Design and Implementation of Interactive TPEG-UCM Application Service Using T-DMB

Sang-Hee Lee¹, Kang-Hyun Jo*²
School of Electrical Engineering, University of Ulsan
Daehak Rd. 93, Nam-gu, Ulsan, Korea
¹shlee@islab.ulsan.ac.kr; ²acejo@ulsan.ac.kr

Abstract-In Korea, the T-DMB (terrestrial-digital multimedia broadcasting) commercial service was successfully launched. However, T-DMB service providers are very weak for beneficial business because T-DMB A/V services have been started free of charge. Therefore, they want to have pay services like data services. Among these data services, the TTI (Traffic and Travel Information) service based on TPEG (Transport Protocol Experts Group) is proposed as a killer application to overcome financial limitations.

At present, the TPEG service is not much popular as it fails to satisfy the users' demands in various aspects. Therefore, to overcome a lack of variety and unidirectional of the existing TPEG application services, in this paper, it is proposed a novel TPEG-UCM (User Created Message) application service. The proposed service uses individual bidirectional media which is initiated and interacted by users. Also, the proposed service is integrated well into the existing TPEG service systems. The usability and the operability of the proposed method are verified through the experiment.

Keywords- TPEG; TTI; DMB; Interactive; Bidirectional

I. INTRODUCTION

The world’s first commercial T-DMB (Terrestrial Digital Multimedia Broadcasting) service was successfully launched around Seoul metropolitan area of Korea on December 1, 2005 with a hope for a future growth engine. At the present of 2012, the T-DMB service has covered national region with full-scale service. As a result, many Koreans are now enjoying digital multimedia broadcasting while moving using their DMB enabled cellular phones, car navigation terminals, personal media players, and so on.

In Korea, the T-DMB is defined as a new mobile multimedia broadcasting that enables a video streaming service, a high quality audio service, and a multimedia data service with various handheld devices. The T-DMB is an ETSI (European Telecommunication Standard Institute) standard which extends the Eureka-147 DAB (Digital Audio Broadcasting) standard to improve the capability of the mobile video streaming service. Fig. 1 shows how the T-DMB system is organized with the existing Eureka-147 DAB system. The basic service of T-DMB is TV-like service in mobile or static environments. At this service, the target quality of video is VCD-like on 5-7 inch LCD display, and maximum picture resolution is 352 x 288 at 30 frame per second (fps). And high quality audio service is also available in T-DMB, which is main purpose of the existing DAB. In this case, CD-like quality audio broadcasting beats analogue FM, and some data service related to audio is also possible, such as slide show. Besides these services, T-DMB can provide a lot of data services, such as EPG (Electric Program Guide), broadcasting website, news, weather, stocks, traffic information, and so on. Therefore, the T-DMB service allows the consumer to view clear moving pictures in harsh reception conditions. Also, it can provide economically a massive multimedia data service up to 1.7Mbps [1][4].

Fig. 1 The T-DMB transmission system [4]

T-DMB receivers which follow the T-DMB standard [6] have been developed and shown in the market as a wide range of terminals including cellular phones, notebook computers, PDAs (Personal Digital Assistants), car navigations, and so on. The number of receivers has been at least 30 million since March 2010 [7]. As the dramatic uprising in the population of the user, the T-DMB service itself is regarded quite successful in the market. The users now have the options to watch existing fixed TV services at home and to use the T-DMB service with mobile phones or car navigations outdoor.

In spite of that, T-DMB service providers are beyond their ability to carry out the role of new media with making different traditional TV contents, as the T-DMB service is free of charge with advertisement as main source of income. As a result, T-DMB service providers carry a considerable amount of financial burden, making it difficult to survive in the market. Therefore, it is necessary to find an additional business model for the T-DMB to acquire the robust position as a new media. It is also necessary to develop new contents to expand the traditional broadcasting concept and to meet on-line environments in digital age.
A variety of T-DMB data services present possible solutions to this includes BWS (Broadcasting Web Site), BIFS (Binary Format for Scene), DLS (Dynamic Label Service), TPEG (Transport Protocol Experts Group), and so on. Especially, among these data services, TTI (Traffic and Travel Information) service based on TPEG has been spotlighted as a killer application in aspects of economic influence and information usability. And the demand of TTI service has dramatically increased due to rapid increase in the number of vehicles and population of frequently traveling on long-weekends.

