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A review on OMAP processors in embedded applications

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Abstract:
OMAP processor is introduced for mobile and multimedia applications which include a general purpose ARM core processor plus one or more specialized processors. In this paper we are describing different OMAP processors available, hardware design guide and hardware design timeline steps of OMAP processors. The advantages and different applications are also described in addition to OMAP architecture and it's working.
Key words: OMAP, ARM cortex-A9, IVA3 accelerator, Hardware design guide, Hardware design timeline steps, Graphics accelerator, frequency, GPU.

I. INTRODUCTION OF OMAP

Open Multimedia Application Platform is a series of image/video processors developed by Texas Instruments. OMAP processor is a category of proprietary SOCs for portable and mobile multimedia applications. OMAP devices include a general purpose ARM architecture processor core plus one or more specialized processors.

The advanced OMAP architecture provides a system solution for the wireless market. It seamlessly integrates a software infrastructure, an ARM-RISC processor, a high performance low power TI TMS320C55x generation digital signal processor and shared memory architecture on the same piece of silicon. The OMAP software infrastructure includes support for advanced operating systems and applications through standard APIs. TI's unique DSP/BIOS bridge allows the developer to optimally partition tasks between the RISC and the DSP to maximize performance without sacrificing the battery power.

In addition, the OMAP application environment is fully programmable. This programmability allows wireless device OEMs, independent developers and carries to provide downloadable software upgrades as standards change or bugs are found. Since there is no need develop new ASIC hardware to implement changes, OMAP OEMs can respond to changing market conditions much more quickly than many of their competitors can.
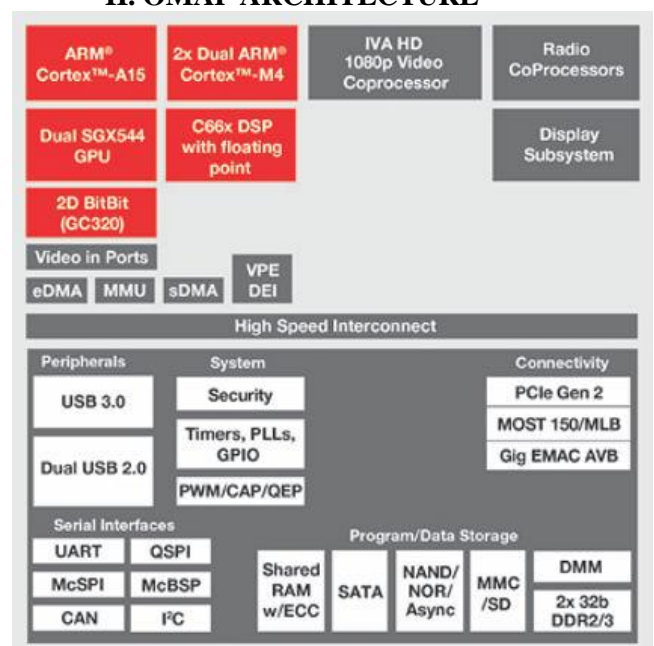
II. OMAP ARCHITECTURE

FIG 1 : OMAP Architecture[5]
The working of OMAP architecture is shown below:

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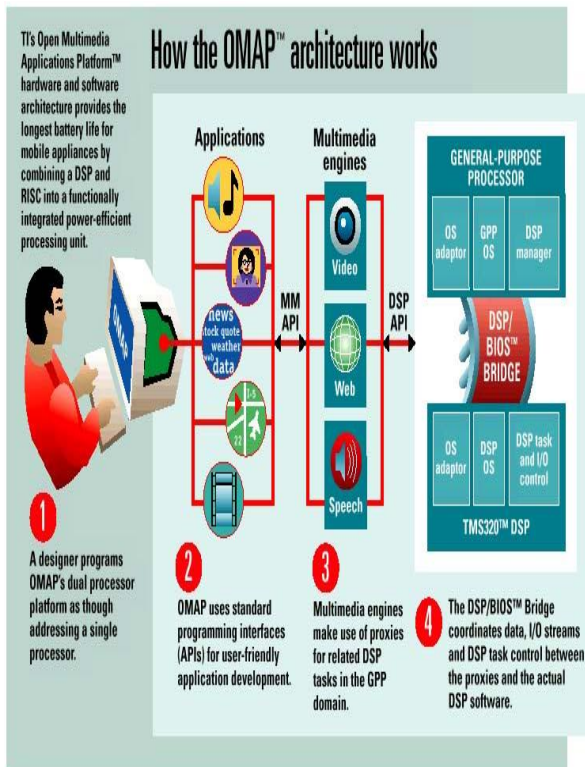*(NCDATES- 09th & 10th January 2015)*

