Estimating and Mitigating the Footprint of ICTs

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I. Introduction

Climate change is recognized as one of the biggest challenges of our society. ICTs offer well-known solutions such as teleconferencing and teleworking that allow for massive CO_2 emission reductions. On the other hand the energy footprint of ICTs is unsustainable[1]. Studies indicate that the share of the use phase of ICT in the worldwide energy consumption is close to 3%. [2][3]

In this paper we will discuss how the energy footprint of ICT's should be estimated and mitigated. We will demonstrate these mitigations by the example of thin clients.

II. Estimating the ICT Footprint

We estimated the current ICT energy footprint and its growth rate. This leads to the forecast depicted in Figure 1. With 156W ICTs currently consume about 8% of the annual electricity production or 2.5% of the overall annual energy production. In 2020 this figure will be closer to 500GW. Considering the estimated growth rate of the electricity production this will lead to a fraction of 14% of the global electricity production.

These figures only consider the power consumed using the equipment. The manufacturing process is hereby not accounted for. This is an important fraction as well. When we look at a desktop PC the energy consumed during manufacturing is about the same amount as the energy consumed during four years of its use phase.

Additionally it is important to note that the ICT footprint is evenly distributed over different categories. Reducing the footprint will required a holistic approach where power

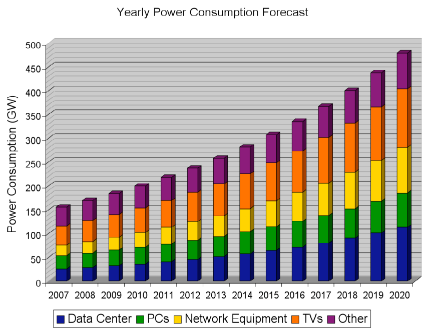

Figure 1 Forecast of ICT energy footprint 2007 - 2020

consumption in the data center, the network and at the user premises will need to be evaluated before a solution can be rated as energy efficient.

III. Mitigating the Energy Footprint

We see tree area's on which to focus in order to reduce this impact.

A. Individual devices.

Reducing the footprint of the individual devices will obviously reduce the footprint of ICTs. This can be achieved by reducing the power consumption and increasing the use phase in the life cycle.

Technically improvements are possible on hardware and software level. One can build hardware that can easily be put in sleep mode and woken up again. Thus a lot of idle state power consumption is reduced.

On the software level a typical example are operating system upgrades that always require higher resources. If these requirements were better kept under control PCs would be less power consuming and would have longer life times.

B. *New network Paradigms*

Reducing the impact of the individual components can only take you so far. One must also assure that the components are being used in their most efficient way. New network paradigms that take energy efficiency and longer equipment lifetimes into account are therefore required. An example is the thin client paradigm that will be discussed in the next section.

C. *Policy Supporting Studies*

In order to assure the above mentioned mitigations are implemented a next step is required as well. Studies on the proposed solutions will lead to standards in measuring the impact and associated benchmarks setting goals for the industry. These benchmarks can be adopted by governments or labeling organizations (e.g. Energy Star).

IV. The Thin Client Paradigm

In this section we will demonstrate that the thin client paradigm is a clear example of a more efficient network paradigm. We consider two scenarios. On the one hand we have a traditional desktop where each user is running a standalone application on a standard PC. In the second scenario the desktops are replaced with thin client terminals and the applications run remotely on servers in the data center. We will demonstrate that this is a more energy efficient solution. Moreover the requirements for the terminals are less stringent and servers are typically a lot more powerful than desktop PCs. This leads to longer life cycles for the individual devices.

Figure 2 displays the results of an analytical analysis we performed evaluating the power efficiency. We evaluated R, which is the power consumption of a desktop divided by the power consumption of a thin client setup for one user. One can see that the more sessions we share on one server – share ratio N – the more power efficient the solution becomes. Contrary as one might expect the PON (Passive Optical Network) technology is the least power efficient. This is due to the high power consumption in the user's network termination (12W) compared to ADSL2 (1.5W) and VDSL2 (6.0W).

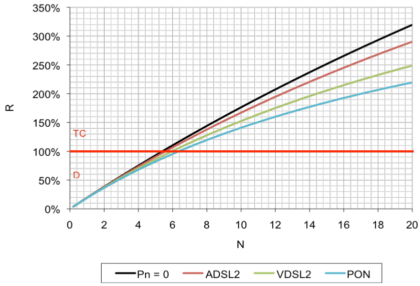

Figure 2 Power efficiency of thin clients in function of the share ratio N

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