3—1 Architecture of Interactive Multimedia Service Platform for the Integration of Broadcasting and Telecommunication Service

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Abstract: Innovation on digital compression technology, high speed networking technology, digital broadcasting technology and distributed processing technology provides new interactive multimedia service that integrates telecommunication, broadcasting, and computer application. To meet the new trends, we focus our research direction to integrate the telecommunication services and the broadcasting services. For this purpose, we designed and implemented an interactive multimedia service platform based on the DAVIC specification. Our research results in the development of integrated interactive multimedia services and its experience will be feedback to the field trial service that will be launched from next year. In this paper, we will describe the overall architecture and system implementation results of the interactive multimedia service platform.

1. Introduction

An interactive multimedia service provides interactive control of the media stream to the user, while conventional broadcasting services only provide unidirectional distribution service. Innovation on digital compression technology, ATM based high speed networking technology, digital broadcasting technology, and distributed processing technology provides new interactive multimedia service that integrates telecommunication, broadcasting, and computer application. It will play much important role in future coming society, and provide new working, shopping and leisure environment.[1] With the advancement of technologies, standardization and interoperability is the key factor to expand interactive multimedia service.

DAVIC (Digital Audio-Visual Council), by recognizing the importance, was established in order to standardize application services that can be commonly used in broadcasting, telecommunication, and computer. DAVIC announced specification 1.0 that includes interfaces, protocols, and tools to interconnect service systems.[2] DAVIC specification not only covers currently well established multimedia services (movies on demand, distance learning, and home-shopping) but also provides the broadcasting-type services. While DAVIC builds a foundation to provide high quality interactive multimedia services, Internet is spreading with enormous speed. DAVIC considers the situation an opportunity to speed-up the convergence between DAVIC and Internet. Currently announced DAVIC 1.1 provides Internet access tools and JAVA virtual machine. [3]-[4]

We focus our research direction to integrate the telecommunication services, the Internet service, and the broadcasting services to meet the new trends. For this purpose, we designed and implemented an interactive multimedia service platform based on the DAVIC specification. The service platform includes various service component systems such as movies on demand server, broadcasting server, ISAP (Internet Service Access Point) server, service user terminal, and delivery system. Interactive multimedia services such as movies on demand, home-shopping, and Internet access service has been developed over the service platform. Our research results in the development of integrated interactive multimedia services and its experience will be feedback to the field trial service that will be launched from next year. In this paper, we will describe the overall architecture and system implementation results of the interactive multimedia service platform.

2. Platform Architecture

Goals

To meet the new trends of communication environment, we focus our research direction to integrate the telecommunication services, the Internet services and the broadcasting services. The main objectives of the research are establishing new service developing environment for integrated interactive multimedia services, and verifying DAVIC service specification and it's validity. For this purpose, we designed and implemented an interactive multimedia service platform based on the DAVIC specification.

Platform Architecture and Service System

As the basic services implemented on service platform, movies on demand, Internet access services, multipoint videoconference service, and switched video broadcasting service are supposed to be built until next year. Among these services, we have implemented MPEG-2 quality movies on demand, home-shopping, and Internet access service based on the DAVIC specification.[2] We will integrate broadcasting type applications such as switched video broadcasting to the service platform.