FIG 2 : Working of OMAP Architecture[7]

III.OMAP PROCESSORS

The OMAP family consists of three product groups classified by performance and intended applications:
1. High performance application processors
2. Basic multimedia application processors
3. Integrated modem and applications processors

1.High performance application processors:

High performance application processors are used in smart phones which are powerful enough to run significant operating systems such as Linux, Android, Symbian ,support connectivity to personal computers and support various audio and video applications.

These high performance application processors include different OMAP serieses (OMAP1, OMAP2, OMAP3, OMAP4, OMAP5).

OMAP1:
The OMAP1 family started with a TI enhanced ARM core and then changed to a standard ARM926 core. It included many variants, most easily distinguished according to manufacturing technology, CPU, peripheral set and distribution channel.

Products using OMAP1 processors include hundreds of cell phone models, and the Nokia 770, Internet tablets.

Processor	Specifications
OMAP171x	220 MHz ,ARM926EJ-S+C55x DSP, low voltage 90 nm technology
OMAP161x	204 MHz,ARM926EJ-S+C55x DSP, 130 nm technology

OMAP2:
These parts were marketed only to handset vendors which include both internet tablets and mobile phones.

Processor	Specifications
OMAP2431	330 MHz ARM1136+220 MHz C64x DSP
OMAP2420	330 MHz ARM1136+220 MHz C55x DSP+ powerVR MBX GPU, 90nm technology

OMAP3:
The third generation OMAP, OMAP3 is of three groups: 1.the OMAP34x

2.the OMAP35x

3.the OMAP36x

Some specifications of these processors are listed below:

OMAP model	Fabric ation	CPU	Freq(MHz)
OMAP3430	65nm	Cortex-A8	600
OMAP3440	65nm	Cortex-A8	800
OMAP3530	65nm	Cortex-A8	720
OMAP3640	45nm	Cortex-A8	1200

OMAP4:

In the 4th generation of OMAPs we are having three processors namely OMAP4430, OMAP4460 and OMAP4470.All these processors use a dual core ARM cortex-A9 CPU with two ARM cortex-M3

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cores as part of the "Ducati" sub-system for off loading low-level tasks.

Processor	Micro architecture	#cores	Freq (GHz)
OMAP 4430	Cortex-A9	2	1.0-1.2
OMAP 4460	Cortex-A9	2	1.2-1.5
OMAP 4470	Cortex-A9	2	1.3-1.5

The 4430 and 4460 use a powerVR SGX540 integrated 3D graphics accelerator, running at a clock frequency of 304 and 384 MHz respectively. The 4470 has a PowerVR SGX544 GPU that supports DirectX 9 which enables it for use in windows 8 as well as dedicated 2D graphics core for increased power efficiency up to 50 to 90%. All OMAP4 come with an IVA3 multimedia hardware accelerator with a programmable DSP that enables 1080p full HD and multi standard video encode or decode.

OMAP5:
The fifth generation OMAP(OMAP5) SoC uses a dual core ARM Cortex-A15 CPU with 2 additional Cortex-M4 cores to offload the A15s in less computationally intensive tasks to increase power efficiency, two powerVR SGX544MP graphics cores and a dedicated TI 2D graphics accelerator, a multiple sub systems and a signal processor. They respectively support 24 and 20 megapixel cameras for front and rear 3D HD video recording. The chip also supports up to 8GB of dual channel LPDDR2/DDR3 memory, output to four HD 3D displays and 3D HDMI 1.4 video output.OMAP5 also includes three USB 2.0 ports, one USB 3.0 OTG and a SATA 2.0 controller.

