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TOWARD TRUE INTEROPERABILITY IN STREAMING MEDIA: DEVELOPING AN INTERACTIVE EDUCATIONAL RESOURCE ON MPEG-4

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TOWARD TRUE INTEROPERABILITY IN STREAMAING MEDIA: DEVELOPING AN INTERACTIVE EDUCATIONAL RESOURCE ON MPEG-4

By

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ABSTRACT

TOWARD TRUE INTEROPERABILITY IN STREAMING MEDIA: DEVELOPING AN INTERACTIVE EDUCATIONAL RESOURCE ON MPEG-4

By

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While streaming media use has risen consistently for many years, the problem is that there isn't a standard that everyone can use. The excitement surrounding MPEG-4 is that it was designed to deal with distributing audio and video content over the Internet at high compression ratios over both high and low bandwidth networks without suffering a major loss in quality.

The purpose of this project is to assist students in learning a new technology (MPEG-4) by interactive multimedia contents. Another critical reason for this project is to promote further adoption of MPEG-4 technology for approaching true interoperability in the Streaming Media industry.

This paper is a supplement to the production thesis project in which the developer's goals and design methods are discussed; and the results of a sample group evaluation and future development are presented.

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Dedicated to my Wife & unborn Baby

For her support and love

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CHAPTER ONE

INTRODUCTION

There are a lot of standards and specifications in the audio-visual area. Most of them have been developed by the industry to serve the interests of the members of that industry. In some other cases, the standard is the result of one company's product being successfully introduced to the market where it has become universally accepted. The result has been that, in most cases, products, services and applications of one industry are not interoperable with those of another industry. When the boundary between industries was very clear this did not constitute a major problem, but today, with audio and video content being delivered in multiple ways, this is a major problem for those producing content, those consuming it and the service providers in between especially the streaming media industry (Chiariglione).

While streaming media use has risen consistently for many years, the problem is that there isn't a standard that everyone can use. Content providers must encode for various users, players, and platforms, while the end user is forced to have multiple media players (and in some cases the most recent version) installed in order to view all the different media types. Because each proprietary format must be viewed within their corresponding proprietary media player (Windows Media doesn't support QuickTime, Real Player doesn't support Windows Media, and

so on), streaming media is more of a hassle than it may be worth for both providers and end users (McCannell).

In the complex world of digital media with its diverse file formats, compression schemes, platform compliance, and interactivity requirements, there is a possible solution that will finally allow content for business, entertainment, and the home to be easily created, shared, and distributed (Greenfield). The excitement surrounding MPEG-4 is that it was designed to deal with distributing audio and video content over the Internet at high compression ratios over both high and low bandwidth networks without suffering a major loss in quality (McCannell).

In addition to providing a single form of compression useable by all players, there is the ability to add graphics, text, animation and digital rights management in an object-based setting. A scene description language, conditional behaviors that can be assigned to objects, and a focus on decoder rendering of objects, all help in delivering very high quality output with minimal data transfered. The biggest advantage of MPEG-4 over proprietary formats is interoperability. It means content encoded on a product from one vendor can be played using a decoder from another vendor, something that is not possible today with the proprietary formats (Greenfield).

Major streaming media companies have tried to deliver the building blocks for seamless production workflow, but instead of accord, we've seen rich, but disparate tools that do not plug-and-play well

across party lines. It's hard to deny that widely accepted standards would allow great strides to be made, and would protect company investments. It would also greatly benefit end-users who could be assured that products worked with one another (Greenfield).

PROJECT OBJECTIVES

Created as an instructional tool, this project aims to introduce MPEG-4 technology to Telecommunication students and assist them in learning this new technology through an interactive multimedia website. The use of diverse media can help convey a difficult concept or simplify instructions, as well as, allow access to and interaction with resources that might be convenient and effective to learners. The other critical motivations for the project are to promote the need of a standard in the streaming media industry and the adoption of the MPEG-4 technology as this truly interoperable standard. The usage of the MPEG-4, as an open standard, will benefit application developers, service providers, content creators and end users.

The summary of main objectives of the website project are as follows:

1. To introduce MPEG-4 technology to Telecommunication students
2. To assist students in learning a new technology (MPEG-4) through interactive multimedia content.

3. To introduce the need of a standard in the streaming media industry
4. To promote further adoption of MPEG-4 technology as the standard for the Streaming Media industry.

PERSONAL OBJECTIVES

1. To deepen more about MPEG-4 technology
2. To expand my ability to build an interactive educational project
3. To advance my skills in state of the art software technology, including Flash MX, Sorenson Squeeze, and Dreamweaver.

CHAPTER TWO

HISTORY

HISTORY OF MPEG

The MPEG standards are an evolving group of compression and decompression standards defined by the Moving Picture Experts Group for digitizing and delivering audio, video and multimedia over computer systems and networks, including the web (Table 1).

MPEG-1 (Approved November 1991)	MPEG-1 was the first MPEG standard. Its major use today is in VideoCD, a hugely popular format in Asia. MPEG-1 is also used in innumerable vertical environments, like video-on-demand systems on airplanes. MPEG-1's Layer 3 audio codec, better known as MP3, is the dominant format for compressed audio distribution.
MPEG-2 (Approved November 1994)	MPEG-2 was an extension of MPEG-1 to support true broadcast and professional quality video. The majority of digital video watched worldwide is MPEG-2. Best known for its use in DVD and digital satellite and cable television. MPEG-2 also appears in kiosks and many other environments.
MPEG-3	Originally, MPEG-3 was being developed to handle high-definition formats, but MPEG found that MPEG-2 was easily extended to support them, and so the MPEG-3 standard was never fully developed.
MPEG-4 (Approved November 1998)	MPEG-4 is designed to deal with distributing audio and video over the Internet at high compression ratios over both high and low bandwidth networks without suffering a major loss in quality while providing for digital rights management. MPEG-4 also employ object based coding technology in audio and video, including those that let the end-user interact with the media. Version 1 of the MPEG-4 standard was released in 1997. Version 2, expanding on the tools available in Version 1, released in 1999. Version 3, 4, and 5 are currently in progress.
MPEG-7 (Completed in 2002)	MPEG-7 is a metadata technology, which will make it possible to annotate video and make it searchable.
MPEG-21 (Part 5 & 6 Completed in 2003)	MPEG-21 is a general multimedia framework, taking the object-oriented concepts beyond MPEG-4 to the next level, radically improving the depth and flexibility of the possible interactivity.