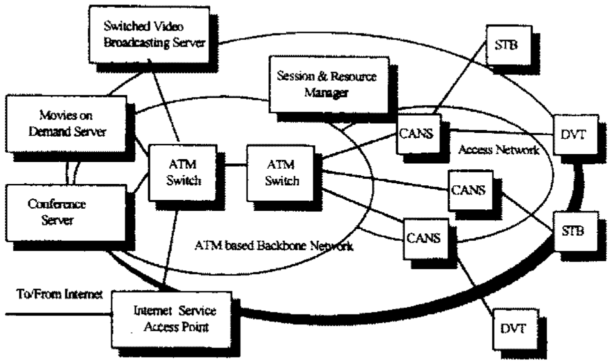

Figure 1. Overall Architecture of Service Platform

Fig. 1 shows an overall architecture of the service platform. ATM switch is used as a core network and CANS (Centralized Access Node System) that has a stream duplication and channel selection control function is used as access node. For the server side, there are four kinds of server: movies on demand server, switched video broadcasting server, Internet server for ISAP (Internet Service Access Point), conference server for multipoint videoconference service. MPEG-2 set-top box, PC based MPEG-2 set-top box, PC based videoconference terminal are being developed as the user service terminal. All the user service terminal is connected with 155Mbps STM-1 interface. Table 1 is a list of service equipment that will be used for service platform. Protocol stack of current service platform is compliant to DAVIC 1.0 and 1.1 specification. [2],[3],[6]-[8]

Table 1. List of Equipment in Service Platform

Core network	Public ATM switch
Access network	CANS (Centralized Access Node System) with stream duplication and channel selection control function
Server	Movies on demand server, Switched video broadcasting server, Internet server for ISAP (Internet Service Access Point), Conference server
Terminal	MPEG-2 STB (Set-Top Box) PC based MPEG-2 STB PC based DVT (Desktop Videoconference Terminal)

3. Design and Implementation of Service Platform System

3.1 System Architecture for Movies on Demand

We have implemented movies on demand server, SRM, and STB for movies on demand service, and completed integrated test. Fig. 2 shows a service platform for DAVIC compliant movies on demand service. We connected all the service system to the access node that has a local ATM switching function through 155Mbps multimode optical fiber line.

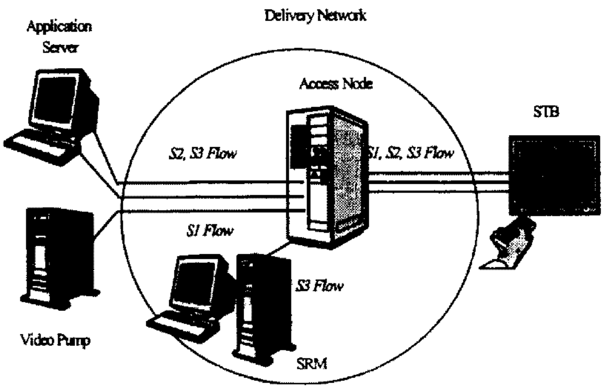

Figure 2. Service Platform for Movies on Demand

Video Server

Video server consists of application server and video pump. To process DAVIC service protocol in the application server, we have implemented DAVIC's S2, S3, information flows in SUN workstation, and video pump for DAVIC's S1 information flow was connected via internal API. To provide real-time stream pumping function, we used high speed SUN Ultra workstation for the video pump hardware platform. For video stream storage, we added 20Gbytes hard disk to the video pump via fast wide SCSI interface. Fig. 3 shows the basic system architecture of the application server and video pump.

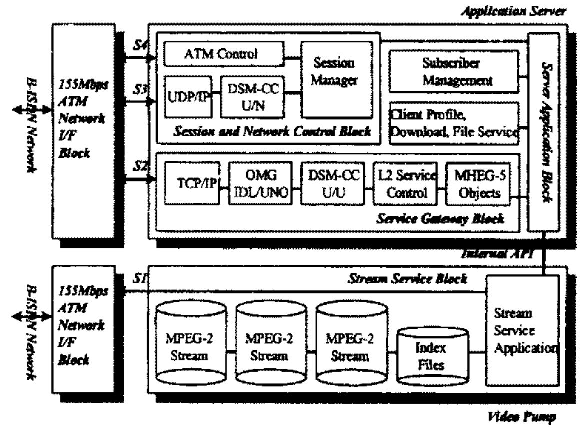

Figure 3. System Architecture of the Video Server

Protocol software of application server operates in the SUN UNIX environment, and consists of four blocks: Session and Network Control Block, Server Application Block, Subscriber Management and Supplementary Service Block, and Service Gateway Block. Session and Network Control Block performs the network connection control, user-network configuration, session establishment/release, resource allocation/deallocation, and status management for session and network connection. Server Application Block controls the other block in application server and video pump via internal API. Subscriber Management and Supplementary Service Block manages subscriber information and provides supplementary services such as client profile, download, and file service. Service Gateway Block is the core function block in application server. It provides user's navigation and application selection function.