Processor	CPU	FREQ	GPU
OMAP5430	Cortex A15 and Cortex-M4	1.5,1.7 GHz	PowerVR SGX544MP2 +dedicated TI 2D graphics accelerator
OMAP5432	Cortex A15 and Cortex-M4	1.5,1.7 GHz	PowerVR SGX544MP2 +dedicated TI 2D graphics accelerator

2. Basic multimedia application processors:
These are marketed only to handset manufacturers which are intended to be highly integrated, low cost chips for consumer products. The OMAP-DM series are intended to be used as digital media coprocessors for mobile devices with high megapixel digital still video cameras.
The image signal processor is used to accelerate processing of camera images. The specifications of various basic multimedia application OMAP processors is given below:

Processor	Specifications
OMAP-DM270	ARM7+C54x DSP
OMAP-DM299	ARM7+Image signal processor + stacked mDDR SDRAM
OMAP-DM510	ARM926+ISP+128MB stacked mDDR SDRAM
OMAP-DM515	ARM926+ISP+256MB stacked mDDR SDRAM

3. Integrated modem and applications processors:
These are marketed only used by handset manufacturers. Many of the newer versions are highly integrated for use in very low cost cell phones. The specifications of various integrated modems and application of OMAP processors is given below:

Processor	Application
OMAPV1030	EDGE digital baseband
OMAP850	200MHz ARM926EJ-S+GSM/GPRS digital baseband + stacked EDGE co-processor
OMAP730	200MHz ARM926EJ-S+GSM/GPRS digital baseband + SDRAM memory support

IV. HARDWARE DESIGN GUIDE
In the designing of OMAP hardware we have to follow different steps which are included in the hardware design timeline. The purpose of hardware design guide is to walk hardware designers through the various stages of designing a board around OMAP. Here in the following diagram we are having various stages of designing a board around OMAP-L138/C6748/AM1808.Each design stage in the timeline links to a collection of useful documentation, application notes and design

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recommendations pertaining to that stage. Using this hardware designers can efficiently locate the resources they need at every step in the board design flow.

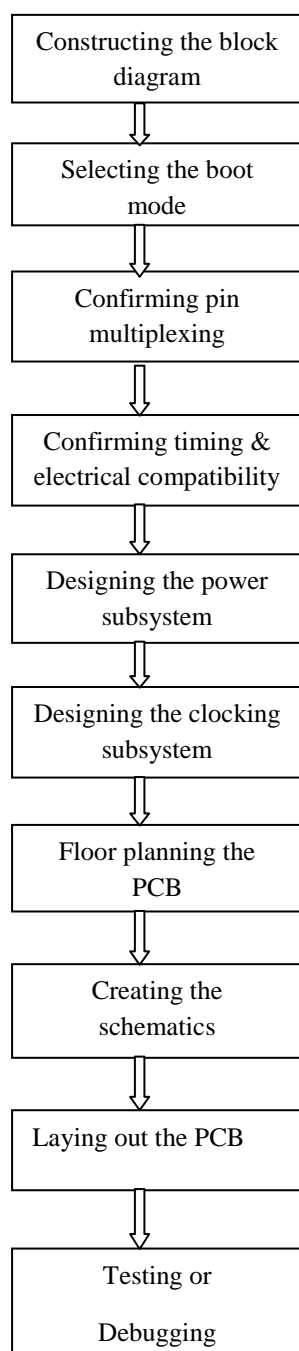The following diagram shows the hardware design timeline steps:

FIG 3: OMAP hardware design steps [8]

V. ADVANTAGES:
Various advantages of OMAP processors are:

- High performance
- Low power consumption
- PC like web browsing
- Faster user interfaces
- More flexibility
- Full HD 1080p30 multi standard video encode or decode
- High security
- Less time to market
- Slim and light weight designs

VI. APPLICATIONS:
- Industrial automation
- Medical appliances
- Automotives
- Mobile phones
- Multimedia/gaming applications
- Consumer electronics

VII. Conclusion:
As complexity of the multimedia system is increasing the demand for the OMAP architecture is increasing because of its high-end technical specifications and accordingly the advancements in the architecture is also taking place. Near future OMAP architectures will have new era in mobile technology.

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