Chapter 1 Introduction

1.1 MPEG-4 Standard Overview

The MPEG (Moving Pictures Experts Group) has developed two successful standards, MPEG-1 and MPEG-2, that have applied on the Video-CD, DVD, digital TV and MP3 codecs in the past years. Since more and more audio/visual applications are necessary in recent years, the development of an open and timely international standard became evident. Therefore, the MPEG developed a new ISO/IEC standard：MPEG-4 [1], which is officially called "Coding of audiovisual objects". The MPEG-4 standard mainly aimed to define the standard of content based audiovisual object manipulation and low bit rate data transmission.

The MPEG-4 standard defines an audio/visual coding standard to meet the following requirement：

1. Content based interactivity：

The future multimedia application will allow people manipulate the content in a media program. For example, user can have different views of the good or zoom in/out the scene by themselves in a TV shopping program. The MPEG-4 standard allows the user to represent various objects in the same scene, access for their manipulation and re-using, compose the audio and the visual objects into one audiovisual scene, describe the objects and the events in the scene.

2. Low bit rate application：

Unlike the previous MPEG standard such as MPEG-1 and MPEG-2 which are applied to the large storage applications such as VCD or DVD. MPEG-4 provides many coding tools to improve the audio/visual coding efficiency which include：

✧ Efficient natural video coding tools：To improve the storage and the transmission efficiency, MPEG-4 provides many tools such as AC/DC prediction, 3 dimension variable length coding, MV prediction to carry out more efficient coding result than the previous standard do.

✧ Speech and general audio data tools：The MPEG-4 Audio facilitates a wide variety of the applications which could range from the intelligible speech to the high quality multi-channel audio. Furthermore, the MPEG-4 also defines the speech and music synthesizing facilities, for example, the TTS (Text To Speech) can input the texts to generate intelligible synthetic speechs.

✧ Synthetic 2D/3D objects tools：The MPEG-4 allows the decoder to synthesize a 2D/3D object according to the object parameter. For example, in the video conference application, the background is usually still and unchanged. Therefore, the encoder can model the specific part by parameters and only transmit the coordinate parameters to decoder. Then, the decoder could synthesis the object by these parameters.

3. Error resilience functionality：

In some critical data transmission channel like the mobile phone application, some segments of the bit stream might be lost or error in the transmission. The MPEG-4 supports the error resilience capability to assist the access of bit stream over a wide range of storage and transmission media. Therefore, the MPEG-4 is suitable for low bit rate application.

1.2 MPEG-4 Video Encoder Development System Overview

The ARM CPU and AMBA bus is the most popular CPU and bus architecture in the

consumer electronic market now. The ARM Integrator picture is shown in Fig.1-1 and it includes the following parts：

1. AP [2]：The Integrator/AP is an ATX form-factor motherboard that supports the development of the applications and the hardware for ARM processor-based products. It supports up to four processors on plug-in modules and provides clocks, AMBA bus, bus arbitration, and interrupt handling for them. Furthermore, there are three PCI slots for developing other more flexible application such as image capture device or USB mass storage device.

2. Core Module [3]：A controller are needed to handle the complex control flow such as bit rate control and frame mode decision. The Integrator Core Module provides an ARM Core and a SDRAM slot which could be mounted on 128 MB SDRAM module.

3. Logic Module [4]：The interface between AP and Logic Module is AMBA interface so the Integrator Logic Module is suitable for developing AMBA peripheral for use with ARM cores. The Logic Module contains an Altera EP20K1000E FPGA, 1MB ZBT-SSRAM, 2 programmable clock generators, general purpose switches, general purpose I/O and prototyping grid. Before taping out the chip, the Altera FPGA are used to accelerate the verification speed. After taping out the design as ASIC, the prototyping grid can be connected the Logic Module with the MPEG-4 encoder chip to verify the system.

