

# Toward the Construction of Hybridcast™

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## Abstract

In this paper, we describe our work toward the construction of Hybridcast, which is a system for the next generation hybrid services of broadcasting and communications network. Hybridcast leverages communications network to enhance and enrich existing digital broadcasting services in various aspects such as customization for each viewer, incorporation of social networking, recommendation of related programs, and collaboration with portable devices. We have developed a prototype receiver and servers to evaluate the system.

## 1. INTRODUCTION

As digital broadcasting and broadband communications network are both becoming more common, many people can now enjoy high quality broadcasting content as well as a large variety of content provided via the Internet. Since broadcasting and communications network have complementary characteristics, their combined use will enable more advanced services in terms of quality, diversity, and flexibility. We are working toward the construction of Hybridcast, which enhances broadcast services by using a communications network, which will be technologically feasible in the near future. We describe the idea behind Hybridcast and show example services as well as technologies used in these services.

## 2. CONCEPT OF HYBRIDCAST

Figure 1 shows the concept of the Hybridcast system. Broadcasting has an advantage in quality, reliability, and simultaneity, while a communications network has an advantage in responding to an individual viewer's request. Hybridcast will closely combine the advantages of both delivery paths and enable high-quality and various personalized services. It uses broadcasting programs as the core of its service and enhances and enriches them using a variety of information and functionalities offered by collaborating network servers. The system rests on the following technologies:

- Synchronization technology that enables combined presentation of broadcast programs and network content.
- Device collaboration techniques to link TV sets and portable devices, such as smart phones to improve access to content and related information.

- Management of program-related information on the cloud server and delivery control of the information in synchronization with broadcasting programs. The information is not only provided by the broadcaster but also created by viewers, such as consumer generated media (CGM) and social networking services (SNS).
- Protection of content rights and personal information. This ensures credibility of the network content and services, which is vital when used with a broadcast service.

The aim of our development is to build a system on which a service provider can implement various services based on broadcast programs. The Hybridcast system will be built upon the existing broadcasting system by adding collaborating cloud servers as well as an extended receiver capable of accessing the cloud services at the same time as receiving broadcast programs. Changes to the existing broadcasting system should be kept minimum so that the introduction of the Hybridcast will not create conflict.

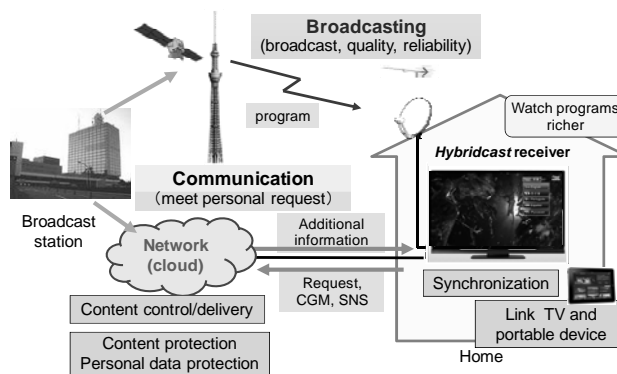


Figure 1. The concept of Hybridcast and its technologies

## 3. ENVISAGED SERVICES

The following are examples of Hybridcast services that feature the concept described above. All of these services enhance the broadcasting service by using a communications network in different manners.

### 3.1 Program Customization Service

Hybridcast can augment programs being broadcast with content provided over a communications network. The receiver combines the broadcast content with additional content, such as closed caption in foreign languages, audio with a slow rate speech for the elderly, and related video

content. This enables a service to be tailored to individual viewer needs. To realize this service, technology for synchronizing broadcast and communications networks is needed[1]. Figure 2 is an image of a multilingual closed caption service that synchronously displays network-delivered closed caption with a broadcast program.



Figure 2. Program customization service

### 3.2 Social TV Service

Social TV services will combine broadcast programs with SNS on the Internet to form “program communities” that viewers can take part in while watching the program. Comments from viewers are displayed in real time so that even viewers who do not use the SNS can see what other viewers are thinking. The comment analysis process running on the server-side will categorize comments into groups and also reject unsuitable ones. Figure 3 is a display of a list of viewer’s comments and a distribution graph of the categorized groups of viewers.



Figure 3. Social TV service

### 3.3 Program Recommendation Service

Hybridcast will present viewers with personalized program recommendations from the large number of on-demand programs available via the communications network. Recommended programs will be derived from different criteria such as similarity to the program on the air[2], viewer’s profile, and comments and ratings from other viewers on the SNS. Figure 4 shows an image presenting recommended programs. Viewers are not only able to watch the recommended program immediately but also

store it to a bookmark service that runs on the network server for later viewing.



Figure 4. Recommendation service

### 3.4 Multi Device Link Service

Hybridcast will offer functions for more convenient viewing when used together with portable devices or PCs. For example, by linking a portable device with a broadcast receiver, viewers will be able to have more familiar and sophisticated control of the receiver than with a conventional remote. Especially, to use personalized services such as bookmark and social TV, a viewer first needs to login to a receiver. Instead of entering a username and password by using the remote, it can be done automatically by sending personal information from the portable device to the receiver.

