Multimedia Streaming by Broadband Connection – Future Prospects and Development Strategy at Oki Electric

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The rapid spread of broadband access networks, most recently in the form of ADSL links, means that high-quality video streaming is now a real possibility.

Video streaming is widely regarded as the "killer application" in broadband networks, and it involves a whole range of issues relating to IP networks, including quality of service (QoS), transmission delays, delivery costs, service models comparable to current broadcast services, copyright protection, and so on. From an early stage, we at Oki Electric have been developing technology for video transmission over IP networks, with a view to the coming broadband generation.

In this essay, I review the latest trends in video streaming over broadband networks, taking a look at Oki Electric's development strategy in this area.

Video delivery systems

Due to the real time characteristics of video and the large data volumes it involves, dedicated high-speed circuits have been used as an alternative to broadcasting systems for video transmission, and the advent of the MPEG image compression technology has made cost-effective video transmission and delivery a possibility. This, combined with the development of video telephony standards, such as H.320/323, and other advances made since the early 1990s, such as increased computer speeds, development of cheap, fast storage technology RAID (Redundant Array of Inexpensive Disks), and high-speed network technology, has enabled great progress to be made in the technical development of computer-based VOD (Video On Demand) systems. In 1995, the industry group DAVIC (Digital Audio-Visual Consortium) was set up in order to achieve standardization in the field of video transmission, and applications, such as VOD, video telephony and bi-directional broadcasting, were expected to become widespread.

The basic technology in DAVIC was MPEG-2 over ATM, which focuses on delivery quality and therefore entails extremely high network and delivery system costs. As a result, these standards were not suitable for content delivery services to ordinary consumers. The main reason for this problem was that CATV was the only high-speed access network available at the time – ADSL was still at the development stage – which meant that there was no solid foundation from which services could expand.

In view of this situation, although MPEG2 over ATM did become popular in normal and satellite broadcasting systems, and the like, it did not take root in a general sense.

Video streaming systems

(1) Internet video streaming

Video streaming has changed massively with the rapid growth in the Internet since 1995. In the United States, where CATV coverage is high and comparatively fast access networks are commonplace, increased bandwidth in backbone networks, along with other developments, have led to the spread of music delivery via the Internet, since 1998, followed subsequently by video streaming technology.

These streaming technologies do not guarantee high quality in video transmission, but instead absorb any delay or jitter on the network by providing a large buffer on the terminal side. Therefore, one of their drawbacks is the delay that occurs before transmission starts.

(2) Content delivery networks

CDN (Content Delivery Network) technology has developed as a result of the spread of WWW systems. It is suitable for video delivery and has spurred cost reduction and expansion in video streaming systems.

The transitions in CDN technology are listed below.

① Internet WWW cache server

In order to avoid simultaneous access bottlenecks in WWW servers due to the rapid growth of Web-based Internet use, ISPs have introduced distributed cache servers.

② Construction of carrier-based broadband CDN networks

Due to the recognized problems in delivering high-bit-rate video streams over general Internet connections, special networks for video delivery have been constructed.

③ Internet broadcasting

In step ② above, the carriers and ISPs equipped with CDN have limited services, and it is difficult for general content holders to supply content delivery services by themselves.

It is envisaged that, in the future, many content holders will become able to provide video delivery services easily, either through speed and bandwidth improvements in core networks and relay networks, or by using a network provider offering CDN.

The architecture of a CDN network involves a trade off between network cost and service cost/storage cost, and CDN design is liable to change in the future as technology develops (Fig. 1).

