

# MPEG-4 IPMP Authoring Tool for Protection and Management of Digital Contents

Kwang-Yong Kim, Jae-Gon Kim, Jin-Woo Hong, Chang-Su Kim, and Hoe-Kyung Jung, *Member, KIMICS*

**Abstract**—The MPEG-4 standard is aimed to define an object based audiovisual coding standard to address the emerging needs from interactive broadcasting. Since a broadcasting program is created on the basis of its objects, it is considered that MPEG-4 is most suitable for interactive broadcasting contents production and it can be retrieved in terms of its properties. But, there is no system that protects the copyright of digital contents and manages copyright and possibility that contents producer and author's copyright receives infringement at process that exchange contents mutually rose very. Therefore, we need to control and distribute contents according to user's permission rights. In this paper, we present the authoring system based on MPEG-4 IPMP for copyright and protection of MPEG-4 contents. The main features of the proposed approach is to provide an MPEG-4 compliant IPMP authoring system in a plug-in type along with standardized interfaces, which is to be able to incorporated into an existing MPEG-4 content authoring system. In this way, it is capable of authoring content to the MP4 file format while accommodating protection and management of content in a unified way. Furthermore, it also allows a user to edit and/or author IPMP information in a more efficient way by offering form based user interfaces.

**Index Terms**—MPEG-4, IPMP, Authoring

## I. INTRODUCTION

MPEG-4 standard is being widely used in various application areas of content delivery in mobile, computer, internet, and interactive broadcasting environments since it provides convenient ways to produce interactive content accommodating various service requirements[1,2,3,4].

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When users exchange information about MPEG-4 contents mutually in such environments, we must have protection system that can keep rights about individual's privacy. Furthermore, content authored and edited by content providers who have intellectual property should be managed to be used according to intended usage rules and to be access by authorized users only. Therefore, in order to make content delivery and consumption business based on MPEG-4 standard feasible in practical application, it is critical to provide a mechanism that protects the copyright of digital contents and manages copyright in an interoperable way[5,6,7]. Also, possibility that contents producer and author's copyright receives infringement at process that exchange contents mutually raised very. Therefore, we need to control and distribute contents according to user's permission rights. Also, we need protective system that intercepts the user's illegal access. Many existing Digital Right Management (DRM) systems in the market are likely to be broken and limited to a specific application. To address this serious issue, the MPEG-4 provides an interoperable interface for applying IPMP systems as an industry-wide standard. The MPEG-4 IPMP specifies an interoperable framework with normative messages that can be used to select and configure the most effective and appropriate tools for the protection of MPEG-4 content in the specific application. The problem is that it is very difficult for an author to use the broadcasting contents based on MPEG-4 without sufficient knowledge on the MPEG-4 IPMP specification. Therefore, it is desired to develop a higher level authoring method with which an author could easily and conveniently produce protected interactive broadcasting contents based on MPEG-4 without in-depth knowledge of the MPEG-4 IPMP system.

In this paper, we present authoring system based on MPEG-4 IPMP for protection and management of interactive broadcasting contents. We need to supply their contents according to user's permission rights and to intercept the user's illegal access. The main features of the proposed system is to provide an MPEG-4 compliant IPMP authoring tool in a plug-in type along with standardized interfaces, which is to be able to incorporated into the existing MPEG-4 content authoring system. In this way, it is capable of authoring content to the MP4 file format while accommodating protection and management of content in a unified way. Furthermore, it also allows a user to edit and/or author IPMP information in a more efficient way by offering form based user interfaces. The proposed authoring system consists of the following modules: user interface, IPMP information generator, media IPMP processor, and IPMPed XMT to IPMPed MP4 converter.

