Broadband access connections at data rates of 250 Kbits/sec or more will exert a profound impact on society. Broadband access is the key to the convergence of communication, computers, and consumer applications such as TV, radio, and other forms of home entertainment. Digital media and the Internet will facilitate this convergence. This article provides an overview of the set-top box (STB) market and how one such company, Equator Technologies, has designed hardware and software tools to meet the needs of that market.

Broadband enables digital convergence
Digital media – digitally encoded voice, images, graphics, audio, and video – will be the main driver for the transition to broadband. In addition, the Internet protocol (IP) network will be the backbone that transports the streaming media as shown in Figure 1 below.

According to a 2001 report by Cahners In-Stat titled VOD & Streaming Drive Growth for Digital Media Servers, the worldwide annual dollar value of digital media servers will top $1.2 billion during 2001, and will expand to surpass $4.4 billion during 2005. The high-tech market research firm finds that two key applications are driving the growth of this rapidly expanding market on the Internet: video-on-demand (VOD) and streaming content. Though the two applications might merge over time, they are growing independently today. During the five-year forecast period, nearly 500,000 digital media servers worldwide will have shipped by 2005. These servers will serve millions of consumers who will need powerful new equipment, such as set-top boxes, to handle the broadband digital media.

Equator Technologies is a leading provider of a comprehensive broadband digital-communications and media-processing infrastructure for the consumer market. The company’s family of MAP-CA Broadband Signal Processors couples a powerful system-on-a-chip (SoC) with a complete suite of software tools. The MAP-CA processor is the world’s fastest digital signal processor and is ideal for broadband media. Equator’s unmatched iMMediaC compiler enables 100% C programming for the rapid introduction and field upgradability of high-performance, video-intensive systems without any assembler-level coding.

Figure 1. The IP network
AD Radstone
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4/C
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The Dolphin reference design platform

Dolphin is a high quality, low cost, and complete hardware/software reference design platform for digital media terminals.

Dolphin offers a platform that meets the evolving broadband market environment and standards, and enables:

- A single, integrated media terminal that subsumes the functions of multiple boxes.
- A flexible, field-upgradeable, and extensible platform providing increased revenue opportunities.
- Full support of all existing and new broadcast and broadband offerings.
- Solutions that address the last mile barrier.

The Dolphin development platform includes a motherboard, a software development tool kit, a real-time operating system, and reference software. The objective of the Dolphin Universal Media Platform is to provide a complete system that accelerates MAP-CA processor deployment. The Dolphin reference design is complete. It comprises all the necessary hardware and software components, including a set of digital-media APIs. The APIs enable plug-in configuration of multiple applications for both emerging broadcast and IP-protocol-based, broadband digital media markets.

The Dolphin platform is not expected to be deployed as a commercial product. Rather, it is a comprehensive, general-purpose design that designers can readily modify, with minimal effort, for various target applications. The Dolphin platform is a universal media platform that is compatible with Internet, broadcast, and broadband media in a wide range of formats, offering consumers new levels of media quality and sophisticated control.

The Dolphin platform is also compatible with existing analog television broadcasting and provides personal video recording of broadcast media.

Overview: A new architecture for set-top boxes

Universal media platform

The Dolphin platform is a universal media platform with a receiver/decoder for displaying digital content on end-user entertainment systems. The platform uses a soft, programmable architecture. For the manufacturers and operators, this programmability means that the resident coder/decoder (codec) of the Dolphin platform can change over time without the need for a new hardware design. The manufacturers, therefore, can upgrade the Dolphin platform’s software via the network, thereby avoiding the costly field upgrade to their boxes as the codec technologies evolve. Additionally, the content provider has the flexibility to provide services tailored for individual consumers. Consumers can change the appearance of the menus and the content of the pages over time, as well as customize them, such as for time of day or other variables. This programmable “user experience” enables users to access information that is in line with their specific interests.

The major features of the Dolphin platform are:

- Complete software programmability enabling field upgrading to keep pace with evolving technology and industry demands.
- Robust security through on-chip security software, triple-DES encryption, and partnerships with vendors who are security specialists and work with the providers of per-view authentication.
- Support for a variety of codecs, including MPEG-2 decoder, MPEG-4 decoder, and H.263+ encoder and decoder as well as proprietary codecs, providing the flexibility needed to develop a comprehensive variety of broadband applications.
- VXWorks support enabling embedded developers of all experience levels to create broadband-media applications.

Applications enabled by the Dolphin platform include but are not limited to:

- Network-specific Enhanced TV
  - STB – movies on demand, graphical user interface
  - Audio/Video Internet streaming – live or prerecorded streaming broadcast, streaming audio
  - Personal video recording – time-shift TV, programming guide
  - Internet access – browsers, e-mail, chat, instant messaging, Internet commerce
  - Video phone
  - DVD

Movies on demand

The Dolphin platform enables movies on demand by supporting low bit rate decoders, such as one based on the emerging MPEG-4 standard, or ones that use proprietary technology. At 1 Mbit/sec, some proprietary codecs can deliver video quality that is comparable to DVD. The key here is the performance and programmability of the MAP-CA processor. A single MAP-CA processor can easily satisfy the computational requirements for such low bit rate decoders. The programmability of the MAP-CA processor accommodates the fast evolving nature of such state-of-the-art codecs. The movie on demand function is not complete without a friendly graphical user interface that users can program effortlessly to run on the MAP-CA processor.