User Terminals

For service platform terminal, STB (Set-Top Box) was developed as one add-on board in PC system hardware. Fig. 4 shows the basic system architecture of the STB [5]. MINIBA (Media and Network Interface Board Assembly) is the main unit that performs the MPEG-2 decoding and ATM network interface function. MINIBA is divided into two modules: ANIM (ATM Network Interface Module) and MPM (Media Processing Module). ANIM provides termination of physical signal, ATM and AAL processing, and Q.2931 UNI signalling function. MPM provides demultiplexing of MPEG-2 TS (Transport Stream), decoding of MPEG-2 AV (Video and Audio), and AV output function.

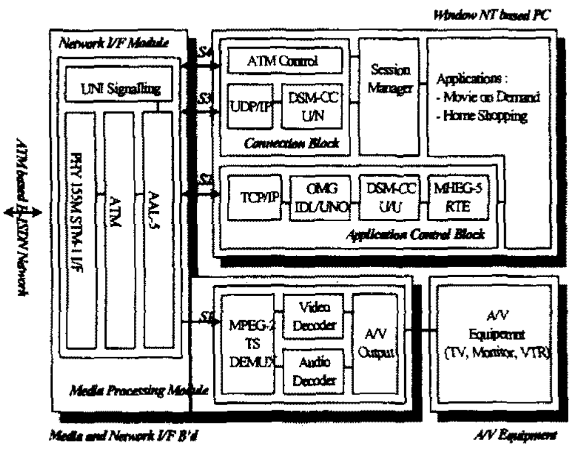

Figure 4. System Architecture of the STB

Software functions of STB operate in the Windows NT environment. They are classed as the CB (Connection Block) that control the low layer connection between STB and server, SM (Session Manager) for session management, and ACB (Application Control Block).

SRM (Session and Resource Manager)

SRM manages sessions and their resources. SRM consists of resource manager, session manager, and configuration module. The resource manager manages many kinds of the resources connected with the session such as VPI, VCI of PVC connection, and PID of MPEG stream. The session manager sets up and releases the session according to the request from a client or a server. The configuration module mainly manages the subscription of users. Since DAVIC defines TCP/IP protocol between server and SRM, and UDP/IP protocol between STB and SRM, SRM has a TCP/UDP conversion function.

Integrated Data and Control Flow

Detailed data and control flow of the integrated protocol test are shown in Fig. 5.

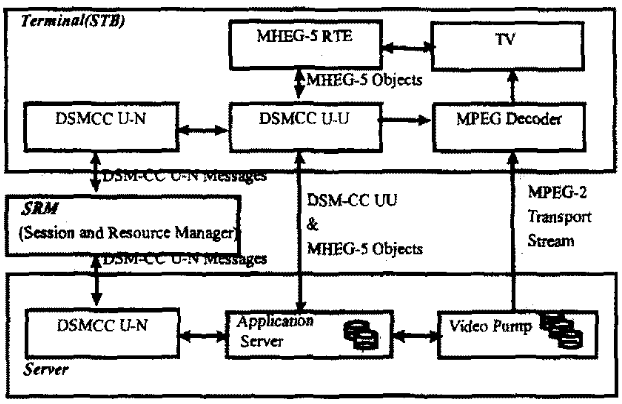

Figure 5. Control Flows Movies on Demand

First, the STB request a session set-up to SRM through DSM-CC U-N. Then SRM sends a session indication to the server. When the session was established between the client and the server, DSM-

CC U-U on the STB gets the information about the services that the server can provide to the users. The server has MHEG-5 and other DSM-CC objects together. The MHEG-5 RTE on the STB renders the scene on the screen, then the user chooses an application such as a movies on demand service. DSM-CC U-U sends the user request to the general server. Responses are send to the STB through DSM-CC U-U. The general server controls one or more video pumps, which store MPEG-2 stream. The user's request about MPEG-2 streams is sent to the video pumps via internal APIs. After that, the MPEG-2 stream is delivered from video pump to the STB. Finally, STB decode MPEG stream and display on TV screen.