## 4. SYSTEM PROTOTYPING

We implemented the above-mentioned example services by developing prototype receiver and servers. The aim of this prototyping was to sort out the functional requirements for the Hybridcast system to implement these services. Figure 5 illustrates the setup and relations between services and servers although this is an interim construction and will be refined through future development. The prototype receiver is built upon a Windows PC, which implements an application execution environment based on GEM[3] for running application programs for each service. Each application is started by selecting an icon from an onscreen menu and the receiver runs the application while presenting a broadcasting program. Each application connects to the

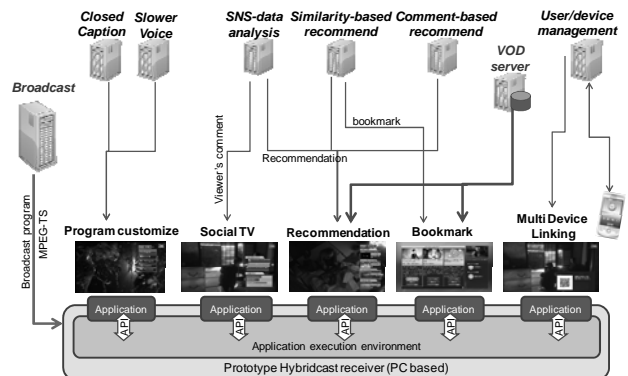


Figure 5. Prototype Hybridcast system

specific server to obtain necessary information or content. In this experimental system, all devices were connected on a single local area network.

We are currently designing detailed specifications of the Hybridcast system, which includes a communication API for information/content transaction and a control API for using enhanced functions of a Hybridcast receiver. In this prototyping, we designed a restful API for network transaction and also extended the GEM API for receiver control. These APIs will be further detailed through future experimental implementation.

## 5. TECHNOLOGIES USED IN HYBRIDCAST

### 5.1 Synchronization

In the program customization service, we use a method to synchronize extra content from a communications network (e.g. video, audio, text, or metadata) with broadcast video and audio[1]. While broadcasting transmits data at a stable rate with a constant delay, data from a communications network tends to be delayed inconsistently or lost during delivery. Also, there will be a delay caused by processing on the network server. Therefore, the system must implement a mechanism to compensate for this variable delay. It is not difficult if a broadcaster can send the network content earlier than the broadcast. However, such a strategy cannot be taken when the program is live. Therefore, we introduced a design to buffer broadcast content for a certain amount of time at the receiver side before presentation to keep both types of content synchronized.

Figure 6 shows how the system handles synchronization. We use a similar mechanism to that of MPEG-2 Systems. The content delivered via a communications network is marked with a presentation timestamp (PTS), which is based on the same clock in the broadcaster. On the receiver side, a fixed-duration buffer is used to delay the presentation timing of the broadcast content to compensate for the delay in the network-delivered content. The receiver combines incoming network content and the delayed broadcast content by matching the PTS then it can present them at the correct, synchronized time.

### 5.2 Linking TV and Portable Device

For a service that links portable devices with a receiver, connection between them can be achieved using Wi-Fi or Bluetooth. However, there are still many devices, such as conventional cell-phones that do not have such functions. We devised a mechanism to link a cell-phone with a receiver by using the phone's 3G connectivity and embedded camera[4].

Figure 7 shows how a cell-phone can be linked to a receiver. At the beginning, a receiver shows a QR-code (a two-dimensional barcode) automatically or by viewer control. The QR-code encodes a terminal ID of the receiver so that a cell-phone can read it by taking a picture of the TV screen. The cellphone sends a pair of IDs, i.e. the receiver ID and the user ID, to the user management server. Then the server uses server-side push technology to notify

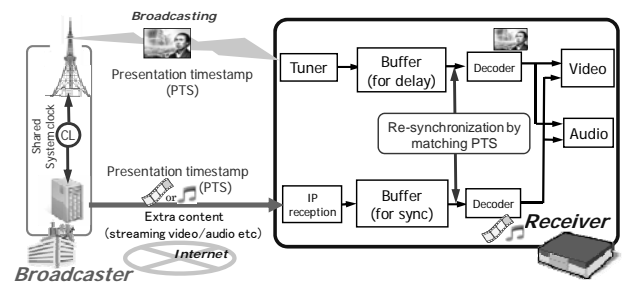


Figure 6. Synchronization mechanism

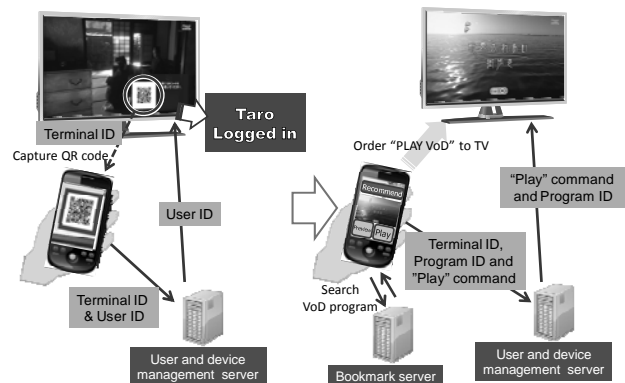


Figure 7. Linking cell phone with receiver by using QR-code

the receiver of the user's information that makes the user logged in to the receiver. Once logged in, a viewer can use the cell-phone to look for a program on a bookmark list and start playing it on the receiver using a similar mechanism.

## 6. CONCLUSION

We presented the concept of Hybridcast and described example services and prototype development. We are currently working to define specifications for the Hybridcast system, such as receiver specifications and specifications for the server transaction API. We are also planning to develop an STB type receiver and carry out a feasibility test with more practical settings.

## REFERENCES

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