Multimedia Streaming Technology in Broadband Networks 1 – Scalable Distributed Parallel Servers

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Conversion of the Internet to broadband is progressing at an amazing speed. The 64 Kbps and 128 Kbps connections which were mainstream just a few years ago are now being replaced by 1.5 Mbps and 8Mbps ADSL links, and 100 Mbps FTTH networks are also beginning to spread. Video delivery services have attracted attention as one of the “killer applications” of the new broadband era. This is because, with the conversion to broadband, network bandwidth, which used to be a barrier to network expansion, is now able to guarantee the capacity necessary for video delivery. However, with the spread of video delivery services, various problems associated with current video delivery systems have floated to the surface. This article will look at these problems, and describe our video server, the OKI MediaServer, which provides corresponding solutions.

The problems of video delivery service systems

As the bandwidth available to users has increased and video delivery services have proliferated, the problems of current systems have become apparent.

① Video servers require step-by-step improvement of delivery functions

Video delivery services are widely anticipated as the next “killer application”, but there remain a lot of technological grey areas. As a result, these services require video servers which can be installed in a scalable manner, so that they can be expanded progressively, step by step, from trial services, up to large-scale services.

② Broader bandwidth is required in providers’ private networks and in network shared between providers

Video delivery involves huge increase in the used bandwidth, placing pressure on network bandwidth, and therefore requires expansion and speeding up of bandwidth.

The OKI MediaServer developed by our company is a video server which resolves problems ① and ② described above, in the following ways.

① It allows gradual improvement of delivery performance in video servers

The OKI MediaServer is a parallel video server which means that servers for delivering video can be added in a scalable fashion.

② It allows expansion of network bandwidth

The OKI MediaServer is a distributed video server. Servers can be distributed in key sites, such as Tokyo and Osaka, for example, and by locating the server near to the end user in this way, it is possible to provide safe delivery, and to achieve a configuration that does not place a burden on the core network.

The next section will look at the features of the OKI MediaServer, and its principal functions as a parallel delivery server and a distributed video server.

Features of the OKI MediaServer

The OKI MediaServer has the following key features.

■ **A total solution for content delivery:**

Total support from creating and encoding contents, through to their management and delivery.

■ **Wide variety of video services:**

Supports stored delivery, live delivery, PC meeting[1].

■ **Scalability:**

Scalability through loosely coupled cluster configuration. Can be used to construct anything from desktop PC system, through to large-scale system handling several 10,000 access operations simultaneously.

■ **Excellent cost performance:**

High-performance system with 600 Mbps independent delivery performance (with 2 CPU, MPEG2, 6 Mbps). Low cost by adopting standard computer hardware.

■ **Distributed VOD function:**

Dynamic selection of optimum delivery route, depending on network connectivity status, fault status, congestion status, etc.

■ **Content security function [2]:**

Copyright management system conforming to cIDf standards [*1], access control, licence management system, encrypted stream delivery.

■ **Support for various platforms:**

Supports many different operating platforms, such as HP-UX, Solaris[*2], Linux[*3], Windows[*4] 2000, etc.

■ **High-performance, high-quality MPEG4 CODEC [3]:**

Supports Advanced Simple Profile. Real-time encoding of CIF[*5] 1 Mbps 30 fps[*6].

*1) cIDf : CONTENT ID Forum (http://www.cidf.org/) *2) Solaris is a registered trademark of Sun Microsystems, Inc., USA *3) Linux is a registered trademark or trademark of Linus Torvalds, in the USA and other countries. *4) Windows is a registered trademark or trademark of Microsoft Corporation USA. *5) CIF : picture size 352 x 288

