Distribution of Multimedia Content Information

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Abstract

Accompanying the dramatic expansion of the Internet, a variety of new applications and services are being built to run on the Internet, and conventional systems are being re-built to run on the Internet.

Services which distribute copyrighted digital works, such as software, games, video, etc. over the Internet (multimedia content information distributors; abbreviated below as “content distributors”) are businesses which become possible when networks become capable of handling the delivery of these actual products. However, the ease of producing illegal copies, due to the content having been digitized, and the accompanying problem of copyright protection are big issues. Another concern is the need to provide broadband networks to enable distribution of the large quantities of data associated with video, etc. In this paper, we review the technologies used in this type of information distribution and discuss some new applications which will come about in the future.

Information Distribution Services

With the advent of WWW (the World Wide Web), anyone can easily access any information available on the Internet through simple operations, and at the same time, anyone can send information via the Internet. For this reason, WWW provided the key to broad general acceptance of the Internet.

Considering methods of information delivery, in contrast to information provision by WWW which is the so-called “Pull” approach, there is also the “Push” method whereby information is delivered from servers to users in broadcast fashion. Push-type services, as a means of doing e-commerce, etc., gained a great deal of attention for a time. However, because of the disadvantage that they placed an excessive burden on networks, they were not as widely accepted as originally expected. For broadcast-type information delivery from servers to users, the technology which is expected to show important developments in the future is “Internet broadcast.” Internet broadcast, by adopting IP Multicast technology, becomes different from Push-type schemes and enables achievement of the “simultaneous transmission” function of broadcasting while keeping the load placed on networks at a minimal level. On the other hand, in contrast to conventional broadcast by means of electronic waves, the Internet broadcast, because it has the unique feature of enabling anyone to readily become a broadcasting station, is gathering great expectations as a new medium.

A huge amount of information is already being provided over the Internet. The majority of this is text-based and free of charge, but many kinds of fee-based information/content providing services have also begun.

Content distribution over networks offers the following advantages:

- Because the delivering side can charge on the basis of use, rather than “possession,” the initial cost of content is greatly reduced (from the user’s perspective), and markets can expand.
- User access to content is quite easy.
- The content-providing side can accumulate and deliver content by itself, so the costs of manufacturing and selling which would normally be associated with a goods-selling business can be greatly reduced. As a result, publication of so-called minor content, for which the number of sales is small, now becomes feasible.

Copyright Protection Technology for Information Distribution

In giving out digital content over networks, it is essential to protect against illegal copies which, due to the ease of copying and redistributing digital information, are a real threat. In this context, we will discuss various activities and new technologies which are aimed at promoting content distribution.

1. “Super-distribution”

Because Super-distribution bases its charges on content usage, rather than possession, the initial cost of content is reduced. This should make possible broad content distribution, but to achieve that, encryption techniques are essential; their development is being actively pursued.

2. Content ID Forum*

The Content ID Forum is a consortium established for the purpose of promoting the distribution of image content. It is preparing a plan for a standard specifica-

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** System Solutions Company, Business Solutions Div.

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*1 Content ID Forum, cIDf. An international forum, established in 1999 and chaired by Hiroshi Yasuda, Professor at Tokyo University.
tion for a method whereby a unique ID is added and used for copyright control, in order to control and protect copyrighted content.¹)

The ID’s given out according to the rules of the Content ID Forum (Content ID’s) consist of [a] an “ID center control number” which the control center for Content ID’s assigns to the content, [b] “information on the copyrighted work” which includes the rights holder, etc., and [c] “distribution information” which records the price and distribution conditions. (See Figure 1)

Digital content which has received a Content ID can be uniquely recognized anywhere in the world by ID center control number. The system is set up so that, by means of that number, information on the copyrighted work and distribution information can be retrieved from the copyright control DB. In cases where the distribution information, such as the conditions for giving out the digital contents, has changed, a new ID center control number will be added to the content. In this way, Content ID is a system that strongly recognizes the importance of distribution. Concerning the correspondence between the information controlled by the copyright control DB and the content, it is recommended that, in practice, the ID center control number should be imbedded in the content as an electronic watermark.

For electronic watermarks, a two level system is used: [1] a “meta watermark” which shows the electronic watermark scheme and [2] an “actual watermark” which has imbedded the ID center control number, based on the watermark scheme designated by the meta watermark. This system is designed to adapt to advances in the field of watermark technology.

### Networks

In delivering video, music and other multimedia content, it is necessary to solve the problems which multimedia data presents, such as large data volume, isochronous delivery, etc. In this context, we will discuss the network technologies necessary for delivery of multimedia content.

1. QoS (Quality of Service) function in IP Networks

   The Internet is becoming a major part of the modern communication infrastructure due to the facts that:
   1. the cost of communication with packet switching over shared transmission paths has dropped greatly compared to conventional circuit switching;
   2. a high degree of affinity with higher order information services due to the length and breadth of (the Internet’s) development as a computer network; and
   3. the advent of WWW as a “killer ap.”

