A Study on Fast Delivery of SI over RF/PON Transmission System

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Abstract— More and more people are watching video over internet using connect devices such as smartphone, and internet traffic is being burst. In order to deal with these environments, technical development and standardization on RF/PON transmission system have been carried out. For commercialization, RF/PON transmission system is designed to accommodate the connected device as a new means to serve broadcast services and to be deployed without any changes of the existing broadcast facilities. But it takes up to 2 minutes at the worst case to deliver service information to subscriber’s device, and it might cause subscriber’s dissatisfaction. In this paper, we propose a better way to reduce the transmit time to a couple of hundreds milliseconds..

Keywords— RF/PON, SI, Service Information, CATV, Cable, Multi-screen, Giga Internet

I. INTRODUCTION

Global IP traffic has increased more than fivefold in the past 5 years, and will increase threefold over the next 5 years. Overall, IP traffic will grow at a compound annual growth rate (CAGR) of 21 percent from 2013 to 2018. Especially, IP video traffic will be 79 percent of all consumer Internet traffic in 2018, up from 66 percent in 2013 [1].

Smartphone is growing as new broadcast media at a rapid rate. Koreans who select smartphone as the required media is 37.3 percent up from 24.8 percent in 2013 [2].

In Korea, the number of homes in which optical or UTP cable is installed inside the building has been increased continuously after “High Speed Information and Communication Building Certification” introduced. Certified were 183,953 apartment houses, 78.2 percent permitted in 2013 [3].

In order to cope with the changed environment, RF/PON transmission system is developed for cable operators with government support. The system provides both cable broadcasting service and giga-class internet service simultaneously without any changes of operator’s head systems. Additionally, it is possible for subscribers to watch broadcast programs through various IP devices, e.g. smartphone, tablet and PC.

All broadcast programs are transmitted by RF signal to customer premise equipment (CPE), and service information (SI) used to choose one is delivered periodically in cable broadcast services. It takes up to 2 minutes for a CPE to receive service information, so the subscriber might feel dissatisfaction when the device is driven for the first time.

In this paper, we propose a method which can reduce maximum SI transmit time significantly from 2 minutes to hundreds of milliseconds.

II. RF/PON TRANSMISSION SYSTEM

RF/PON transmission system combines optical RF transmission system and PON transmission system on a single interface. Figure 1 shows RF/PON network architecture.

RF broadcast signal is converted to optical signal by AM optical transceiver, and then amplified by optical fiber amplifier, and then relayed to WDM (Wavelength Division Multiplexer). Internet data are converted to optical signal by OLT (Optical Line Terminal), and then relayed to WDM. The optical broadcast signal and the optical internet signal are multiplexed by WDM, and are transferred using different wavelength from each other. Wavelength is 1550nm for RF downstream, 1310nm for PON downstream and 1490nm for PON upstream [4].

PSIP/SI server provides viewer information and system information. The viewer information is sent through both RF downstream and PON downstream, and may be used by a decoder to provide an electronic program guide. System information is sent only through PON downstream, and provides information used internally by a decoder, including the following [5]:

- Network information, describing one or more distribution networks,
- Conditional access information, providing information to the decoder on any conditional access system in use,
• Timing information, passing to the decoder the current time and date,
• Information on services not provided by MPEG-2, such as closed captioning/subtitling, teletext, and data services

OMT (Optical Media Terminal) is a core equipment of RF/PON transmission system, and has wavelength-division multiplexer for separating RF downstream and PON downstream transmitted through different wavelength. OMT also has a RF video converter, RF tuners and demodulators to extract RF broadcast stream while a RF-STB for traditional CATV services has them. Figure 2 shows an architecture of OMT [5].

**Figure 2. Optical Media Terminal Architecture**

In RF/PON transmission system, subscribers can use various their IP devices such as PC, tablet and smartphone as well as IP-STB to view broadcast programs. To do that, IP devices should make connection to and communicate with OMT by TCP/IP [6]. Figure 3 shows difference in behaviour between traditional RF-STB and RF/PON IP devices.

**III. SERVICE INFORMATION DELIVERY**

Service information provides all the information necessary for broadcast services, such as frequency and modulation schemes. SI is composed of eight kinds of table: MGT, STT, RRT, AEIT, AETT, CVCT, NIT and NTT. Each table is transmitted repeatedly for each set period [7].

Table 1 describes briefly about service information tables.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT</td>
<td>Master Guide Table</td>
</tr>
<tr>
<td>STT</td>
<td>System Time Table</td>
</tr>
<tr>
<td>RRT</td>
<td>Rating Region Table</td>
</tr>
<tr>
<td>AEIT</td>
<td>Aggregate Event Information Table</td>
</tr>
<tr>
<td>AETT</td>
<td>Aggregate Extended Text Table</td>
</tr>
<tr>
<td>CVCT</td>
<td>Cable Virtual Channel Table</td>
</tr>
<tr>
<td>NIT</td>
<td>Network Information Table</td>
</tr>
<tr>
<td>NTT</td>
<td>Network Text Table</td>
</tr>
</tbody>
</table>

As shown in Table 1, CVCT has the longest maximum cycle time, 2 minutes, among the SI tables [2]. This means that subscribers may wait up to 2 minutes at worst to see information about broadcast programs and choose one of them. To solve this problem, we invent a fast and simple SI delivery method that OMT gathers and caches service information, and offers the cached information to IP devices directly. Figure 5 shows the proposed procedure to deliver service information.

**Figure 4. Procedure of SI delivery in RF/PON network**

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**Figure 5. Proposed procedure to deliver service information**

During the boot process, OMT joins the multicast group by sending IGMP JOIN message, receives service information from SI server, and saves it at internal storage. There is still the same problem of time delay in this process. But it has little influence since OMT serves internet service and broadcast...
service simultaneously, and would not be turned on and off frequently.

Figure 4. Fast SI delivery procedure

An IP device should connect to OMT and keep the connection. Using the connection, it should request service information, then OMT offers service information right away. Eight kinds of table making up of service information are transmitted individually. Since the IP device is located in the network segment managed by OMT, network propagation time of a data packet between them is just a few milliseconds. But it takes a couple of hundreds milliseconds to send all the tables since internal processing time of OMT.

As described above, each table is repeatedly transmitted periodically. OMT should look at version information of tables in order to check whether it is updated or not. If updated, OMT sends it immediately to devices which requested service information before.

IV. CONCLUSIONS

Although TV is still the primary means to watch broadcast programs, consuming videos through internet has been being increased significantly and viewing pattern of user has been changed as well after emergence of connected devices such as smartphone and tablet. But it is not easy for commercial providers to accommodate a new type of device while maintaining the existing services without changes of existing facilities.

In this paper, we introduce RF/PON transmission system with which service operators can accommodate various IP devices as a gate to serve broadcast services, and propose a method that OMT rather than PSIP/SI server transmits service information so as to significantly reduce the service information transmit time from 2 minutes at worst to a couple of hundreds milliseconds.

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REFERENCES


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