New TTI Value-Added Services Converged over a Hybrid-network

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Abstract—This paper proposes the network structure and services model to deliver new Traffic and Travel Information (TTI) value-added services over a hybrid-network of Terrestrial Digital Multimedia Broadcasting (T-DMB) and a bidirectional network. We have newly specified a POI (Point-Of-Interest) and a NWS (News Information) application services which are perfectly compatible with TPEG (Transport Protocol Expert Group) protocols, and implemented T-DMB based TTI systems including TPEG encoder/decoder and a return-channel server system through CDMA as a bidirectional network. We verified the proposed services and their related systems in the real-field environment and showed their excellent results in this paper.

Keywords-component: traffic and traveler information, TTI, point of interest, POI, digital multimedia broadcasting, T-DMB

I. INTRODUCTION

Currently Terrestrial Digital Multimedia Broadcasting (T-DMB) Service has been commercialized since December 1, 2005 in Korea, and the several T-DMB’s data services were launched already such as TTI, BIFS, and BWS. T-DMB was born based on Eureka-147 DAB systems, and it allows mobile users to enjoy clear and real-time seamless video service as well as CD-like audio service with laptop computers, PDAs, and even mobile phones in harsh reception [1].

A Traffic and Travel Information (TTI) service is worthy of notice as a killer application service among other data services and is based on TPEG (Transport Protocol Expert Group) which is a bearer and language independent TTI service protocol. Also TPEG has unidirectional and byte oriented asynchronous framing structure and TPEG frames are transmitted through the TDC (Transparent Data Channel) of DAB/DMB signal [1–3]. By now TPEG mainly has two standardized application specifications. One is RTM (Road Traffic Message) for the information of road traffic status message application and another is PTI (Public Transport Information) for the public transport information message application [4–9]. Besides WEA (Weather Information), PKI (Parking Information), and CTT (Congestion and Travel Time Information) are being standardized by TPEG Forum. But these applications are focused just on traffic status, road events or public transportation, which are dull and unexciting for travelers. Accordingly we have presented new application services of POI (Point-Of-Interest) and NWS (News Information) which include the contents of their interesting points like hotels, restaurants, theaters, gas stations, museums, and regional or entertainment articles. These have new meanings to provide location based services (LBS) via broadcasting network not communication network [10–11].

This paper proposes the network structure and service model to deliver new TTI value-added services over a hybrid-network of T-DMB and a bidirectional network. We have newly specified POI and NWS application services which are perfectly compatible with TPEG protocols, and implemented T-DMB based TTI systems including TPEG encoder/decoder and return-channel server system using CDMA mobile network as a bidirectional network. Also we have verified the implemented systems and services in out-door mobile reception field by 40 W power transmitter coverage and 64KB ~ 96KB data speed in T-DMB, and showed the tested results of traffic CCTV service and POI reservation service in this paper.

II. BIDIRECTIONAL TTI SERVICE MODEL

When compared to a unidirectional TTI service through only broadcasting network, a bi-directional TTI service means to provide the user oriented, rich, and interesting multimedia service by using uplink data through communication network.

A. A Hybrid-Network Structure of DMB and CDMA

Fig.1 shows a hybrid-network structure which T-DMB network is combined with wireless communication network like CDMA, and there exist key systems: TTI Data Server, Return-Channel Server and TTI Receiver.

Fig. 1. Hybrid-Network Structure for bidirectional TTI services. This is consisted of three key systems: TTI Data Server, Return-Channel Server and TTI Receiver.
The TTI data server makes TPEG stream encoded from TPEG database which saves RTM/PTI/POI/NWS, and then sends it to T-DMB multiplexer. The encoded TPEG stream is propagated via COFDM modulator and transmitter after being multiplexed with Audio/Video (A/V) stream and others. The TTI receiver which receives T-DMB signal decodes TPEG stream and displays TTI data on an application converged with electronic map or navigation software. If the receiver is equipped with a wireless communication capability and its user wants to proceed the additional or next doings like a hotel reservation, the receiver establishes a communication channel between the receiver and the return-channel server, and service request/response does on it. The return-channel server, which is connected with contents providers and manages bidirectional TTI contents, accomplishes a user authentication and a service management.

