Virtual Channel Management for IPTV using Channel Domain Systems

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Abstract

The CDS (Channel Domain System) logically extends channel allocation capability over limited channel resources. The CDS provides CPs with flexible channel mapping mechanisms for various IPTV applications. Examples of such applications include channel naming using phone numbers and company names. The advantage of the CDS is two folds; it reduces cost of channel management and also, it facilitates usability of virtual channel for commercial and personal purposes. Proposed CDS mechanisms have been successfully implemented and applied in building commercial IPTV services.

Keywords: *Channel Domain Systems, Virtual Channels, IPTV*

1. Introduction

Recently, digital contents industry has been facing a rapid change of services as a result of dramatic increase of new media such as smart phones and DTV. According to the survey, subscribers prefer watching on-demand programs mainly for freedom of choice [1]. They want to have a choice over various form of broadcasting services. Examples of such choices include streamed on-demand TV shows, movies, downloadable contents, pay-per-view contents, etc. In such an environmental change of services, lack of channel capacity becomes a critical problem for both contents providers and subscribers. Channel allocations become conflicting, and navigation of channels complicated, increasing channels capacity costly.

In order for channel services to be efficient, we present a means for easing channel allocation problem using a concept of utilizing virtual channels. Traditionally, in providing IPTV services, broadcasting systems have followed two different standards – OCAP (Open Cable Application Platform) for digital cable broadcasting, ACAP (Advanced Common Application Platform) for Internet TV. Fundamentally there are not interchangeable, and independent service providers have presented their services either on OCAP or on ACAP platforms. However, it becomes problematic when convergence services such as different platforms supporting single contents simultaneously in N-screen environments have emerged.

As a related work, there are two distinctive attempts carried both in the USA and in European countries. In America OCAP version 1.1.1 has been accepted as a bi-directional interconnection. CableLab's *Tru2way* [2] which becomes OCAP version 1.1.1 base, defines functional requirements for digital cable services, and common API's for interconnecting host devices and middleware components. A problem with *Tru2way* is that they require high performance STB, whereas over 70% of cable subscribers still use low specification STB. Unlike OCAP, the European digital broadcasting standards have developed DVB-MHP [3]. DVB-MHP supports APIs for building interactive applications over internet media using EPG for all kinds of digital receivers including STB, TV, and PC, etc. They are designed using

Java language and XHTML, and provide good features for interconnecting with the internet and IMT-2000 contents.

In this paper, we introduce virtual channel systems that support bi-directional interconnection with different types of media. The virtual channel system is working successfully for IPTV services both on OCAP and on ACAP. This paper is organized as follows. Section 2 gives basic ideas on virtual channels. In section 3 a framework and architectures for virtual channel management systems are outlined. Section 4 introduces case studies as an application of virtual channel systems. Section 5 concludes this paper.

2. Concept of CDS

In this section, we focus on issues shown in conventional channel management systems and explain motivations and ideas leading to a new channel management technique, namely CDS (Channel Domain Systems). In conventional channel systems, TV channels are assigned to independent content providers according to strict predefined channel naming policy, e.g. channel 20 to entertainment and movie, channel 21 to songs and music, etc. In such a number based channel systems, subscribers may allow channel navigation only in a linear fashion. That is, target contents are accessible through hierarchical menu traversal, thus subscribers usually see only menu screen until they reach target programs (figure 1). Other problems with traditional channel systems are as follows;

- Target contents are unreachable until subscribers know exact location of the target channels.
- Searching program contents is not allowed while performing channel zapping.
- Subscribers may access only small numbers of contents due to a limited channel capacity.

