The 2nd Conference on Management, Business, Innovation, Education, and Social Science (CoMBInES)

Taichung, Taiwan 3-6 March, 2022

CRYPTOCURRENCY MINING EFFECTS ANALYSIS ON SEMICONDUCTOR SHORTAGE ON PC OWNER COMMUNITY

Hendra Wijaya Lim, Tony Wibowo

Faculty of System Information, Batam International University, Indonesia

{1831162.Hendra@uib.ac.id tony.wibowo@uib.ac.id }

ABSTRACT

Cryptocurrency is a revolutionary peer to peer transaction method which utilize Block chain technology to enable frictionless transaction across the globe with relatively low fees. As Block chain technology goes mainstream, several problems had emerged, one of these problems are semiconductor shortage caused by booming popularity of such Cryptocurrency mining. Which cause widespread problems in the whole world, crippling not only technology industries and spilling to other industries such as car industries and electronic industries. In this study, we delved into what causes these problems and how and what will help solve these problems that are occurring in the market, in this research used Case study model for this phenomenon and came into conclusion that cryptocurrency mining will not last long and shortages maybe easing.

Keywords: *Cryptocurrency, Block chain, System Information.*

INTRODUCTION

Cryptocurrency is an asset class with a booming market capitulation surging more than 500% in the time of writing, cryptocurrency itself is a block chain technology which contradicts traditional market commodities such as gold, silver etc by having no physical form whatsoever, One of the more popular example of cryptocurrency is Bitcoin, Bitcoin is first invented in 2008 by an unknown person using the pseudonym "Satoshi Nakamoto" created Bitcoin as a purely peer-to-peer electronic cash system, removing trusted third party (bitcoin serves as a digital unit of account of Bitcoin network). using Block chain Technology. Block chain as a technology relatively unheard before cryptocurrency albeit its advanced technology in data storage to ensure data integrity(Wibowo & Christian, 2021).

Block chain technology aims at creating a decentralized environment which exclude third party who are in control of the transactions and data [19]. In general, the block chain is a time-stamped chain of blocks conjoined by all participating nodes. Blocks are basically containers that aggregate transactions. The blocks are chained together cryptographically: each block is digitally signed and 'Linked' to the previous block by including that block's hash value(Chowdhury et al., 2018). New blocks can only be appended to the end of the chain, thus the block chain provide an immutable data storage (existing transactions cannot be updated or deleted). For this reason, many systems could be built on the block chain technology to achieve safe and secured distribution of digital assets among untrusted clients. Block chain technology is an decentralized publicly distributed ledger which are verified by power of personal computers through a process called Proof Of Work (PoW) algorithm (Nofer et al., 2017). Participation of such validation, reward the miners some of the respective asset validated which in turn can be traded into fiat currency, this causes mania akin to California gold rush in 19th century, which spark massive demand of computational power.

One of the most popular Cryptocurrency mining hardware is Graphic Processing Unit or commonly referred to as GPUs, an GPU primary usage is to compute complex computational equations such as rendering Video games or even Video clips we normally see, An GPU's primary powerhouse is the

same semiconductor material used to create integrated circuits are called MOSFET (metal–oxide–semiconductor field-effect transistor) or chips, that can behave as a transistor to execute logical computations. Semiconductor material has the electrical resistance halfway between a conductor and an insulator, and through the process of doping it is possible to achieve the electrically controlled switching function (to act as either conductor or insulator), which way they become the transistors (MOSFET) in modern computer chips (Hajdu, 2021). A GPU is a perfect solution for solving cryptocurrency's puzzle like algorithm with its massive computational resources to get its reward.

A global supply shortage of semiconductors has crippled the production of GPUs paired with COVID-19 pandemic furthermore crippling the production of semiconductors(Wilson, 2021), these factors causes GPU pricing to soar pass Manufacturer's Suggested Retail Price (MSRP), on average popular GPU such as NVidia's RTX 3060Ti and RTX 3080 is selling upwards of Rp 14.500.000,- (1000$ USD) and Rp 23.500.000,- (1653$ USD) respectively (according to a popular online marketplace Tokopedia in Indonesia), This causes an uproar as average PC users/owners are unable to upgrade their hardware because of such pricing. Therefore, we are interested to research deeper into what causes such outrage in pc building community by using Survey method in the research titled "Cryptocurrency mining effects analysist on semiconductor shortage on PC owner community"