TABEL 1: THE HISTORY OF MPEG STANDARD

DEVELOPMENT OF MPEG-4

MPEG-4 is an ISO/IEC (International Organization for Standards/ International Electrotechnical Commission) open standard developed by the Moving Picture Experts Group. It codes audio-visual information in a compressed format. The MPEG-4 project started in 1992. Its goal was to set a standard for very low bit rate audiovisual coding. By 1994, because of the way the multimedia arena was developing, MPEG redefined the project's goals. The standards now apply to coding of any audio-visual object.

Basically MPEG-4 lets users distribute both audio and video content through the Internet. But this is not what makes it special. What makes MPEG-4 special is that it allows this distribution at high compression ratios, and quality is not sacrificed. Another thing that makes MPEG-4 special is that it works on both high and at low bandwidth networks. It has the added feature of helping manage digital rights. Finally, MPEG-4's object-based coding technologies make it possible for an end-user to interact with the medium.

But finally what makes MPEG-4 so very important is its reach. Its standardized elements let the industry integrate across every stage of product development: the same template can be used for production, for distribution, and for content access. Furthermore this can be done in the three most important fields of digital technology: digital television, interactive graphics applications and interactive multimedia with Web content.

CHAPTER THREE

MPEG-4 TOOLS

This section provides detail of the major tools available in MPEG-4 technology. Truly ground breaking, even revolutionary, features in MPEG-4 include object based coding, Binary Format for Scene (BIFS), Delivery Multimedia Integration Framework (DMIF), and Profiles and Levels.

WHAT'S AN OBJECT-BASED CODING?

MPEG-4 is an object-based multimedia representation standard. It might be easier to understand object-based coding by comparing it to what MPEG-2 did. In the MPEG-2 world, encoded contents like text, graphics, video, were put together in a scene and treated there as a single pixel plane, when anything in the content was meant to move, every step in the motion had to be created as an individual frame. MPEG-4 is a vast improvement; in its objects, rather than frames, are coded.

So what counts as an object in MPEG-4? Basically everything you see and hear. Some of these objects are still images, some are video objects (either two or three dimensional) and some are audio objects. To manage these objects, MPEG-4 has developed a language to describe when and where an object goes on the scene.

This scene description language is called Binary Format For Scene, or BIFS for short. BIFS is a real-time binary scene description language that makes it ideal for streaming content. A simple command, just a tiny binary command, makes an object move. You can also attach behavior to an object that is conditional: when the user interacts with an object in a certain way, the object reacts in a certain way.

WHAT IS DMIF?

DMIF stands for Delivery Multimedia Integration Framework. This framework allows you to deliver multimedia content to many more destinations than MPEG1 and MPEG2.

In MPEG-1 and MPEG-2, the transport protocol (how the data is transmitted) for the content was an integral part of the specifications. MPEG-1 created a method for storing data in a file format that made it transportable and retrievable. Later MPEG-2 made it possible to retrieve TV broadcasts sent over dedicated networks.

MPEG-2 Transport Stream has been very successful. However, it was designed for "raw" transport mediums in which data were combined in such a way that they could not later be separated. As a consequence it is difficult to transport MPEG-2 content over networks other than TV networks. Carrying MPEG-2 TS over IP (or ATM) networks requires either removing something or accepting its duplication: the first is hard to do, the second is inefficient.

In other words, MPEG-1 and MPEG-2 focused on particular delivery technologies; the solutions were very successful, but they were monolithic.

Now DMIF enters the picture. Its objective is to define a separate delivery layer, so that MPEG-4 can ignore the details of various delivery technologies. (MPEG-1 and MPEG-2 could not ignore them.) In addition DMIF enables the simultaneous access, presentation, and synchronization of MPEG-4 content; and it lets the data be carried through a variety of delivery formats.

MPEG-4 with DMIF can adapt many different applications, including stored files, remotely retrieved files, interactive retrieval from a real time streaming server, multicast, broadcast, interpersonal communication. It also adapts to many different delivery mechanisms. DMIF is a major step forward. Because of it, MPEG-4 is likely to be adopted across several industries.

WHAT ARE PROFILES AND LEVELS?

To make sure that MPEG-4 products will work with one another, conformance points have been developed. Some of these points involve Profiles and Levels. Specifically, they set standards for Tools that can be used, Bitrates, Image Sizes, and Number of objects. Without these Profiles and Levels, we could never be sure that one product would work with another.

MPEG-4 is a rich set of tools that are useful for a large number of applications. The projects it helps with include studio editing, interactive broadcasting, Internet streaming, and wireless devices. Each of these has its own set of requirements.

For example, studio editing needs very large image sizes and great speed in decoding; these could never be supported on a small wireless device. Because each has different requirements, each has a different Profile and Level. Within MPEG-4, every product created at a certain Profile and Level works with all other products built to the same profile and level. In other words, MPEG-4 provides a high level of interoperability. There are dozens of profiles in MPEG-4, and most of them have many levels within them. The table below shows a few relevant to streaming. They are being used now or are likely to be used soon (Table 2).

Visual Profiles	**Simple** - The basic level video profile in MPEG-4
	Advanced Simple - Advanced simple adds a number of new tools to simple, enabling higher quality at lower bitrates
	Advanced Video Coding - Advanced Video Coding is also called H.26L, H.264, and JVT. It's all-new codec with lots of new features to dramatically improve quality at lower data rates.
	Advanced 2D - The Advanced 2D profile is becoming the standard level of BIFS(Binary Format for Scenes) interactivity support in those tools and players that support it.
Audio Profiles	**High-Quality Audio** - The most popular audio profile so far is High-Quality Audio. This supports two codecs, AAC-LC (Advanced Audio Coding – Low Complexity) for music and other general-purpose audio, and CELP (Code Excited Linear Predition) for low-bitrate speech.

TABLE 2: CURRENT & POSSIBLE USAGE OF PROFILES

The following tables give an entire profiles of the MPEG-4 (Table 3) and a detailed look at the levels and specifications for the visual profiles (Table 4, 5, 6).

