# Multimedia Streaming Technology in Broadband Networks 2 – Visual Communications System

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With the recent expansion of broadband networks, two-way visual services, such as video conference and video chat, are being developed by ISPs (Internet Service Providers) and network carriers. In services supplied by ASPs (Application Service Providers), on the other hand, attention has focused on visual applications, such as conferencing system services aimed at business users looking to cut staff travel costs, as well as remote lecturing services for educational institutions, and an increasing number of firms are introducing visual systems of various kinds in order to evaluate their performance.

These communications services are based on video, voice and data integration networks using IP (Internet Protocol), rather than conventional services based on voice communication models, and are attracting interest as a new broadband network service for the future.

In order to provide a base system for these visual communications services, at Oki Electric, we have focused on media quality in the development of our "OKI MediaServer" system (hereinafter, called the "MediaServer") which gives excellent cost performance and comprises bi-directional PC conferencing functions. Below, we trace the related development policy, and look at the overall structure and features of the system.

## Development concepts

Two-way communications services, such as chat, conferencing and collaboration functions, have clearly become a crucial part of the range of services supplied over broadband networks, alongside on-demand streaming services, such as film and live event delivery.

The reason for this is that, as evidenced by the spread of mobile phones, communication is a basic human desire, a potential need, and since the service user is also the content provider, there is no need to prepare content in advance, providing the merit of easy development from the service operator's point of view.

Version 4 of the Oki MediaServer already offered integrated multimedia service functions which allow services of this kind to be achieved via a single platform.

In the field of video delivery, from a very early stage, we have been involved in the development of new products based on codec technology, and have focussed our efforts on providing high-speed, high-quality H.263 and MPEG4 encoders and decoders.

Version 5 of the MediaServer has achieved improved scalability through parallel operation of conferencing servers, which allows the system to be expanded in line with increase in the number of users.

A broadband content environment constructed using the MediaServer is able to link visual communications functions with streaming functions, thereby supplying bi-directional collaboration services to users at low cost. In this configuration, by merging streaming delivery functions with a core H.323-compliant multipoint conferencing server function[1)], an environment is created which allows participants in two-way communications to share, view and hear the same multimedia contents, independently of the conference session.

The user terminal is assumed to be a domestic or business PC. This is because of the increase in the number of inexpensive platforms capable of achieving high-quality video services and the excellent service expandability PCs provide through addition of new applications.

## Overview of PC conferencing systems

A PC conferencing system is built in a modular fashion as one of the three core services of the MediaServer (delivery of stored contents, live delivery, multipoint video conferencing). The system is built as a multipoint video conference server conforming to ITU-T H.323 standards.

Server side components include an MCU (Multipoint Control Unit) for multipoint conference control server, a gatekeeper for address management, a linkage gateway to the VOD (Video On Demand) system, and VOD delivery servers which include special conference service processes.

The client side, on the other hand, is equipped with an H.323 middleware environment and standard PC conference applications (Fig. 1).

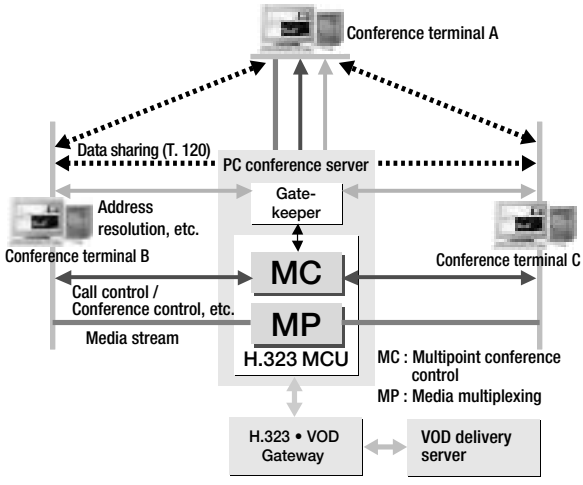


Fig. 1 Configuration of PC conferencing system

**(1) MCU (Multipoint Control Unit)**

This is a centralized multipoint control server which processes conference-related control requests from user terminals distributed between multiple locations, as well as managing a media data (video and voice data) delivery schedule. The MCU has a central role in the provision of visual communications services.

The MCU server comprises two processes: an MC (Multipoint Controller) which has a conferencing control function, and an MP (Media Processor) which has a media processing function. The PC conferencing function is achieved by combining these two functions.

**(2) Gatekeeper**

The gatekeeper provides address resolution, bandwidth control and an admission control function, to H.323 end-points (terminals, MCU, and gateways), situated within a prescribed region of the network. Address resolution is a function for converting a communicating party specified in a non-IP address format, to an IP address, and bandwidth control is a function for controlling communications quality in the managed area of the network. These functions are installed as standard software modules in the Oki MediaServer.