LITERATURE REVIEW

Research done by (Nofer et al., 2017) describe what exactly is a Block chain, Block chain is a publicly distributed ledger system, which enables users to keep records in a verifiable and permanent way, even with the absence of the trusted central server. It was invented by a developer using the pseudonym "Nakamoto" in (2008) to serve as the transaction ledger of cryptocurrency, Bit- coin. Blockchain and cryptocurrency have been attracted the attention of the industry, academia, and the public, and several applications have been proposed and many more are in development. A block chain is consisted of chains of data packages (blocks),

where a block comprises multiple transactions at a time. The block chain is extended by each additional blocks and hence represent a complete distributed ledger of transaction history, blocks can be validated by using cryptographic methods, in addition to transaction histories, each block contain a timestamp, which are written in the form of hash number of previous block (Parent-block) and nonce (a random number identifying the block), ensuring the integrity of block chain through the first block (Genesis-Block). Hash value of each block is unique hence the risk of fraud can be minimized.

Research done (Auer, 2019)describe what is in the core of block chain technology such as Cryptocurrency, block chain in its core is a appended-time stamped chain of data, each of which can record information, many widely used blockchains such as Ethereum and bitcoin, are based on Proof of Work consensus (PoW) , Where multiple set of globally distributed "Miners" work simultaneously to try and solve a cryptographic puzzle based on the current chain of data, When a miner succeeds—which acts as proof of the miner's work—they bundle a set of pending transactions to create a new link in the block that is added on top of the chain. Miners then proceed mining a new cryptographic puzzle based on the new chain, the central role of miners remains essentially the same: They grow the chain by using their computational capability to solve cryptographic puzzles, and they maintain it by exchanging updates about the current situation of the chain.

(Szalachowski et al., 2019)described limitations Proof of Work (PoW) consensus based cryptocurrency such as Bitcoin and Ethereum had, in this study they described the computational power needed to maintain the main network of such cryptocurrency is astronomically high which translate directly to insane electrical power consumption which in turn is not economically feasible to maintain such model of consensus in long term without reaching the equilibrium among the cryptocurrency "miners"(People who devoted their computational power to maintain the network), which cause centralization as opposed to the true mission of bitcoin: to have a decentralized network.

Research done by (Islam et al., 2018)further look into details from the usage of cryptocurrency

and advantages and disadvantages of cryptocurrency compared against Fiat currency(Traditional currencies), this study also mentioned the risks of traditional currencies remittance such as slow transaction between continents and risk of FOREX(Foreign exchange)fees and also high remittance fee that users suffer when using this service.

Research done by (Eyal, 2021) describe how digital cryptocurrency wallets were made and go into details how it is almost impossible to hack because of specific and secretive mnemonic words used as keys to secure cryptocurrency wallets, (Eyal, 2021)in his study also mentioned that cryptocurrency personal wallets is close to impossible to hack, in fact in his research result, it show that cryptocurrency wallet thefts numbers between 0 to 1% of probability for a wallet getting hacked.

Research done by (Ekparinya et al., 2019) delve into vulnerability of Proof of Work cryptocurrencies, although neigh impossible to hack nature of cryptocurrencies such as Bitcoin and Ethereum are prone to "Attacks", such "attacks" on the main net may happen if some of the miners with ill intent got hold of 51% of total hash power of the main net, with this control they can rewrite the transactions to their will, causing monetary losses in the millions, albeit rare such attacks did happened and is increasing over the year correlating to surging cryptocurrency prices it has increased over 450% since the inception of Bitcoin.

Cryptocurrency surging market has caused Semiconductor shortage according Research done by (Wilson, 2021)which focuses on cryptocurrency and the hardware used to mine, the surging market has caused a massive spike of demand in computational hardware such as Graphic Processing Unit (GPU), in light of this prices of GPUs has risen well beyond their MSRP(Manufacture Suggested Retail Price) some even risen upwards of 250% from the original price.