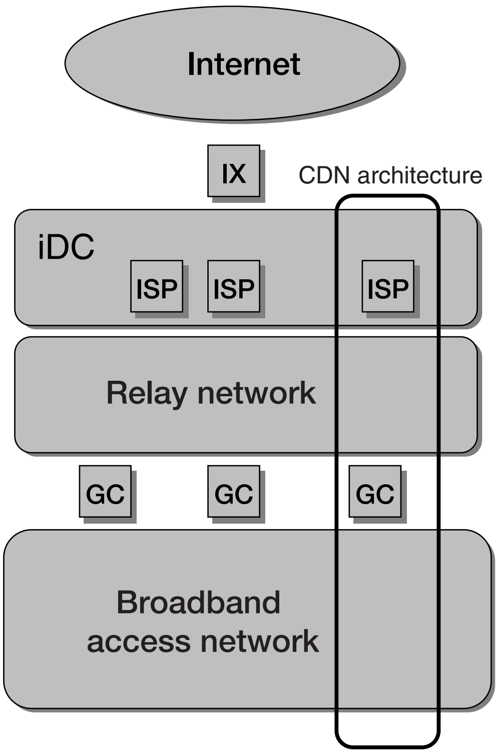

Fig. 1 Content delivery network architecture

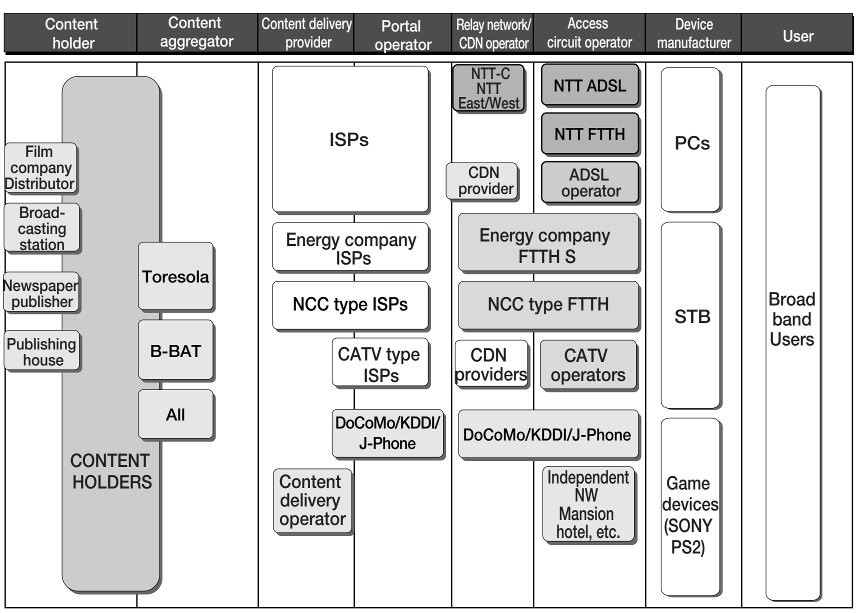

Fig. 2 Video content delivery services

Video delivery services : the current situation and prevailing trends

Many ISPs already support streaming services, and streams of several tens of Kbps to 200 – 300 Kbps are commonplace. Fig. 2 shows some examples of streaming services provided by different carriers and ISPs.

In this way, a large number of carriers or ISPs, as well as general contents holder, can provide streaming services, but few are yet able to do this successfully on a commercial scale. The reasons for this include the problems involved in achieving the high quality levels required for subscription services using conventional bandwidths of several 10s of Kbps to several 100s of Kbps, as well as the fact that broadband networks do not yet reach enough people to allow consumer-orientated services to be set up. Another factor is the poor offer of really attractive services or contents.

In the past, the practical implementation of content delivery has faced the following problems.

① **Incomplete broadband network infrastructure**
② **Delivery costs**
③ **Content supply**

With respect to problem ①, ADSL networks are currently expanding at a dramatic rate, and are expected to have reached 5 to 6 million subscribers by the end of 2002. Together with the increasing spread of FTTH, we can soon expect to reach the critical volume required for commercial implementation of these services on broadband networks, and content delivery, video telephony and other broadband services of this kind are set grow spectacularly.

