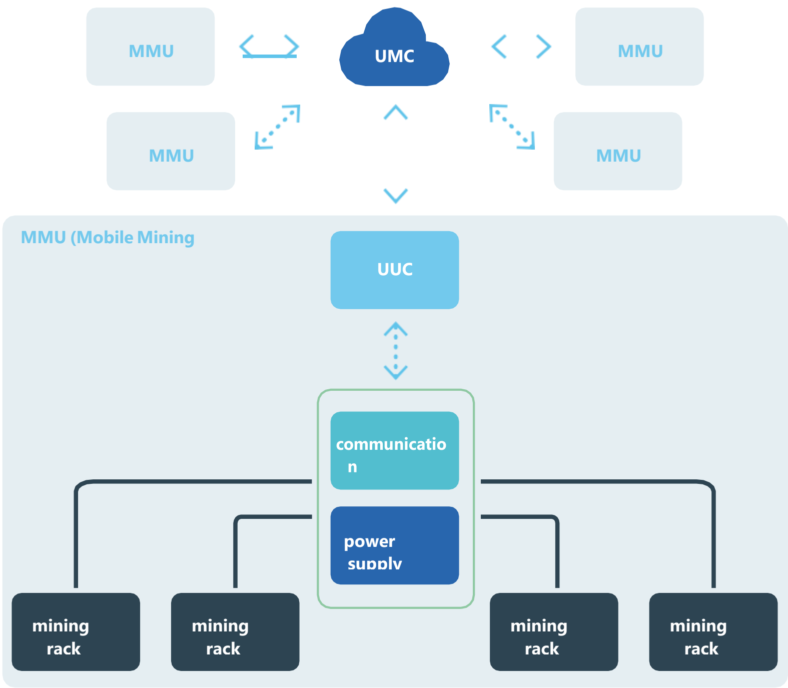


Figure 11. Component Overview of Unified Unit Control.

The central unit in the MMU collects, aggregates, processes and monitors data from all systems at a high level. Even if the different monitoring systems are designed to work independently, the UUC will bring them together to form a fault-tolerant monitoring system, keeping track of all devices to recognize failures. Based on defined rules, it will handle certain events in a predefined manner. As long as the UUC has an available internet connection (secured by multiple failover connections) it synchronizes and reports all incidents to the UMC (Unified Mining Control) via REST-API.

To ensure comprehensive control and monitoring of device information, the UUC offers a wide range of REST-API endpoints.

The UUC uses Java, is embedded in Docker containers and is built according to the standards of enterprise application development. Based on automated build-pipelines, the UUC will acquire updates continuously with the help of continuous delivery. This ensures stable and fast release cycles. The source code is hosted on GitHub and portions of it will become public to enhance the quality of the software by supporters and contributors.

AUTOMATED INITIALIZATION

To meet the modularity and flexibility requirements, the internal network of an MMU is completely dynamic. All workers (rigs and ASICs) and other devices request an IP address when they are connected to a new network (DHCP) for the first time. Directly afterwards, the rigs and devices send their status, IP address and additional information to the UUC. The UUC then creates a virtual map of IP addresses and devices based on this information. This map is regularly updated whenever there is a change in the system. Because our control systems are able to manage the power supplies of other sub-systems including workers, the UUC automatically figures out which control system is responsible for which power supply. This automation is the last step to ensure absolute modularity.

Racks, mining workers, andevennewmonitoring systemscanbeplaced in the MMUwithout any further configuration and will be smoothly integrated into the whole ecosystem by the UUC and its automated initialization. Assembling MMUs likewise becomes much cheaper as processes are further streamlined.

REDUNDANCY

To prevent a single point of failure, the UUC runs in two different instances in the MMU. One of them is the master while the other is in slave (failover) mode.

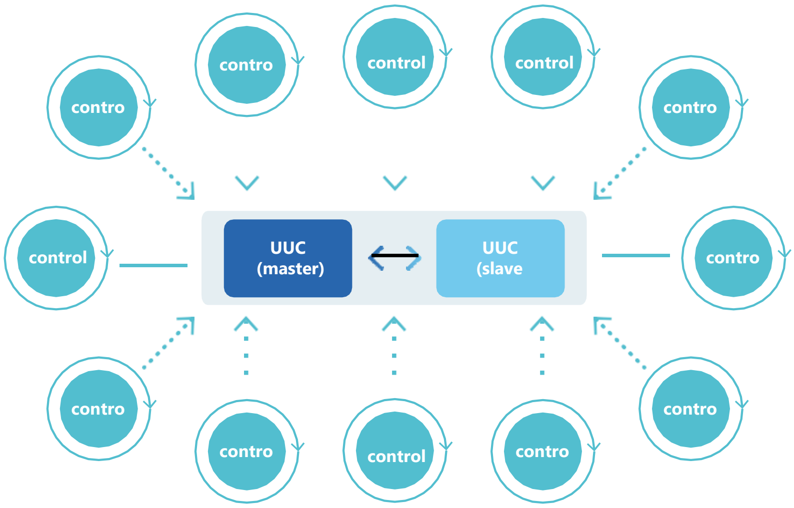


Figure 12: Unified Unit Control. Master- Slave configuration.

Whenever one of them fails, this failure will immediately be reported to the Unified Mining Cloud (UMC). If the master instance fails, the slave instantly becomes master to make sure the central unit remains operational. Should both UUCs experience issues, all connected workers will shut down automatically as a protective measure and only as a last (unlikely) resort.

UNIFIED MINING CLOUD (UMC)

The automated, decentralized management of Mobile Mining Units is carried out by the Unified Mining Cloud (UMC). The UMC is an application running in the cloud which aggregates all the information from UUCs. Frontends connected to the UMC like web-based applications or mobile apps can watch, supervise and configure MMUs and their components.

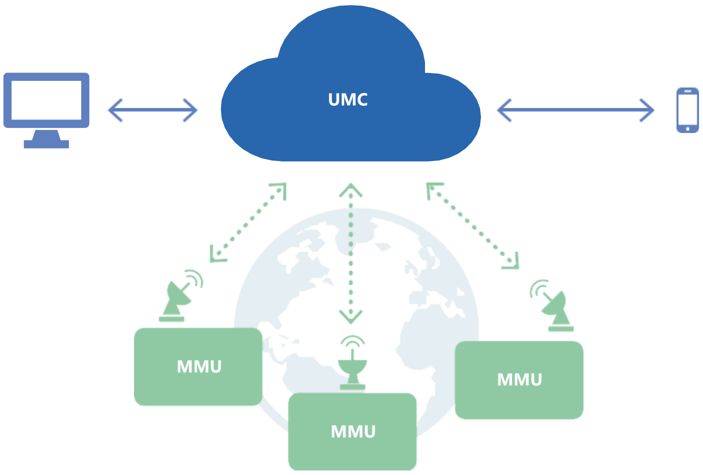


Figure 13. Unified Mining Cloud. Worldwide connection of MMUs via cloud.

Each Mobile Mining Unit reports its position, status and performance to the UMC. The UMC and its intuitive user interface (web application frontend) then aggregates the data and provides it to the user. This data contains historical data for all connected UUCs, as well.

The UMC can be further configured to match different scenarios, which is why user and role management will be expanded in the future. With the help of the UMC, admin users can change the configuration of mining workers, shut down or start systems, turn on / switch off power supplies of devices, or tune control systems without being anywhere near the MMU.

The UMC is built as a smart application, which helps to handle errors and failures gracefully, and is partially automated. Based on standard configurations for failures, it analyzes the current situation of the UUCs when status updates are obtained and starts error handling and recovery routines based on the severity of the error.

With the help of a built-in message system, messages are sent to the person responsible for the MMU whenever status changes happen, failures are handled, or when human supervision is needed. All of these features can be managed and configured in the user interface of the UMC.

SMART MINING

One of the biggest advantages of running an application on top of UUCs in the cloud is to have a centralized point for main decisions. One main decision is which coin to mine. This decision is dependent on the following factors:

- current coin price / exchange rate
- difficulty factor
- electricity price at location
- hash algorithm
- location and temperature situation
- hardware generation of workers

These conditions need to be taken into account when making the decision to get the best return on investment. Smart mining is the result of an automated process maximizing the potential of these conditions in real time. The UMC frequently analyzes the current situation and switches to a suitable mining strategy. Since the decision is based on location, it will be made for each MMU separately. This can lead to different mining strategy clusters. The UMC can even run two strategies against each other to test which one is working better if this can not be accurately predicted (the resulting partition of workers is called clusters in our dashboard).