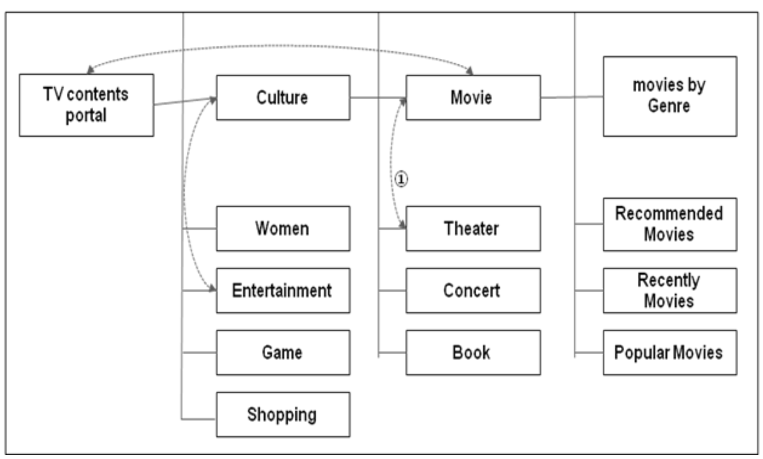
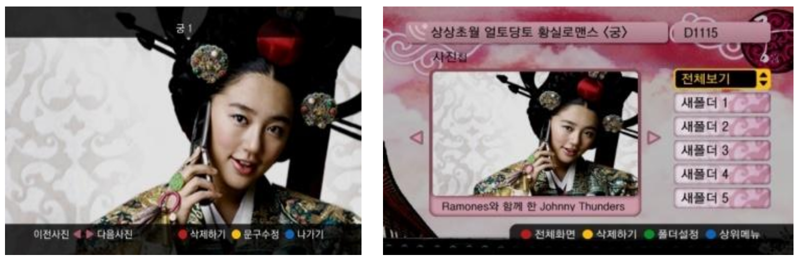


Figure 1. Navigation Problems in Conventional Channels

In conventional channel systems subscribers navigate channels with left, right, up and down keys that prohibit direct jumping desired channels. For example in figure 1, the channel *Theater* is only reached via *Culture* to *Movie* path. In order to ease channel navigation problems, it is necessary to provide a means for allowing subscribers to navigate expandable logical channels for flexible channel zapping and direct accessing the target channel for IPTV services using virtual channel management. The CDS is a channel control mechanism that manages assignment of *virtual channels (or symbolic channels)* to data units. The virtual channel can be treated like ordinary AV channels that can be accessed with Direct Channel Access (DCA). Thus, we treat CDS as an extension of conventional channels services for on-demand broadcasting on the web-based environments. In CDS each unique data units has distinct identification for direct access. Channel managers can assign logical channel to each contents categories, for example, game channels to channel G1, G2, and Shopping channels to C1, C2, etc. (Figure 2)



(a) (b)

Figure 2. Conventional Channel (a) vs. Virtual Channel (b)

Hierarchical numbering of channels can be easily managed by allocating channel information in a hierarchical order. For example, in a weather forecast channel W1, local weather channels are named as W10, W11, W13, etc.

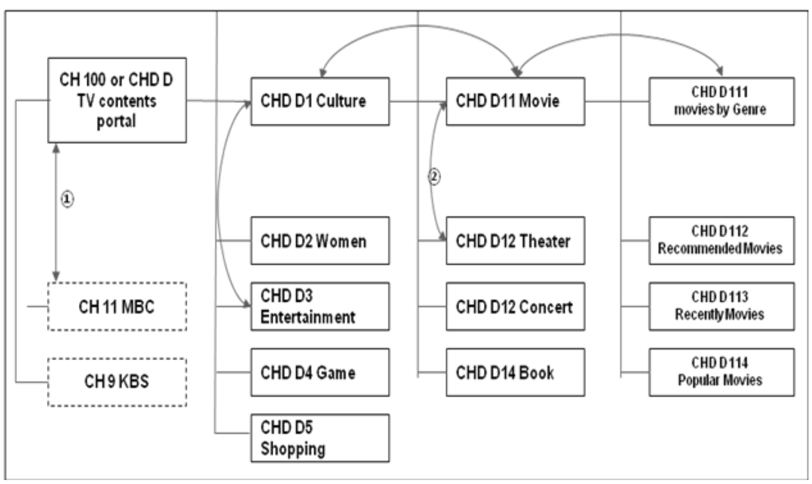


Figure 3. Fundamental Concept of CDS Navigation

With CDS services, subscribers can press buttons for channel domains in remote controller. For example in figure 3, channel controls move to movie channel by pressing D11, a virtual channel for on-demand movie, otherwise channel control takes standard channel denoting MBC with channel 11. Likewise, Culture channel D1 can be reached by pressing up button from the channel D12 or + button from Channel D2.

