

Chapter 37

Low Power Techniques for Greener Hardware

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ABSTRACT

The last two decades have seen an exponential growth in the fields of electronic communication and information technology. Not surprisingly, ICT devices have become an integral part of our daily life. As demands for the development of more compact and versatile devices arise, there is mounting pressure on the designers to efficiently use the available resources. The new age ICT has become a matter of serious concern for the environment due to increased power consumption by the devices, the backbone infrastructure and eventual electronic waste disposal. This chapter describes techniques to reduce power consumption in ICT by reducing power at the very basal level of usage, which is the hardware. Careful architecture and design in hardware that keeps the principles of carbon reduction in mind can not only increase the efficiency of the device but also help in making it a green device. The primary focus of the chapter is to reduce the power utilized in the computation part of the device. The chapter also provides a background to other studies being carried out to reduce power consumed by the device as a whole.

INTRODUCTION

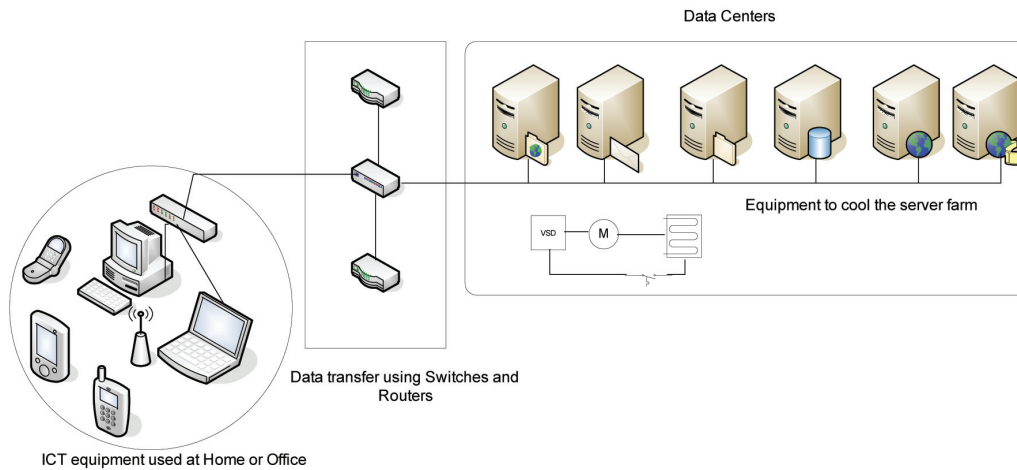
The use of Information and Communication Technology (ICT) has grown manifold in the past decade. ICT technology and devices have, due to extensive networking, made the world smaller.

The large proliferation of these devices has led to considerable power consumption. One approach towards greener ICT is to optimize the power consumed by numerous ICT devices around us.

Examination of the overall structure of IT usage in daily life leads to its categorization into two areas – Personal resources and Common resources. Personal resources include mobile

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Figure 1. Commonly used ICT equipments and information flow



phones, desktops, laptops, palmtops, PDAs etc. to name but a few. Common resources comprise of bigger infrastructural elements like routers, network switches, enterprise servers, server farms for data centres and so on. Most of the above mentioned devices are digital devices or contain large sections of digital hardware and they are shown in Figure 1. The feature additions to the electronic gadgets and the processing requirements of large systems have made it almost mandatory to design and develop hardware which consumes less power, making power a primary design constraint for digital designs at all levels.

We shall discuss the basic techniques of power reduction in both these categories of IT devices.

PERSONAL ICT DEVICES

Personal ICT devices include desktops, laptops, mobile phones, PDAs etc. The operation of personal ICT devices can be simplified into three main functions: Communication, Computation and User interface. As the size of these devices keeps shrinking, the demand for reducing the power consumption keeps increasing.

These devices are widely used in today's IT age. As the technology advances, these devices have evolved into stand-alone electronic equipments encompassing several applications. Consider a normal mobile phone that has now become an integral part of ICT system and human life. The same phone before a decade was used as a communication equipment, providing some basic features like phone number memory, call list and some basic settings. Today, mobile phones possess several features and are used for purposes ranging from communication to entertainment to health care. All these features require a fairly large amount of hardware. The shrinking chip geometries and the Very Large Scale Integration (VLSI) industry following the Moore's law have been the basis for all the exponential growth that these ICT devices have registered.

However, with the increasing need for hardware, these devices also need processors which are low power, especially because these are battery powered. The battery size is also a concern for making compact mobile phones. To support a large number of features, a high-performance processor is required.

Similarly, in case of other personal ICT devices like desktops and laptops, there have been similar trends and these devices have a need of

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