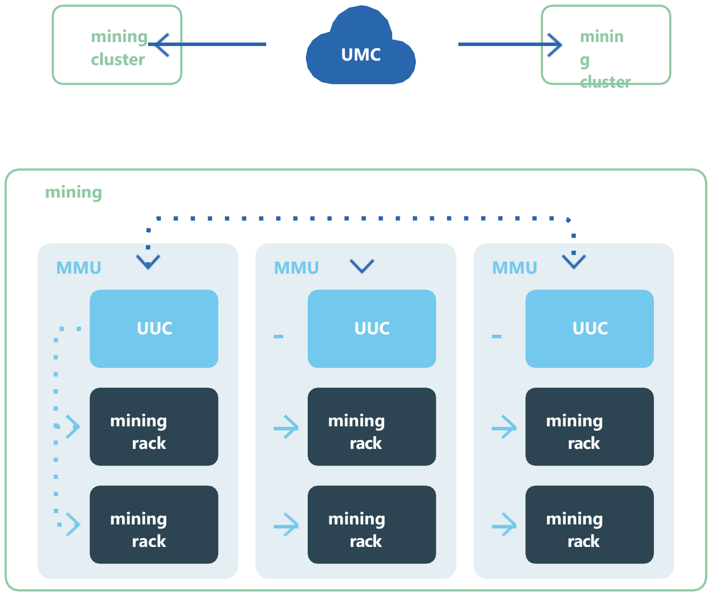


Figure 14. Smart mining clusters. The UMC decides which coin is best to mine based on different conditions to ensure the best ROI.

Zelos

TECHNOLOGY

Just like the UUC application, the UMC is built using the Java programming language by our core development team.

The UMC is currently running decentralized in the cloud, embedded in Docker containers. In the future, we will run tests to operate the UMC on our own UUC instances to build our own cloud. This ensures that the software is running entirely on Zelos-controlled hardware. The UMC software is frequently updated by our continuous delivery pipeline. With top knowledge development cycles and processes, which can even be scaled and outsourced, we are able to speed up this development quickly.

UMC ARCHITECTURE

The Unified Mining Cloud is designed as a multi-tier architecture that prevents data loss while introducing compartmentalization for security purposes and high-scalability for performance increases. During the initial deployment phase, the data routing and frontend tier will be running. Long-term storage and crypto-storage will be added as operations. The planned tiers are briefly displayed in the following section (see also figure Communication Architecture) and will be elaborated in the subsections to follow:.

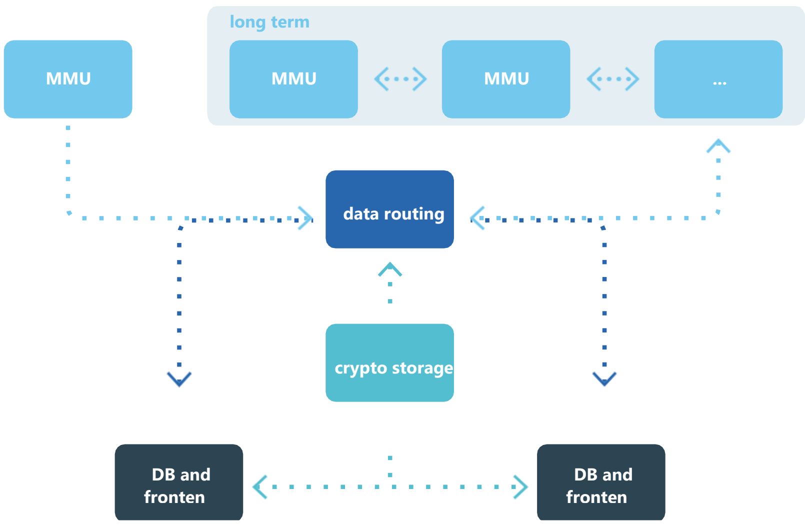


Figure 15. Communication Architecture. Dataflow between the different tiers.

1. **Long-Term Storage:** Tier 1 will be realized as a distributed system across all MMUs where every MMU acts as an independent data center. Because MMUs will literally be distributed around the globe, it is extremely unlikely that a single event will affect all of our MMUs. As a result, we can achieve an extremely high degree of data safety. In addition, the available storage space can automatically scale according to application requirements.
2. **Data-Routing:** Tier 2 is security-relevant and will - at a later stage - run in Zelos's own high-security data center. Its purpose is to distribute data to the correct frontend instances.
3. **Frontends and Reduced Databases:** Tier 3 is based on virtual machines designed to run on cloud-based hosting platforms. Our virtual machines are not bound to specific hardware requirements and do not require a lengthy installation process if we decide to switch the hosting configuration or location. Therefore, tier 3 instances can be easily scaled, satisfying individual requirements.

4 **Crypto Storage:** Tier 4, known as Crypto Storage, will be located in Zelos's high-security data center. It secures the private keys required for communication and encryption.

DATA-ROUTING

The data-routing layer is the main vantage point for all MMU data storage units. All transactions from MMUs are sent through our data-routing layer. A database within the data-routing layer contains information about which MMU is assigned to which owner or operator and routes messages accordingly. In addition to this functionality, data meant for long-term archiving is sent to our Zelos Storage Blockchain (ESB). Moreover, the data-routing layer provides an interface for routing information directly between MMU and frontend instance processes. This interface is designed for the administration and maintenance of the MMUs.

FRONTENDS AND REDUCED DATABASES

Each frontend is a web application that runs in combination with a reduced database. As the assignees authenticate against the frontend, authenticated and encrypted connections are required. As we implement a browser-based application, we use TLS connections for authentication and encryption. Server-side authentication is realised by means of standard TLS certificates. Enforcement of TLS secured connections, selection of secure ciphers, and additional precautions like HSTS prefetching are inherent attributes of this methodology.

As our Tier 4 Crypto Storage goes live, we will reduce the required trust in the cloud platform as TLS private keys will no longer be stored on the server, but in Zelos's Crypto Storage. We use a feature in the TLS handshake to authenticate messages sent by the server. Both client and server perform a handshake upon connection, which includes a Diffie-Hellman key exchange to generate a shared ephemeral session key. One message in this handshake must be signed by the server in order to be authenticated by the client. Our server then forwards this message to the Crypto Storage where the message is signed and sent back. As a result we can initiate an authenticated connection between client and server without the server actually holding the certificate's private key.

A reduced database is a regular database that contains a specific subset of data. Each assignee can be provided with his own instance. This design allows us to implement Zelos's internal "Chinese wall" security policies if required[12]. This means we can separate data access within Zelos if clients or regulations require this and allows for better scalability overall. Everything runs inside of Docker containers. This gives us the opportunity to choose a specific system configuration at any time, meeting assignee-specific requirements. New instances can be set up quickly to be filled with data from the data-routing layer without manual effort, allowing rapid migration between instances and configurations.

The database contains further assignee-specific information such as login information (in secure form). This specifically includes a per-assignee, role-based, access model. The described usage of assignee-specific instances implements compartments so that a vulnerability in the application would only compromise the respective assignee's data. This deliberately prevents assignee cross-data access issues.

When operational, the ESB encryption keys will be stored in memory only. The data-routing layer will distribute these keys on demand. The keys themselves will be stored in Zelos's Crypto Storage as soon as it goes live. In this way, long-term key material will always remain in a confined and secure location. The communication between data routing and MMU is encrypted (see chapter Security, page 40 for details)

CRYPTO STORAGE

Crypto Storage will be the heart of Zelos's infrastructure. It holds the private keys required for secure communication within the network and will be located in a specially secured facility. Our system design separates performance-critical and security-relevant components. This allows us to run specially hardened operating systems with extremely high security standards in the Crypto Storage without causing performance issues. We again enforce strict compartmentalization within our Crypto Storage. This ensures that keys for TLS connections, UMC-to-UUC communication, ESD storage encryption, and cryptocurrencies are kept strictly separated.

LONG TERM STORAGE

Long term storage will be implemented by our Zelos Storage Blockchain (ESB). Each MMU includes a data storage unit and acts as full node in the ESB. All information that needs to be archived will be sent to the ESB and stored safely. The stored data will be encrypted (AES-256 CBC) in case a MMU is physically compromised.

ZELOS STORAGE BLOCKCHAIN (ESB)

The Zelos Storage Blockchain (ESB) will be a private blockchain spanning across all MMUs. For this purpose each MMU will be equipped with a storage module that acts as a full node in the ESB. The ESB functions as a secure overlay network and is not accessible from outside Zelos. Communication is encrypted as described in the security section, Communication, page 42.

