INTERNATIONAL JOURNAL OF FRONTIERS IN SCIENCE AND TECHNOLOGY
www.ijfstonline.org

Research Article

ISSN 2321 – 0494
Indexed in CAS, OPEN J-gate and GOOGLE SCHOLAR
Received on: 22.12.2017, Revised and Accepted on: 10.1.18

IMPROVING THE ENVIRONMENTAL SUSTAINABILITY OF CLOUD INFRASTRUCTURES

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Abstract

Information and communications technology (ICT) as a key enabler in addressing the daunting energy and climate challenges the world faces. Smart 2020, an influential report by The Climate Group, found that the use of ICT could help society reduce its CO_2 emissions by approximately 7.8 giga tons in 2020. This would be the equivalent of 15% of global emissions, an amount greater than the current total emissions from the United States. The emergence of cloud computing, providing individuals and organizations with hosted computing services over the Internet, can play a major role in contributing to environmental sustainability. First, cloud computing enables reductions in cost and energy consumption by moving computing from on-premise servers to data centers optimized for energy efficiency. It also reduces barriers to develop innovative environmental solutions by allowing organizations flexibility to scale up their needs based on what they require without investing in additional IT infrastructure. Perhaps most importantly, the cloud allows government agencies, environmental organizations, utilities and other business to focus on ways to reduce environmental impacts without worrying about maintaining the servers and IT infrastructure to accomplish that.

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1. Introduction

Green power generation, the direct carbon footprint of the ICT sector is dominated by electricity consumption, so an obvious way to reduce emissions is to use as much electricity as possible from renewable sources. ICT companies can do this by purchasing renewable electricity, by installing renewable generation on their sites and by making renewable electricity integral to their products. The sector can also encourage policy makers to create the right regulatory and fiscal environment to encourage investment in large-scale renewable generation as this will ultimately lead to a reduction in the "in use" phase of the ICT product life cycle.

Data centres In the "information age" there is a vast amount of data that is stored and instantly made available upon request. This has led to a vast increase in the number of data centres – buildings that house a collection of servers, storage devices, network equipment, power supplies, fans and other cooling equipment – which provide information at our fingertips, supplying business, government, academia and consumers around the world.

2. Carbon Footage

In 2002, the global data centre footprint, including equipment use and embodied carbon, was 76 Mt CO_2e and this is expected to more than triple by 2020 to 259 Mt CO_2e – making it the fastest-growing contributor to the ICT sector's carbon footprint, at 7% pa in relative terms is shown in Figure. 1. Calculating the data centre footprint in 2020 If growth continues in line with demand, the world will be using 122 million servers in 2020, up from 18 million today. In addition to this 9% pa increase in server numbers, there will be a shift from high-end servers (mainframes) to volume servers, the least expensive kind of server that can handle much of the computational needs of businesses. Row A of Figure. 1. shows the increase in footprint that would be expected by simply scaling up today's data centre technology without the application of virtualisation technologies in data centres. Power consumption differs by server type but, like PCs, no increase in overall consumption is expected in the coming years, in spite of increased processing demand. This is due mainly to new technologies in all types of servers and explains the net zero change in Row B. A major trend driving down the overall growth in the footprint of data centres (Row C) is virtualisation – pooling assets such as computing and storage where utilisation is low, so they can be used across the enterprise and beyond. Virtualisation represents a radical rethinking of how to deliver the services of data centres, pooling resources that are underutilised and could reduce emissions by 27% – equivalent to 111 Mt CO_2e. Technologies are also available to detect where within the data centre temperatures are running high and to direct cooling to those areas thus delivering a 12% reduction in cooling costs.

