Green IT - Why Should We Care?

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Abstract. Recent years saw an incredible amount of breakthroughs in a wide range of fields. Computer Science, perhaps the quintessential example of such innovations, relies heavily on what computers can do and what their many advantages are. It is due to such dependency, that, like it, other areas in the IT domain are seeing an increased level of concern regarding the byproducts of computers. Namely, their energy consumption and environmental threats. The present work, then, focuses on explaining the concepts behind an alternative to the traditional paradigm in computing, as well as, providing a look into real world scenarios that make a strong argument in favour of such alternative.

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1 Introduction

Green Information Technology is one of the branches of information technology and focus on optimising the usage of technological resources, while making the lowest possible impact on the environment.

Instead of formulating laws, Green IT tries to encourage manufacturers by designing guidelines. For example, replacing hazardous materials by biodegradable ones. Instead of throwing away used product, it is possible to replace damaged part by new ones and re-sell the device, or donate it to people in need.

In 1992, the American program Energy Star was born. The team was composed by volunteers and had the goal of identifying efficient product. By using the Energy Start catalogue, manufacturers could save money, while reducing gas emissions.

2 Fundamental Concepts

The focus of the present section lies upon the following realisation: Green IT does not contemplate just one fundamental concept, but rather, many intertwined aspects. Therefore, the following paragraphs will serve the purpose of highlighting those aspects and what they ultimately mean.

Reduction in Energy Consumption This aspect could be considered the strongest argument in favour of green alternatives. Computers, and their usually associated infrastructures, consume immense amounts of energy. The situation has been overlooked by what computers make possible and their cost is often considered a necessary evil [7]. Unfortunately, the IT *status quo* will not be sustainable for future generations, already playing a major role in how much electricity we consume worldwide. Taking the Internet as an example, this marvel of engineering is responsible for, roughly, 70 billion kilowatt-hours worth of energy, in a single year [4]. Despite being a massive number, it comes really short of a decent approximation with all things considered (datacenters, personal/work computers, etc...).

Efficient Recycling of Electronics Electronic waste is, like most other forms of material waste, a big concern in developed countries and, particularly, in developing countries. The situation, will, probably, get worse before it gets better, as any potential solution will likely take years to reach tangible results. Nonetheless, Green IT encompasses these efforts to reduce the ecological footprint left by electronic hardware and its plethora of reusable components. More specifically, metals (including harmful ones, like lead and beryllium), plastics and other pollutants [1]. Moreover, recycling used electronics (e.g. computers, phones, tablets, etc...) would be beneficial even if we only cared about financial reasons: recycling goods could help alleviate the costs of manufacturing new products.

Deployment of Virtualisation Techniques Virtual environments are extremely useful when another machine becomes useful for a given task. Instead of resorting to an actual system, a virtual one could be used. Such setup could consume more power (i.e. running one or more virtual machines can be a heavy workload) and the performance would not match, by definition, that of a real counterpart. In spite of these somewhat negative aspects, virtualisation brings about some really compelling upsides, namely, reduced waste and more efficient use of existing resources. The former is obvious (one machine simulating a handfull of others will, likely, produce less physical waste) and the latter is intuitive (instead of buying or allocating other machines, we can make use of the one we, presumably, already have and it should still work just fine).

Adoption of Cloud Computing Perhaps the latest addition to the core concepts of Green IT, the use of Cloud solutions has rapidly grown in both quality and quantity. The biggest platforms in this space are Microsoft Azure, Amazon AWS, IBM Cloud and Google Cloud. The advantages of opting for these techniques include their storage capacity, increased computational prowess and other commodity features (e.g. quantum computing, AI services, etc...). Additionally, there are free trials that allow the company/team to assess the usefulness of these solutions, and, when it is time to pay, the actual fees are likely much lower than the costs of running equivalent hardware and software onsite.