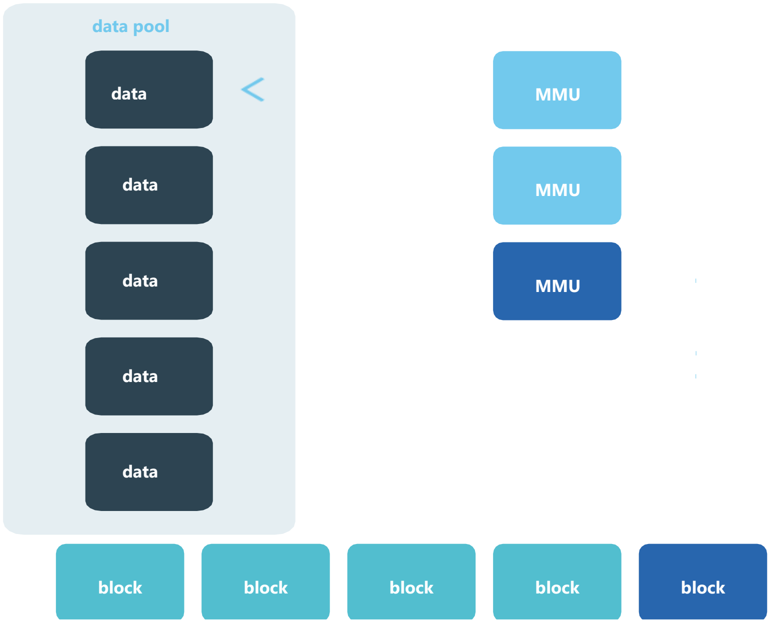


Figure 16. Adding Data to ESB. MMUs add data to the data pool for storage (dotted line) and pull data from the data pool (solid lines) and sign the resulting blocks (lower right). Signed blocks are appended to the global ESB.

Building storage distribution directly into Zelos's main assets has many benefits. First of all, storage capacity automatically scales with the business. Secondly, as the value of the stored data increases, the safety of the data scales automatically. The distributed and mobile nature of the MMUs also protects our data from natural disasters, given that the data is spread all around the globe. Due to our satellite uplink, data access is independent from destroyed landlines and blocked connections and can be maintained as long as the MMU has power supply.
stake, but threshold signature count. This means that a block is official if a preset number of nodes cryptographically have signed the block. The number of required signatures allows us to tune the initial replication factor in the system. To put it in a nutshell, this means that the number of required signatures is equivalent to the number of copies in the network until the data is considered safely stored. Over time, the data will propagate to all full nodes and reach maximum redundancy. Figure Adding Data to ESB gives an impression of the system design.

Zelos SECURITY

Security of our community members as well as data safety and availability are core values of Zelos. From the very beginning, we have put significant effort into designing and delivering a secure platform. This starts with a professional software development lifecycle and is complemented by well-organized operational security. However, we do not stop here. Bugs in software do exist and human errors occur. As such, we always aim to design our systems in ways that limit the impact of possible future incidents.

MMU SECURITY

Since MMUs will be distributed around the globe, and are not fixed in a single location, we put a special emphasis on security. The core idea is to not only build a safe system but to mitigate the impact of hypothetical security breaches by design. This implies that the entire design within each MMU is based on strict compartmentalization. All contained components will be assigned to different compartments. These compartments are:

- Communication
- Mining Workers
- Automated Cooling System
- Automated Doorman System
- Automated Security Module
- Network

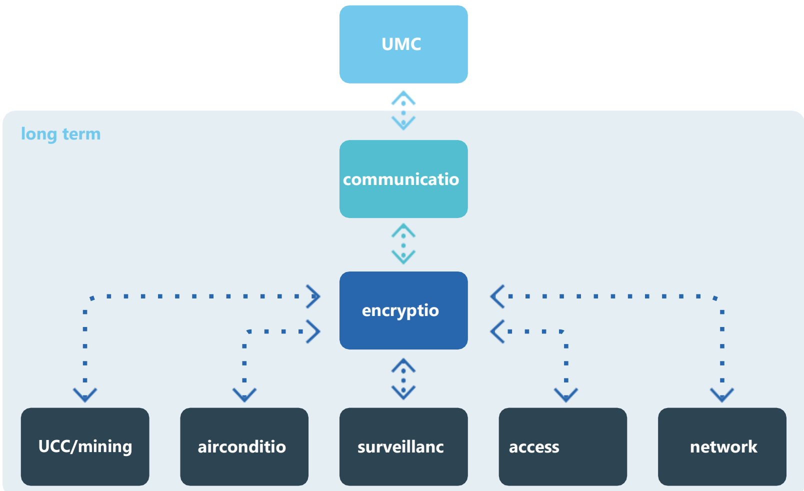


Figure 17. Compartment Interconnection. Communication between UMC, UUC and compartments with the UUC. All compartments are separated.

Following a security-in-depth-strategy, our system design exemplifies the compartmentalization concept. Our design is based on separation by virtualization. The first generation is based on off-the-shelf virtualization technology introducing separated compartments from the start. In later generations, we will migrate the host operating system to a microkernel platform. The microkernel then acts as trusted computing base (TCB), which forms an abstraction layer between hardware and software. Multiple virtual machines can run in parallel on top of the microkernel. Communication between virtual machines must be explicitly allowed by the TCB. The benefit of this design is such that even if one compartment is compromised, the other compartments will not be affected.

All communication between between UMC and UUC is encrypted (details see chapter Security - Communication). To strengthen security we have introduced an explicit encryption compartment. This compartment resides between the communication system and all other compartments. The communication compartment is connected to the internet and as such has the broadest surface for possible attacks. However, even if a breach of the communication compartment should occur, the key material is still secure in the encryption compartment. The resulting system design is depicted in figure 17 Compartment Interconnection.

NETWORK LAYOUT

There is no need for intercompartmental communication aside from the encryption compartment. As such, each compartment, with the exception of encryption, will be assigned its own VLAN. As a result, a network breach would only allow access to one VLAN and not the entire MMU network. By default, the encryption compartment does not allow inter-VLAN communication. Outgoing connections will only be allowed through the encrypted communication channel, ending in Zelos’s network. Therefore, even if an attacker sUUCessfully compromises a component, they will not be able to exfiltrate any data via the network.

PHYSICAL SECURITY

In addition to the perimeter security of each MMU, enforced by physical access restrictions and surveillance, we take additional precautions regarding system security and safety.

SYSTEM AND DATA SECURITY

From the very beginning we deploy trusted platform modules (TPM) and secure boot whenever available. All data disks are encrypted and a removed disk is, as such, useless. In the first generation, passwords and keys will be stored within the MMU. The integrity of the system is enforced by signed executables. In future generations, we will introduce full disk encryption (including operating system). At this later stage, passwords will be stored outside of the MMU and will be provided on demand only. This securely locks the entire MMU, and especially our servers, until they are remotely activated by Zelos.

NETWORK SECURITY

Supervision of the switch status is integrated into the UUC. The physical disconnection of cables or devices is strictly monitored and reported immediately. In future generations, an additional safeguard will be implemented. The safeguard will supervise connection status and disable switch ports if a cable was unplugged unintentionally. This prevents the introduction of additional network devices. If a service process is triggered, a service mode will be enabled that explicitly allows swapping equipment to be marked as defective.

UUC UPDATE SAFETY

An important goal of the IT-infrastructure design is to avoid a single point of failure. A major concern with regard to UUC update safety are failed system updates. Our virtual compartment-based design allows us to mitigate this issue: If an update is scheduled, the TCB clones the running compartment and applies the patch to the clone. The TCB then attempts to start the clone and performs compartment-specific checks. As soon as all checks are passed sUUCessfully, the TCB switches over to the clone and terminates and removes the old version of the compartment. Even if the update process gets interrupted by a loss of power or any other reason, the TCB will always start a running configuration. An update process is depicted in figure 17 Update cycle of a compartment.

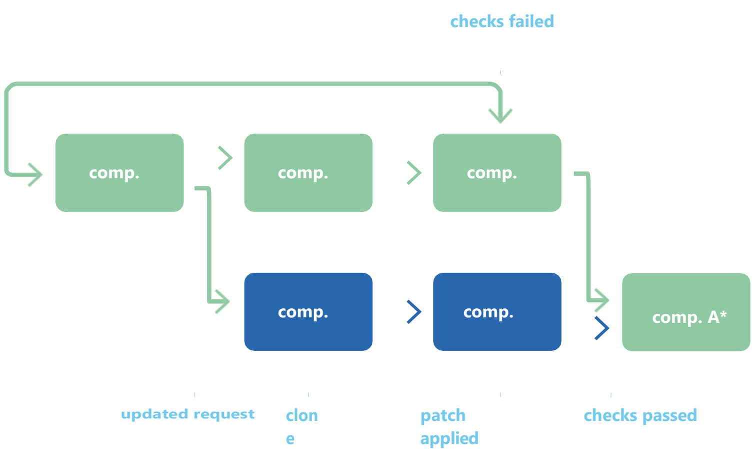


Figure 18. Update cycle of a compartment. As long as not all checks are passed the original compartment remains active (green)

Updates of the TCB are extremely rare. If they are required, operational safety is provided by the two redundant UUCs running per MMU.