TPEG application services based on the T-DMB in Korea have been commercialized by main service providers in Seoul metropolitan area of Korea since the second half of 2005. However, TPEG application services have been applied in a few application areas, and their real-time information is focused on the traffic status of the major city roads and national highways. Drafting specifications are also limited to information on traffic conditions. Therefore, services provide traffic information only for drivers, not for the traveller on foot with mobile phone. This is one possible reason for low usage of TPEG service on T-DMB.

Therefore, it is necessary to provide a variety of TPEG service for the activity of TTI service on T-DMB, and to overcome the limitation of unidirectional T-DMB service. Accordingly TPEG forum in Korea have pronounced the TPEG-POI (Point of Interest) application service to deliver new TTI service. A LBS (Location Based Service) is one of the most important applications in mobile environment. While driving or walking around, consumers want to find an optimal path to destination or information of POI such as restaurants, hotels, cinemas, gas stations, and so forth. Up to now, it has been served not via broadcasting but telecommunication channel. However, in using a mobile communication network for this purpose, there are several disadvantages such as high service charge and low data throughput. Therefore, T-DMB is emerging as an optimal solution to address the several drawbacks of the mobile communication network. However, there are several limitations in existing TPEG-POI application service using the wireless communication network.

First, the TPEG-POI application service includes the contents of interesting points for drivers or travellers such as roads, restaurants, hotels, hospitals, banks, and so on. As its service sphere is too wide, it is still questionable whether the TPEG-POI service’s goal comes true faithfully. Therefore, it is necessary to develop a specialized user-friendly service within the limited travel information sphere.

Second, in order to update seamlessly the POI data on service provider side, it is necessary to put additional cost and time. Web has many contents and is updating seamlessly even now and in the future. Therefore, if a service provider uses the LBS website such as the panormio of google, the story map of cyworld, etc., the POI data may be updated seamlessly. As a result, the bidirectional service initiated and interacted by the user comes true, not the unidirectional service by service providers.

In this paper, it is proposed a new interactive TPEG-UCM (User Created Message) application service as a business model combining the T-DMB with wireless communication network like CDMA (Code Division Multiple Access), WiFi (Wireless Fidelity) or WiBro (Wireless Broadband) that provide us broadband wireless internet access. The proposed service is designed to enable the user to receive the user created travel information in web sites through not wireless communication but T-DMB network. On the other hand, uploading for user created information is performed using internet service of wireless communication network, which is return channel.

The proposed TPEG-UCM application service may overcome a lack of variety of existing TPEG application services and the unidirectional service. As a result, it is realized the bidirectional T-DMB service in stage of DMB2.0 or more as in the sphere of Web2.0.

This paper is organized as follows. The theoretical background of the TPEG and the need of interactive service are described in Section 2. In Section 3, a scenario and a system structure of the TPEG-UCM application service business model are presented. Section 4 contains a structure of proposed application service protocol which is interoperable with the existing TPEG application services. In Section 5, experimental results are provided by showing an example of the authoring tool and the decoding tool suitable for the TPEG-UCM application service in mobile phone. Also, the required bit rates and the updated period for service value are presented. Finally, the brief conclusion on the usability and operability of the proposed service, and the future work on another interactive service contents by the user such as UCC (User Created Contents) are given in Section 6.

II. BACKGROUND

TTI service has been more and more important as people spend more time in their car or in public transportation. The provision of TTI has long been at the center of development of ITS (Intelligent Transport System). Therefore, the architecture for TTI service has been upgraded for many years following the development of each new excellent communication and broadcasting system appears.

TPEG is a new standard format for delivering real-time traffic information to drivers over digital radio channels. TPEG is an international protocol to provide TTI service and is developed by EBU (European Broadcasting Union). And it is a bearer and language independent protocol that can be used for many data broadcasting channels like DAB, DARC (Data Radio Channel), DVB (Digital Video Broadcasting), Internet and others. Therefore, it has become the most appropriate protocol to be used for TTI service. And it has been implemented and wide-used in many areas, like Korea, British, Beijing, and so on.