## II. THE ARCHITECTURE OF MPEG-4 IPMP SYSTEM

As illegal copy and usefulness according to increase of multimedia contents are increased rapidly, DRM (Digital Right Management) system constructed for protection and management of contents. But, problem that DRM constructed by system that is applied from correct special environment lower part in each field but compatibility between each other becomes poorly at program such as different system environment or different user application happened. But, when DRM is used different system environment or different user application, mutual compatibility caused lacking problem between each other. MPEG is going to solve the problem of multimedia consumption and distribution using IPMP to solve mutual compatibility's problem. Because proposed MPEG-4 IPMP authoring system basically normalized IPMP system interface, several IPMP tools or players are implemented so that can become plug-in to this system. IPMP tools act role that protect and manage MPEG-4 contents directly in MPEG-4 IPMP system as shown in Figure 1.[6,7]

IPMP tools are tools that execute IPMP functions such as authentication, encryption, decryption and watermarking. IPMP system can protects and manages MPEG-4 contents using these IPMP tools. And IPMP tool list can search necessary IPMP tools to manage contents or confirm used IPMP tools in tool lists. IPMP descriptor describes necessary IPMP Tool's information to protect and manages MPEG-4 contents. Here, XMT (eXtensible MPEG-4 Textual) format is a text based XML file that express multimedia stream contents[5]. XMT is a textual file format that MPEG-4 contents developer makes to become easy to edit MPEG-4 contents instead of MP4 file that is created to binary file

## III. DESIGN OF MPEG-4 IPMP AUTHORIZING SYSTEM

Proposed authoring tool is a system that protect and manages MPEG-4 digital contents according to MPEG-4 IPMP standard.

Proposed authoring tool enables an author to easily and conveniently produce object-based interactive broadcasting contents by using MPEG-4 specifications. It is also a tool that can edit MPEG-4 contents by object unit and offer function for interaction between these objects.

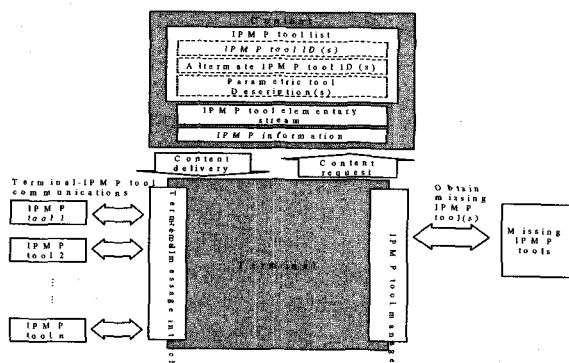


Fig. 1 The Architecture of MPEG-4 IPMP system

Specially, using XMT file that is XML's application language as standard language that describe MPEG-4 object, offered compatibility in exchange between file. Specially, because this system uses XMT that is International Standard in file storage form. File interchanges that have generality is possible.

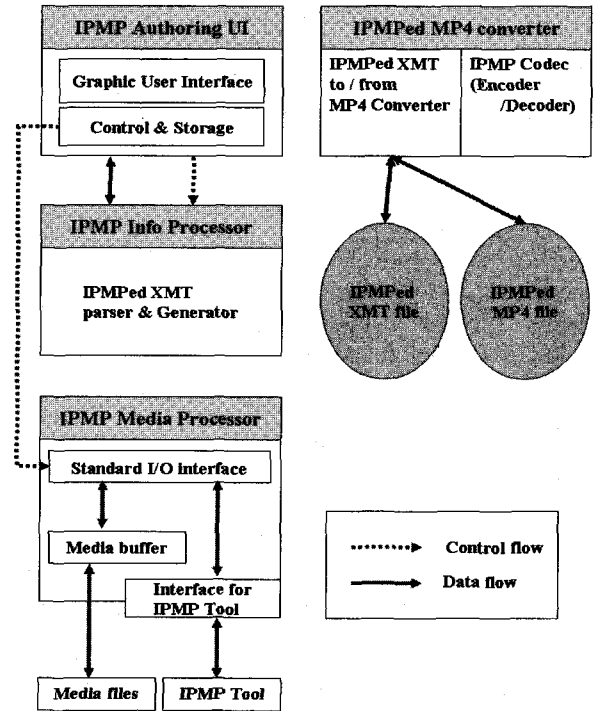


Fig. 2 The Architecture of MPEG-4 IPMP Authoring Tool

This system also provides powerful graphic user interface and produces MP4 file format as an efficient binary format for storage or transmission. We developed the MPEG-4 IPMP authoring system that is consisted of four parts as we see in figure 2.

For non-professional authors without knowledge for MPEG-4 IPMP, the proposed authoring system supports IPMP authoring templates that can be customized and reused by intuition.

IPMP authoring user interface(UI) offers form type interface so that author can edit easily IPMP information and it does control about each module. IPMP information processor creates, corrects and deletes IPMP information in XMT.