COMMUNICATION

Security and authenticity of communication between components is an essential security goal. The first generation will be based on an off-the-shelf VPN solution with public- private key authentication. The VPN connection allows us, in contrast to HTTPS (SSL) connections, to tunnel all connections. To keep our infrastructure flexible, connections will use DNS names for address resolution. To mitigate resulting DNS-based attack vectors, we deploy Domain Name System Security Extensions (DNSSEC)

FUTURE COMMUNICATION SECURITY

For future generations we will migrate to our own encryption protocol, thereby further reducing code complexity and attack surface. Our protocol will feature long-term identity keys and ephemeral communication keys. Our protocol is based on the NaCl: Networking and Cryptography Library by the well-known cryptographers Daniel J. Bernstein, Tanja Lange and Peter Schwabe[13]. For authentication, we use Ed25519 public-private elliptic- curve signatures. For encryption, we rely on symmetric authenticated encryption based on XSalsa20 (encryption) and Poly1305 (message authentication).

For each connection, ephemeral communication keys are exchanged, which provides so- called “forward secrecy”. This means that a compromised session key becomes useless as soon as the session ends. We implement the well-understood and widely-applied Diffie- Hellman key exchange protocol to achieve the said properties. This protocol allows us to calculate secret keys from publicly readable messages. For authentication purposes, the key exchange messages are signed with the identity keys.

The message authentication (mac) built into NaCl allows the receiver to verify the integrity of each received message. Therefore, an attacker cannot alter messages in transit. This property requires the use of so-called “nonces” (numbers used once), which are sent alongside the encrypted messages. We implement nonces as counters for both communication partners. These counters are initialized by a bitwise comparison of the long- term public keys. When the first different bit is found, the partner with a zero initializes its counter with zero, while the other partner initializes its counter with a one. Both increase their counter incrementally by two for each consecutive message.

In addition to the original purpose of the nonce, we also use it to prevent replay attacks. Each side stores the last received nonce and only accepts messages with higher nonces. Because we use TCP, message reordering or packet loss are not concerns. Therefore, only accepting higher nonces is not a problem in this application.

TAKING OWNERSHIP OF UUCS

A newly installed UUC is assigned a private key as part of the primary initialization process. The corresponding public key is used as the unique identifier (UUCID) of this UUC throughout the system. It is specially stored in the UMC for authentication purposes. In addition, the public key of the UMC is installed in the UUC. From this point on, authenticated and encrypted communication is possible. We refer to this process as taking ownership of the UUC.

ACCOUNT SECURITY

The security of our community members is one of Zelos’s highest values. We therefore take various precautions to keep our community secure. According to our core security strategy, we do not stop with a secure system but think ahead and plan for hypothetical incidents. As an example, we store passwords in such a way that, even if a password database should leak, accounts are still secure.

STORAGE OF PASSWORDS

All passwords in Zelos’s systems will be stored using state of the art security precautions. The goal in terms of password storage is to keep passwords safe even if a password leak should occur. To prevent rainbow table attacks, each password is stored in combination with a random salt (at least 24 byte). To cope with increasing computing power we introduce scrypt what allows us to tune the computational and memory requirements for an attack. For computational requirements, scrypt uses a keyed hash construction HMAC-SHA256 with a password and salt as inputs. Hashing is repeated multiple times which increases the runtime and slows down an attacker. In more detail we use password (p) and salt (*s*) as input for the hash function (*H*(*salt*,*password*)) in the first round resulting in: $r_1=H(s,p)$. In the n-th round $r_{(n-1)}$ is used as salt and the result is XORed with $r_{(n-1)}$: $r_n= H(r_{(n-1)},p) \times r_{(n-1)}$. For memory requirements, scrypt introduces random memory access on an encrypted block. On a practical level, the Salsa8 encryption algorithm is used to produce a stream of pseudo-random bits. When the stream reaches the preset length, bits are sampled from random positions and used as output. This forces an attacker to create a bit stream of the same size, thereby controlling his memory requirements. The number of hash iterations as well as the memory requirements will be increased over time to keep up with availability of resources will be increased over time to keep up with availability of resources.

TRANSACTION AUTHENTICATION NUMBERS (TANS)

Password security cannot be solved entirely on the server side. The password has to be kept secret on the user side as well. However, this is known to be a common issue. In order to protect our community from unwanted actions, our system features transaction authentication numbers (TANs). TANs will be required for critical actions like the withdrawal of funds. We also plan to include an additional two-factor authentication by means of mobile TANs, software, or hardware security tokens.

USER MONITORING

To further protect our community members, we track typical login behaviour (in conformance with privacy regulations and standards). If an anomaly is detected, actions can be taken. Possible reactions can include notifying the account owner, requiring a TAN for the next action, and locking the account temporarily. Monitoring includes but is not limited to:

- Number of failed login attempts;
- Monitoring of typical devices used;
- Monitoring of typical countries or regions the user logs in from

DDOS MITIGATION

MMUs only initiate connections and do not listen for incoming traffic. Therefore, MMUs are not vulnerable to DDoS attacks in the first place. A possible vector is the saturation of MMU uplinks. However, the physical distribution of MMUs will be mimicked by their distribution across subnets. As a result, a DDos attack is very likely to only affect a small subset of MMUs.

REMOTE MONITORING & MAINTENANCE

Our server infrastructure is modularized and based on virtual containers. Static parts of our infrastructure are hosted by a content delivery provider that has state of the art DDoS mitigation in place. Dynamic parts of our infrastructure can easily be moved across hosters, evading DDoS traffic if necessary.

SYSTEM MONITORING

Huge hashing power needs to be monitored at all times. Incidents need to be reported, logged, evaluated and handled. Therefore, Zelos focuses on a concept of smart system monitoring.

FAILURES

Each component of the infrastructure will be monitored. If a component fails, it will be recognized by the respective higher unit, reporting the failure to the UMC. Each incident will be logged and evaluated. The higher the priority of the incident, as estimated by the UMC, the higher the priority of the error handling response. These error handlings are configurable and can, for example, be messages of a complex fault-handling chain. Page 46 on the Smart Maintenance Concept goes further into detail about this.

THRESHOLDS

In addition to watching out for healthy statuses, the UUC and the UMC monitors important KPIs and treats certain cases. One example of such a case could be a decrease or increase in temperature; another would be if the hashrate behaves irregularly. The point at which a case is treated is defined by thresholds. We are planning to implement a so-called threshold management system.

The threshold management will take place inside the UMC. The thresholds are configured by default but can be changed manually if needed. If a component falls under a certain threshold, configurable operations are triggered automatically. These operations can be messages to certain responsible parties or system interventions like shutdowns or exclusions on the network layer. Two important examples are elaborated below.

HASHRATE

If the hashrate falls under a certain threshold, but the mining worker is responding with healthy messages, it leads to the assumption that somebody is stealing the hashing power. In a worst case scenario, an attacker could place himself in the middle of the system (e.g. a man-in-the-middle attack or compromised a component). This unlikely situation could occur when somebody gains access to the MMU and somehow connects to an active port on the switch and one of the VLANs of the switch. If such an improbable scenario were to take place, it would lead to the shutdown of the component and the exclusion of related parts from the network. An escalation of security on-site and for the supporter would also be triggered.

TEMPERATURE

As explained in the section about the Automated Cooling System (ACS), the temperature inside the MMU is monitored and controlled by the ACS, but it will also be reported to the UMC. If certain thresholds are reached, the UMC is able to trigger select operations such as messages to remote hands or the shutdown of parts of MMU.

MOVEMENTS

Movements recognized by Automated Security Module (ASM) will be reported to the UMC. Only the UMC will know if the movements match with currently open maintenance cases (e.g.: supporter inside the unit) or if the movements happen unexpectedly. For the latter case especially, the UMC can start triggering exception handling or security alerts.

SMART MAINTENANCE CONCEPT

As described in the System Monitoring paragraph, the UMC supervises all MMUs and their components. This allows the UMC to make smarter decisions based on the error messages, their assessment and prioritization.

Therefore, the concept provides that each error message will be logged and evaluated. The evaluation could take the following parts into account:

- **error type.** Errors can be manifold. They could be failures, interruptions, hacking attacks or others, like threshold warnings. All these types will be prioritized.

- **component type.** Depending on the type of the component (e.g.: Mining Unit, MMU or others) a natural priority level results.

- **number of components.** As more devices of a component type will fail, the higher the priority is.

- **number of MMUs at location.** Failures of MMUs or their components at the same location could be counted together. This leads to higher priorities.

- **cost for maintenance.** Depending on the location of the MMU and the contractual relationship to the supporter or agency, the cost per maintenance is different. The priority of errors can be adjusted by taking this into account.