Delivery costs comprise both the cost of delivery systems and network costs, but Japan already has the cheapest access network costs of any country. Further cost savings will be made by the transition from ATM to IP networks for core and relay nets, as well as the development of high-speed network technology, such as WDM. The cost of delivery systems, on the other hand, has already been reduced to levels where it no longer poses a problem in practical terms. This has been achieved by reducing storage costs, which account for a large part of system expenditure, as well as developing cheaper, higher-performance computer systems.

As for content supply, issues of copyright protection and right of portrait used to be major stumbling blocks, but the spread of content protection technology based on improved access control techniques, such as digital watermarking technology, encryption, etc., as well as the raised expectations of the content delivery market as broadband access networks continue to grow, mean that the obstacles to content supply are being chipped away. Most recently, legal frameworks aimed at the convergence of communications and broadcasting are allowing the establishment of broadcasting services via IP networks, and the supply of broadcast content, an area that is likely to grow from here on.

The following future trends can be anticipated.

① **High picture quality**

Subscription services are difficult to implement at the same quality as conventional streaming services, and it is important that consumer-orientated services are achieved which match television image quality. At present, image encoding technology is being developed which permits higher image quality, such as MPEG-4 ASP (Advanced Simple Profile), H.264, or Microsoft WMT CORONA (Windows Media*1) 9), future improvements in image quality aimed at commercial services are likely to progress very quickly indeed.

② **Establishment of consumer-orientated environments, such as STB**

Consumer-orientated services need machines that are easy for anyone to operate, and this requires the commercialization and popularization of cheap, straightforward Set Top Box (STB) devices.

③ **nternet services**

One of the problems of video streaming services is distinguishing them from TV broadcasts, and in this respect, the convenience of VOD, which allows a user to see a film of their choice, whenever they want, is a key selling point. However, it is also necessary to have other Internet-specific services which differentiate it from regular broadcasting.

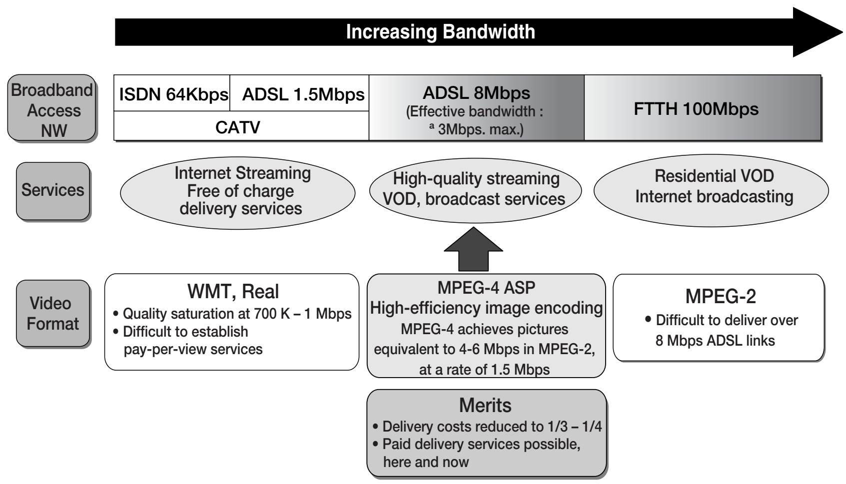

Fig. 3 Delivery using MPEG-4 ASP over ADSL

Oki Electric's development strategy

Oki has identified video delivery as the main application of the broadband age, and has been developing the various technologies required for multimedia distribution over IP networks: image encoding technology, video delivery and QoS technology, delivery platform technology, content protection technology, and more. The product of this research is the OKI Media Server*2)

(1) Market strategy

We set the following development goals when building the OKI Media Server V.5 (Fig. 3).

Although the spread of ADSL communications means that video streaming is growing as an Internet service, the effective bandwidth in current 8 Mbps ADSL networks is actually 3 Mbps or less. This makes it difficult to achieve pay-to-use services using conventional image encoding techniques, and it had been thought that these services would have to wait for the spread of FTTH links which enable MPEG-2 delivery providing high image quality.