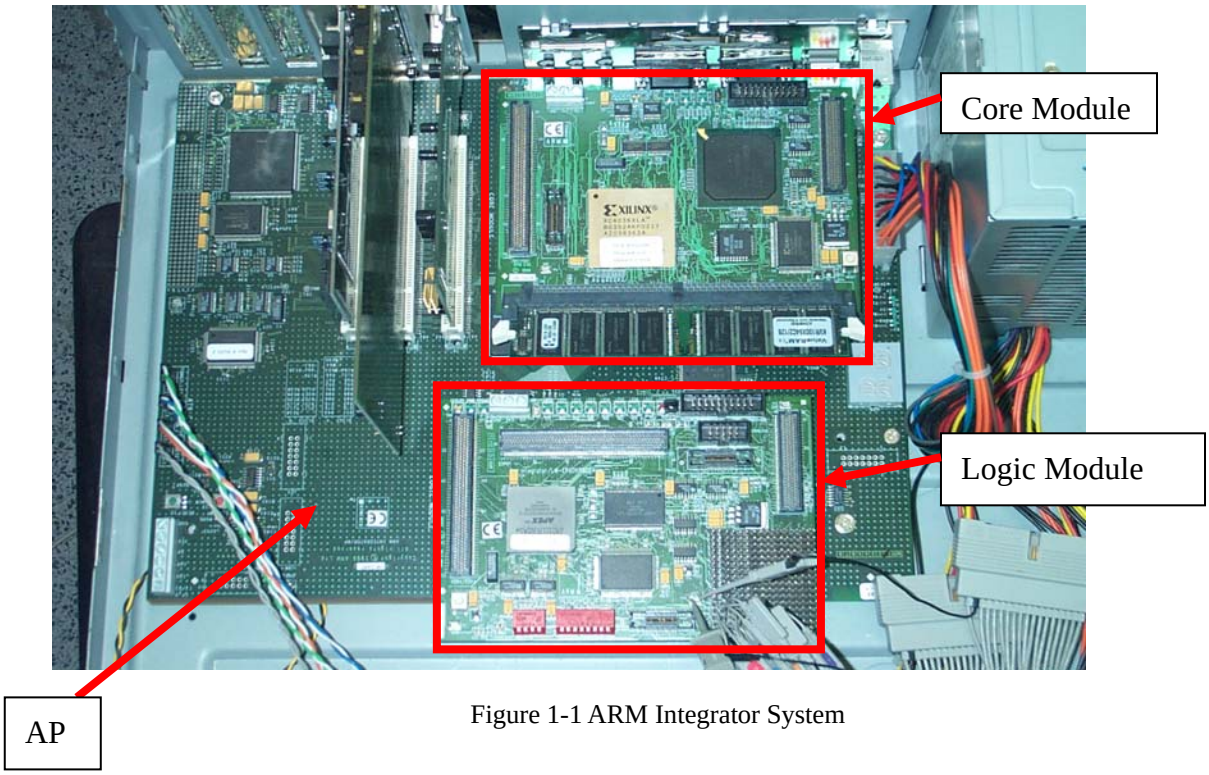

Figure 1-1 ARM Integrator System

1.3 Summary

Our goal is to implement a high performance and reusable MPEG-4 video encoder IP which is defined as a coprocessor to help the embedded processor to handle the complex video compression algorithm. Considering the verification procedure and reusable of this IP, it's better to choose a platform which is popular in the market and allow developer to verify design quickly. Therefore, the ARM Integrator is a good choice to meet our requirement.

1.4 Thesis Organization

The organization of this thesis is described as follows. An introduction of the MPEG-4 standard and the development system are given in this chapter. In chapter 2, the motion estimation and the variable length coding algorithm are described and our specific hardware architecture is proposed. Besides, how to integrate these modules into the MPEG-4 encoder IP will be described. In chapter 3, we will explain how to wrap this MPEG-4 encoder IP in the

AMBA system. In chapter 4, the hardware implementation result and the comparison are listed. In chapter 5, the conclusion of this thesis and the future improvement are listed.