Positive Energy Worker

Autonomous Positive Energy Machine Running on The Blockchain

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General Introduction

Whether we are online shopping, streaming videos or reading the feed on social media, every internet activity involves huge amounts of data that needs to be stored and processed somewhere. Datacenters are there all over the word to accomplish this mission. They have already spread from virtually nothing 10 years ago to consuming about 3 per cent of the global electricity supply and accounting for about 2 per cent of total greenhouse gas emissions. That gives it the same carbon footprint as the airline industry[1].

“ *If we carry on going the way we have been it would become unsustainable – this level of data centre growth is not sustainable beyond the next 10 to 15 years. The question is, what are we going to do about it?* ”

Professor Ian Bitterlin [1]

We have already improved everything around compute architecture, the only thing left to improve is the compute side of the equation. It’s either a breakthrough in our perspective about it, or we need to get deadly serious about doubling the number of power plants on the planet. One way to curb their carbon footprint is to increase the amount of renewable energy they use. But even if the industry was able to shift to 100 per cent renewable electricity, the volume of energy they would need would put intolerable pressure on the world’s power systems. So which way the industry decides to go could have a huge bearing on whether renewable energy receives the huge investment that drives innovation – bringing down the cost of green electricity to everybody’s benefit. It could also play a large role in determining whether the world can avoid the worst ravages of global warming.

[1] Professor Ian Bitterlin is a Chartered Engineer with more than 25 years’ experience in data-center power and cooling, CTO of Emerson Network Power Systems in EMEA and a Visiting Professor at University of Leeds in the School of Mechanical Engineering.

In this context, this project, originally suggested by iExec, is performed as part of the preparation to obtain the computer science engineering degree from the Faculty of Mathematical, Physical and Natural Sciences of Tunis, University of Tunis ELMANAR, Tunisia. It aims to suggest a solution to this problem in an innovative approach by embracing Edge computing concept combined with solar energy.

This report illustrates the work that has been done, from design to requirements and implementation. Those topics are covered in five chapters, we start by contextualizing the project and discussing the state of the art with a comparison between our perspective and some existing ones. Then, we present the different requirements and technical specifications which leads us to the implementation details. Finally we conclude and suggest some improvements to the current limitations.

Chapter 1

Project Context

1.1 Introduction

The aim of this chapter is to contextualize the project by giving its background, to present the host company and to define in a later section the main problem as well as the way we adresse it.

1.2 Project Background

This project is about desining and implementing a positive energy worker. A Raspberry Pi based system that powers iExec's infrustructure and serves - at the same time - as an IoT device to embraces the Edge computing concept. It is achieved in the context of the preparation of the end of studies project submitted to obtain computer science engineering degree.

1.3 Host company

Fig. 1.1 iExec's logo

Started in 2016, iExec[2] was co-founded by Dr. Gilles Fedak and Pr. Haiwu He.
Ph.D, CEO and Co-Founder, Dr. Gilles Fedak has been a permanent INRIA research scientist since 2004 at the ENS in Lyon, France. His research interests lie in Parallel and Distributed Computing, with a particular emphasis on the problematic of using large and loosely-coupled distributed computing infrastructures to support highly demanding computational and data-intensive science. He co-authored about 80 peer-reviewed scientific papers and won two Best Paper awards. Pr. Haiwu He, Ph.D, Co-Founder and Head of Asian-Pacific Region was a research engineer expert at INRIA Rhone-Alpesin Lyon, France from 2008 to 2014. He has published about 30 refereed journal and conference papers. His research interest covers peer-to-peer distributed systems, cloud computing, and big data.

iExec aims at providing decentralized applications running on the blockchain a scalable, secure and easy access to the services, data-sets and computing resources they need. This technology relies on Ethereum smart contracts and allows the building of a virtual cloud infrastructure that provides high-performance computing services on demand.

iExec leverages a set of research technologies that have been developed at the INRIA and CNRS research institutes in the field of Desktop Grid computing. The idea of Desktop Grid (aka. Volunteer Computing) is to collect the computer resources that are underutilized on the Internet to execute very large parallel applications at the fraction of the cost of a traditional supercomputer. iExec relies on XtremWeb-HEP[3], a mature, solid, and open-source Desktop Grid software which implements all the needed features: fault-tolerance, multi-applications, multi-users, hybrid public/private infrastructure, deployment of virtual images, data management, security and accountability, and many more.

iExec is developing a new Proof-of-Contribution[4] (PoCo) protocol, that will allow off-chain consensus. Thanks to the Proof-of-Contribution, external resource providers will have the usage of their resources certified directly in the blockchain.

iExec aims to deploy a scalable, high-performance, secure and manageable infrastructure sidechain that will promote a new form of distributed governance, involving key HPC, big data and cloud industry leaders.

iExec is using its ERC20-compliant token to provide standard and secure payments. RLC[5] which stands for "Run on Lots of Computers", can be securely and easily stored, transferred, traded, divided and used to make payments. This widely adopted cryptocurrency (87 million RLC are currently in circulation) is used to access all iExec's services.

From a research project, iExec is now a company, whose headquarters are in Lyon, France, with a subsidiary in Hong Kong.

1.4 Problematic

With the huge increase of human dependency on Information Technology for even daily activities, comes the massive consumption of electricity. In 2016, global data centers used roughly 416 terawatts (more than 90 billion kilowatt-hours for just U.S. data centers) or about 3% of the total electricity in terms of percentage, which is nearly 40% more than the entire United Kingdom. Predictions have shown that this consumption will double every four years[6].

As processing-power demanding technologies like artificial intelligence and blockchain have been appearing, the network of data centers that have sprung up in the past decade will spread. Moreover, internet-connected devices is changing the entire landscape because IoT is projected to exceed 20 billion devices by 2020. Given there are currently 10 billion devices, doubling that will require huge increases to our data center infrastructure, which will massively grow our electricity consumption, and that is just adding fuel to the fire.

There has been some trials to remedy the situation such as using other alternatives to silicon in data storage and counting on virtualisation to reduce the use of physical machines, but all of that still can not keep up against the extreme consumption rate.

1.5 Suggested Solution

- use IoT devices in the right way - Idle IoT devices - Multi-functionality IoT devices
  - totally green
  - Trend to Edge computing

1.6 Adopted Methodology

- To Do

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General Conclusion And Perspectives

References

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[2] iExec https://iex.ec.

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[4] PoCo https://iex.ec/news_categories/poco-series/.

[5] RLC token https://iex.ec/rlc-token/.

[6] Radoslav Danilak. Why energy is a big and rapidly growing problem for data centers. *Forbes*, December 2017.
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