**(3) VOD linkage gateway**

This is a relay module for supplying the powerful, high-quality content delivery and storage capacity provided by VOD servers to the conferencing system. The module itself functions as a type of H.323 terminal, and by having protocol and audio/video data converting functions, it provides communications with the VOD servers.

**(4) Conference service server**

With the MediaServer, multiple of logical services, such as on-demand content delivery and live delivery, can be provided, and the conference service server module operates on the VOD delivery server as a point for receiving functional requests relating to PC conferencing. More specifically, it supplies retrieval and select functions for content information used by the conference service, to the VOD linkage gateway.

**(5) H.323 middleware environment**

This is an H.323 execution environment installed in the user terminal. This environment comprises: call control functions (for controlling call origination/incoming call answering for the communicating party), conference control functions (terminal capability negotiation, opening and closing of media broadcast channels, etc.), gatekeeper communications functions (address resolution, bandwidth control, etc.), and data sharing functions (electronic whiteboard, application sharing, file transfer, etc.). This middleware is constructed by an open API group, and provides an environment which allows a whole range of different applications to be developed.

**(6) PC conferencing standard applications**

This is an application in the MediaServer for providing visual communications services. It is built on the H.323 middleware environment and has the following functions.

- Organize conference / Invite participants / Participate in conference
- Broadcast from designated terminals by conference chairman / various conference control functions
- Application sharing , file transfer
- Sharing of multimedia contents (synchronous playback)
- Recording and playback of conference video / voice data

The various functions of the PC conferencing system are listed in Table 1.

Table 1 PC conferencing functions : Specifications

| | |
|---|---|
| Communications speed | Video : 32K~1Mbps<br>Voice : 64K, 5.3/6.3Kbps |
| Video encoding method | H.263, MPEG4 |
| Voice encoding method | G.711, G.723.1 |
| No. ground connections | Max. 32 connections<br>(16 for picture display) |
| Connection terminals | Windows 98 SE, 2000, XP |
| Operational management | Web browser interface |
| Media delivery system | Automatic synthesis by voice level detection, specific terminal broadcasting, participation order setting |

## Features of the PC conferencing system

**(1) Software solution**

Since all server components and terminal applications are realized by software, it is possible to achieve service platform functions which have excellent cost performance.

Furthermore, by updating modules, functionality can be expanded easily and high-function services can be provided in line with platform performance upgrading.

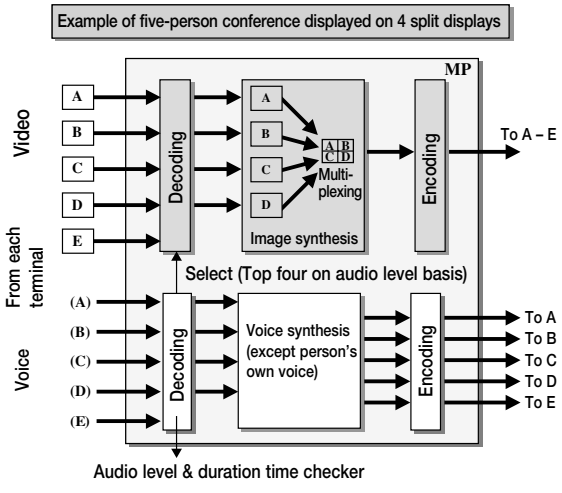


Fig. 2 Video / Voice synthesis processing in MCU

**(2) Video/ voice synthesis by high-speed codec**

As shown in Fig. 2, the MCU server performs real-time synthesis processing by means of high-speed voice and video codecs.

This centralized architecture is used to monitor the audio level of the voice and duration time received from the respective terminals, and decode, synthesize and encode images of selected video, as well as performing synthesis processing for voice signals to be transmitted to each terminal.

By implementing the respective codecs partially at the machine instruction level, delay times are minimized.

**(3) Data sharing**

In the PC conferencing system, data sharing functions (based on the T.120 protocol) required for collaborative work are provided as standard.

More specifically, a data control having the following functions is implemented on each terminal:

- Whiteboard function
- Chat function
- Application sharing function

This has two modes: an exclusive operation mode in which the party who started up the application retains the operation right, and a joint work mode which allows the operation right to be transferred between participants.

- File transfer

This function enables files to be transmitted to specific participants, or to all participants, and is particularly useful when forwarding documents, etc., created during a conference, when it terminates.

**(4) VOD linkage gateway**

By implementing this VOD linkage gateway (hereinafter, "VOD gateway") as another end-point in the H.323 system, the following functions are achieved.

- Conference video and voice recording

A user terminal without a video camera input and with virtually zero microphone input level is made to function as a VOD gateway, and this dummy terminal is invited to the conference by means of the chairman control function. A dummy terminal taking part in a conference records the conference, live, by sending the video and voice data from the MCU, directly to a VOD server.

- Synchronous playback of general contents

This function allows all conference participants to view contents stored on the MediaServer, simultaneously. The function is based on the following set-up.