Internet streaming

The enabling technologies for Internet streaming media are similar to those needed for movies on demand. One major difference, however, is interoperability. While a proprietary codec may be ideal for a closed-system application, Internet streaming will probably use a standardized codec. To date, the standard for Internet streaming is still evolving, with major companies such as Real Networks, Microsoft, and Apple all vying to become the de facto standard. Because the MAP-CA processor is fully programmable, users can program the Dolphin platform, with a single MAP-CA processor, to run any standard or proprietary codec without changing the hardware.

Personal video recorder

The digital personal video recorder function enabled by the Dolphin platform includes time-shift TV and programming guide features. The time-shift feature allows consumers to watch what they want, when they want. This feature allows consumers to record favorite shows from their TV program guide, save the shows on the STB, and watch the shows with VCR-like functionality, known as “trick-play.” With additional programming by the manufacturers, this feature also “learns” the consumers’ viewing preferences, automatically recording programs similar to selected ones. The typical programming guide features a simple, user-friendly mechanism to display what shows are playing and to program the TV to record shows of interest to the consumer. A wireless keyboard and remote control can function with the Dolphin platform as part of the user interface.

Internet access

Web browsing in a product based on the Dolphin platform can enable access to the public Internet without a PC. The platform
supports a wireless keyboard for input, and a TV can display the Web pages. Usually, such a TV-based Internet browser supports only limited and controlled browsing in a "walled garden" environment. However, Equator is working with browser vendors who are bringing up a full-featured browser on the Dolphin platform with capabilities ranging from the core browser for HTML rendering, to JavaScript, cascading style sheets, Flash, and the Java Virtual Machine (JVM). The user can program all other Internet-based applications such as e-mail, chat, instant message, etc., along with the browser on the Dolphin platform.

Open software architecture:
Flexible, field upgradeable, full support for existing and new broadcast and broadband offerings

Software architecture requirements
The high-level software architecture of the Dolphin platform (see Figure 2) enables a software-based universal media platform. The flexibility given by this software architecture allows remote field upgrades to keep pace with codec technologies, user experience, and the addition of new applications. In addition, it enables the technology providers to keep their intellectual property in software instead of hardware. The architecture has the ability to support any standard and/or proprietary codecs simultaneously. The "codec Independent Media API" is intended to keep the middleware independent of the underlying codec being used.

Software development platform
The Shark PICMG Development System and VxWorks embedded real-time operating system support the initial software development. In addition, the Equator Technologies iMMediaTools™ software development tool kit (SDT) and the Wind River Systems Tornado II for VxWorks IDE are also part of the development environment (see Figure 3). The Shark PICMG Board Support Package for VxWorks is directly available from Wind River Systems. Equator Technologies offers media libraries that include reference code for an MPEG-2 video decoder, an MPEG-4 video decoder, an H.263+ video encoder, an H.263+ video decoder, an AC-3 audio decoder, an MP3 audio decoder, etc.

Hardware architecture
A reusable Dolphin motherboard that has a video daughter card interface, enabling various combinations of analog and digital tuners, is the basis of the Dolphin reference platform architecture (see Figure 4). The video daughter card is optional and it can support up to two AV channels.

The Dolphin motherboard supports the standard set of I/O devices so users can use it as a universal media platform.

Figure 5 shows the block diagram of the Dolphin motherboard. The South Bridge (Super I/O) chip supports hard disk drives, USB, and RS-232 devices. The Ethernet chip supports 10/100BaseT. The board supports high-speed SDRAM. Although the basic design of the board supports 32 Mbytes, it can also support 64 Mbytes as an option. For the resident boot code, the board supports Flash memory in 0.5 Mbyte, 1 Mbyte, 2 Mbytes, and 4 Mbytes configurations. The board supports one NTSC/PAL input and one NTSC/PAL output device. In addition, the board also supports progressive video output through a VGA connector.

The key value of the Dolphin platform is that the hardware implementation covers a wide spectrum of possible products yet
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Before joining Equator, Huang was director of product marketing at TriMedia Technologies and was responsible for both tactical and strategic product marketing. Previously, Huang held various senior technical and managerial positions with Motorola between 1992 and 2000. Among other accomplishments, Huang was one of the original team members and later senior operations manager at Motorola for the popular DragonBall processors for the personal digital assistant (PDA) consumer market. Huang has five patents and 34 publications to his credit.

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Figure 4. Dolphin reference platform architecture

Figure 5. Dolphin motherboard