B. POI and NWS Specifications

The hierarchical transport frame structure including POI/NWS message that is made up of three data fields is shown in Figure 2, and also it is specified to be compatible with the existing TPEG applications. POI/NWS message has three containers in a message, and the Event Container includes contents to deliver over T-DMB. Figure 3 describes POI/NWS hierarchical components.

C. Value-added TTI Services with bidirection

It is difficult to deliver rich contents of bulk data or private information just through T-DMB’s TTI data channel. If a TTI receiver is equipped with a wireless communication modem like CDMA, its user can request additional or individual services which couldn’t get via the broadcasting network. We have defined and developed the various value-added services as shown TABLE 1.

<table>
<thead>
<tr>
<th>Applications Services</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTM(Road Traffic Message)</td>
<td>Traffic CCTV</td>
</tr>
<tr>
<td></td>
<td>Weather</td>
</tr>
<tr>
<td>POI(Point Of Interest)</td>
<td>Reservation</td>
</tr>
<tr>
<td></td>
<td>Buying</td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
</tr>
<tr>
<td>NWS(News)</td>
<td>Article</td>
</tr>
<tr>
<td></td>
<td>Terminology</td>
</tr>
</tbody>
</table>

D. An Example of Service Flow: traffic CCTV service

Figure 4 and Figure 5 show the overall architecture and the service flow of traffic CCTV service among bi-directional TTI services defined above. The Data Broadcasting Server(DBS) generates TPEG encoding stream with RTM/PTI/CTT/POI/NWS application information. This data are broadcasted to TPEG terminals via DMB network. TPEG terminals decode the received TPEG stream and convert it into meaning information. RTM and CTT can be combined with a navigation software program and displayed in various styles(text, speech, figures) on road traffic status. The Return-Channel Server(RCS) and the Contents Management Server(CMS) are logically divided into a functional role and both can be one system physically. In Traffic Information Service Center, the Traffic Image Server(TIS) collects each CCTVs’ monitoring image and saves it in realtime. After media format conversion, the TIS compresses and sends it to the CMS which makes the fixed size’s images with time information. The CMS can provide the moving picture or a still image according to user’s requirement like a terminal performance, data speed, and user preference.

If an user has the TPEG terminal with CDMA or HSDPA capability and wants to see the real traffic status on his way in order to detour his destination, he requests the CCTV information of an accident point or congestion section. As soon as user’s signal is detected, the terminal’s network adapter initializes and establishes a data session with the RCS. Through opened data session the terminal forwards user’s request to the RCS. The RCS authenticates the user before handling user’s service request and generates the list of available CCTVs from Time Information, Article Information, Authorship) including newly defined 9 tables.
the CMS. The user selects the interesting point in the list and receives its result of moving picture or still image. The user can request the contents about the continuous section and release the data session in case no more user’s requirement.

Fig. 4. An Overall Architecture of traffic CCTV service. The Return-Channel Server can include the Contents Management Server in a stand-alone system.

Fig. 5. The Service Flow of traffic CCTV service. A terminal connection to wireless network observes each telecommunication network access procedures.

III. DESIGN AND IMPLEMENTATION

A. A Unidirectional TTI Data Server

TTI Data Server plays roles of TPEG message generation and transmission to T-DMB system. We connected the serv system to one of the governmental traffic information center and successfully received the useful information. TTI Data Server was designed and implemented based on Client/Server model (see Fig. 6). The server subsystem has two application modules and a database.

- **Adaptation**: It collects the traffic information data of road speed and status in real time, and then inputs them into database according to TPEG specification.
- **Streamer**: Based on the database information, it generates TPEG encoding stream periodically and sends the stream to T-DMB multiplexer.