Visual	**Natural**	Simple, Advanced Simple, Advanced Real-Time Simple, Simple Scalable, Core, Core Scalable, Main, Advanced Coding Efficiency, N-Bit Visual, Fine Granularity Scalability, Simple Studio, Core Studio
	Synthetic	Basic Animated, Texture, Scalable Texture
Audio	Speech, Synthesis, Scalable, Main, High Quality Audio, Low Delay Audio, Natural Audio, Mobile Audio Internetworking(MAUI)	
Graphics	Simple2D, Complete2D, Complete	
Scene Graph	Audio Simple 2D, Complete2D, Complete	
MPEG-J	Personal, Main	
Object Descriptor	Core	

TABLE 3: MPEG-4 PROFILES

Visual Profile	Level	Typical visual session size	Max objects	Object type	Max bit rate(kbit/s)
Simple	L0	QCIF	1	Simple	64
	L1	QCIF	4	Simple	64
	L2	CIF	4	Simple	128
	L3	CIF	4	Simple	384
Advanced Real-Time Simple	L1	QCIF	4	Simple or Advanced Real-Time Simple	64
	L2	CIF	4	Simple or Advanced Real-Time Simple	128
	L3	CIF	4	Simple or Advanced Real-Time Simple	384
	L4	CIF	16	Simple or Advanced Real-Time Simple	2,000
Simple Scalable	L1	CIF	4	Simple or Simple Scalable	128
	L2	CIF	4	Simple or Simple Scalable	256
Core	L1	QCIF	4	Core or Simple	384
	L2	CIF	16	Core or Simple	2,000
Advanced Core	L1	QCIF	4	Core or Simple or Advanced Scalable Texture	384
	L2	CIF	16	Core or Simple or Advanced Scalable Texture	2,000

TABLE 4: MPEG-4 LEVELS & SPECIFICATION FOR THE VIDEO PROFILES

Visual Profile	Level	Typical visual session size	Max objects	Object type	Max bit rate(kbit /s)
Core Scalable	L1	CIF	4	Core or Simple or Core Scalable Or Simple Scalable	768
	L2	CIF	8	Core or Simple or Core Scalable Or Simple	1,500
	L3	CCIR601	16	Core or Simple or Core Scalable Or Simple Scalable	4,000
Main	L2	CIF	16	Main or Core or Simple	2,000
	L3	CCIR601	32	Main or Core or Simple	15,000
	L4	1920×1088	32	Main or Core or Simple	38,400
Advanced coding efficiency	L1	CIF	4	Advanced Coding Efficiency or Core or Simple	384
	L2	CIF	16	Advanced Coding Efficiency or Core or Simple	2,000
	L3	CCIR601	32	Advanced Coding Efficiency or Core or Simple	15,000
	L4	1920×1088	32	Advanced Coding Efficiency or Core or Simple	38,400
N-Bit	L2	CIF	16	Core or Simple or N-Bit	2,000

TABLE 5: MPEG-4 LEVELS & SPECIFICATION FOR THE VISUAL PROFILES CONTINUED

Visual Profile	Level	Typical visual session size	Max objects	Object type	Max bit rate(kbit/s)
Simple Studio	L1	ITU-R601:4224 ITU-R601:444	10	Simple Studio	180
	L2	ITU-R709.60I:422 ITU-R601:444444	10	Simple Studio	600
	L3	ITU-R709.60I:444 ITU-709.60I:4224	12	Simple Studio	900
	L4	ITU-R709.60P:444 ITU-R709:444444 2K×2K×30P:444	12	Simple Studio	1,800
Core Studio	L1	ITU-R601:4224 ITU-R601:444	10	Core Studio or Simple Studio	90
	L2	ITU-R709.60I:422 ITU-R601:444444	10	Core Studio or Simple Studio	300
	L3	ITU-R709.60I:444 ITU-709.60I:4224	10	Core Studio or Simple Studio	450
	L4	ITU-R709.60I:444 ITU-709.60I:4224	10	Core Studio or Simple Studio	900
Advanced Simple	L0	176×144	1	AS or Simple	128
	L1	176×144	4	AS or Simple	128
	L2	352×288	4	AS or Simple	384
	L3	352×288	4	AS or Simple	768
	L4	352×576	4	AS or Simple	3,000
	L5	720×576	4	AS or Simple	8,000
FGS	L0	176×144	1	AS or FGS or Simple	128
	L1	176×144	4	AS or FGS or Simple	128
	L2	352×288	4	AS or Simple	384
	L3	352×288	4	AS or FGS or Simple	768
	L4	352×576	4	AS or FGS or Simple	3,000
	L5	720×576	4	AS or FGS or Simple	8,000

TABLE 6: MPEG-4 LEVELS & SPECIFICATION FOR THE VISUAL PROFILES CONTINUED

CHAPTER FOUR

APPLICATIONS

POSSIBLE APPLICATIONS

MPEG-4 does not target a major and exclusive killer application but opens many new frontiers. Playing with audio/visual scenes and creating, reusing, accessing, and consuming audio/visual content will become easier and more powerful. New and richer applications can be developed, for example, in games, mobile multimedia, and virtual environments. MPEG-4 allows new services to emerge combining the traditionally mutually exclusive services models: broadcast, on-line interaction, and communication.

MPEG-4 does not provide any guidelines regarding the relation between applications and profiles and levels. This is a choice left for the implementers taking into account their specific needs and constraints. The document that defines the MPEG-4 standard suggests the following possible applications, using both audio and visual information or just one of them:

- Broadcast
- Digital television set-top box
- DVD
- Infotainment
- Mobile multimedia
- Streaming video
- Surveillance
- Virtual meetings.

BROADCAST

Integrated Service Digital Broadcast (ISDB) is a concept for constructing a complete digital broadcasting system, which offers a great variety of services with high spectrum efficiency, flexibility and extendibility. ISDB provides not only existing basic broadcasting services such as SDTV and HDTV, but also new services, such as multimedia TV, the TV newspaper (multimedia information services) and two-way information services. An integrated-services television is a terminal for receiving ISDB services. It enables viewers to make better use of television and offers services with multiple functions as well as new multimedia information services such as the TV newspaper.

DIGITAL TELEVISION SET-TOP BOX

Digital Television (DTV) will change the nature of television broadcasting since digital data together with digital audio/video can be delivered to consumers. Digital data can enhance the consumers' viewing experience by providing a more interactive environment. Some of the possibilities are:

1. Linking TV programs and advertising to web pages with the data tailored to users
2. Access to Internet entertainment and information
3. Simple Electronic Mail and Messaging on TV sets with cordless keyboards

4. Secure and authenticated Electronic Commerce such as banking and shopping
5. Interactive games and video-on-demand

DVD

DVD's main application areas are interactive movies, knowledge/travel/whatever guidance, self-learning, games, Internet karaoke, or interaction with other incoming bitstreams such as broadcasting or Internet. Interactive movie application enables the audience to interact with the content.

An example is a story selection in the middle of reproduction by the audience interaction. Another example is a parental switch that suppresses unsuitable scenes for children. Example of the DVD-RAM application is time-shifted reproduction of broadcast programs. Users can enjoy broadcast programs at any time by storing the streams in DVDs.