Media IPMP processor reads media data and IPMP tools that select in User Interface and creates media data including IPMP information. Finally, IPMPed MP4 converter converts XMT file including IPMP information to MP4 file including IPMP information.

### A. IPMP Authoring User Interface (GUI)

User interface has a information procedure as see in figure 3.

This module supports so that user can input edit information for audio/video/graphic objects and output device plays MPEG-4 contents according to input information. Also, it shows edit status of editing contents through output device.

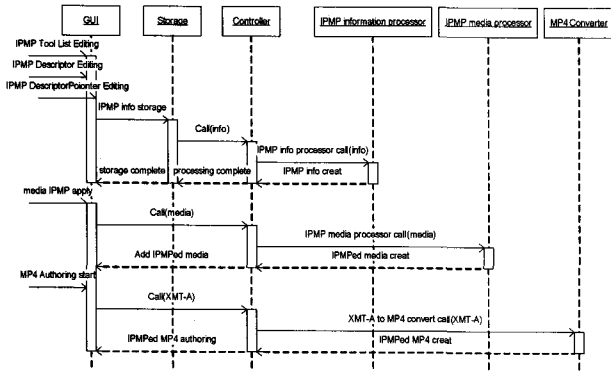


Fig. 3 Information Flow through User Interface

This module supports so that user can input edit information for Audio/Video/Graphic object. It also helps so that we can play MPEG-4 contents according to inputted information. Also, it shows edit status of editing contents through output device. This UI supports to edit IPMP information conveniently using form based GUI. Also, this module is interfaced with control/storage module to process IPMP information effectively. Storage module designed to be easy to store and re-edit information that user inputs according to IPMP class structure. control module controls so that control module can transmits stored information at IPMP info processor and IPMP information processor can create IPMPed XMT file. Also, control module can re-edit new XMT file that is stored to storage module through form based editor window. if user select IPMP tools, we designed so that user can use IPMP tools in IPMP media processor automatically and user can create IPMPed MP4 contents.

**B. IPMP Information Generator**

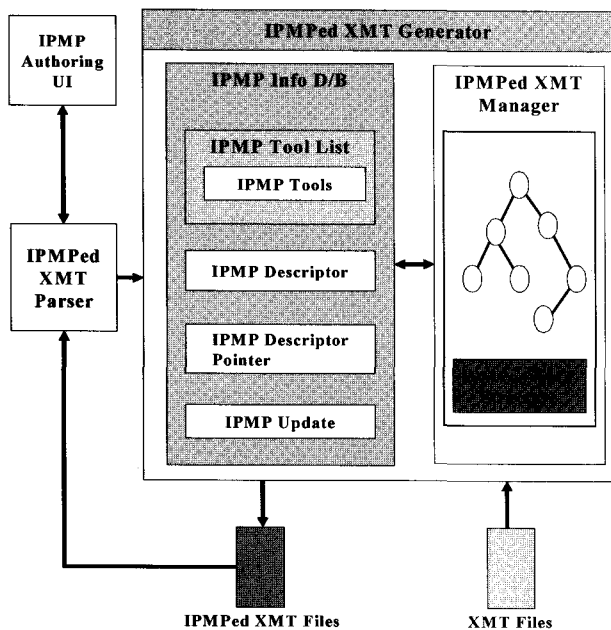


Fig. 4 IPMP Information Processor

IPMP information generator is largely consisted of two modules as see in figure 4. One is the IPMPed XMT parser for syntax analysis of IPMPed XMT and another is

the IPMPed XMT manager to compose IPMP information database according to the schema structure of IPMPed XMT. IPMPed XMT manager compares IPMP information that user inputs with IPMP Info D/B and IPMPed XMT structure(schema) and analyze them. And this creates IPMPed XMT file using XMT parser according to analyzed result. IPMPed XMT structure analyzes XMT file and IPMP information. If IPMP class information that there does not exist in XMT file through such analysis is added, it creates high position structure of toolListDescr, ipmpDesc, ipmpDescPtr and so forth and it modifies an XMT file. On the contrary, if IPMP class through analysis is created already, IPMPed XMT structure replaces the creation position of correct node. An XMT parser creates DOM structure after it examines syntax and semantics error reading XMT file. Then, it routes from DOM's root node to its leaf node by depth first search, adds IPMP node according to creation position and replaces necessary IPMP information. Therefore, Authoring UI can re-edit IPMP information. Input information of Authoring UI's is transmited to IPMP info D/B. An XMT file that is loaded into memory is analyzed through IPMPed XMT manager using XMT parser. If its analysis finishes, IPMPed XMT generator locates transmited IPMP information rightly to XMT structure (schema). Figure 5 is IPMP information generator's sequence diagram that explains so far.