3 Main Obstacles and Benefits

As it, hopefully, became clear so far, Green IT has serious potential in many areas and its fundamental concepts are well established. Despite this, certain obstacles persist between these technologies and widespread adoption. Therefore, the present section will focus on presenting those obstacles and, on the other hand, the benefits that Green IT could bring [5].

Main obstacles:

- **Initial investment**: certain technologies (like cloud services or equipment needed for green solutions) can, and probably will, be seen as an undesirable initial investment (although, the benefits in the long-term outweigh the short-term setback).
- **Resistance to accept a new paradigm**: employees and employers may see a shift to green solutions as completely unnecessary, preferring the *status quo*.
- **Challenge of redesigning processes**: like any other fundamental change, adopting green technologies can prove challenging due to the highly probable redesign of existing processes and protocols (especially in companies or environments with older technologies deeply rooted).
- **Lack of incentives**: a potential impeding factor can be the lack of incentives (financial or otherwise), which would go along way in promoting the adoption of the techniques mentioned in the present document.

Main benefits:

- **Compliance with formal regulations**: if going green is not motivated by a genuine desire to do so, investing in such technologies can be essential to follow regulations set by the official authorities.
- **Improved efficiency**: as mentioned before, virtualisation and cloud computing are efficient ways of using existing resources, by doing more with them than ever before (i.e. beyond the actual computational power of said resources).
- **Good public relations**: a company that is seen by the public as being environmental friendly, could have a competitive advantage, making future customers more inclined towards such company.
- **Modernisation of the business model**: new technologies often require the rethinking of existing infrastructures, leading to their modernisation, greatly benefiting the business model (i.e. possible gains in speed and/or ability to fulfil the customers' needs).

4 Real Use Cases

As the times passes, more and more companies and organisations are trying to incorporate green fundamentals in their business. This kind of approach tends

to benefit not only the environment and the planet, but also the manufactures and consumers. In this sections, we are going to see some examples of real world green IT applications.

Real World Examples:

- **Coca-Cola Enterprises:** in 2013, Coca-Cola Enterprises took action in its IT sector [6]. The plan targeted two major consumption sources, the employees and the devices used by them. For the first, a course on green IT was created, where staff would learn consumption-aware habits. For example, when taking off the laptop from the dock, they should turn-off the monitor. For the second, searching to minimising the footprint made by each device. Here, the company replaced high-consumption by low-consumption devices, as an example switching from a laptop to a tablet, and automating switching was implemented, where gear that was inactive for a given time, would automatically be turned off.

- **Computer Aid:** This foundation aims to bring technology to people that, without their help, wouldn't be able to access it [2]. Their *modus operandi* consists of cleaning all the data, refurbish and, finally, reuse devices from donations made by companies. This idea merges the world of social dynamics and ecology to bring a wise usage of resources, while providing means for third world country to have access to 21st century technology.

- **Apple:** this multi-billion dollar company aims to become carbon neutral by 2030 [3]. One of the company's goal is to have a fully green development cycle. In order to achieve this, they recycle parts of old devices to build new ones. The same happens to the carrying package. For example, in their website, the company states that all the models of iPhone 11 were made from 100% recycled rare materials and their packaging uses 60% less plastic, when compared to data from 4 years.

5 Conclusion

When developing new methods and technologies, the first goal is, obviously, to build a solution that works. Such solution can, unfortunately, be extremely heavy in terms of the resources used, like time, energy, or even amount of processing. After meeting the efficacy part, a search for efficiency usually follows. This analogy serves to picture the current state of Information Technologies.

In this current century, it is possible to do almost anything, but the problem surges as "at what cost?". Generally speaking, the cost sometimes is cheap for the end user, but heavy to the environment. Green IT arises as the scope needed to elevate a given solution. If it is possible to build the same product, but using recycled materials, then the second option should always be preferred. Furthermore, instead of throwing devices away, why don't we donate them to people in need?

This new set of guidelines will lead the new revolution in IT. Innovative programs that encourage companies to go green are being created and, even though sometimes such programs don't exist, people are starting to become aware of environmental crises and taking on the "green transformation".

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