   On the other hand, with the Internet of today there is the problem of transmission path sharing with no guarantee of bandwidth. When networks become overloaded, delivery of video and audio signals that require isochronous transmission becomes a problem and sound skips or frame losses may occur. Much technical development work is being conducted in the area of QoS in order to solve these problems so that the Internet can become the next real network

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¹) Special Edition on 21st Century Solutions

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**Figure 1: Composition of the cIDf content ID**

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<tr>
<th>ID center control number</th>
<th>Information on the copyrighted work</th>
<th>Information on distribution</th>
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**Figure 2: Building the infrastructure for Internet communication**

- Reduction in cost by means of packet switching (sharing of network resources)
- Establishment of an Internet communication infrastructure
- Exchange between existing circuit switching networks and telephone networks using QoS technology.
- Next generation Internet
  - High speed Backbone/IPv6
  - QoS technology
  - High speed access networks (xDSL, HFC, WLL, FTTH, moving objects)
- Network revolution

- Communication revolution
- All kinds of new NW business, such as MOD, information distribution, etc.
- Changes in lifestyle; changes in organization/activities of businesses
- Support of isochronous data through QoS technology
  - >> substitute for circuit switching network
  - >> communications infrastructure which integrates telephone networks & data networks
- 2003 ~ 2005 (proliferation of high-speed access networks to the home)
  - Low-cost bi-directional networks which anyone can use and methods for collection and delivery of information.
infrastructure, replacing conventional circuit switching systems. At present, technologies such as DiffServ\(^2\), QoS Routing, etc. are being developed and it is expected that in the future they will be put in place on the Internet. (See Figure 2)

2. Broadband networks

To deliver content such as video via networks, there must be an infrastructure (of core networks and access networks) with sufficient bandwidth. In the US, for some time now, the penetration rate of CATV (Cable Television) has been a very high 70%, and lately proliferation of ADSL (Asymmetric Digital Subscriber Lines) has been proceeding rapidly. With these broadband access networks in the background, video streaming services have now become accepted as one of the generally available Internet services. Similarly, recently commercial VOD (Video on Demand) services have begun.

Even domestically in Japan, commercial CATV and ADSL services have already begun and are expanding rapidly. Also, with commercial FTTH (fiber to the home) services using optical fiber having begun, the environment needed for commercialization of multimedia content distribution services is being put in place. (See Figure 3)

3. Distributed content delivery

Because the bandwidth required for delivery of video content is large, by directly connecting user and server, a heavy load is placed on the core network and delivery server, and it becomes difficult to provide a service which satisfies customers. In that case, a distributed delivery system configuration, made up of numerous cache servers, is adopted.

Figure 4 shows a visual representation of a high-speed Internet video delivery service using this kind of technology. Around the edge of the network, local VOD servers (which are cache servers) are placed. The local VOD servers deliver content to general households that are connected to broadband access networks, such as ADSL, CATV, FTTH, etc.
In order to solve the above problems, we developed the OKI Media Server V4, a parallel VOD server, which is shown in Figure 5. This system is composed of: [a] several stream controllers, each having one or two low-cost CPU’s in parallel, for sending out video streams, [b] several SAN RAID (Storage area network RAID) systems connected to a fiber channel network (FC-LAN) as storage which can access each stream controller simultaneously and at high speed, and [c] a service gateway (service GW) for controlling the above elements. The service GW has the function of allocating the optimum stream controller based on the demand from the user’s terminal. Because the network for storage and the network for streaming (the IP network) are completely separated, when content is increased (when the amount of content being sent out is increased), additional stream controllers can be added proportionately. In this way, it becomes possible to achieve the ideal level of expansion, according to the objective. Since the FC-LAN and the IP network (for sending) are separated, expansion of each can be done essentially independently.

This system has the function of performing the distributed-type content delivery shown in Figure 4. In other words, the VOD service GW placed in the center responds to demands for content from user terminals and seeks out the local VOD terminal nearest to the terminal sending the demand. In addition, via the service GW for that local VOD, the optimum stream controller is allocated.

2. Copyright control system

To control content copyright information, we developed a copyright control system based on cIDf. The system configuration is shown in Figure 6.

To the content supplied by the content provider, the content ID control server adds a unique ID based on cIDf. The copyright control server is a DB system for managing copyright information. The electronic watermark portion performs the processes of embedding the above mentioned ID in the content as an electronic watermark and reading the imbedded electronic watermark. The technique of embedding an electronic watermark in content is not limited to conventional “packaged media.”

The server for detecting irregularities has the function of cycling through the network and checking for illegal (unauthorized) use of the content registered in the copyright control server. Collected content is checked to verify whether or not it has an electronic watermark. If an ID, imbedded as an electronic watermark, is detected, the server for detecting irregularities searches the DB, using that as a key, and checks whether or not that content is being delivered under the allowed conditions. The authentication server generates certificates and sends them via the network to the content provider who has registered his content, to the server for detecting irregularities, and elsewhere as needed.

An Image of Content Distribution in the Future

1. Internet broadcasting

Once Internet broadcasting is actualized, it will be different from digital satellite broadcasting; users will be able to receive the broadcasts they want to see, at the time they want to see them. Moreover, it will be possible to realize services such as delivery of programming according to the preferences of each user and online shopping which utilizes the bi-directional feature of the Internet and the ease of connection to computers.

2. Residential VOD system

This system will of course enable services such as Movie on Demand (with images having high picture quality), distance learning, etc. Additionally, through linking with multi-location video-conferencing systems, “video chats” among Residential VOD users, remote medical treatment, etc. will become feasible.

Conclusion

We have discussed the technical problems and future applications that can be expected in multimedia content distribution over broadband access networks. We also described the basic outline of the OKI Media Server V4, as a platform for this growing field, and of the “copyright control system.”

In realizing actual use of content distribution, the technical problems discussed in this paper (foremost of which are network problems), must of course be solved. Another important factor required to enable content providers to supply content safely, is strengthening of the legal framework for copyrights and other rights related to authorship.

References