3.2 System Architecture for DAVIC Internet Sevices

Service Architecture and Method

Recently published DAVIC specification 1.1 provides tools for Internet access. In this section, we focus on our approach to harmonize the Internet and DAVIC services.[3] Fig 6 illustrates architecture for Internet access service.

In DAVIC specification 1.0, session control for an interactive service uses DSM-CC U-U protocol, and navigation presentations depend on MHEG-5 RTE. An end user who wants to receive a movies on demand service, for example, needs an STB with MHEG-5 based navigation RTE. However, our proposed architecture utilizes WWW, JAVA, and CORBA to distribute DSM-CC U-U client as a JAVA applet. Thus, an end user can navigate multimedia services interactively using its familiar and user friendly WWW browser.

For the direct Internet access, ISAP relays IP over ATM traffic from/to an STB. It is a typical router which has ATM and IP LAN interface. Any commercial routers of this category will fit for its purpose. For our development, UNIX workstation based gateway is used instead and will be replaced in the future.

In the service provider system, HTTP server is installed besides existing application service modules. It maintains navigation presentation objects and DSM-CC JAVA applets. Another important role is to advertise its service to not only DAVIC users but also non-DAVIC Internet users. It can be excellent means to establish and expand its customer base. We are planning to add RSVP (Reservation Protocol) and RTP (Real Time protocol) to support high quality multimedia services for non-DAVIC Internet users.

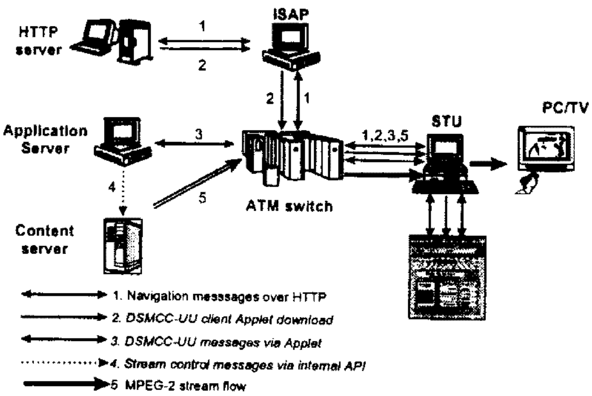

Figure 6. Architecture for Internet Services

Based on the above architecture, an example senario for the Internet access service is given as follows: When an STB starts up, a configuration setup module initiates a dialogue with its DAVIC network provider's configuration setup module. As the result, the STB receives information about the ISAP to connect for the Internet access. After its connection with the ISAP, an end-user starts a web browser. While navigating through the Internet, user finds an interesting multimedia service site. During further surfing, user decides to accept the service provider's contractual terms and select high quality DAVIC VOD service. Through the negotiation, the service provider gets enough information about the user and it's STB. After authentication verification, it downloads an applet to the customer. After successful resource allocation, VOD service navigation menu with a DSM-CC U-U client applet is downloaded and the user selects a favorite movie. Finally, the movie is delivered to the user through MPEG-2 downstream channel. Figure 6 illustrates interactions involved with this scenario pictorially. While watching the movie, user not only can control the stream interactively but also can navigate the Internet at the same time.

4. Conclusion and Future Directions

To meet the new trends of communication environment, we focus our research direction to integrate the telecommunication services, the Internet service and the broadcasting services. We have designed and implemented an interactive multimedia service platform that meets this trend. Platform has been developed as environment to develop new interactive multimedia services, as well as a verifying tool of service specifications and their validity. The service platform includes various service component systems such as movies on demand server, broadcasting server, ISAP (Internet Service Access Point) server, service user terminal, and delivery system. Interactive multimedia services such as movies on demand, home-shopping, and Internet access service has been developed over the service platform. We are going to integrate broadcasting type applications such as switched video broadcasting to the service platform from next year.

Our research results in the development of the integrated interactive multimedia service and its experience will be feedback to the field trial service that will be launched from next year. We hope that this effort will become a corner stone to provide integrated interactive multimedia services and to promote its standardization throughout the world.

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