INFOTAINMENT

As interaction with audio-visual objects is considered as the most important aspect of MPEG-4, infotainment applications, containing a combination of entertainment and information are well within the scope. Generally, the users of such systems have the means both to get information about specific subjects of interest and to configure and

amuse themselves within a multimedia environment. The interactivity aspect includes e.g. the requesting of additional objects and changing of content of existing scene. A key feature of infotainment applications is the manifold of necessarily diversified features. Typical infotainment applications will make heavy use of natural and synthetic audio and video in the form of spoken text and music of all kinds with underlying visual animation.

MOBILE MULTIMEDIA

Mobile computing means the use of a portable computer capable of wireless communication. That is, a portable computer is not only used for local, standalone data processing, but also for wireless communication situations of a mobile user in motion. In a typical mobile computing scenario, a mobile user communicates with a remote computer system using a notebook or a Personal Digital Assistant (PDA) via wireless communication links. The requirement of high compression performance adaptively is a very important requirement for mobile applications, because of the following reasons:

- Diversity of mobile devices (e.g. PDA, sub-notebooks, notebooks, or portable workstations) in regard to available resources.
- Diversity of wireless networks (e.g. HIPERLAN, GSM, UMTS, or satellite) in regard to network topology, protocols, bandwidth, reliability etc.

STREAMING VIDEO

Streaming Video on the Internet is an application that enables video transmission from a server to clients using the Internet. Different from a file transfer, video can be viewed immediately after receiving data without waiting for the entire file to download. Associated audio, text as well as video can be played back with the correct synchronization. A viewing tool at the client site can be installed as a plug-in software for a Web browser.

SURVEILLANCE

Many modern surveillance sensors produce output in the form of images or sequences of images (i.e.video). Audio sensors are also used. In many applications, these sensors are connected via a telecommunications system to one or more terminals that provide both monitoring and control.

Unlike video conferencing, the surveillance application usually involves unidirectional communication of audio-visual data, with only control and configuration data on the reverse channel. Surveillance imposes a different concept of quality to other applications, such as entertainment. Subjective degradation in images, video or sound is important only if it inhibits its use. In a perimeter surveillance system around a factory, this might occur if the degradation prevents a human operator from detecting an intruder. It might also occur if the

degradation increases the fatigue suffered by the operator such that the operator's ability to detect intruders is decreased.

VIRTUAL MEETING

People in a virtual meeting are each represented in a simple virtual environment by 3D animated faces driven by video and/or audio. The virtual meeting environment could be as simple as one texture-mapped background rectangle. A future extension to this application will allow local interaction with the meeting environment and animated faces. For example, the animated faces may be re-arranged in the virtual meeting room with corresponding changes to volume.

CURRENT APPLICATION

SURVEILLANCE

MPEG-4 provides a complete end-to-end solution for video surveillance applications over IP. Using MPEG-4 technology, security officers and guards can:

- Encode several videos simultaneously in real time.
- Benefit from latency between reality and the displayed videos for a faster reaction time.
- View the videos on a computer or wireless pocket PC that can be used by mobile security agents.

- Run several videos in the player at the same time and use zooming features.
- Save the files during the encoding for later review.

DISTANCE LEARNING

MPEG-4 products and solutions provide for both synchronous and asynchronous distance learning applications for academic, as well as corporate training markets. The instructor can push objects to the students whether they are PowerPoint slides, vector-based animations, or video content. Within the same MPEG-4 scene, students can nearly simultaneously view the live videos of the instructor. In addition, instructors can poll the students, push quizzes, and keep track of records and students' answers. Low latency, high-quality video, and two-way interactivity make distance-learning solutions the most efficient way to provide engaging training outside the classroom.

CORPORATE COMMUNICATIONS

With a turnkey solution for corporate communications, enterprises can stream live meetings with synchronized video and collaborative material, such as PowerPoint slides or web pages. A web interface lets a moderator control the live encoders and start/stop the presentation at any point. The interface also makes it easy to publish the meeting for on-demand review immediately after the presentation.

Users can view the live meeting almost instantaneously within a single MPEG-4 scene. The entire corporate communications solution runs on a standard PC.

VIDEO ON DEMAND (VOD)

With MPEG-4 products, producers can:

- Use Encoding Station to encode content in DVD resolution.
- Use authoring tool (with digital rights management) to add interactivity, protect, and encrypt content, and enable pay-per-view services.
- Use Streaming Server to serve up the content to users, who can view the content on their TVs through MPEG-4 set-top boxes.

MPEG-4 technology has made it easier and more efficient to provide quality VOD services using any network system around the globe. It allows encoding of thousands of films in MPEG-4 format with DVD resolution.

CHAPTER FIVE

FUTURE OF MPEG-4

Streaming Media industry is still young and vulnerable and everybody is scrambling about trying to build their own business models. For that reason, we can't look to streaming media companies as a reliable source of information. The only way that streaming media will become a strong viable industry is through the adoption of common standards by the streaming media community (McCannell). MP3 has become a digital music standard. Because it is so widely used to download music files, its popularity led the electronic industry to adopt it universally. Now one can play MP3 music files on almost any media player. MPEG-4 can do to the same to the streaming media market.

MPEG-4 is a standard that builds on the successes of MPEG-1 and MPEG-2, two standards that have changed the audio-visual landscape. It is a powerful standard, rich in functionality, encompassing other successful standards. It can be customized to serve the needs of specific industries while preserving a high level of interoperability across applications of different industries (Chiariglione).

Adoption of MPEG-4 as the industry standard wouldn't solve every problem, but it would help eliminate many obstacles, particularly incompatible tools, formats, and processes in the streaming media area (Chiariglione).

Over the last two years I have seen MPEG-4 gradually adopted by vendors, service providers and customer applications. We are likely to continue to see incremental increases in awareness of the new standard, and broader adoption of it. Eventually it should pervade the market. The quality of both content and services should then continue to improve (Greenfield).

CHAPTER SIX

PRODUCTION DESIGN

OVERVIEW

- **TITLE EXPLANATION**

The website project is named "Toward True interoperability in Streaming Media: Developing an interactive educational resource on MPEG-4." "Toward True Interoperability in Streaming Media" emphasizes the central accomplishment of MPEG-4. The subtitle expresses the purpose of the project, to develop a user-friendly site explaining the major tools available in MPEG-4.