However, this situation has changed with the development of encoding technologies, such as MPEG-4 ASP, aimed at providing high-quality content services over broadband networks.

At Oki Electric, we have achieved a high-quality MPEG-4 ASP CODEC 1), which achieves images equivalent to 4 Mbps – 6 Mbps in MPEG-2, at a rate of only 1.2 – 1.5 Mbps. This high-quality MPEG-4 ASP system enables paid content delivery services in 8 Mbps ADSL networks, which are currently enjoying the greatest increase in subscriber numbers. It also reduces network and storage costs to 1/3– 1/4 those of existing MPEG-2 systems and creates the potential for commercialization of video delivery services, here and now.

(2) OKI Media Server : Product strategy and technical features

① **Integrated video platform**

The spread of broadband networks means that the OKI Media Server is not just a VOD server, but rather, a general video platform supporting store and forward delivery for video applications (VOD), real-time delivery, and multilocation TV conferencing.

② **High-quality MPEG-4 CODEC**

Achieving high-quality services is vital if video streaming is to expand in the future, and this CODEC also allows delivery costs to be reduced by making full use of the encoding efficiency.

*1) Windows Media is a trademark or registered trademark of Microsoft Inc.
*2) OKI Media Server is a registered trademark of Oki Electric Industry Co., Ltd. for general video delivery systems.

What is more, the CODEC is extremely fast and has very low delay. Indeed, in a LAN network it can achieve a delay of less than 200 msec, from encoding, through delivery via a delivery server, to decoding. These characteristics make it suitable for real-time applications, such as video telephony, TV conferencing, broadcasting, surveillance, and so on, as well as content delivery.

③ **Scalable servers** [2)]

In order to achieve a large-scale, commercial VOD system at low cost, a loose integrated cluster architecture is adopted, wherein storage, host and network are connected via standard high-speed switches (gigabit Ethernet switches, fibre channel switches), a set-up which not only affords scalability, but also brings massive cost savings compared to conventional, dedicated parallel machines.

④ **Distributed VOD functions (CDN functions)**

Large-scale wide area commercial services are subject to an enormous number of access operations, which means that with a single server, relay network costs and delivery server installation are problematic, and hence a distributed VOD system is vital.

With the OKI Media Server, CDN functions are achieved by a distributed VOD structure and a transparent user interface is provided on a plurality of servers distributed over a broad range. Operational management functions relating to a highly advanced distributed system, such as dynamic route select functions, delivery status management, content schedule transmission, and the like, are also installed.

⑤ **Installation of functions required by commercial systems**

In addition to the basic streaming function, a commercial content delivery system must support a whole range of functions required to operate the service, such as user authentication, access control, billing, content browsing, operational management, and so on. The OKI Media Server is a powerful system which is installed with all of the functions needed to run a commercial service.

Conclusion

This essay has looked at the technical problems involved in video delivery, and traced the progress of video delivery and streaming technology. We have also looked at the very latest developments in video streaming technology, the current state of practical implementation, and likely future trends.

As ADSL continues its rapid expansion, we can expect to see an increasing variety of applications which use video streaming. In order to commercialize video streaming via present network infrastructures, high-quality image encoding technology is needed which will enable subscription services to be provided over the effective bandwidth currently afforded by access networks. We expect MPEG-4 ASP to be recognized as a valuable technology of this kind, in the future.

We have therefore designed our high-quality, low-delay CODEC to make the most of the technical characteristics of MPEG-4 ASP. Moreover, we have developed the OKI Media Server as a scalable video server with high functionality, which will be usable as a platform for a whole range of different video delivery applications in the future.

From here on, Oki Electric plans to continue its development of technology and products aimed at further improvements in image quality and delivery characteristics. ◆◆

■ References

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