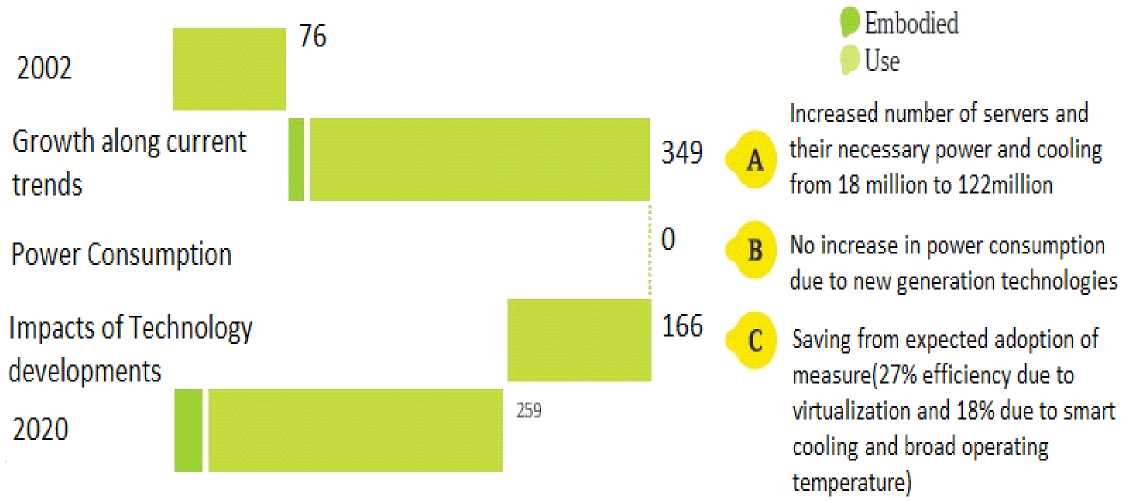

Figure: 1 Global Data Center Carbon Footprint

By 2020, the analysis predicted that these measures could achieve an approximate 18% reduction (55 Mt CO_2e) in consumption. Only about half of the energy used by data centres powers the servers and storage; the rest is needed to run back-up, uninterruptible power supplies (5%) and cooling systems (45%). There are a number of ways to reduce this energy overhead, some of which are expected to be adopted by 2020. The simplest way is to turn down the air conditioning. Similarly, in climates where the outside temperature allows, simply directing external air into the data centre can save cooling costs for much of the year. By allowing the temperature of the data centre to fluctuate along a broader operating temperature range, a 24% reduction in energy consumption from cooling is possible. Distributing low voltage direct current (DC) into the data centre would eliminate the need for mechanical back-up, uninterruptible power supply units. By 2020, the net footprint for data centres is predicted to be 259 Mt CO_2e. At this point, volume servers will represent more than 50% of the data centre footprint (174 Mt CO_2e) and cooling systems for data centres alone will amount to 4% of the total ICT footprint which is shown in Figure. 2.