- **component version.** In some cases, errors of older versions of components will lead to lower priorities. This could ensure that maintenance processes will only be triggered when there are more of these errors.

The weights of these points will have default values but can be configured individually.

When the UMC has evaluated the error messages and prioritized the events, it will initiate the error handling. Handlings are based on prioritization and error type. The following table indicates some important errors and their classification:

	LOW	MIDDLE	HIGH
failure	message	**maintenance**	**maintenance**
maintenance error	message	**fatal**	**fatal**
security issue	message	**maintenance**	**fatal**
temperature threshold	message	**intervention**	**intervention**
hashrate threshold	message	**message**	**maintenance**
movement threshold	message	**maintenance**	**fatal**

Table 6. Errors and error classification. Definition of errors, degree of severity and resulting handling of the error.

The errors and the priorities lead to some type of handlings:

- **messages.** Messages can be emails, SMS, Push-Notifications or any other technology to contact responsible persons. They are purely informative.
- **maintenance.** Maintenance is a complex process in which supporters are requested to manually fix errors in the MMU. An example of this process will be given in the next chapter.
- **intervention.** An intervention will most likely be done by the system automatically. It is connected to a message to to inform a supervisor about the system intervention. During an intervention, components can be shutdown or network parts can be disabled, for example.
- **fatal.** Fatal classifies all handlings which need to be done by internal technical supporters with higher access. This type of handling typically needs deeper knowledge. However, humans can speed up processes if necessary to reduce overall costs. Errors leading to this type typically need some investigation to prevent recurrence.

EXAMPLE MAINTENANCE PROCESS

As an example to demonstrate the smart maintenance concept, let's assume that a rig partly fails (defective GPU) in an MMU. As described in the previous chapter, the number of failed GPUs needs to be above a location-specific threshold for the UMC to classify the failure as "MEDIUM" priority. In this example, the handling type will fall into maintenance. In maintenance mode, the UMC will automatically trigger messages to supporters next to MMU's location. These supporters are partners onboarded by Zelos. They can be external individuals, agencies or internal support staff.

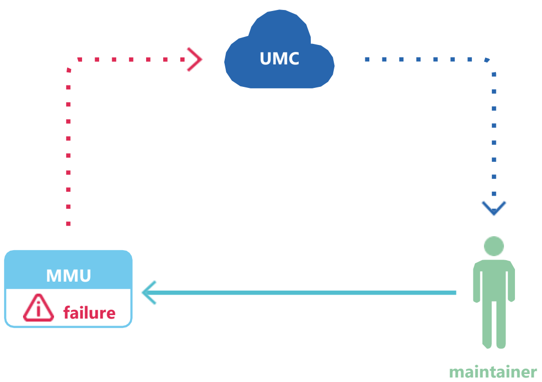


Figure 19. UMC Maintenance process. From MMU failure to solution.

Depending on which components failed, the UMC will automatically trigger production and shipping of these components to the support partner if the partner does not already have them in stock (normal scenario). For first MMU deployment scenarios, Zelos will deploy a sufficient number of MMUs in one location to warrant at least one dedicated supporter per location to test service routines and operations.

Once the partner has received the components and starts maintenance, the UMC will generate a one-time pass for the ADS. This pass can be used by the employee only once (and with time restrictions), to gain access to the MMU. When the employee enters the code into the ADS, the UMC will shutdown the affected components if this has not already been done. Since the rigs have partly failed in our example, this shutdown is necessary. When the employee enters the MMU, the ASM will monitor the procedure. The employee will change the affected GPUs (as indicated by red LEDs) and initialize them via mobile app or a responsive web interface to begin the status check. To standardize service operations, several components like GPUs and riser cards are always exchanged together (the defective component is identified at a later stage). If all components start without errors, the technician can leave the MMU. Otherwise, depending on the failure, other procedures will be initialized. The graphic below illustrates the flow of process.

HARDWARE OPTIMIZATION PROCESS

Our emphasis lies in creating a process of efficiently configuring our hardware to the optimal point of operation. We have invested heavily in analyzing, testing and configuring different kinds of hardware so that we can uphold flexibility regarding the choice of what the market has to offer in the future. The most important goal for our endeavor was to reach an efficient way to quickly ascertain the optimal configuration and thus the value of a given component (design of processes). Thanks to this established process, we are now able to react to the supply- and cost factors in a flexible manner.

Our findings show that even though there are graphic cards more suitable for the task, which are evidently also those facing high demand, shortages and increasing prices, a deeper analysis is needed to assess the total life-time efficiency of a GPU (driven by factors such as effective price tag, its power consumption, reliability and cooling capabilities). These driving factors are key in deciding which hardware component is currently the optimal choice for GPU-based mining operations.

Due to our experience in assessing not only popular but also niche products, we are now able to react to the availability of supply, in contrast to some of our competitors who focus almost entirely on the hashing power of GPUs, which is neither reasonable nor scalable to a sufficient extent. Note that this bespoken flexibility will not result in significant variances of a mining worker's output; total hashing output will stay within a constant array, guaranteeing that there are no significant variations in hashing power of the MMUs, unless desired.

HARDWARE ASSESSMENT AND CATEGORIZATION

The assessment and categorization of mining hardware, especially GPUs, has been applied to a broad variety of products, including those which are not considered to be suitable for mining by popular belief. Now, this popular belief does not account for aspects that are crucial when scaling a mining operation to a high level, for instance price-energy consumption ratios, supply availability, cooling, robustness of components, product lifespan, or maintenance intensity. Also, most openly available assessments of a specific GPU's energy consumption merely focus on Thermal Design Power, and thus the maximal performance the chip can deliver, meaning that benchmarks are usually done in idle- or full-performance states, neither of which applies to GPU mining. This, however, is not satisfactory for large-scale mining operations, which require a careful planning of power balances to assure low maintenance requirements. Therefore, Zelos decided to build an in-house testing laboratory for hardware benchmarking and has developed a technique to measure energy output at all in- and output locations of any GPU. These measurements flow into an assessment matrix, which computes the efficiency and eligibility of the component in question. This method gives Zelos a competitive advantage, because Zelos can react to supply and demand with high adaptability

Hardware assessment furthermore includes measuring hashing power. There are quite a few points which have to be taken into account as a GPU’s hashing power depends on several aspects like the possibility to manipulate memory timings, for instance, which is dependent on the memory manufacturer and has a great influence on hashing power.

Electric Current Riser Card					Power Consumption								Business Case (per day)			
12V Riser (Yellow) A	5V Riser (Red) A	12V Molex 1 A	12V Molex 2 A	12V Molex 3 A	Total System	Calculated B	12V Riser (Y)	5V Riser (Red) V	12V Molex 1 W	12V Molex 2	12V Molex 3	Total Graphi	Hardware Cost	Electricity Cost	Hashrate	Watt per Mh
3.06 A	0.25 A	0.50 A	0.46 A	0.48 A	91.30 W	47.83 W	34.72 W	1.23 W	6.00 W	5.52 W	5.73 W	43.17 W	€150.00	€0.06	12.83 Mh/s	3.65 W/Mh
6.70 A	0.23 A	0.00 A	0.00 A	0.00 A	120.90 W	39.35 W	80.40 W	1.15 W	0.00 W	0.00 W	0.00 W	81.55 W	€137.37	€0.10	11.80 Mh/s	7.22 W/Mh
6.90 A	0.23 A	0.00 A	0.00 A	0.00 A	130.40 W	46.45 W	82.80 W	1.15 W	0.00 W	0.00 W	0.00 W	83.95 W	€149.00	€0.11	12.30 Mh/s	7.30 W/Mh
2.53 A	0.13 A	0.63 A	0.60 A	0.56 A	119.70 W	67.22 W	30.36 W	0.65 W	7.56 W	7.20 W	6.72 W	52.49 W	€166.89	€0.07	12.19 Mh/s	4.81 W/Mh
5.64 A	0.12 A	0.00 A	0.00 A	0.00 A	114.50 W	46.20 W	67.68 W	0.62 W	0.00 W	0.00 W	0.00 W	68.30 W	€151.00	€0.09	11.20 Mh/s	6.43 W/Mh
5.07 A	0.24 A	0.00 A	0.00 A	0.00 A	107.30 W	45.27 W	60.84 W	1.19 W	0.00 W	0.00 W	0.00 W	62.03 W	€165.89	€0.08	9.80 Mh/s	6.71 W/Mh
3.52 A	0.13 A	0.37 A	0.36 A	0.38 A	117.30 W	61.11 W	42.24 W	0.63 W	4.44 W	4.32 W	4.56 W	56.19 W	€165.89	€0.07	11.80 Mh/s	5.07 W/Mh
													€105.73		-	
2.01 A	0.14 A	0.78 A	0.64 A	0.55 A	110.70 W	63.94 W	24.12 W	0.68 W	7.68 W	7.68 W	6.60 W	46.76 W	€166.89	€0.06	12.10 Mh/s	4.17 W/Mh
4.05 A	0.25 A	0.46 A	0.37 A	0.45 A	122.30 W	56.88 W	48.60 W	1.28 W	5.48 W	4.38 W	5.40 W	65.12 W	€155.89	€0.08	12.60 Mh/s	5.46 W/Mh
3.75 A	0.25 A	0.39 A	0.33 A	0.37 A	116.30 W	56.78 W	45.00 W	1.23 W	4.73 W	3.90 W	4.39 W	58.22 W	€155.89	€0.08	12.57 Mh/s	5.01 W/Mh
2.20 A	0.13 A	0.57 A	0.61 A	0.54 A	113.50 W	65.98 W	26.40 W	0.66 W	6.84 W	7.26 W	6.49 W	47.64 W	€166.89	€0.08	12.48 Mh/s	4.11 W/Mh
2.18 A	0.24 A	0.53 A	0.50 A	0.51 A	106.50 W	62.91 W	26.16 W	1.19 W	6.12 W	6.00 W	6.12 W	45.59 W	€123.45	€0.06	12.85 Mh/s	3.81 W/Mh
													€123.45			
					942.90 W	0.00 W						942.60 W	€2,618.95	€1.14	171.80 Mh/s	5.51 W/Mh
					1,959.25 W	0.00 W						1,959.25 W	€4,623.95	€2.36	366.37 Mh/s	5.36 W/Mh
					150							150	800	€0.18	40.30 Mh/s	3.84 W/Mh

