Research Internship Project plan

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1 Where?

Institute for Computing and Information Sciences (ICIS), Radboud University, Nijmegen

2 (Daily)Supervisor

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3 Context

Distributed ledger technologies like Blockchain are widespread nowadays. Among many advantages, one of the key concepts is relying on a (often computationally intensive) consensus protocol as mean to accomplish trust. When we look at the Bitcoin cryptocurrency system which uses a proof-of-work consensus algorithm at its core, we see that the combined computational power has increased dramatically over the last few years [1]. At the same time, the energy usage of Bitcoin has been a point of debate with numerous estimates being made. A recent estimate in a paper by Vranken [2] estimates a total energy usage of 100 MW - 500 MW.

The second largest Blockchain technology is Ethereum, which is different from Bitcoin as it facilitates execution of so-called Smart Contracts. Smart Contracts are pieces of code whose correct execution is also enforced by a proof-of-work consensus algorithm but is estimated to consume around 10 times as little energy as Bitcoin [3]. The Ethereum system therefore differs from Bitcoin and estimates of its power usage, let alone a model for its energy usage has not yet been clearly defined or are based upon highly debated models [4]. The latter will be the focus of this research internship. By looking at available literature on the subject, a mathematical model will be constructed to determine or estimate the total power consumption of the Ethereum system.

4 Research Activities

For now:

- Literature review
- Defining a mathematical model of the energy usage of Ethereum

Possibly later:

- Doing measurements using an experimental setup
- Validation of the mathematical model

5 Planning

For now, an estimate of the amount of time literature review will consume is approximately 1,5 weeks: 60 hours. From there the next activity will take place which is defining a mathematical model from which it is not yet clear how much time this will consume. The total amount of hours in the scheme below amounts to 420 hours (15 ec).

Week 48		**Week 49**		**Week 50**		**Week 51**	
Day	**Hours**	**Day**	**Hours**	**Day**	**Hours**	**Day**	**Hours**
Mon	8 hours	Mon	8 hours	Mon	8 hours	Mon	8 hours
Tue	8 hours	Tue	8 hours	Tue	8 hours	Tue	8 hours
Wed	8 hours	Wed	8 hours	Wed	8 hours	Wed	8 hours
Thu	8 hours	Thu	8 hours	Thu	8 hours	Thu	8 hours
Fri	8 hours	Fri	8 hours	Fri	8 hours	Fri	8 hours

Week 52		**Week 1**		**Week 2**		**Week 3**	
Day	**Hours**	**Day**	**Hours**	**Day**	**Hours**	**Day**	**Hours**
Mon	Holidays	Mon	Holidays	Mon	8 hours	Mon	8 hours
Tue	Holidays	Tue	Holidays	Tue	8 hours	Tue	8 hours
Wed	Holidays	Wed	Holidays	Wed	8 hours	Wed	8 hours
Thu	Holidays	Thu	Holidays	Thu	8 hours	Thu	8 hours
Fri	Holidays	Fri	Holidays	Fri	8 hours	Fri	8 hours

Week 4		**Week 5**		**Week 6**		**Week 7**	
Day	**Hours**	**Day**	**Hours**	**Day**	**Hours**	**Day**	**Hours**
Mon	8 hours	Mon	8 hours	Mon	8 hours	Mon	8 hours
Tue	8 hours	Tue	8 hours	Tue	8 hours	Tue	8 hours
Wed	8 hours	Wed	8 hours	Wed	8 hours	Wed	8 hours
Thu	8 hours	Thu	8 hours	Thu	8 hours	Thu	8 hours
Fri	8 hours	Fri	8 hours	Fri	8 hours	Fri	8 hours

Week 8	
Day	**Hours**
Mon	8 hours
Tue	8 hours
Wed	8 hours
Thu	8 hours
Fri	8 hours

References

[1] Hash rate. `https://www.blockchain.com/charts/hash-rate?timespan=all`.

[2] Harald Vranken. Sustainability of bitcoin and blockchains. *Current opinion in environmental sustainability*, 28:1–9, 2017.

[3] Ryan Cole and Liang Cheng. Modeling the energy consumption of blockchain consensus algorithms. In *2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData)*, pages 1691–1696. IEEE, 2018.

[4] Ethereum energy consumption index (beta). `https://digiconomist.net/ethereum-energy-consumption`.