A. TPEG History

The EBU seeks to develop a bearer independent TTI delivery technology which builds on the infrastructures, but
which will be more flexible. The technology envisaged is one for a near universal protocol. This is important, both from an end user viewpoint and from a Service Provider’s need to deliver services via one or more delivery technologies as the multimedia age develops.

As a result in 1997 the EBU established, through its normal procedures, the B/TPEG Development Group, with wide sectoral interests, including: Consumer Electronics Manufacturers, Digital Mapping Companies, Service Providers, Transmission Operators and Broadcasters. Reminiscent of other technologies which seek bearer independence and universal applicability, the name: Transport Protocol Experts Group, was derived.

The main development work for the protocol started in 1998 and the work was completed in 2002. TPEG protocol has become an ISO (International Standardization Organization) standard since 2006, with the expectation that it will provide a common data format for media companies, public bodies and ITS application providers for exchanging traffic and travel information.

TPEG has become a generic title for two aspects of the technology platform. First, for delivery to end-users, TPEG technology is particularly about applications such as TPEG-RTM (Road Traffic Message), TPEG-PTI (Public Transport Information), and so on. Second, TPEG technology is also about the pipeliner which fits the applications into the bearer such as DAB, DARC, DVB, Internet, and others, which are the pipes. TPEG technology assumes transparent data delivery by all bearers [18],[19].

B. TPEG Technology

The TPEG technology specifications comprise a number of ‘Parts’, defining the mechanisms that permit service providers to operate services which can use one or more delivery technologies (e.g. DAB, Internet, etc.) from one message generation process. Furthermore, they will allow a range of receiver types to be used simultaneously, ranging from sophisticate agent receivers serving navigation systems to simple receivers (e.g. perhaps a PDA plug-in receiver/decoder card) only able to decode top level information.

TPEG specifications are being developed by the EBU B/TPEG Development Group which is working concurrently as the CEN TC 278 WG4 Project Group 7. The finalized specifications comprising Parts 1, 2, 3, 4, 5, and 6 were completed and delivered to CEN/ISO for their voting procedures in October 2002. These covered: Part 1: Introduction, Numbering and Versions (TPEG-INV); Part 2: Syntax, Semantics and Framing Structure (TPEG-SSF); Part 3: Service and Network Information Application (TPEG-SNI); Part 4: Road Traffic Message Application (TPEG-RTM); Part 5: Public Transport Information (TPEG-PTI); and Part 6: Location Referencing for Applications (TPEG-Loc).

In Korea, Korea Standards are defined at KS 18234-1~8 and TTAS.KO.-07.0036 POI, TTAS.KO.-07.0037 SDI, and TTAS.KO.-07.0038 NWS is defined as TTA standardization, as shown in Table 1.

D. The Need of Interactive Service

Since the beginning of this century, the convergence between broadcasting and communication has been emerging rapidly. New needs of consumer for bidirectional LBS services became pronounced.

For example, the POI service is one of the most important LBS applications in mobile environment. While driving or walking around, consumers want to find an optimal path to destination or information of POI such as restaurants, hotels, cinemas, gas stations, and so forth. Up to now, it has been served not via broadcasting but telecommunication channel. However, in using only mobile communication network for this purpose, there are several disadvantages such as high service charge and low data throughput. In using only broadcasting network, bidirectional services such as reservation and purchase are not available. Therefore, the coupling between broadcasting and wireless communication for bidirectional LBS is very economical and effective [3].

The TPEG standard also specifies an XML (Extensible Markup Language) format, called TpegML (CEN/ISO TS 24530), for the delivery of traffic and travel information over the internet [18].
III. THE PROPOSED TPEG-UCM APPLICATION SERVICE AS NEW BUSINESS MODEL

TPEG application service which presents the real time traffic information on T-DMB in Korea since 2006 is CTT (Congestion and Travel Time information), CTT-SUM (CTT-SUMmary / Simple map information), SDI (Safety Driving Information), RTM (Road Traffic Message), NWSS(NeWS information), and POI [9][10][11]. However, its service is not various and is only restricted to traffic information for drivers, and the supported receiver is vary according to TPEG application service providers. Also, unlike video and audio streaming service which is free, TPEG application services are paid small cost, that it is not popular service. Therefore, new service development is necessary for walking users as well as drivers.