- **SCOPE OF THE PROJECT**

The website contains five main categories. They are

1. What is MPEG-4?
2. Media Quality Comparison
3. Interoperability Test
4. Creating MPEG-4 File Tutorial
5. Resources

The "What is MPEG-4?" section was originally intended to contain animated movies for each section (Definition, Characteristics and Application). Due to time limits, however, Definition and

Characteristics categories were completed but Application was not.

- **PLATFORM**

This website project was designed mainly in Macromedia Flash MX. All video contents were compressed in Sorenson Squeeze 3.5, and all audio materials were edited and compressed in Sonic Foundry Sound Forge. Finally, all Flash files were embedded in HTML web pages using Macromedia Dreamweaver. The other supplementary tools are Adobe Photoshop 7.0, Final Cut Pro 3, Avid Express, Adobe GoLive 6.0, and QuickTime Pro 6.0.

The website can be viewed on both Windows and Mac operating systems with the Flash 6 player. In order to be viewed as MP4 files, users need QuickTime player or Real player or other MP4 players.

- **TREATMENT**

This educational project focuses on introducing and understanding MPEG-4 technology through interactive multimedia content. The interactive learning website conveys difficult concepts simply and enjoyably.

- **TARGET AUDIENCE**

The project was designed for Telecommunication students who are interested in learning more about making interactive videos and

websites related to MPEG-4 technology. Students enrolled in the telecommunication undergraduate and graduate programs ordinarily have a fair amount of computer skills and web knowledge. The project may also be beneficial to professionals in the streaming media industry who are interested in learning more about MPEG-4.

PRE-PRODUCTION

Pre-production activity included collecting material, scriptwriting, designing elements and interface.

- **MATERIAL COLLECTION**

Intensive research about MPEG-4 technology was conducted in books, magazines, and websites including video and audio materials. The choice of contents was based on two references – The MPEG-4 Book by Fernando Pereira and Touradj Ebrahimi, and MPEG-4 document by MPEG group.

The project aimed to introduce the functionality of the major tools in MPEG-4 rather than the entire contents of it. This approach meets the study objective, to introduce MPEG-4 technology to audiences effectively.

- **SCRIPTWRITING**

To prepare the script for the animated movies, research on each

topic was conducted thoroughly. To visualize the scripts, a storyboard was used. A design diary was used to keep and revise the storyboard. Creating the animated movies was a long process, so it was really helpful to use the design diary to keep track of the ideas being used.

- **INTERFACE DESIGN AND ELEMENTS**

The website was made user friendly by the choice of media elements such as font types, color scheme, graphics, and animation which was metaphorically related to content. The focuses of the interface design were straightforward and friendly, unlike other websites on the topic. Here are details of the design concept for the project.

1. INTERFACE DESIGN

A semi-transparent number four background graphic image was used throughout to symbolize the fact that this was an MPEG-4 website. All main navigational buttons on each webpage were lined up following the curve of the number four, a visually comfortable alignment.

2. COLOR SCHEME

Four main theme colors (blue, red, green and yellow) derived from the MPEG-4 logo were used. Color schemes were designed to help tie together content within each category, and to distinguish it from material in other categories.

3. TYPOGRAPHY

This is an instructional and educational project, so font choices are critical to help users quickly and easily read text. Three major types of font were chosen for the project. Future MD BT is used for the MPEG-4 title and Futura MD BT is used for signs and main buttons. For words in a paragraph, Arial Narrow is used to provide comfortable readability.

4. ICONS

In the main category pages and animated movies, a female guide icon was used to give a warm and friendly look and represent MPEG-4 logo. In order to maintain consistency, the buttons on the pages were slightly altered versions of the guide icon.

5. GRAPHICS

For the most part, rectangular shaped frames were created for the animated movies, texts, and buttons, to give users a sense of watching a movie.

6. VIDEO AND AUDIO CLIPS

Most video and audio materials were produced by Marketing & Creative Services (MCS), the division of University Relations where I worked for more than two academic years. I used videos and audios

made for campus clients and targeted to Michigan State University students because it helped meet one goal of the project, "creating educational website for Telecommunication students".

PRODUCTION

- **STRUCTURE OF THE WEBSITE**

The structure of the project consists of a homepage and five major sections. Each section contains sub-sections (Figure 1). The following table gives contents of the each section (Table 7).