Figure 20. Energy Consumption Assessment Matrix (ECAM).

A precise measurement of hashing power is achieved by means of an iterative process involving asymptotic approximation, where the GPU is brought to its absolute performance limit, while maintaining stability. This process leads to a point of maximum operability. The point of maximum operability does not necessarily correlate with hash rates reported by competitors and online sources. The reason for this is that many competitors and online sources usually do not account for long-term stability, which is a crucial aspect for low-maintenance MMUs (Mobile Mining Units) and, in fact, has a higher priority than peak performance hash rates. As a result, not only do we overclock, which is a common practice, but we also go into much further detail, namely changing the bios of the GPU, including changes in the memory timings (“memshift”), component names (flashing a unique identifier on every GPU ensures that every card is identifiable in our MMU to facilitate service operations), clock rates, etc. This is all achieved in Zelos’s specially-designed hardware laboratory, where all eligible GPUs on the market are assessed.

The previously described assessment tools thus lead to a categorisation of the majority of hardware eligible for mining and give guidelines on how to react to market supply in order to guarantee the stable performance of MMUs.

SMART MINING OPERATIONS

COIN SWITCHING - IMPERATIVE FOR LONG-TERM PROFITABILITY

Since the cryptocurrency market has proven to be volatile, Zelos has developed mechanisms that hedge against the risk of volatility and ensure investment returns with long-term prospects. This is highlighted even more by the current development of Ethereum, which is likely to head towards a proof of stake concept with reduced mining profitability. The incoming hard forks coupled with ice age could mean that it is more profitable to mine a different coin. The structure of Zelos is highly adaptable in this aspect - deciding which coin is mined will occur automatically based on algorithms calculating the most profitable coin to mine, or will be based on individual preferences.

The importance of such flexibility is highlighted by an analysis of the projected difficulties in Ethereum (see graph); here, it becomes clear that mining Ethereum will not remain profitable over the long term, which is shown by the projected exponential increase of mining difficulty and the corresponding decrease of mining rewards. This is furthermore visualized by the so-called “difficulty bomb”, which was delayed by the Byzantium hardfork by 42mil seconds (approx. 1.4 years). Assuming an average block time between 10 and 19 seconds, the difficulty will remain constant for that amount of time. After the besaid 1.4 years, the “difficulty bomb” will start to increase ETH mining difficulty every 10^3 blocks, making it virtually impossible to mine new blocks. In our model, we assume the block time to be constant, which yields a lower bound scenario. Thus, when building a long-term mining operation, flexibility with regard to coin choice is key.

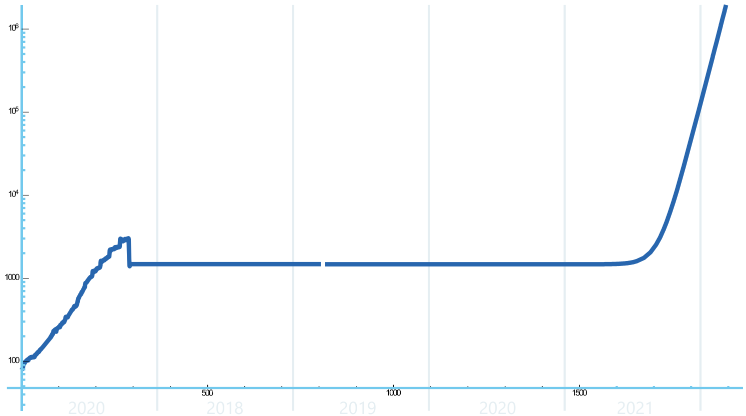


Figure 21. Projection of ETH Difficulty Growth.
block_diff = parent_diff + parent_diff / 2048 * max (1 - (block_timestamp) / 10, -99) + int(2**(block.number / 100000) - 2)) }

The above model visualizes only the difficulty change invoked by the “difficulty bomb”, but not the difficulty change tendency though increased network hash rate. The Ethereum difficulty increases when the network hash rate increases, but the difference to the model is negligible.

Next to mining difficulty and rewards, the current exchange rate of the mined coin is decisive for a sound decision regarding which coin to mine. The following graph shows an approximate prognosis for the ETH/USD course, highlighting that there is a significant amount of volatility involved. Using the historic Ethereum price data we fit an Ornstein– Uhlenbeck process to model the future price development of Ethereum. The Ornstein– Uhlenbeck process was proposed by Uhlenbeck and Ornstein in 1930 and is an adaption of Brownian Motion, which models the movement of a free particle through liquid and was first developed by Albert Einstein. It satisfies the stochastic differential equation,

$$dX(t) = \theta(\mu - X(t))\, dt + \sigma\, dB(t)$$

where B(t) is standard Brownian Motion, $\theta > 0$ is the rate of mean reversion, μ is the equilibrium level and $\sigma > 0$ is the average magnitude of the random fluctuations that are modelled as Brownian motions. This gives the following prognosis for a ETH/USD price chart (which, naturally, does not account for externalities, and is therefore not to be seen as a binding statement).

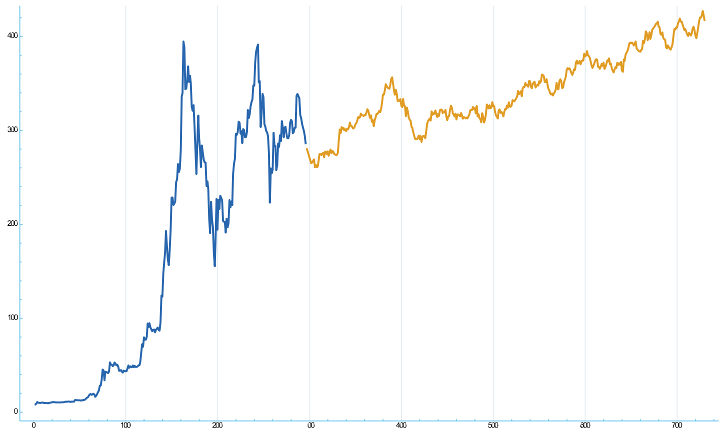


Figure 22. Estimation of USD/ETH Rate. Based on an Ornstein–Uhlenbeck process.

As mentioned earlier, there are several factors to take into account when deciding which coin to mine. There might be periods where, for instance, Ethereum is undisputedly the most profitable coin, while in other periods this decision could be prone to change on a daily basis.

APPLICATION OF COIN SWITCHING

Our MMUs are able to mine all of the most common mining algorithms (GPU-based workers). Examples of what are MMUs can mine include Ethash, CryptoNight and Equihash, as well as the important Blake algorithm which enables the ability to dual-mine two coins simultaneously. With each of those mining algorithms, it is possible to mine a variety of coins, giving us a lot of flexibility in terms of which coin we can mine at any given time. Furthermore, our algorithms track the mining performance of each mining algorithm to determine the mining profit of all available coins and their mining value in terms of revenue. If our real time analysis suggests that it would be more profitable to mine a different coin, the UUC is able to automatically command the MMU to mine the most profitable coin at that time without any maintenance effort by an operator. This enables us to react to the market quickly and ensures that we are not dependent only on the best mining option at a given moment.