3. Architecture of CDS

In this section we define a service structure for virtual channel management systems and show how they work in CDS platform architectures. It is required to build CDS platform on top of Open Contents Platform (OCP) that supports digital cable broadcasting. In order to explain CDS service platform it is necessary to view the system from two perspectives, i.e. service providers (SP) and service platform.

First, service providers see the CDS platform as a service base reaching to subscriber's STB. The service providers have authoring systems that construct application data or digital contents, contents repository. Also, the SP and DP act as a CDS clients that connect CDS system, and request virtual channels for each application data. SP's application data are stored in multiple application servers in SP side, and make the contents available when contents request arrives from STB. The exchange of contents information is bi-directional, and return server is responsible for such bi-directional communication. Second, service platform contains compulsory components that handle contents incoming request from both service providers and subscribers attached in STB.

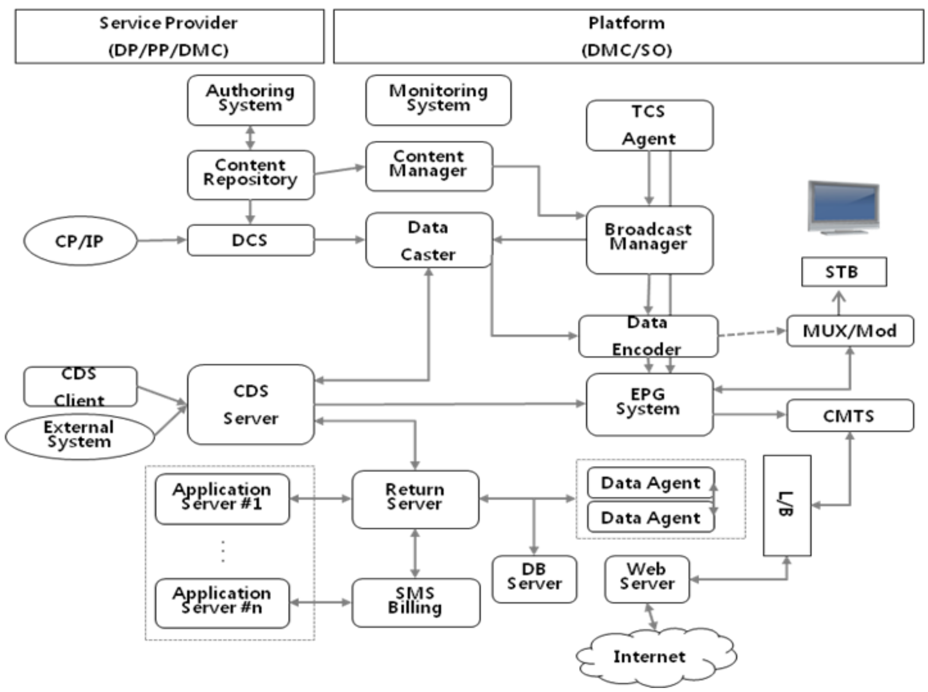


Figure 4. CDS Platform Structure

The OCP service platforms consist of four main parts;

- CDS Servers manage virtual channels requested from CPs or other clients
- Return servers receive channel requests from CDS servers and match the request over the set of application servers
- Electronic Program Systems (EPG) manages hierarchical channel information that is decoded by the STB. It also interacts with CDS servers to resolve virtual channel binding.

- Return server is responsible for controlling bi-directional communication between CDS servers and Application servers.

From the viewpoint of CDS as shown in figure 4, it has tight interaction with 3three other systems, i.e. EPG system, CP clients and Return servers. In this context we define the main role of CDS is to perform *channel hosting*. Channel hosting is a service that binds CP's application data unit to a designated virtual channel. Channel hosting systems consist of four components on top of embedded middleware. Figure 5 demonstrates internal components of the CDS.