Traveling populations go on increasing with upgrading our life level and fixed 5 working days a week. Now they do not simple enjoy travelling, travelling populations go on increasing to share information across writing their travel diary and uploading internet portal web site, travel site, blog, and so on. Assuming T-DMB providers use plentiful contents of internet, they reduce time and cost for collecting data.

It is easy to construct bidirectional service on vehicle navigation or mobile phone which can be combined with wireless communication network like CDMA, WiFi or WiBro for return channel [2]. Therefore, TPEG service using the conventional mobile communication infrastructure is conquering unidirectional limitation and can develop the bidirectional user created service with meeting individual variety needs of user in Web2.0. In this paper, it is proposed the TPEG-UCM application service as new business model which adopts this trend and develops new receiving benefits.

A. The Scenario of Interactive TPEG-UCM Application Service

As shown in the Fig. 3, the proposed business model for interactive TPEG-UCM application service consists of contents provider domain, DMB service domain, return channel domain, and DMB user domain.

The contents provider domain is the panoramio of google, the story map of cyworld, and so on. The LBS information, which is created by the user of the contents provider domain, is transferred to the DMB service domain, and the information is saved at the database in accordance with proposed protocol for TPEG-UCM application service.

Then DMB service domain reads data from this contents database and local banner advertisement database as new earnings, and encodes them into the proposed UCM message. The TPEG-UCM message is transferred to DMB user domain with video and audio streaming service, other data services, and existing TPEG services. The DMB user domain uses TPEG-UCM application service parsed and decoded in the receiver. According to the request from the user, the additional information is sent to the receiver through the conventional wireless communication internet service. More active users transfer newly created travel information to the contents provider domain. They can also easily find the required location by optimal route service with inner map of the receiver. The service flow of the proposed business model for interactive TPEG-UCM application service is shown in detail in Fig. 3. The service flow is further explained by the following example.

A businessman in Seoul has an appointment to do a business presentation for his client in Ulsan, which is approximately 300km southeast from Seoul. He arrived around half an hour earlier than the appointment. For his ice-breaking, he wanted to take a short trip around in Ulsan to view scenery. He started TPEG-UCM application service with his car navigation. After searching the lists, he selected to see around ‘spring news in Ulsan’. The list presented travel information such as beautiful spring flower pictures of ‘The theme botanic gardens and arboretum’, writer, region, date, and so on. Below the list, it showed the banner ad of local area.
He clicked ‘view more’ menu to view other pictures, and connected to the wireless communication internet service. He then searched LBS websites, like the story map of Korean popular mini-blog Cyworld. After searching for more pictures which were taken at ‘The theme botanic gardens and arboretum’ in Ulsan, he decided to visit there. Henceforth, he clicked ‘map’ menu to fine routes. He knew a few of routes with the transferred location information and with the car navigation inner map, he was able to visit ‘The theme botanic gardens and arboretum’ in Ulsan.

There he appreciated the well-arranged and gardened beautiful flowers. Therefore, he took a picture with his mobile phone incorporated camera. He wanted to upload the pictures at LBS websites and used wireless internet service in his mobile phone, and transferred the location information, picture, and travel information. Consequently, LBS website data were updated instantly. In addition, the pictures sent by the user acquired some mileage from the website, and he had many benefits such as getting some discounts on the phone bill. The return channel domain bills to the user for wireless Internet service. This fee shares the return channel domain, the DMB service domain, and the contents provider domain. Also, the DMB service domain creates benefits from hosting new advertisement using sending the banner ad of local area.

The travel information created by the user on the LBS website is transferred by TPEG application service on T-DMB. And the infrastructure of the mobile communication meets users’ request for more information. As a result, it may overcome a lack of variety of the existing TPEG application services, and realized the bidirectional T-DMB service in stage of DMB2.0 or more as in the sphere of Web2.0.

B. The System Structure of TPEG-UCM Application Service

As UCM message is a new application service based on TPEG, its data should be integrated into existing TPEG services. Therefore, we implemented the TPEG-UCM application service both on the TPEG data server and the TPEG decoder on the receiver. The whole system of the business model for TPEG-UCM application service is shown as block diagram in Fig. 4. The proposed model consists of four kinds of system components such as contents provider domain, DMB service domain, DMB user domain, and return channel domain. Details of each system components are described in the following sub sections.