This research done by (Hajdu, 2021) will look into NVIDIA, one of the largest GPU manufacturer in the world, on why the semiconductor market is in a shortage, one of the primary reason for the shortage according to (Hajdu, 2021) is COVID-19 outbreak, which cripples not only NVIDIA but also TSMC, the main manufacturer of semiconductors, Semiconductor material is used to create integrated circuits (or chips), that are able to behave as a transistor to execute logical computations. Semiconductor material has the electrical resistance halfway between a conductor, and through the process of doping it is possible to accomplish the electrically controlled switching function (to act as either conductor or insulator), which way they become the transistors (MOSFET) in modern computer chips. In other words, semiconductors are the rudimentary building blocks of processing units, and their presence is critical in other electronic devices.

Based on the results of the previous studies, we will do a research titled "Cryptocurrency mining effects analysist on semiconductor shortage on PC community" by quoting research done by (Wilson, 2021), further backed by (Hajdu, 2021), in addition to look into block chain's history by research done by (Nofer et al., 2017) aand also how Cryptocurrency can be mined.

Cryptocurrency and mining

Cryptocurrencies are digital or virtual currencies underpinned by cryptographic systems, they are un-fungible which means they cannot be physically touched and only exist as a strain of codes, however so they can enable frictionless and secure online payments without the use of third-party intermediaries such as banks and other financial services. "Crypto" refers to the various encryption based algorithms and cryptographic techniques that safeguard these entries, such as elliptical curve encryption, hashing functions, and public-private key pairs.

Cryptocurrencies can be mined or purchased from cryptocurrency exchanges. Not all e-commerce allow purchases using cryptocurrencies. In fact, cryptocurrencies, even popular ones like Bitcoin, are rarely utilized for retail purchases. However, the skyrocketing value of cryptocurrencies has made them popular as trading commodities. To some countries such as El-Salvador, they are also used for cross-border transfers.

Bitcoin is the most popular and valuable cryptocurrency. An anonymous person that used the

The 2nd Conference on Management, Business, Innovation, Education, and Social Science (CoMBInES)

Taichung, Taiwan   3-6 March, 2022

pseudonym "Satoshi Nakamoto" invented Bitcoin and introduced it to the world via a white paper published in 2008 which in turn paved way to thousands of cryptocurrencies present in the market today, each cryptocurrency claims to have a different function and specification. Bitcoin, which was made available to the public in 2009, remains the most widely traded and covered cryptocurrency. As of November 2021, there were over 18.8 million bitcoins in circulation with a total market cap of around $1.2 trillion. Only 21 million bitcoins will ever exist. For example, Ethereum's ether markets itself function as gas (fee) for the underlying smart contracts platform. Ripple's XRP is used by banks to facilitate transfers between vast geographical distances.

In the wake of Bitcoin's success, many other cryptocurrencies, known as "altcoins," were launched. Some of these are even clones or forks (child) of Bitcoin, while others are new currencies that were fundamentally unique and were built from scratch. Which include tokens such as Solana, Lite coin, Ethereum, Cardano, and EOS. By November 2021, the combined value of all the cryptocurrencies in existence had reached over $2.1 trillion—Bitcoin currently representing approximately 41% of that total value.

PROPOSED INNOVATION

Cryptocurrencies are considered one of the miracles of coding in 21st century as it enables ability to users for transferring any sums of fiat currency to virtually anywhere in the world so long as they have internet connection, this transaction is done using block chain technology which means it is secured and almost impossible to hack and using only a miniscule amount of fee compared to traditional banking remittance services which is particularly expensive and lengthy process.

However these innovations came at a cost, as COVID-19 pandemic swept around the world factories producing semiconductor otherwise known as chips, began to reduce their numbers of employees as concerns of COVID-19 virus grew, this causes production to slow significantly and coupled by Cryptocurrency mining booming popularity causes mass shortage that affected around the globe, GPU(Graphic Processing Unit) which

normally used to render videos and games became prime target for Cryptocurrency mining namely ETHEREUM(ETH), this causes massive uproar as GPU prices skyrocketed. in this occasion we will look into what are the main causes of this shortage and spread a survey to several PC community forums whether they agree or not to the results of research done.