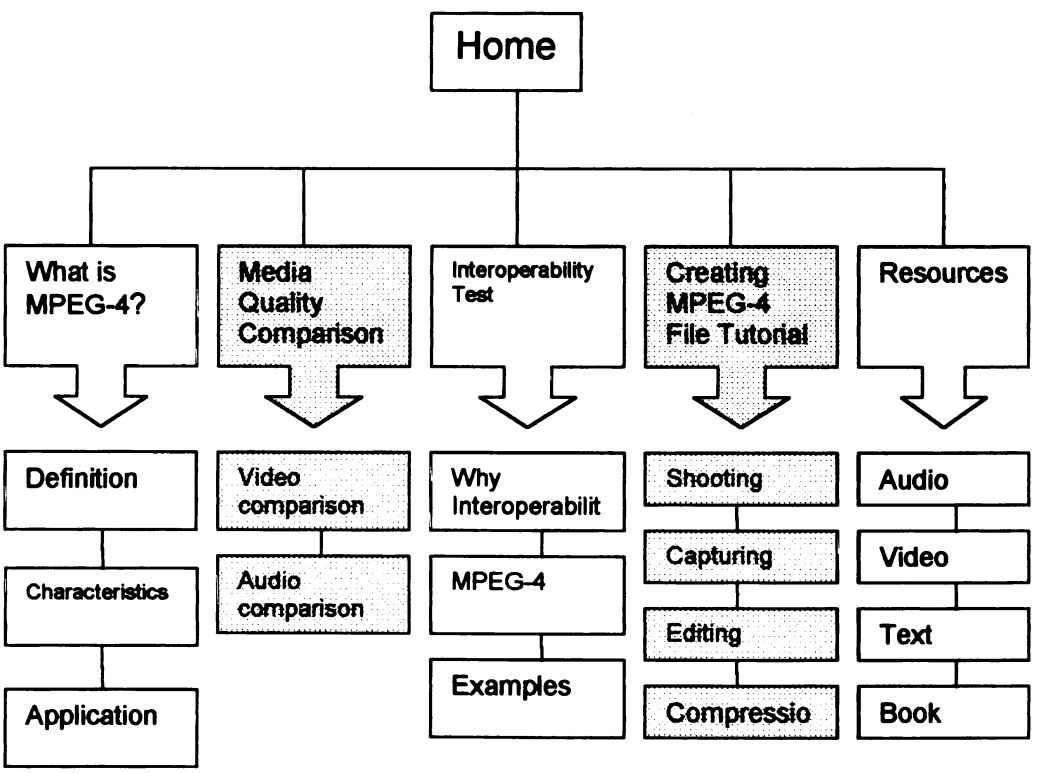

FIGURE 1: THE STRUCTURE OF THE WEBSITE

TITLE	CONTENT
Homepage	This section contains a title, five main buttons, the purpose of the project, and navigational buttons on top of the page.
What is MPEG-4?	Animated movies explain some difficult concepts (object-based coding, DMIF, and Profiles and Levels) within MPEG-4.
Media Quality Comparison	Video and audio samples created to the same specifications but done in different media allow the user to compare them.
Interoperability Test	The user experiences what true interoperability means by playing a movie. This movie can be viewed on Real, QuickTime, and other MP4 players.
Creating MPEG-4 File Tutorial	User learns how to create MP4 file and gets tips for shooting and compression.
Resources	This section provides links to audio and video materials about MPEG-4, including books and a useful website

TABLE 7: CONTENTS OF EACH SECTION

CHAPTER SEVEN

EVALUATION

OVERVIEW

The goal of the project evaluation is to compare the effectiveness of my website "Toward true interoperability in Streaming Media" with the "MPEG Homepage" for users wanting to learn MPEG-4 technology. The evaluation provides valuable information showing whether the project meets its goals. The evaluation used a questionnaire and also allowed users to comment. Collected data will be available to instructors who consider using my interactive site to teach their classes in the future.

METHODS

In order to examine the effectiveness of the project for learning MPEG-4, participants compared two sites. E-mail asking Telecommunication professors to relay the information to interested students in their courses advertised the study. All participants were given one-week notice of the study.

A testing session was conducted for two days during specified time slots at Communication Technology Lab (CTL) conference room. The study invited a sample group of 12 telecommunication students to compare the two sites. I set up two computers so two users could test the sites at the same time. Participants signed a consent form approved

by UCRIHS. Users were randomly and equally distributed in terms of which site they looked at first.

Each participant tested the "MPEG Homepage" for approximately 15 minutes and my "Toward true interoperability in Streaming Media" for approximately 15 minutes. After this, they were asked to complete 17 learning and attitude questions about each site.

RESULTS

A total of 12 users participated in the evaluation of the project. Five graduate and seven undergraduate students majoring in Telecommunication took part in for the test. Five were female.

All of the survey participants responded that they would choose "Toward true interoperability in Streaming Media" to find information about MPEG-4 instead of the "MPEG Homepage".

All users said that they would like to visit "Toward true interoperability in Streaming Media" site again. Only two participants, however, responded that they would visit "MPEG Homepage" some day again.

All of the users agreed that the dynamic contents and interactive elements of "Toward true interoperability in streaming media" significantly enhanced their enjoyment of experience.

For question 3, "Before you used these websites today, how knowledgeable were you about MPEG?" the average participants responded 2.16 on a scale of 1-5, "1" being "not knowledgeable at all", "5", being "very knowledgeable" (Figure 2). For question 4, "How interested are you in technical details of MPEG-4?"The average users asked if they were interested in the technical details of MPEG-4, chose 3.58 on a scale of 1-5, "1" being "not interested at all", "5", being "very interested" (Figure 2). The Figure shows that even though participants had little knowledge about MPEG, they were interested in learning MPEG-4 technology.

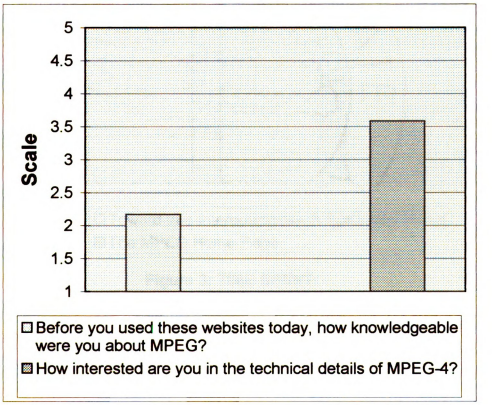

Figure 2: KNOWLEDGE AND INTEREST

Originally, users were supposed to browse the two sites for an approximately equal amount of time, however, all of the participants spent almost twice as much time on "Toward true interoperability in Streaming Media" as on "MPEG Homepage" (Figure 3).

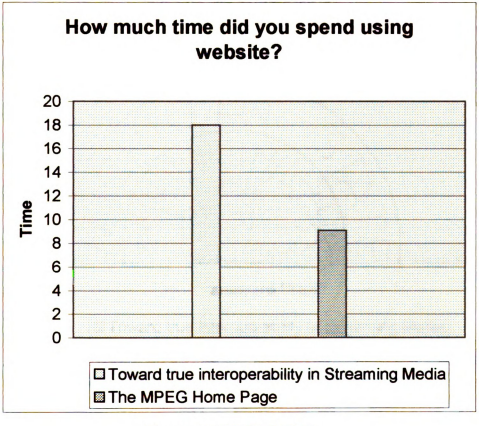

Figure 3: TIME SPENT

Users were asked several questions about Appropriateness and Amount of content. All users said that they found some information they cared about on "Toward true interoperability in Streaming Media", but only 5 users said the same about the MPEG Homepage (Figure 4).

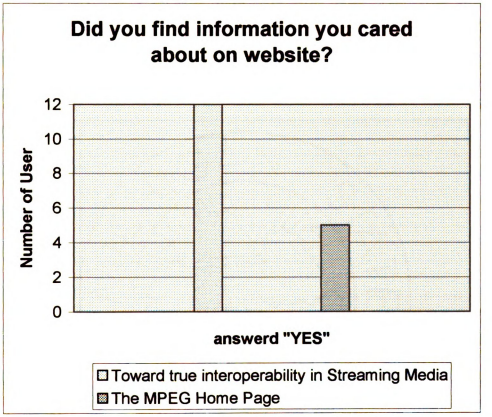

Figure 4: INFORMATION USER CARED ABOUT

Eleven out of twelve participants answered that the amount of links in "Toward true interoperability in Streaming Media" was "just right" while ten users said the links on the MPEG Homepage were too many (Figure 5).