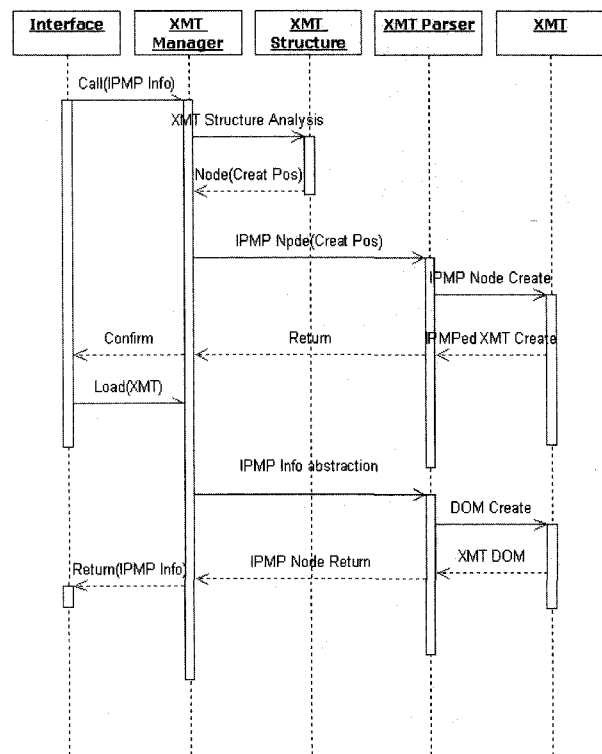


Fig. 5 IPMP information processor's sequence diagram

**C. IPMP Media Processor**

IPMP media processor offers standard I/O interface so that various IPMP tools may become plug. It also contains media buffer and standard I/O interface controller to process media.

Figure 6 shows the structure of IPMP media processor.

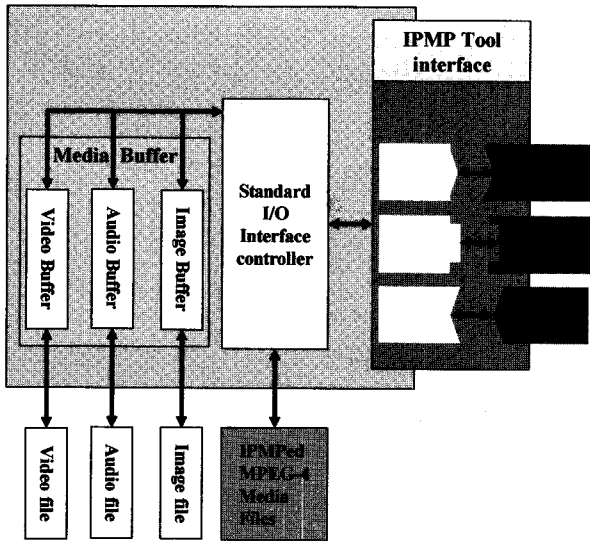


Fig. 6 IPMP Media Processor

IPMP tool interface includes interface devices that connect various input information and return values of output in the form of standard I/O. Also, this interface is designed to add new IPMP Tool. Media buffer acts a role that loads in memory to process media object of video, audio or image via each decoder. And standard I/O interface controller applies the function of IPMP tool through interface of standard I/O, and then it creates IPMPed media in media buffer. Here, function of IPMP tool for protection and encryption is achieved when media contents is initialized.

**D. IPMPed MP4 Converter**

As see in Figure 7, IPMPed MP4 converter extended to handle IPMP information in existing MP4 converter. Bifs encoder reads an XMT file in token form through XMT syntax analyzer. Also, this encoder is a device that analyzes an XMT file by real time and processes in an intermediate file.