RESEARCH METHODOLOGY

This Research uses Case study model, which is made of 4 steps which are, identification of the problem, study of literature, analysis phase & conclusion.
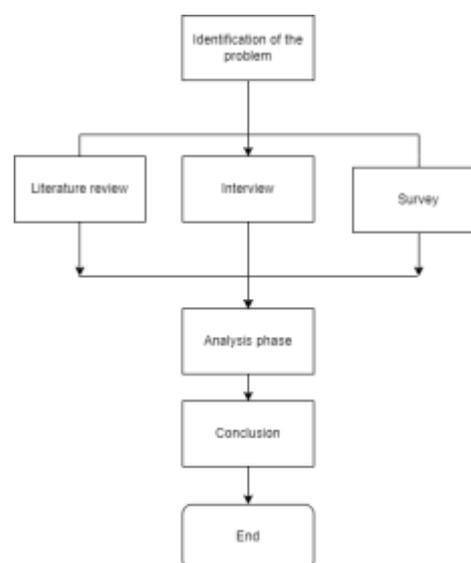
Fig 1. Case Study research flow

In literature review, writer will find studies done by experts regarding this phenomenon. from the research and journals done by experts, we will conclude problems found within the studies found in google scholar ranging from journals done from 2017 and summarize them before interviewing correlated person which were the focus of this research.

POPULATION AND SAMPLE

Population is the total of object that will be analyzed, the object can be in the form of peoples, items and others that can be the research object or a accumulation of all research object. Population that are taken in this research is on

popular PC Gaming platform "Steam" Indonesian forum which has 25,979 members as of writing.

Sample is a group of people, objects or items that are taken from a larger population for measurements. Sample will be a representative of the population as writer is unable to reach the total number of the population. Sampling method used for this research is slovin's formula which will calculate exactly how many samples would be needed, which result in 396 respondents. Data from the research done is randomly taken among the 396 respondents which questions were based on literatures review and interviews conducted by us.

DATA COLLECTING METHOD

Data Collection method is a method used to gather data needed for continuing the research across different research locations, Technique used for gathering the data is first doing interviews to trusted source regarding how the market got to the current situation, and then spreading *Google forms* to PC enthusiasts' community regarding how they agree to the questions.

INTERVIEW

The interview done for this research require us to find trusted supplier and manufacturer's information regarding what causes the problem, and then interviewing "Miners", people who are directly linked to cryptocurrency mining, before moving on to the regular people who were affected negatively. We will write several questions according to studies found on literature and asking for their opinion.

QUALITATIVE QUESTIONS

In this research we deployed 2 types of data collecting which is a mix of qualitative and quantitative approach, we had interviewed numerous people from sectors effected by the GPU Shortage phenomena such as Computer parts suppliers, Cryptocurrency miners and Pc owners. Questions of such qualitative approach are as below:

- Cryptocurrency effect on your GPU sales wise, does it negatively or positively impact sales count?

- Does Cryptocurrency mining directly impact GPU supply?
- Your sentiment on this GPU shortage condition positive/negative and why?
- Do you think regular pc owner is negatively affected by this shortage?
- When do you think this shortage will end (2022 or 2023+)?
- How do GPU Shortage effect your plans for upgrading your PC?

RESEARCH INSTRUMENT

Research instrument in Qualitative Data gathering is people who are specifically connected or contributed to this shortage such as Personal computer hardware suppliers and cryptocurrency miners.

After interviewing several categories of people who were connected to this phenomenon, we summarize the data collected from interviews and make several questions in for the survey, then we will start spreading surveys in popular PC related community forum regarding whether they agree or not to the statements collected from the interview.

QUANTITATIVE QUESTIONS

In Quantitative approach we will spread surveys made with likert scale to several forums, the questions were written according to what were gathered in previous interviews to be compared in the end results such questions are as below:

- Do you ever heard of Cryptocurrency mining?
- Do you have plans to buy/Upgrade your PC?
- Do you own cryptocurrency?
- is cryptocurrency miners is causing GPU shortage?
- Do you agree that Cryptocurrency mining causes PC hardware Shortage?
- PC Components currently are overpriced?
- Do you agree that PC Owners are struggling to build PC because of the price in the current market?
- Do you agree that GPU Shortage will ease when cryptocurrency crash
- Do you think Cryptocurrency mining is having a huge impact in Tech industry?
- Crypto mining is becoming a main problem in this shortage?
- When do you think this shortage will end?

DATA ANALYZING METHOD

Data analyzing method used in this research is to first, analyze results collected from interviews, writer will summarize statements from interviews according to the quantity of such statements collected from the interviews, after the first step is done, writer will further analyze data collected from surveys that were spread to forums, the final result will be compared between interviews and surveys to achieve final result of analysist.