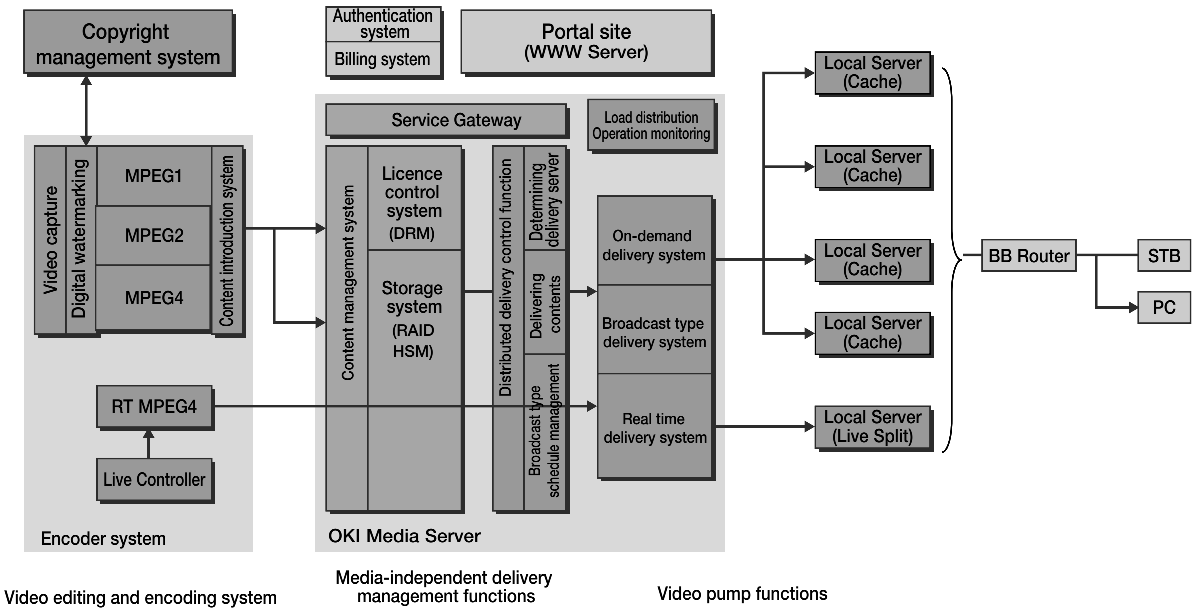

Fig. 1 Structure of the OKI MediaServer

Achieves low delay of 200 msec or less, and is applicable to real-time applications, such as TV conferencing/telephony, monitoring systems, etc.

Fig. 1 illustrates the structure of the OKI MediaServer. Next, we will look respectively at this product's features as a scalable parallel video server which permits step by step addition of servers, and as a distributed video server which allows a configuration that relieves the burden on the core network.

Scalable parallel video server

With increasing diversification of end users, it is becoming harder and harder to estimate the scale that services require. This has created demand for systems which allow a small-scale, experimental system to be built first, and then expanded progressively according to the rate of end user access.

The OKI MediaServer makes it possible to improve delivery capacity in a scalable fashion, by adding video pumps for picture delivery. Fig. 2 illustrates a parallel video server configuration of this kind. This set-up consists of a service gateway which receives playback requests from players, an array of video pumps, and a RAID connected by fibre channels, in such a manner that all the video pumps can access the same video data.

The issues in paralleling functions are: ■ a scalable system, ■ a load distribution method when the system is made up of a plurality of devices, ■ the video data sharing system, ■ access concentration to a particular RAID, * troubleshooting, and the like. These problems are solved in the following ways.