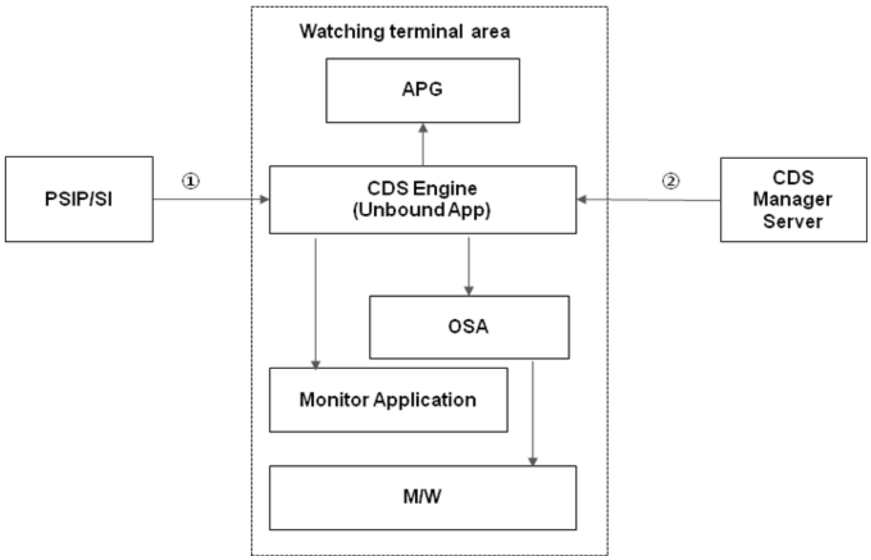


Figure 5. Main Components of the CDS

There are four major components inside the CDS, i.e., APG, CDS Engine, OSA, and Monitor application. Functional details of each component are as follows;

CDS Engine

The CDS engine receives program information from PSIP/SI (Program and System Information Protocol/Service Information) attached in head-end of each program. There are two types of application that the CDS Engine can handle. In service bound applications, programs can run only when they are signaled to run on, otherwise, they stop. However in unbound applications unlike MHP, applications are not bound to specific services, and thus they can run no matter what service is currently being under serviced. In the CDS, unbound service is providing in order that it facilitates advertisement clips to run on presenting programs without stopping or interrupting the programs.

Monitor Application

Monitor application supports essential control mechanisms to make service flow work correct between different service levels. This service is strictly based on compliance policy specified in OCAP/ACAP standards. Main activities defined in monitor application module are to control watching mode for TV program, to manage lifecycle of unbound services, and to upgrade user terminals when service model policy changes. As shown in figure 6, APIs defined in monitor application layer are application filtering, system reboot, application upgrade, resolving resource conflict, etc.

APG

In CDS framework we have developed APG (Advanced EPG) over EPS. APG provides services for bidirectional user interface for interacting with EPG (Electronic Program Guide). Each EPG data is represented in XML schema, and is stored in EPS database. EPG database contains program tables that are retrieved by CDS engine, and sent as Service Information signal.

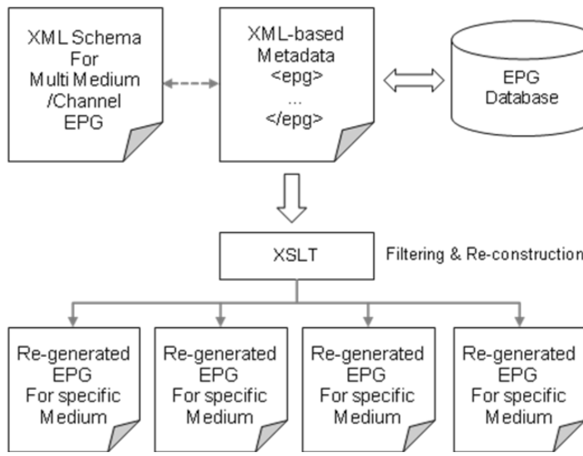


Figure 6. Information Structure of APG

In the APG module, each EPG has EPG plug-ins that are integrated into an EPG base browser. Adaptation of the EPG plug-in is performed using dynamic configuration mechanisms, i.e. all requests for different EPG requests are handled in a run time basis. Figure 6 shows how individual EPG information is filtered and reconstructed to produce target EPG for each specific UI types.