FINDINGS AND DISCUSSION

In this chapter we begin to research and analyze data collected through interviews and surveys done by us, first and foremost we will need to look through literatures that correlated to this research after searching through google scholar regarding this research what we found was that the main causes of the Semiconductor shortage are not limited to Cryptocurrency miners, but it is also caused by Covid-19 pandemic which swept all around the world, Semiconductor foundries were forced to reduce staffs attending in fear on covid-19. After the literature review is done, we will begin to interview, firstly we will ask for permission before we began the interviews, however we will not disclose our informant's identity to avoid problems in the future.

Next, we will begin to develop questions for surveys, the questions for the survey are created based on the result of the interview conducted in the previous step, after the questions have been developed, and we will start the survey on Google's platform called google form.After data from the survey had been collected, we will summarize the result of the survey, interestingly, 94.2% of the respondents have heard about Cryptocurrency mining despite of being illegal in Indonesia.

Next, we will question where the respondent currently resides, in the survey conducted most of the respondent came from Southeast Asia with the breakdown of blue representing 60.9% from Indonesia, Brown representing 22.5% from Malaysia, purple representing 7.6% from Singapore totaling to 91% of the total sample. Majority of the respondents agree that Cryptocurrency miners is the main problem GPU is on a shortage represented with these 2 questions with the average of 4.4002 from the scale of 1 to 5.

Respondents also agree that PC components are severely overpriced for regular users, interpreted from these questions below where the average agreeableness is 4.420454545 from the scale of 1 to 5. Surprisingly most of the respondents agree that Cryptocurrency is making a huge impact in the Tech industry as shown in the figure below, which it's impact we will discuss later.

In the last question, we ask the respondents their opinion regarding when will Semiconductor shortage end, 57.8% of the respondents answered 2023+, 40.4% answered soon and a few of respondents have answered with their own opinion such as "depends on the ongoing global shortage of silicon chips" (See Fig. 2) Overall most of the respondents agree to the statements given by suppliers and miners during the interviews except that the question "When do you think this shortage will end", the interview results point towards 2025 to resolve the global shortage, however 40.4% of the respondents answered soon.
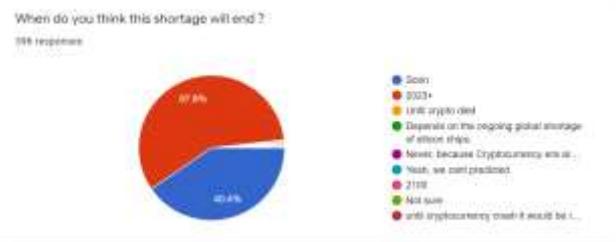
Fig 2. Question "When do you think this shortage will end"

It is undeniable that cryptocurrency miners are one of the main problems of this shortage, we will see in cryptocurrency miner's point of view first, we will test using our current PC (RTX 3080 LHR (LHR= Lite hash rate, NVidia's attempt at countering cryptocurrency miners by reducing its computational power)) how profitable cryptocurrency mining really is.

A single RTX 3080 LHR can produce an average of 69 MHs which translate to 2.5 $ USD per day before power consumption considering the original MSRP (Manufacturer Suggested Retail Price) of 699$ USD, Miners can reach ROI (Return of Investment in less than 1 year (274 days to be exact) which means it is extremely profitable.

Cryptocurrency have had some impacts in the tech industry such as the creation of METAVERSE and NFT (Non Fungible Token) but such innovation is still arguable underwhelming considering not many people know cryptocurrency outside of its speculative value let alone understand it. METAVERSE itself is a network of

connected 3D virtual world where people can explore, buy lands and trade. Hypothetically it is the iteration of internet as a singular universal virtual world which is facilitated by VR (Virtual Reality) Headset to explore the vastness of this universe.

NFT(Non Fungible Token) are cryptographic tokens and can be minted by using cryptocurrency (Ethereum) as Gas fee, the difference of NFT and cryptocurrency is: Cryptocurrencies are fungible that means if you exchanged your for example bitcoin with someone, some amount of bitcoin would still remain, there is no difference between one bitcoin and another, In the other hand NFTs are Non fungible which means each NFT is unique and that token prove that you are the sole ownerships rights over a digital asset for example Bored ape NFTs one of the highest priced NFTs series that cost over 200k USD$ to own one.