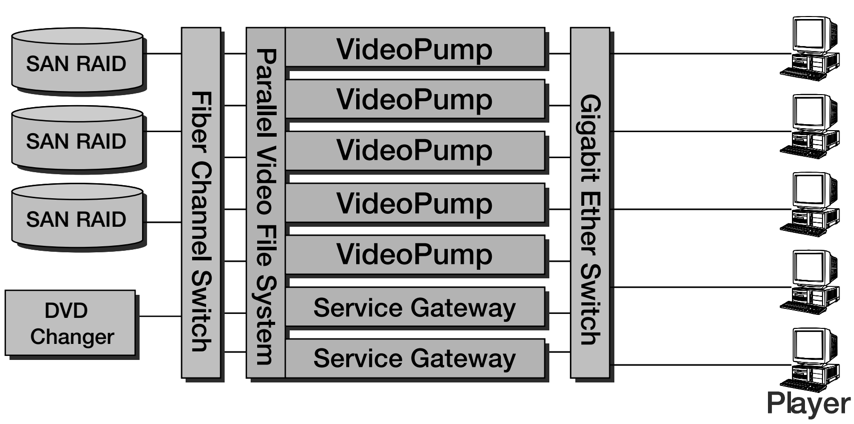

Fig. 2 Configuration of parallel video server

■ **Scalable system**

Video pumps can be added to increase the number of video deliveries. Servers acting as video pumps are added to the configuration and connected by a fibre channel to the RAID.

■ **Load distribution system**

It is necessary to distribute the load between a number of video pumps, in order to prevent concentration on a particular pump. Therefore, if there is a delivery request, the video pump with the lowest load is assigned as the delivery server. The pump with the

*6) fps : number of frames processed per second lowest load is determined on the basis of the CPU usage rate, DSK usage rate, network usage bandwidth ratio, number of delivery terminals, delivery bit rate, etc.

■ **Picture data sharing system**

Picture data is managed by a built-in video file system, which makes it possible for picture data to be accessed by any video pump.

■ **Avoiding access concentration on a particular RAID**

The load is distributed between RAIDs by means of a dynamic copying function which copies picture data to another RAID when access to picture data by the video pumps is concentrated on one RAID.

■ **Failure processing**

The Service Gateway collates the statuses of the video pumps at the same time as collecting the load distribution information, and if a video pump is in an abnormal condition, no services are allocated to that pump. The pump in question is set to degenerated operation, and the operation management function reports the related abnormality information. The Service Gateway has a dual configuration, which means that if one device breaks down, operation is continued by the other gateway device.

Furthermore, a DVD changer can be connected as a layered file system. Using a RAID as a cache memory, it is possible to make effective use of a DVD changer, which is an inexpensive, large-capacity archive, in combination with a relatively expensive RAID set-up.

Distributed video server

The distributed video server is a function for installing video servers at a number of different locations and making these servers work in conjunction with each other. The end user accesses a central server, and only receives video delivery from a local server. By placing local servers at access sites near to the end user, the load on the core network can be reduced. The distributed video server has the following features.

■ **United operations management for all servers**

United operations management for the whole system is performed by the central server.

■ **Distributed content management**

All contents are managed by the central server, and copies can be delivered automatically to previously designated local servers when they are introduced.

■ **Local server delivery control**

The central server identifies information, such as the local server operating status, by the aforementioned operations management function, and the content holding status, by the distributed content management function. The nearest server to the end user capable of delivering the required pictures is determined and a picture delivery request is sent to that local server.

Fig. 3 shows an example of the configuration of a distributed video server. The central servers and the local servers each have the same structure as the parallel video server.

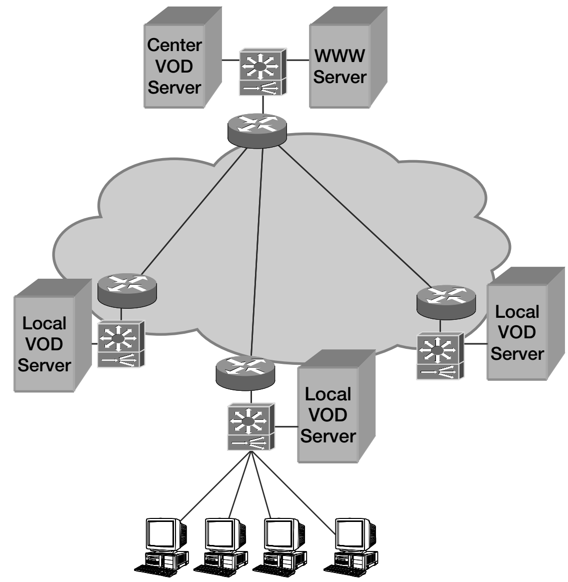

Fig. 3 Configuration of distributed video server

Issues in distributed delivery include: * the content management system, * the local server determining system, * operations management, * troubleshooting, and the like. These issues are resolved in the following ways.