DUAL MINING

Zelos has achieved operation of dual mining in a profitable setting. Dual mining, which means mining two coins on the same hardware component by utilising both core- and memory power, is often regarded to be unprofitable because it increases energy consumption to a significant extent. Due to the highly adaptable structure of the MMU project, Zelos is not bound to regular household- or industrial energy price levels, and can therefore offer dual mining in a profitable and stable setup, which will give an additional performance boost. Dual Mining can, of course, be enabled or disabled on demand, adhering to our claim of a high degree of adaptability and flexibility for all of Zelos's mining operations and therefore the unique selling point of Zelos. In our testing lab, we have optimized hardware configurations for dual mining and can command an MMU to switch to these configurations instantly.

SCALABILITY WITH REGARD TO MINING REWARDS

The current go-to solution for small-scale miners nowadays is to pool resources and share processing power with other small-scale mining operations. Here, individuals work together to solve a block, therefore increasing one's chances to get a block reward, which is then shared with other miners at the cost of a fixed fraction of the reward, which is paid to the pool facilitator. With a sufficient quantity of MMUs, Zelos is able to eliminate common pool mining in favor of autonomously mining blocks in their own pool, ultimately ridding the Zelos community of the vexing fees that are usually paid to the facilitator as well as ridding the community from having to share their proceedings with individuals outside of the Zelos network. Instead, the Zelos community will pool their internal resources to solve blocks and share the rewards.

COMPANY STRUCTURE

Zelos AG will be a Swiss corporation, headquartered in Zug, the so-called "Crypto Valley" of Switzerland, where players like Ethereum Project, Monetas, Bitcoin Swiss and Bancor have laid the foundations for a major blockchain cluster.

Our structure is very simple: Shareholders are the founders, nobody else. This in turn means that we don't have to satisfy the hunger of institutional investors for returns and can share the profits of our operations with our token holders in a fair and transparent way.

Operations are run by the team of founders (see "Team"). On the supervisory board ("Verwaltungsrat") are Founder Christoph-René Fischer, who will handle administrative tasks and the initial business development. We view the community of token holders in this context as a pool of know-how and a provider of impulses for Zelos to operate in sync.

After the ICO, we will found a 100% subsidiary for R&D and the management of container production: Zelos technologies GmbH, located in the German blockchain capital of Berlin.

TEAM

Christoph-René Fischer: Product developer and engineering manager; blockchain expert and advisor. CPO and Operations Manager to Aeternity Blockchain; deep knowledge in smart contracts; early adopter of blockchain and cryptocurrencies in 2015/16.

Tatjana Fischer: software engineer and expert for ethereum smart contracts; design and development of decentralized blockchain applications; smart contracts for finance, industry and NGOs; senior consultant to Astratum.com.

Phillip Simon Werner Klodt: An IT-professional with over 6 years of experience as a strategy consultant at A.T. Kearney with a focus on digital, retail and eCommerce; 10 years of startup and programming experience; second career as a serial founder of startup companies.

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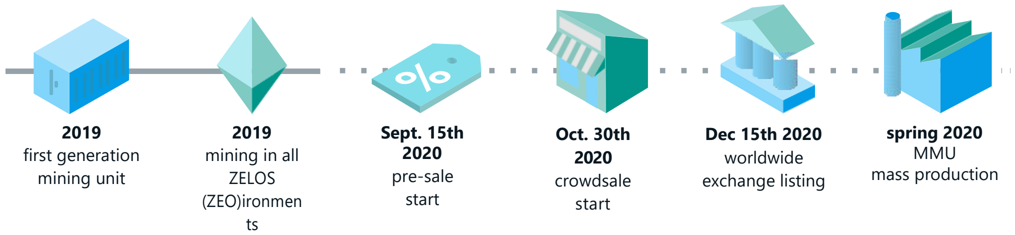
HISTORY



In 2018 Christoph-René met an entrepreneur from the PV ecosystem, an experienced professional, co-founder of one of the largest solar companies in Germany and an experienced investor in PV parks globally. He complained about an investment in Chile that began as a landmark project for climate preservation. With financial support from the World Bank, the German state bank KfW and the Canadian Climate Change Program, the project was also hyped in the media as the first unsubsidized PV park in the world[14].

Placed in the Atacama desert, the sunniest place on earth, it sold electricity to the booming copper mines in the Chilean north for $0.14/kWh. As the copper boom collapsed, the demand for energy plummeted and with it the price of electricity. At $0.04/kWh, the once profitable PV park suddenly produced millions in losses per annum.

As these events unfolded in Chile, global energy demand for cloud computing was increasing sharply and the niche world of crypto mining was growing in size. Once Matthias told his story to the other founders, they began to develop a vision: to connect the proliferation of renewables with the growing energy demands of crypto mining - and thereby help both industries solve their problems.

Two years of hard work followed. First, plans and visions were developed; then followed engineering and trial & error:

- **Concept and strategy development:** creating the Zelos idea and approach
- **Researching of energy markets** and potential future partners
- **Development of the Zelos control hardware** (custom developed circuit boards, energy components, monitoring systems, industry 4.0 automation)
- **Development of our proprietary cooling system:** Planning, airflow and heat calculations, design, simulation, prototyping and construction of a self-regulating cooling system for the units
- **Hardware optimization** for underlying “mining” hardware to reduce the energy footprint
- **Preparation of the initial coin offering (ICO):** website, white paper, smart contract development

AC	Air Conditioning
ACS	Automatic Cooling System
ADS	Automated Doorman System
AES	Advanced Encryption Standard
AG	Joint-Stock Company
AIC	Automated Internet Connection
AMI	Advanced Metering Infrastructure
API	application programming interface
ASICs	Application Specific Integrated Circuit
ASM	Automated Security Module
BTC	Bitcoin
CAPEX	Capital Expenditures
CPU	Central Processing Unit
CSC certificate	Civil Service Commission
DB	Database
DDoS	Distributed-Denial-of-Service
DHCP	Dynamic Host Configuration Protocol
DNA	Deoxyribonucleic Acid
DNS	Domain Name System
DNSSEC	Domain Name System Security Extension
ESB	Zelos Storage Blockchain
EIA	US Energy Information Agency
EOS	Zelos Operating System
ETH	Ethereum
ZELOS (ZEO)	Zelos Token
GDP	Gross Domestic Product
GMT	Greenwich Mean Time
GPU	Graphics Processing Unit
HD	High Power Density
HMAC	keyed-hash message authentication
code HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICO	Initial Coin Offering
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISO	International Organization for Standardization
KVA	Kilo volt ampere

KW	Kilowatts
kWh	Kilo Watts per hour

LAMP	Linux operating system, Apache Server, MySQL database, PHP
LED	light-emitting diode
LNG	Liquefied Natural Gas
LTE	Long-Term Evolution
MD	Medium Power Density
MMU	Mobile Mining Unit
MWp	Mega Watt peak
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and
Development P&L	Profit and Loss Statement
PCB	printed circuit board
PM	post meridiem
PMO	Proprietary Mining Operations
PO	Proprietary Operations
PV	Photovoltaic
R&D	Research and Development
REST	Representational State Transfer
ROI	Return on Investment
SEC	United States Securities and Exchange Commission
SES	Smart Energy Sourcing
SSL	Secure Sockets Layer
TAN	Transaction Authentication Number
TPO	Third-Party Operations
TWh	Terra Watts per hour
UHD	Ultra High Density
UMC	Unified Mining Cloud
UMTS	Universal Mobile Telecommunications
System US	United States
USD	US-Dollar
UUC	Unified Unit Control
VPN	Virtual Private Network
WIFI	Wireless Local Area Networking

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APPENDIX - EXEMPLARY HARDWARE SPECIFICATIONS & KPI

Based on an exemplary MMU setup with ~50% ASIC- and ~50% GPU miners (split based on capex investment) and conservative estimates (e.g. no overclocking of GPUs), we have calculated the total ROI of Zelos's proprietary mining operations to be 181% (based on current market conditions as detailed in table 1). This estimate is based on the current mining difficulty and takes into account hardware power inflation (e.g. newer GPUs are introduced that are more efficient) and hardware defects (e.g. hardware failures of GPUs) - compare assumption A7.