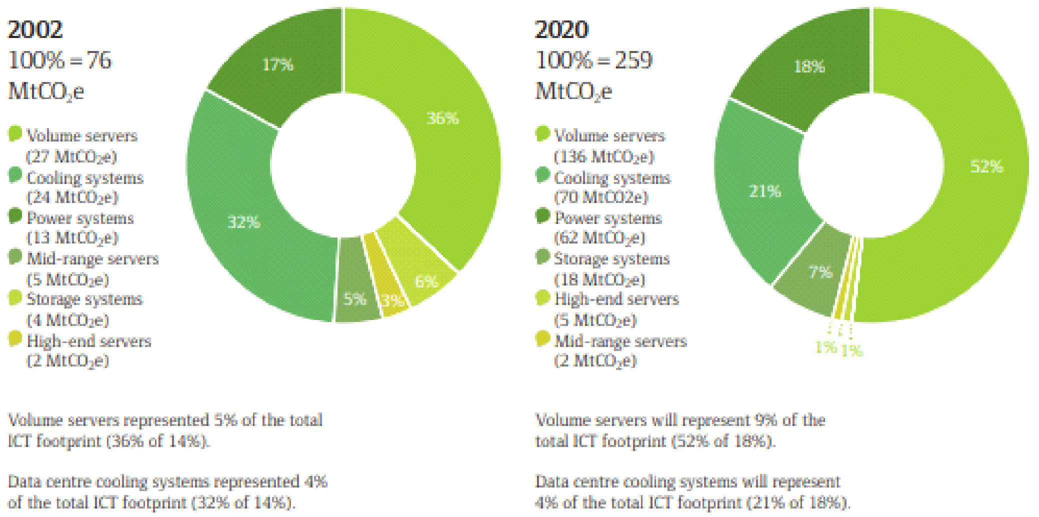

Figure 2: Composition of Data Center Footprint

3. Methods to Reduce Carbon Footage

Though it may be possible to achieve 86% efficiency in one data centre by more efficient virtualisation architectures and changing the data centre location to reduce cooling needs, adoption of best practice has its challenges. And, although the cost of energy is high, companies are not often organised so that the person paying for the IT equipment is also paying for the energy consumption of that equipment. However there is a significant consolidation trend that may help in dealing with the existing or legacy data centre impact. Also, organisational attitudes are changing as costs of operating a data centre surpass the initial investment in equipment and as the data centre operation becomes a larger share of a company's overall energy costs. Companies now have a number of options for computing services, which shift costs from the enterprise to an external provider that can potentially deliver these capabilities with economies of scale and at higher energy efficiency. The "software as a service" business model allows companies to access key enterprise applications such as customer relationship management databases or collaboration tools via a web browser, with no need to host their own data centre facilities. Companies can also pay to use server space on demand to build their own applications and websites, the way one would pay monthly for electricity or water, known as “utility computing”. These are both simple examples of what is more generally called “cloud computing”, centralised and highly scalable services that could lead to further capacity to virtualise or consolidate resources with breakthrough gains in energy efficiency. Predicting the pace and intensity of these virtualisation trends is difficult, but the industry is well aware of the huge efficiency opportunity. Initiatives such as the Green Grid, a global consortium dedicated to data centre efficiency and information service delivery, working towards new operating standards and best practices, has attracted support from the industry.

4. Smart Framework

Smart Framework is a low carbon infrastructure This framework set out below outlines what needs to happen for this reduction in emissions to be realised.

- **Standardise:** Develop protocols to enable smart systems to interact
- **Monitor:** Make energy and carbon missions visible
- **Account:** Link monitoring to accountability and organisational decision making
- **Rethink:** Optimise for energy efficiency and find alternatives to high carbon growth
- **Transform:** Implement low carbon infrastructure solutions across all sectors at scale.

Standardize

Ensure that the standards organisations working in the ICT industry bring climate change considerations into their existing work. Energy consumption should be an important component of all ICT technical standards. Ensure standardisation of measurement methods across the whole life of products and services to understand emissions from raw material extraction, through manufacturing, in use and from final disposal.

Monitor

Use ICT technologies to monitor energy consumption of ICT products and networks and feed the information back into technology optimisation. Ensure that the monitoring is consistent throughout companies. Monitoring devices and tools for power management should be required as standard. Remote monitoring and control of systems should be applied wherever appropriate. Account Make energy and emissions transparent all along the supply chain by reporting and labelling. Use this information to optimise products and services in each innovation cycle. Incorporate the cost of carbon into current decision making processes to future proof the cost of manufacturing and operating new products and services, in preparation for having an enforced cost of carbon in the future.

Rethink

The sector needs to continue to rethink and research radical innovation across high emission devices and services. The information above will enable the sector to optimise its own operations and product development for energy reductions.

Transform Systematically follow best practice for rollout of new products. Transform the ICT sector to an exemplar of low carbon technology. Source low carbon power wherever possible and in particular support the use of renewable energy. ICT companies can also use their own products to demonstrate where dematerialization is possible.

Conclusions

The fundamental key to a sustainable cloud environment is a usage of renewable energy and improving the over all efficiency of the system. If Data centers are already to move in the renewable source power regions that definitely reduce not only the cost and also to reduce carbon footage by trillion metric tons. The cloud infrastructure allows the firm to reduce the power consumption which minimize their environmental impacts which inturn improves the performance and efficiency of the firm.

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