■ **Content management**

Content management is divided into three operations.

• Data Introduction

Firstly, picture data is input to a central server. Simultaneously with its introduction into the central server, the data is also input to designated local servers. The data can also be input to the local servers by scheduled delivery. The contents and their positions are logged in a database.

• Data Deletion

Data can be deleted by specifying a particular server storing contents or by selecting all of the servers. The deletion is performed instantly.

• Data Copy

Picture data can be copied from the central server to local servers according to schedule settings.

■ **Local server determining algorithm**

The local server with the nearest address is not necessarily the closest local server. The network configuration and bandwidth, and the usage status of the local servers are taken into account when determining the local server to be used for delivery.

■ **Operation monitoring**

An operations management module in the central server constantly collates information, such as the local server usage statuses, number of delivery users, delivery bit rate, used bandwidth, and so on, in order to monitor the operation of the whole distributed video server and generate reports in the event of an abnormality.

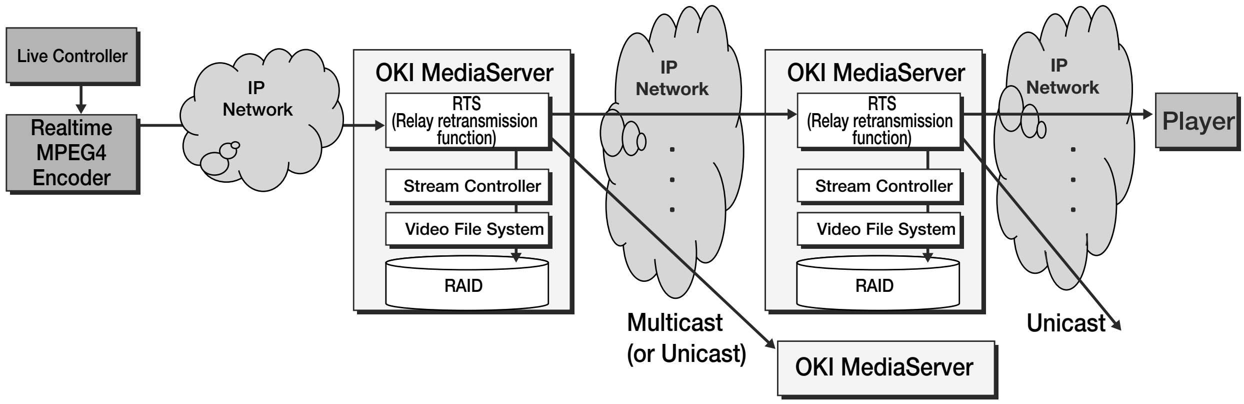

Fig. 4 Live delivery system

■ **Troubleshooting**

A local server which has generated a fault in the operations monitoring described above is notified to the local server determining module, so that the server in question is not assigned.

One of the application examples of distributed video delivery is a large-scale live delivery system. Fig. 4 shows the structure of such a system. A central server receives live pictures from an encoder, and relays these pictures to the local servers in the form of a multicast or unicast. The end user accesses the central server in the same way as the distributed video delivery system described above, and receives and reproduces live pictures from the nearest local server. In this system, the access network requires bandwidth corresponding to the number of users receiving the video delivery from each respective local server. However, in the system upstream of the access networks, in the case of a multicast transmission, bandwidth corresponding to each video delivery data object is required, and in the case of a unicast transmission, bandwidth corresponding to the number of local servers is sufficient. This means that the network bandwidth can be used efficiently. A whole range of applications, from live broadcasting to e-Learning systems4), can be built using this configuration.

Summary

This article has looked at the OKI MediaServer in relation to:

■ **a scalable parallel video server which allows gradual expansion; and**

■ **a distributed video server which reduces network load.**

Through the application of these functions, we can expect to see continuing progress in video services over broadband networks. ◆◆

References

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