This number is based on a set of assumptions:

#	BACKGROUND ASSUMPTIONS	VALUE
A1	ETH/USD rate (conservative number based on data from the 24th of November 2020)	**$400**
A2	BTC/USD rate (conservative number based on data from the 24th of November 2020)	**$8,000**
A3	Average local energy price	**$0.03**
A4	Share of raised ICO capital invested into MMUs (refer to white paper for details)	**91%**
A5	Total number of MMUs in operation (relevant for calculation of overhead share per MMU)	**1003** **(~$90,974k**
A6	Contributor token share [5] [6]	**83%**
A7	Depreciation of mining efficiency (due to GPU power inflation, hardware defects, etc.) [7]	**20% (GPU mining)** **25% (ASIC mining)**

Table 1: Background assumptions

Detailed tables showing costs and earnings as well as key efficiency parameters can be found below. These tables should give first insights into the basis of ROI calculations (costs and benefits) as well as into the performance of an MMU in an exemplary configuration as indicated above. The model shown here

is a simplified model of the Zelos operating model. The following model calculation consists of a mixed operation (50%/50% based on invested capital) of GPU and ASIC mining. It is important to recognize that this MMU configuration is hypothetical. It's purpose is to best reflect a reality in which our operation will be split into GPU and ASIC mining - each operating in separate mobile mining units (one with 100% ASICs, one with 100% GPUs) as depicted in our whitepaper (this does not impact the business plan below). The purpose of the shown model below is to provide approx. performance indicators that best reflect the actual units that will be built. Please note that this configuration differs from the first generation that we have built (e.g. with 48 GPU-based mining rigs with 624 GPUs in total). Furthermore, the calculation is conservative and does not take overclocking of GPUs into account and is based on USD.

#	COMPONENTS	VALUE
C1	Total number of mining rigs (currently 13 GPUs each)	**27**
C2	Total number of graphic cards [1]	**351**
C3	Total number of ASICs	**27**

Table 2: Components inside the 50%/50% configuration

#	COMPONENT PERFORMANCE	VALUE
A1	Hashrate per ASIC	**13.50 TH/s**

A2	Monthly revenue per ASIC[2]	**$597.12**
A3	Energy consumption per ASIC	**1,323 W**

A4	Monthly energy cost per ASIC	**$28.97**
A5	Monthly profit in USD per ASIC[2]	**$568.14**
A6	MH/s output of GPU mining rig (not overclocked)	**149.5 MH/s**
A7	Energy consumption of GPU mining rig	**840 W**
A8	# Graphics cards of rig (compare C2)	**13**

Table 3: Individual component performance

KPI #	COMPONENT PERFORMANCE	VALUE
K1	Total investment in MMU including mining hardware[3]	**$103,171.00**
K2	Total investment in GPU mining rigs incl. share of MMU[9]	**$50,629.60**
K3	Total investment in ASIC miners incl. share of MMU[9]	**$52,541.40**
K4	Investment in USD per ETH MH/s	**12.54 $/MH/s**
K5	Investment in USD per BTC TH/s	**144.15 $/MH/s**
K6	Investment in USD per KW	**1.75 $/kW**
K7	Total GPU hashrate (ETH)	**4,037 MH/s**
K8	Total ASIC hashrate (BTC)	**364.50 TH/s**
K9	Total energy consumption of MMU	**59.10 kW**
K10	Energy consumption in kWh / month	**43,144 kWh**
K11	Energy consumption in kW per ETH MH/s	**5.71 W/MH/s**
K12	Energy consumption in kW per BTC TH/s	**98.96 W/TH/s**
K13	Total annual mining profit	**$247,757.74**
K14	Total annual GPU mining profit	**$78,119.17**
K15	Total annual ASIC mining profit	**$169,638.57**
K16	Profit in USD per kWh	**$0.48**
K17	Profit in USD per MWh	**$478.55**
K18	Raw ROI[4]	**240%**
K19	ROI with 83% contributor share[5]	**199%**
K20	ROI with 91% investment share[6]	**181.38%**

Table 4: Key Performance Indicators (MMU configuration: ~50% ASIC miner share).

	FIXED COST FACTORS	FIXED SETUP COSTS (1 MMU)
F1	Housing	**$9,400.00**
F2	Energy Components	**$2,400.00**
F3	Monitoring Electronics	**$1,750.00**
F4	Mining Equipment	**$88,371.00**
F5	Installation & Shipping	**$1,000.00**
F6	Other	**$250.00**
	Total	**$103,171.00**

Table 5: Fixed Costs per MMU (configuration: 50% ASIC miner share).

	VARIABLE COST FACTORS	MONTHLY RUNTIME COSTS (1 MMU)
V1	Depreciation (GPU and ASIC power efficiency inflation, hardware defects, etc.)[7]	**$1,774.40**
V2	Energy	**$1,294.31**
V3	Local Maintenance	**$150.20**
V4	Security, Land Usage, Monitoring	**$50.00**
V5	Overhead	**$248.02**
	Total	**$3,516.92**

Table 6: Variable Costs per MMU (configuration: 50% ASIC miner share).

APENDIX DISCLAIMER

Cost structure as depicted in these table are based on an MMU with 50% GPU miners and 50% ASIC miners. The overhead calculation is based on assumptions that might be wrong or change, such as, but not restricted to, prices of third party services, levies and fees on crypto related activities, tariffs on computer hardware in various jurisdictions, expenses for litigation and settlements, changes in the regulatory ZELOS (ZEO)ironment, insurance for directors and officers, insurance for containers, costs of transport, changes

in the supply chain, expenses for experts in production logistics, energy markets, data centers or other business segments. Therefore the costs for overheads displayed in this document provide only a rough guidance, but cannot be guaranteed by Zelos. The company is not liable for deviations from projections described herein and will not award any damages based on these projections. The above model shows the assumed return using an annual projected token profit based on a 25% reinvestment strategy and current mining difficulty & market conditions. Actual results can be higher or lower. The model is a sample calculation. The model should not be regarded as information for an investment in tokens or as an offer of or a solicitation to buy tokens.

The calculations are according to the "use of proceeds" (as defined in the Whitepaper) of the Zelos ICO and the distribution of 83% of the tokens to investors. Calculations show the business case for the average investor (it does not take into account different token prices): It does not factor in the possible dilution effects of any rebates as scheduled for the four phases of the ICO (see our website www.Zelos.org). In the private pre-sale ending on the 30th of November 2020 up to 6m ZELOS (ZEO) tokens will have been placed

in order to finance the ICO and advancement of the Zelos business case (e.g. patent application). As the proceeds of this placement will not be invested in MMUs they also have a diluting effect on the payout. The dilution effect is not factored in the above projection because it depends on the size of the ICO.

All projections are calculated before taxes, which depend on MMU locations and and the question whether the payouts will be categorized as profits or costs by the jurisdictions of these locations. Therefore final payouts can deviate because of tax reasons.

APENDIX REFERENCES

(1) We have tested multiple GPUs for our first generation mobile mining unit based on extensive testing performed as described in our Whitepaper (see chapter "Zelos Mining Excellence"). The GPU model has been chosen based on cost/benefit ratios, supply/demand ratios, and energy usage among all viable mining GPUs. The chosen model is subject to change. The hardware model selected for MMUs will be determined at the time when component sourcing & procurement starts.

(2) Compare https://www.coinwarz.com/calculators/bitcoin-mining-calculator/?h=13500&p=1323&pc=0.03&pf=0.00&d=1452839779145.92000000&r=12.50000000&er=8000&hc=0.00 for USD profitability)

(3) This includes housing, energy components, monitoring electronics, mining equipment, installation, and overhead

(4) This ROI resembles the raw ROI from operations. It does not take into account that 17% of all tokens are not distributed and does not take into account that only 91% of invested funds are invested into mobile mining units (the rest is spent for R&D and other company expenses)

(5) This ROI takes into account that only 83% of all tokens are distributed among investors (10% remain with folders, 5% in the company, 2% are reserved for the bounty program). The resulting ROI is one that an investor in the company would have if 100% of invested funds were to go directly into mining units (compare 91% investment share)

(6) This ROI takes into account that 91% of all invested funds after the ICO costs of 1.5m USD (already mostly raised at the time of writing and maybe fully raised at the time of ICO) are spent building mobile mining units and that 83% of tokens are distributed to investors. See also (4) and (5)

(7) We understand that there are widespread opinions in the mining community as to what the correct value for monthly depreciation is. We decided not to include uncertain factors like the future development of total network mining power into those numbers as there are countless models that try to make assumptions about the future development. Our numbers reflect only hardware defects and include a general yearly inflation of processing power efficiency as newer GPUs or ASICs come out. Positive effects like rising prices of cryptocurrencies (e.g. Ethereum or Bitcoin) or emerging of new, even more profitable cryptocurrencies are not taken into account in this calculation and offer additional growth potential for token holders or might at least compensate negative factors like difficulty increases. This means that Zelos token holders profit directly from positive market developments for cryptocurrencies. For full details, please refer to our Whitepaper

(8) A depreciation of 20% per year means that a full depreciation is expected after five years, a depreciation of 25% per year means that a full depreciation is expected after four years

(9) Investment includes share of MMU itself including share of electronics and labor

(10) The ROI shown on the Zelos homepage shows 161% per year which is an older number. We decided not to change the ROI on the website all the time but present very up to date numbers with this calculation. This calculation is more conservative but also some factors changed positively why the resulting ROI assumption is higher.