If the function is activated during a conference, then the chairman invites a new VOD gateway to take part in the conference, and sets up a second channel between the MCU server and the respective terminals.

The chairman issues instructions for broadcasting video and voice signals from the VOD gateway to all of the participants, via the second channel.

The VOD gateway creates a video input and voice input by forwarding the stored contents delivered by the MediaServer. This stream is delivered via the MP to all of the terminals.

**(5) Scalability**

This function makes it possible to select an optimum host from multiple of MCU server machines, when organizing a conference, by using the distributed load function of the MediaServer.

The server selection is made with the middleware, so the user does not need to be aware of the selection operation.

The items taken into account when selecting the server include the CPU usage rate and load, disk I/O load, and the network load.

**(6) Operation management**

It is important that a variety of management functions are provided for running the conferencing system. In the MediaServer, conference management is based on the Web browser, and comprises these functions:

- Monitoring of the user conference terminals
- Display of conferences in progress
- Historical display of conferences held
- Conference reservation/Prior notification
- Unified centre management of environment parameters for conference applications and function for downloading from user terminals

## Application examples

By combining visual communications services with live relay functions (see Fig. 3), it is possible to achieve applications, such as large-scale net panel discussions.

Normally, when a large-scale conference (involving several hundred points) is organized using an H.323 or other bi-directional system alone, problems arise, such as the complexity of controlling the conference and increased delay in media data communications.

Using the live delivery functions of MediaServer, it is possible to achieve large-scale implementation of applications which combine participants who always

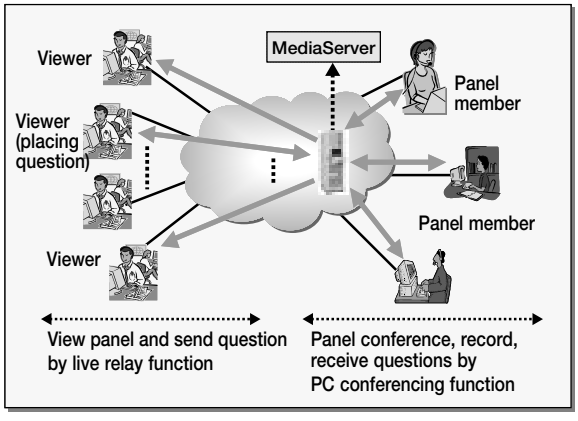


Fig. 3 Panel discussion system

need two-way communications functions, and participants (audience) who are able to communicate on request only.

The first set of participants take part in a conference (panel discussion) over a PC conferencing system using the H.323 function. At the same time, if the conference is recorded, then it will be managed as another live content in the MediaServer.

The latter set of participants are able to take part in the conference as viewers, by playing the panel discussion as a streaming content. If one of this group wishes to say something, then another live content is added to the MediaServer by an application using a live transmission function. The chairman of the panel discussion selects this statement via the VOD linkage function, in such a manner that the other members are able to hear it, simultaneously.

## The future of the MediaServer

**(1) NAT compatibility**

In implementing bi-directional communications, such as H.323, IP address conversion functions, most typically, NAT (Network Address Translation), have become a significant barrier to the establishment of services.[2] This is because the sender address is written into the data portion of the communications message, and the NAT transversal function, which is included in the UPnP (Universal Plug and Play) functionality, has been highlighted as a potential solution to this.

In response to expanding use of NAT traversal, the possibility of supporting this function in the MediaServer is also being studied.

**(2) Enhancing management functions**

Visual communications services have required different functions, depending on their application, be it chat, video conferencing, or the like.

For example, a video conference between corporate officers requires that the existence of the conference is not made public and that only video images of specified participants are displayed at all times.

On the other hand, in a video chat service, or the like, the manager needs functions for monitoring the conference situation, without actually taking part in.

It is planned to summarize these varying requirements into subsets and then integrate them into the operation management function.

(3) SIP compatibility

SIP is based on HTTP and, with its excellent Internet compatibility[3], is regarded potentially as a key protocol of the future. For this reason, we plan to release it as a basic protocol for visual communications functions in the MediaServer, in the near future.

Above, we have looked at the visual communications functions of the Oki MediaServer. As broadband network environments continue to advance, and services between ISPs and wider area operation become more fully established, it has become necessary to implement co-operative operation between MCUs situated in geographically diverse points. In this case, the delay time can be expected to increase due to the cascade processing between MCUs, and this makes it technologically difficult to achieve a distributed MCU architecture which manages to maintain quality of service. From here on, in our continuing development of the MediaServer, we will be concentrating on the issue of network QoS with the aim of providing a user-friendly service environment. ◆◆

## References

1) ITU-T, Packet-based multimedia communications systems, 1998

2) V. Kumar, Markku Korpi, Senthil Sengodan, “IP Telephony with H.323: Architectures for Unified Networks and Integrated Services”, Wiley, 2001

3) D. Collins, “Carrier Grade VOICE OVER IP”, McGrawHill, 2001

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