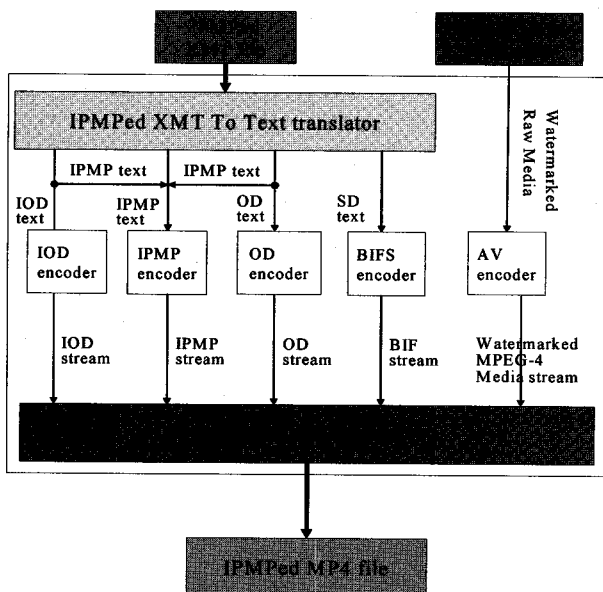


Fig. 7 IPMPed MP4 converter

Here, an Intermediate file creates SD stream that describe scene and OD stream that describe object and finally it creates an Ist file that have coding information. We designed IPMP encoder in addition to process IPMP information to this encoder. MP4 encoder creates IOD stream through IOD encoder being inputed a src file that describes information of initial object. Also, we added an extended design so that used IOD encoder may refer IPMP encoder. Now, if IPMPed MP4 converter receives IOD stream, SD stream, OD stream and each media stream by input and passes them through muxing process. IPMPed MP4 file is created lastly.

**IV. IMPLEMENTATION**

We implemented the authoring tool by MPEG-4 IPMP standard to protect and manage contents that edit in conventional authoring tool based on MPEG-4. Implementation environment of this system developed using Visual C++ 6.0 SP5s in Windows XP Professional O.S. IPMPed XMT parser used Apache's Xerces C++ XML Parser 1.6.0. This system can also converts watermarked video sequence format(yuv) into MPEG-4 video sequence format(m4v) using MPEG-4 video encoder. This system can also compose various audio, video, still image, string, graphic objects unlike a tool that edit conventional interactive contents and it can edit by each object unit.

Figure 8 shows the IPMP authoring user interface that user inserts IPMP information in various media object and creates protected MPEG-4 contents. Authoring system shows the edit results of IPMPed XMT file and IPMPed MP4 file that follow ISO/IEC 14496 - 1 standard and permit conversion mutually between these two files. Also, this tool permits the production of protected interactive contents that has user interactivity between various objects.

