Multimedia and Security

Frederic Andres
National Institute of Informatics, Japan

The applications accessing multimedia systems and content over the Web have grown immensely in the past five years. Furthermore, many end users can easily use tools to synthesize and edit multimedia information. Thus, security has become one of the most significant problems for distributing new information technology. It is necessary to prevent illegal copying, misappropriation, and misrepresentation of digital audio, images, and video because they can be so easily copied and multiplied without information loss. It's also important to determine where and how much a multimedia file differs from its original. Thus, a need exists for developing technology that will help protect the integrity of digital content and secure the intellectual-property rights of owners.

Watermarking is becoming the key method for protecting digital elements such as image, video, and sound. Digital watermarking embeds a signal into the original element, and the signal uniquely identifies the owner. This requires security solutions for such fields as distributed production processes and e-commerce because the producers seek to provide access control mechanisms to prevent their material's misuse and theft.

Watermarking development

To better manage digital content security, researchers have evolved watermark processing in three categories according to specific applications' requirements: robust, fragile, and semifragile watermarks.

Robust watermarking resist attempts to remove or destroy the watermark. Primary applications are copyright protection and content tracking. Fragile watermarks can be easily destroyed. Authentication applications use such kinds of watermarks. The semifragile approach combines the properties of robust and fragile watermarks. Semifragile watermarks tolerate some degree of change (quantization noise from lossy compression) to the watermarked digital content. The semifragile watermark can localize regions of digital content that have been tampered, and it distinguishes them from regions that are still authentic. Thus, a semifragile watermark can distinguish between localized tampering and information-preserving, lossy transformations.

The challenge of the evolution of watermarking is related to the information-preserving transformations. Watermarks and attacks on watermarks are two sides of the same coin. A watermark's goal is to be secured and robust enough to preserve the digital data's value. However, watermark protection's goal is to be robust enough to resist attack but not at the expense of altering the value of the data being protected. On the other hand, the goal of the attack is to remove the watermark without destroying the protected data's value.

Scanning the issue

Based on the experiences at four workshops on multimedia and security at the ACM Multimedia conference, the objective of this issue is to give an overview of current developments and problems in the field of multimedia and security. This special issue brings interesting and innovative papers from the ACM Multimedia 1999 Workshop on Multimedia and Security to a wider audience. The special issue analyzes specific security problems of multimedia systems and material in the digital environment.

Based on our discussions in the workshops, we want to continue with state-of-the-art evaluation and discuss future needs for the design of multimedia security. Especially in the watermarking field, we need to evaluate the progress of robustness and of practical usage. With this special issue, we introduce the problems and general solution of multimedia security based on cryptography and digital watermarking. Out of various approaches, this issue is dedicated to improvements in digital watermarking through diversity and channel estimation. In the field of confidentiality, Jessica Fridrich et al. discuss a novel approach related to reliable detection of LSB steganography in grayscale and color images. Tirkel and Hal raise the question of unique watermarks for every image.

1070-986X/01/$10.00 © 2001 IEEE

Many researchers consider content-based authentication and protocols for watermark verification the key issue of security for multimedia content. Yu, Kong, and Wolf introduce some techniques for content-based graph authentication. The approach is based on the granularity of the process either at the object or pixel level.

Kundur looks at improving the existing watermarking process. Her approach is based on basic channel estimation and communication estimation diversity principles.

Dittmann, Wohlmacher, and Nahrstedt propose a new approach based on cryptographic and watermarking algorithms to increase multimedia's security.

Gopalakrishnan, Memon, and Vora propose new protocols for watermark verification. They evaluate the presence of watermarking without revealing the knowledge of the watermark.

What's next?

No single standard has prevailed for digital watermarking, and it remains to be seen whether one standard or open standards will in fact triumph. Proponents for a single technology standard argue that this focus would allow standardization across the industry and sufficient effort dedicated to developing a secure, reliable technology. Proponents of open standards feel that competition in research and development is necessary to keep the technology progressing. With competition, firms and researchers will need to keep innovating and improving their technologies to beat competitors. Thus, consumers would benefit from the best, most evolved, and innovative digital watermarking technologies. **MM**

Acknowledgments

I thank Jane Dittmann, Petra Wohlmacher, and Klara Nahrstedt, who helped me with this special issue. I also offer my sincere thanks to all the reviewers and authors for their time and comments. Many thanks are also due to the *IEEE MultiMedia* editorial staff, who supported us.

Frederic Andres is an associate professor in the Software Research Division at the National Institute of Informatics, Tokyo, Japan. He is a scientist advisor at Laval Mayenne Technopole, France, and managing director of the Multimedia Annotation Consortium. His research interests include distributed and heterogeneous multimedia information systems, geomedia document retrieval, intelligent information engines, and semantic knowledge from documents. He received his PhD from the University of Paris VI, France, and HDR degree from the University of Nantes, France. He is a member of the *IEEE MultiMedia* editorial board. He is also an ACM and IEEE member.

Readers may contact Andres at NII, Hitotsubasi 2-1-2-1407 Chiyoda-ku, Tokyo, 101-8430, Japan, email andres@nii.ac.jp, http://research.nii.ac.jp/~andres.

For further information on this or any other computing topic, please visit our Digital Library at http://computer.org/publications/dlib.