![Diagram](image)

Fig. 6. A unidirectional TTI Data Server with Client/Server was connected to Traffic Information Provider via ADAPTION and interfaced to T-DMB transmission system.

The client subsystem enables a TTI service author to handle TPEG messages using an authoring tool (GUI) and to control and monitor Adaptation and Streamer status. As the TPEG application uses TDC (Transparent Data Channel) of the DAB/DMB data channel, we should set the data inserter and ensemble multiplexer to this mode for the TPEG applications. Here, with the user interface of the streamer, the traffic and travel information service data rate can be controlled by the operator. This is done by using the binary file between the TPEG encoder and streamer inside the system. The binary file works as a buffer to constantly control the rate of the TPEG data to be provided to the DMB ensemble multiplexer.

B. A Bi-directional TTI Data Server

TTI Return-channel Server is connected with bidirectional TTI terminal by user request. On receiving an additional service requesting, the system generates contents dynamically and sends them to the request. We used HTTP protocols simply for interactions between both and composed HTML for contents producing. That is, this system is executed by JSP (Java Server Page) as a general Web Server.

Also TTI Return-channel server is divided into TTI service contents part and TTI manager part. TTI service contents part consist of reservation (hotel, golf, restaurant, hospital), buying (ski, cinema, culture facilities), coupon ticket, additional information (article/terminology, POI estimates), CCTV, environmental information and BTS (Bi-directional TTI Service). TTI manager page part consists of subscriber management, service management (service categories and service components), CP management (CP categories, CP components), and CP host server management. TTI Contents Server was implemented as following:

<table>
<thead>
<tr>
<th>Items</th>
<th>Tools</th>
<th>Ver.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Server / JSP engine</td>
<td>tomcat</td>
<td>5.5.9</td>
</tr>
<tr>
<td>DBMS</td>
<td>mysql</td>
<td>4.1.13a</td>
</tr>
<tr>
<td>JDK</td>
<td>j2sdk</td>
<td>1.3.0-04</td>
</tr>
</tbody>
</table>

C. TPEG based TTI Receiver

If the terrestrial DMB signal is received by the receiver and
the FIC (Fast Information Channel) of the DAB/DMB ensemble says that it contains the TPEG application service in the TDC (Transparent Data Channel), the data stream is provided to the TPEG decoder. The data received through the terrestrial DMB signal is decoded from the terrestrial DMB receiver and is parsed and decoded before they go into the navigation application. The navigation module can be combined with the digital map and easily be used as a navigation system with real time traffic information.

In the implementation of the receiver, general DAB/DMB data receiver with USB (Universal Serial BUS) interface is used for the T-DMB signal reception. By using this receiver, all the data in the terrestrial DMB signal can be decoded and provided to the PC, notebook or PDA which have data decoding program and navigation application with digital maps as well as GPS connection application.

Also TTI receivers for bi-directional interactive service are equipped with wireless access adapter like WLAN and CDMA, as well as GPS module.

IV. VERIFICATION AND TEST RESULTS

For verifying the implemented prototype according to designed architecture, we developed TPEG authoring server, adaptation module and stream server to automatically make TPEG message from the data coming from the information provider and to provide the encoded TPEG messages to the DMB ensemble multiplexer with the user specified data rate. We also implemented software TPEG decoder in a notebook with cdma adapter module.

We have tested the implemented system with the receiver and navigator like in the figure 7 and 8 in out-door reception field (city) of Daejeon by transmitting the TPEG message contained terrestrial DMB signal with 40 W power transmitter covering the test field, while the TPEG information server getting and converting the traffic information data from the traffic information provider in real time. In 5 km of coverage, and 96 kbps of TTI service in terrestrial DMB ensemble, both the terrestrial DMB based TTI service provider and the TPEG message based navigation system worked well in most of the area.

ACKNOWLEDGMENT

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Digital Network (ISDN) and Digital Enhanced Cordless Telecommunications (DECT)"