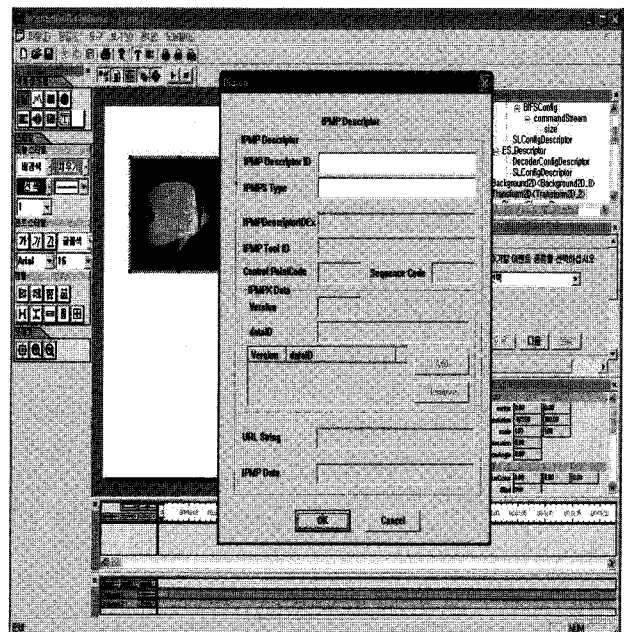


Fig. 8 IPMP authoring User interface for IPMP description

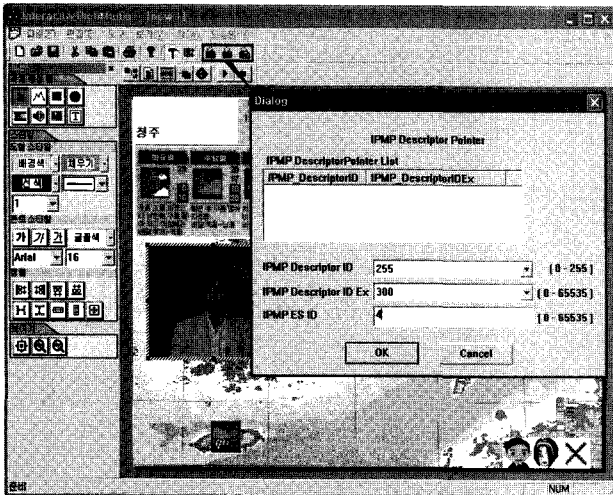


Fig. 9 IPMP Authoring User Interface for IPMP descriptor pointer

Figure 9 shows the form based IPMP authoring UI that author selects a media object and an IPMP descriptor pointer according to MPEG-4 standard and he/she inserts the IPMP information. User calls the form of IPMP tool list and adds IPMP tools using IPMP information insertion interfaces at the top menu of the this system. User inserts watermark or encryption information in media file using IPMP tools and then IPMP is applied in media file via IPMP media processor. Next, user inputs IPMP information using the form box of IPMP Descriptor and IPMP Descriptor Pointer. We implemented this tool so that user may can edit IPMP information easily even if user does not know well about the internal structure of MPEG-4 IPMP. As we see in figure 10, authoring tool transmits IPMP information to IPMP information generator and this tool creates an XMT file that has IPMP information.

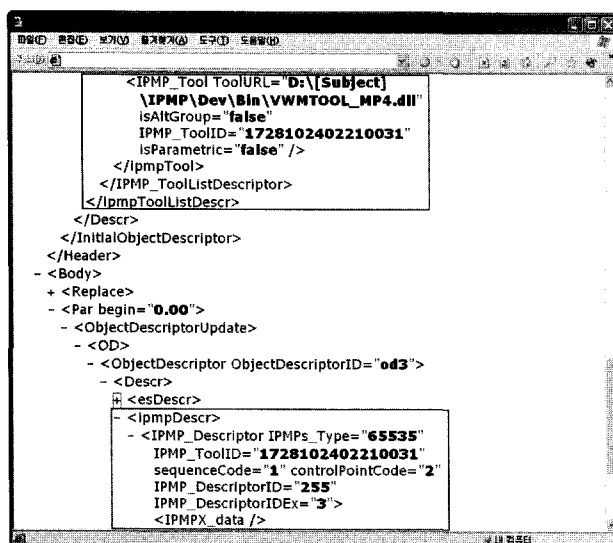


Fig. 10 An IPMPed XMT file

Finally, if an user converts IPMPed MP4 file from an IPMPed XMT file using IPMPed MP4 converter, an IPMPed MPEG-4 digital contents is created and this file is managed in the IPMP system.

## V. CONCLUSIONS

MPEG-4 standard was successful as the standard of high compression encoding techniques being used in multimedia data processing of mobile communication, but several problems of this were detected. For example, MP3 content has the quality of CD level by row capacity but it has a large problem in copyright protection because copy and distribution of MP3 content are easy. Therefore, IPMP system that equips the function of copyright's protection and management is an integral subject in process that user produces, distributes and consumes MPEG-4 digital contents. Thus, we developed the extension system that follows MPEG-4 IPMP interface standard to protect and manage MPEG-4. The characteristics of development system can summarize as following. First, we developed an MPEG-4 IPMP authoring system to be plug-in easily IPMP tools. Second, this system offers the form type's interface so that user may can edit IPMP information intuitively. Finally, we supplied method that can protect MPEG-4 contents creating MP4 binary file that IPMP information is described.

In future research, we should develop the player which can decode IPMP information from MP4 file that IPMP information is described and which can control protection function according to the decoding information. Also, we need the development of various protection tools that offer reliable protection function such as certification, encryption, decryption and so forth.

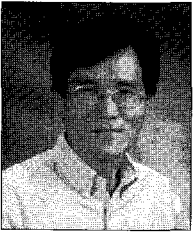
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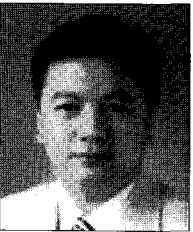
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