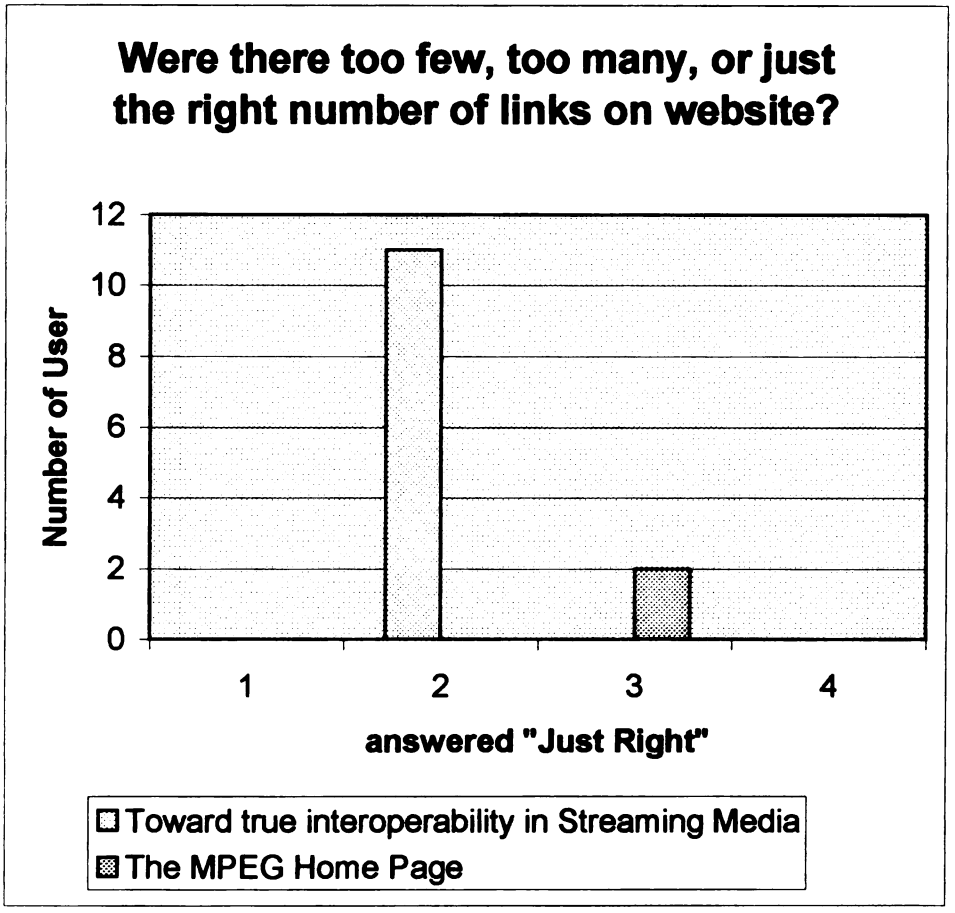

Figure 5: LINKS ON WEBSITE

For question 13 "How useful were the links on the website?" the average response was 4.25 for "Toward true interoperability in Streaming Media" and 2.16 for "MPEG Homepage" on a scale of 1, "very difficult", to 5, "very easy" (Figure 6).

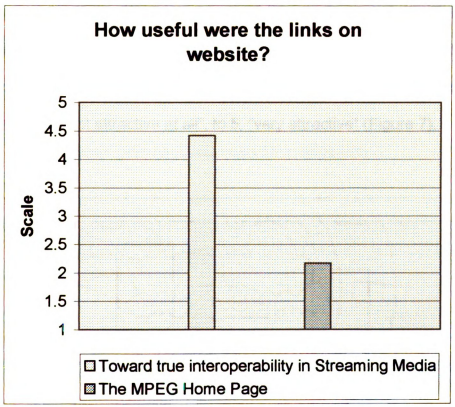

Figure 6: USEFUL LINKS

In order to examine if the interactive media elements are effectively used, two questions about appearance were asked. For question 9 "how friendly did the website feel?" the average users response was 4.66 for "Toward true interoperability in Streaming Media" and 1.58 for "MPEG Homepage" on a scale of 1, "not friendly", to 5, "very friendly" (Figure 7). For question 10 "how visually attractive was the website?" the average participants responded 4.25 for "Toward true interoperability in Streaming Media" and 1.25 for "MPEG Homepage" on a scale of 1, "not attractive at all", to 5, "very attractive" (Figure 7).

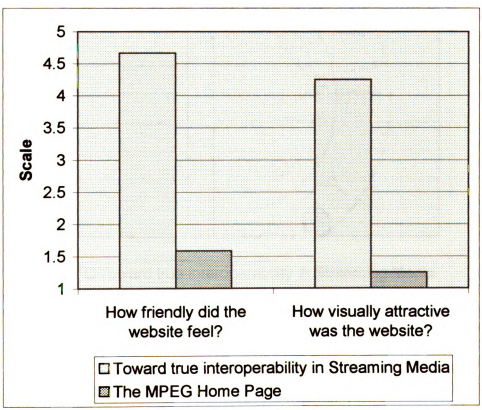

Figure 7: APPEARANCE OF WEBSITE

Also, I asked a question about enjoyment. This was to find out whether the users feel directly engaged when they interacted with the project, and whether a level of interest and enjoyment was maintained. For question 11 "How interesting was the website?" the average participants responded 4.5 for "Toward true interoperability in Streaming Media" and 1.41 for "MPEG Homepage" on a scale of 1, "not interesting at all", to 5, "very interesting" (Figure 8).