OSA

OSA (Open Security Adaptor) manages security related information in order to get proper security privileges to view programs and billing procedures. The main role of OSA is to exchange authentication information from CA (Certificate Authority). A communication process between OSA and CA starts from a CA application module. The CA application sends through OSA interface a request for access permission of OSA contents. The CA system then checks requested data by consulting a subscriber’s information from a billing server in order to send an acknowledge signal to the CA application. The CA application sends back the results through OSA interface. This information then is used to start pay-as-view services.

4. Case Study

This section presents a case study performed in building prototype service in order to demonstrate applicability of CDS platform. In this prototype the procedures for channel management is as follows; first, an IPTV service company assigns a set of channels from the reserved channel pools to its clients who wish to subscribe private application data. Then, the CDS systems assign virtual channels according to their contents structure.

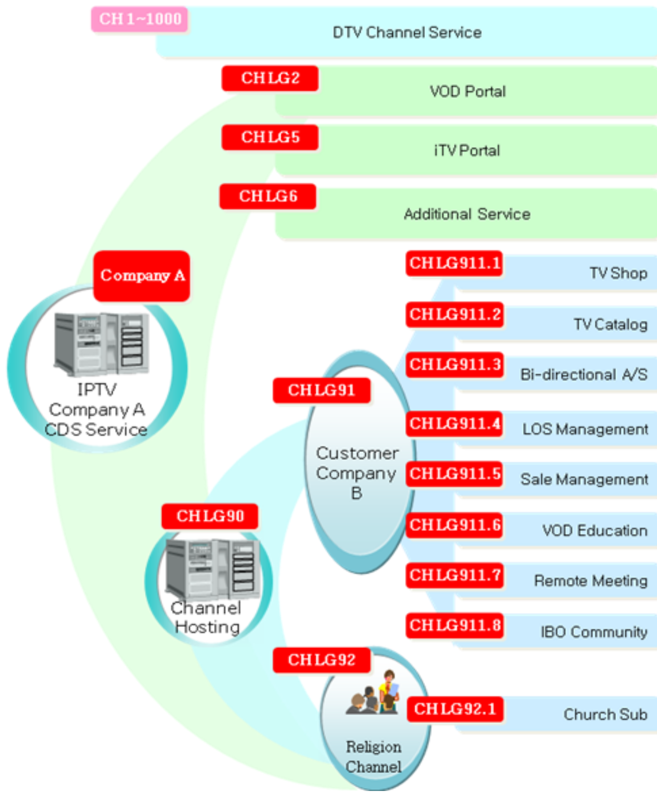


Figure 7. Virtual Channel Structure

In Figure 7, an IPTV company A has registered CHLG90 domain for commercial services. The company A then set LG channel 91 to its customer B who wants to provide private program to their company's clients as CHLG91 prefix. The channel prefix then expands to sub-channels ranging CHLG911.1 to VHLG911.8 that each sub-channel contains application data as designed. The prototype system was implemented with Java, and Javascript supporting Xlet.

5. Conclusions

The CDS provides contents providers with expandable logical channel structures aiming to support flexible channel mapping for IPTV applications. The advantage of the CDS is two folds; it reduces cost of channel management. Also, it facilitates usability of virtual channel for commercial and personal purposes. In designing CDS platform, we have addressed compliance issues with OCAP and ACAP. In order to interoperate with OCAP individual module APIs defined in OCAP have been used. As for ACAP compliance, the functionality of CDS servers adapted EPG systems that send program information in head end messages, and return server that controls bi-directional message sending. The proposed architecture has been tested and verified in building commercial services explained in case studies. While performing case studies we also have added up client modules supporting N-screen devices which utilize single user created contents over different display media. As a future work we will design flexible client browsers to support OCAP, ACAP, and MHP standards. A server side reconstruction will also continue to manage multiple channel allocations requested from heterogeneous clients.

Acknowledgements

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