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Smartphone's Hardware Architectures and Their Issues

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Abstract
Smart phones provides us the capability of a typical computer with absolute mobility and small form factor. But the hardware architecture of smart phone is significantly different from the conventional hardware architectures. The feature and architecture of the processors is totally different the traditional processor as these processors are developed to cope-up with fewer energy availability with smart phones or any other ultra portable devices.
Key-Words: Smartphone platform independence, Cross-Platform development for Smart phones.

I. INTRODUCTION

A smartphone is a mobile phone built on a mobile computing platform, with more advanced computing ability and connectivity than a feature phone. The initial smartphone were devices which mainly combined the functions of a personal digital assistant (PDA) and a mobile phone or a camera phone. Today's models also serve to combine the functions of portable media players, low-end compact digital cameras, pocket video cameras, and global positioning system (GPS) navigation units [1] [2]. Modern smartphone typically also include high-resolution touch screens, web browsers that can access and properly display standard web pages rather than just mobile-optimized web sites, and high-speed data access via Wi-Fi and mobile broadband.
Hardware architecture of smart phone or any feature phone differs significantly from the conventional processor architecture like x86 and x64. Multiple computational units which are most obvious part of conventional CPU can't fit in energy starved smartphone. So, lots or changes are required to be done in conventional CPU design and architecture to make them suitable for smartphone or any other ultra portable devices.

II. Smartphone and their OS's

The Smartphone comes with an integral component called Operating system. The most common mobile operating systems (OS) used by modern smartphone include Apple's iOS, Google's Android, Microsoft's Windows Phone, Nokia's Symbian, RIM's BlackBerry OS and embedded Linux distributions such as Maemo and MeeGo. Such operating systems can be installed on many different phone models, and typically each device can receive multiple operating software updates over its lifetime.

III. The Problem of Power Consumption

Ever since the development of smartphones, these devices has incorporated more and more functions. One of the big problems is that more features mean more chips and more processing cycles, which means higher power consumption. Because batteries do not evolve at the same speed as the appetite of the manufacturers (and buyers) for new features, so a tradeoff always exists between battery and mobile device.

A typical mobile phone comes with LI-Ion 860 mAh battery which offers approximately 3 watts of energy to perform all its functions until the next refill. A laptop will last for only 5 minutes with this much energy, so energy available for use is major concern. To accurately calculate the total energy stored by the battery, multiply the voltage in volts and the amperage in mAh. For example a battery of 850mAh and 3.7V stores a total of 3,219 mill watts, or 3.219 watts which is very small. A laptop is charged to work for few hours as compared to mobile phone which are supposed to work for days. So it's a tough battle for the designers to achieve the desired motto.

On personal computers PC x86 based processors e.g. core2Duo, Phenom, are used for computation. They are highly optimized for performance and comes with very large transistor count. The L1, L2 caches in these systems are very fast and have more capacities for storage, in addition to this they have dedicated units for decoding instruction, scheduling, branch-prediction circuits and multiple execution units per core. To get an idea, a Core 2 Duo E8200 Penryn-based core (which is a relatively small chip by today's standards) has no less than 410 million transistors and has a typical consumption of 65 watts.

Maker of smartphones are interested in using such capabilities but the heating constraints and power consumption constraints would not let them go e.g. to run a Core 2 Duo processor will

require 80 mm copper heat sink and a 6-cell battery which is impossible to achieve with present technology.

That is why no smartphone has been made based on x86 processors architecture. Even low-power processors like the Atom, have an electrical load that is too high for a smartphone and the phone battery would last only for 5 to 10 minutes. The restrictions regarding the size and consumption has made the hardware of smartphones evolve in a way quite different from the PC, using low-power processors and highly integrated chips.

Advanced RISC (Reduced Instruction Set Computer) machines are being used to mitigate the above mentioned problem of x86 processors. ARM (Advanced RISC Machines) are 32-bit RISC processors, with highly optimized architecture and low numbers of transistors and have very low power consumption.

ARM processors are produced in larger volumes and brutally used in all sorts of devices, routers and Asymmetric Digital Subscriber Line (ADSL) modems to video games. Virtually every electronic device you have at home uses a 32 bit ARM processor including smartphones and only exception is your PC.

Another secret is the integration of components and the use of dedicated controllers for different functions, different from what one have on a PC, where almost everything is done by the main processor. The advantage of using dedicated controllers is that they perform their functions directly in hardware, instead of software implementation and have very fast execution. Thus, they can perform their tasks with fewer transistors and less processing cycles, which translates into lower power consumption. Any smartphone now has several of these controllers, which are off most of the time and are awake only when they have some work to do.

IV. Use of ARM in Smartphones

as from the just concluded discussion ARM is the architecture that must be used for smartphone or any other feature phone. ARM derives it's roots form RISC computer architecture which offers a very simple architecture and has only few memory access instructions. Figure 1.1 shows a basic ARM processor architecture. It can be

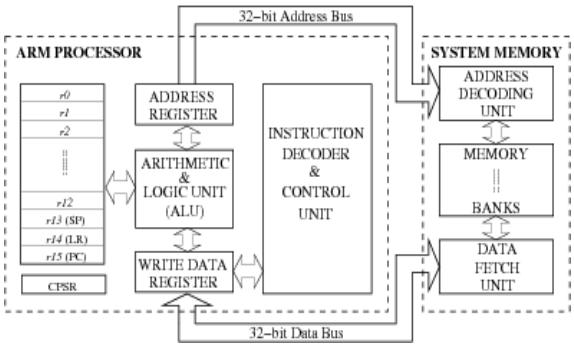

Figure 1.1 : ARM Processor Architecture.

concluded from that diagram that this archicture requires very less circuitry as compared to x86 based processor architecture.

V. Conclusions

Problem of power consumption and energy conservation plays a vital role in ultra portable mobile devices. The size of the smartphone or size of any other ultra portable device also plays a major role in its computational and energy efficiency requirements. More the size more the power backup one can house in the smartphone. But the size is very limiting factor as we can't increase the size by large extent and if we will do so we will lose the ultra portability in proportion with the size. So the main focus is the power consumption by the processor and we should limit it to the extent we can. The conventional architecture cant work with few energy so specialized hardware's (processors) must be developed to cope up with limited energy availability. ARM is the one architecture which offers lots of options to cope up with the fewer energy availability.

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