The dynamic of creating an NFT is simple, you just had to go to one of the marketplace of the digital art to mint one, once minted on Ethereum network, and the NFT is presented on the public ledger that can't be changed. By owning the token means you have the full ownership over the respective NFT, in the online community there are nothing stopping people from copying, viewing and sharing digital art, however with the advent of NFT they cannot fake and claim ownership over of the art anymore.

LIMITATIONS

- Due to the Covid-19 Pandemic, we cannot directly conduct interview to the suppliers and miners because of covid-19 fears, therefore the number of informants is limited.

- During observation period we encountered some obstacles, where we had difficulty contacting several cryptocurrency miners and asking for picture to support this research because of privacy reasons, therefore we cannot provide pictures of cryptocurrency miners due to privacy reasons.

FUTURE WORKS

The research of "Cryptocurrency mining effects analysis on semiconductor shortage on PC owner community" is far from perfect, however in the future we plan to do more research regarding

blockchain and recently created NFT (Non-Fungible Token).

CONCLUSION

After conducting research regarding Cryptocurrency shortage, we can conclude that: Cryptocurrency miners was one of the main problems in this shortage, however the COVID-19 pandemic also play a huge role contributing to this shortage, as semiconductor foundries reduce their number of staffs due to Covid-19 fears, production begin to lag thus the production cannot meet the demand, causing worldwide shortage, however GPU Manufacturer such as NVIDIA had been trying to counter this problem by introducing their LHR(Lite Hash Rate) RTX 3000 series lineup however this all in vain because it only took cryptocurrency miners 2 months to unlock 75% such limitation in the GPU.

REFERENCES

Auer, R. (2019). Beyond the Doomsday Economics of "Proof-of-Work" in Cryptocurrencies. *Federal Reserve Bank of Dallas, Globalization Institute*, *2019*(355). https://doi.org/10.24149/gwp355

Chowdhury, M. J. M., Colman, A., Kabir, M. A., Han, J., & Sarda, P. (2018). Blockchain Versus Database: A Critical Analysis. *Proceedings - 17th IEEE International Conference on Trust, Security and Privacy in Computing and Communications and 12th IEEE International Conference on Big Data Science and Engineering, Trustcom/BigDataSE 2018*, 1348–1353. https://doi.org/10.1109/TrustCom/BigDataSE.2018.00186

Ekparinya, P., Gramoli, V., & Jourjon, G. (2019). Impact of man-in-the-middle attacks on ethereum. *Proceedings of the IEEE Symposium on Reliable Distributed Systems*, *2019-Octob*, 11–20. https://doi.org/10.1109/SRDS.2018.00012

Eyal, I. (2021). *On Cryptocurrency Wallet Design*. https://edition.cnn.com/2021/02/08/investing/tesla-bitcoins/index.html

Hajdu. (2021). *COVID-19 pandemic and managing*

supply chain risks: NVIDIA's graphics card shortage case analysis. Satakunta University of Applied Sciences.

Islam, M. R., Al-Shaikhli, I. F., Nor, R. M., & Mohammad, K. S. (2018). Cryptocurrency vs fiat currency: Architecture, algorithm, cashflow & ledger technology on emerging economy subtitle: The influential facts of cryptocurrency and fiat currency. *Proceedings - International Conference on Information and Communication Technology for the Muslim World 2018, ICT4M 2018*, 69–73. https://doi.org/10.1109/ICT4M.2018.00022

Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. *Business and Information Systems Engineering*, *59*(3), 183–187. https://doi.org/10.1007/s12599-017-0467-3

Szalachowski, P., Reijsbergen, D., Homoliak, I., & Sun, S. (2019). StrongChain: Transparent and collaborative proof-of-work consensus. *Proceedings of the 28th USENIX Security Symposium*, 819–836.

Wibowo, T., & Christian, Y. (2021). Usage of Blockchain to Ensure Audit Data Integrity. *EQUITY*, *24*(1), 47–58. https://doi.org/10.34209/equ.v24i1.2357

Wilson, L. (2021). *GPU Prices and Cryptocurrency Returns*.