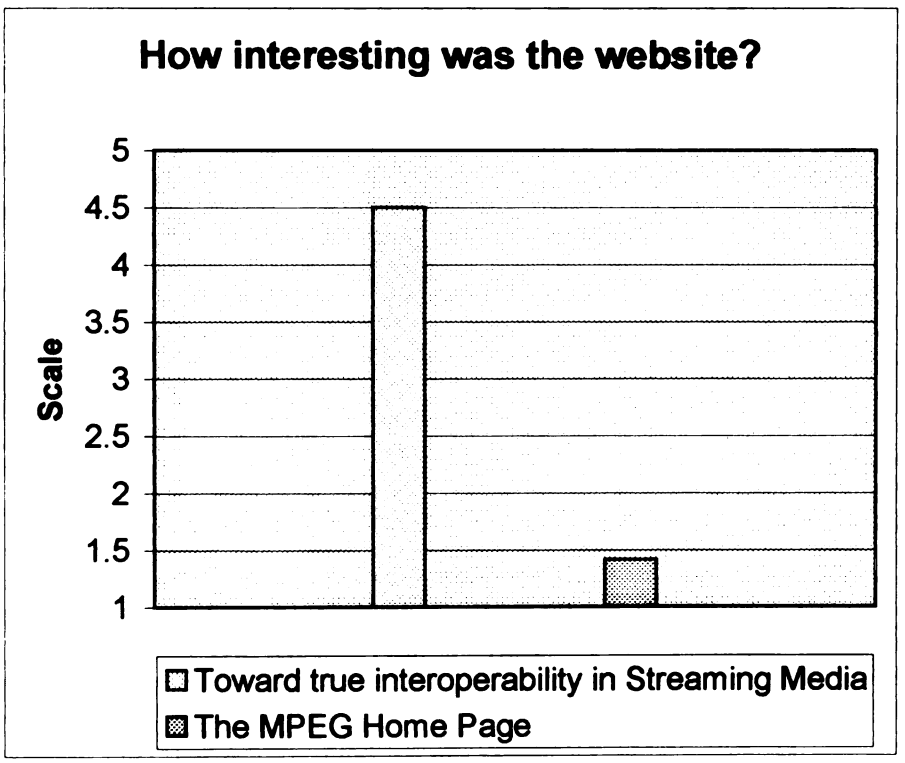

Figure 8: INTERESTING

Participants were asked about ease of use. For question "12 How easy was it to use the website?" the average participants responded 4.58 for "Toward true interoperability in Streaming Media" and 2.25 for "MPEG Homepage" on a scale of 1, very difficult, to 5, very easy (Figure 9).

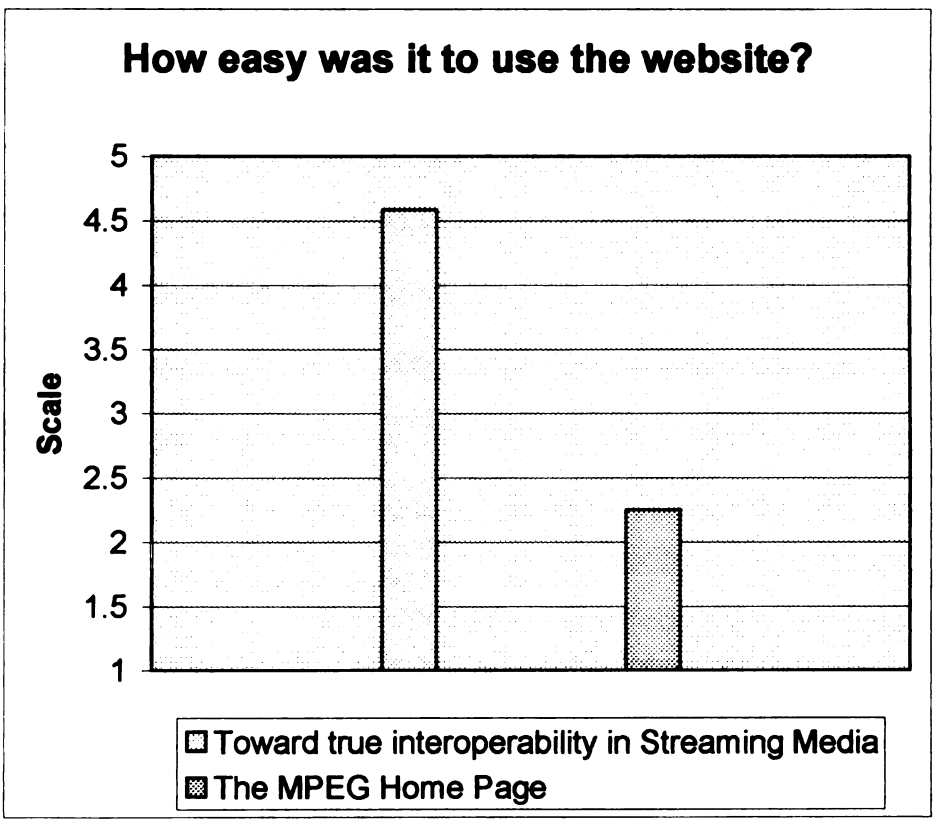

Figure 9: EASE OF USE

CHAPTER EIGHT

CONCLUSION

EFFECTIVENESS OF THE PROJECT

After carefully reviewing the results of the project evaluation, my "Toward true interoperability in Streaming Media" website apparently meets its first objective, "To introduce MPEG-4 technology to Telecommunication students" and the second objective, "To assist students in learning new technology (MPEG-4) by interactive multimedia contents". Overall, based on the evaluation, the following project goals were reached with the web site:

1. The project is an interesting and enjoyable instructional tool with well-organized content.
2. Its simple and friendly interface design enhanced the educational and aesthetic experience.
3. Its dynamic contents and interactive elements enhanced the educational usefulness and interactivity.
4. An interactive learning product is an effective way for informing people about new technology, such as MPEG-4

Although I did not explicitly ask about the third objective of my project in the questionnaire, "To introduce that there is a need for a standard in Streaming Media," several subjects mentioned that there is

not at present a standard in the streaming industry and suggested that MPEG-4 could serve that role. Finally, the availability of the website may promote further adoption of MPEG-4 by providing users with an understanding of technology.

In terms of the personal objectives, all were well fulfilled to a high level. The creation of the website project with cutting-edge software tools has proved that a developer, such as myself, could present complex content through an interactive design for educational purposes.

FUTURE DEVELOPMENT

From the evaluation, I learned of a few areas that could be improved, in order to provide an optimal learning experience to future users. The majority of the users commented that the design and media elements are well presented and contain just the right amount of content. However, creating more animated movies in the application section, in place of the current set of slide shows would help comprehension of difficult technical concepts. Listening and watching are better than just reading, for my target audience, which is a generation of visual learners. And movies are better for demonstrating 'killer applications" like PDAs, mobile computing and diverse wireless networks. Slide shows are too static to show these applications well.

The website contains a basic overview of the MPEG-4 technology targeted for students, so it does not go into great depth, as

found on the MPEG home page. In order to reach broader audiences, including additional content and possibly redesigning the website will be necessary. To avoid information overload, as found on the MPEG homepage, it may be ideal to develop two different websites, one for a beginner or intermediate users and the other for an expert user, leaving the choice to the user as they enter the site. An alternative approach would be to keep the site in its present form but add additional hypertext links throughout to information contained on the MPEG home page. This way, users could get an overview of the MPEG-4 technology on this site and then follow links for more detailed technical information if they desire it.

Lastly, there are other approaches to informing people about MPEG-4 and other technologies, approaches such as books, text-oriented websites, and magazines. These approaches are not as effective as interactive media for 21st century audiences. This century is a digital one. Internet users are more likely to be engaged by dynamic contents. My interactive media project could be used as an example of how to give instruction in other interactive technologies. I am hoping to see more such interactive instructional sites in many different areas in the future.

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