1) Contents Provider Domain:

The contents provider domain is the LBS website such as the panoramaio of google, the story map of cyworld, the post map of naver, and so on. The user-created data are transferred into DMB service domain, and are saved in the contents database by the proposed protocol for interactive TPEG-UCM application service.
Fig. 4 The whole system of the proposed business model for interactive TPEG-UCM application service

2) DMB Service Domain:

As shown in the Fig. 4, DMB service domain system for TPEG application service consists of data source, TPEG encoder, streamer, and DMB transmission system. Data source module generates TPEG message such as RTM, CTT, SDI, POI, NWS, and so on [15]. Also, the proposed UCM message is generated at the UCM data source module. The UCM data source module consists of contents database, advertisement database, and UCM authoring tool. The contents database makes database from data transferred at the contents provider domain. The advertisement database is the banner ad of local area. The UCM authoring tool converts data from the contents database and advertisement database into binary UCM message and saves in the message database. The UCM messages generated by its authoring tool are transferred to the TPEG encoder with existing TPEG message. Next, the DMB transmission system multiplexes the TPEG stream data with video, audio, UCM service and other data services. Then, it is sent by the T-DMB transmitter.

3) DMB User Domain:

The DMB user domain is the receiver such as car navigation, mobile phone, and so on. The received TPEG stream from the DMB receiver is parsed and decoded before they are used in the navigation application. All the service types RTM, POI, SDI, NWS, etc. will be decoded separately and provided to application layer. Also, the parsed UCM message data are saved in the database of the receiver and implemented near real-time service. TPEG-UCM application software reads the UCM message from the database and displays the UCM message in many different types such as text, voice, and graphic. If receiver has the return channel such as CDMA, WiFi, WiBro, etc., users’ request for and response to more information is provided through the return channel. As a result, users can easily use the ‘finding route service’ by combining receiver digital map with the transferred location information.

4) Return Channel Domain:

When more information service is requested by the user, the return channel domain firstly checks whether the user is authorized or not. If authorized, more information is transferred through wireless mobile internet service as requested by the user. If the user-created picture is sent, the data are uploaded to the contents provider domain for updating website contents by the wireless internet service of return channel.

IV. THE UCM MESSAGE PROTOCOL STRUCTURE AND EVENT CODING

In the previous section, it proposes a business model for the interactive TPEG-UCM application service on T-DMB, and presented four components such as contents provider domain, DMB service domain, DMB user domain, and return channel domain. In these components, the data source module for UCM message at the DMB service domain is necessary to develop for the proposed service. There, in the section, it is proposed the UCM message protocol structure and event coding.

A. The Transport Frame Structure of UCM Message

The hierarchical transport frame structure including the UCM message is shown in Fig. 5. Also, it is compatible to the existing TPEG application services [9]-[12]. The TPEG application service is identified by service component identifier of service component frame level. The application data are included in the component data field of service component frame level [21], [22]. The new UCM message defined in this paper is included in the component data field. The detailed structure of UCM message is described in the following sub sections.

1) The Structure of TPEG Protocol:

As shown in Fig. 5, each transport frame includes synchronization word (Sync Word), the length of service frame (Field Length), the header CRC, the frame type indicator and the service frame. The sync word is 2 bytes long, and has the value of FF0F hex. The field length consists of 2 bytes and represents the number of bytes in the service frame. The frame type indicates the content of the service frame and is 1 byte long. The header CRC is two bytes long, and is based on the ITU-T polynomial $x^{16}+x^{12}+x^5+1$. The TPEG byte stream is built according to the above mentioned repetitive structure of transport frames [22].

Each service frame comprises service IDs, the encryption indicator and the component multiplex comprises one or more component frames. If the value of frame type is equal to 0, the data in service frame mean the stream directory information. The conventional service frame data consist of the service frame, when frame type is 1. Each transport frame may be used by only one service provider and one dedicated service which supports a
mixture of application. The service IDs are structured in a similar way to internet IP addresses. The combination of these three service ID elements must be uniquely allocated on a world basis. The encryption indicator is defined as one byte according to TPEG primitive syntax. If the indicator has value 00 hex, all data in the component multiplex are no-encrypted. Every other value of the encryption indicator indicates that one of several mechanisms for data encryption or compression has been utilized for all data in the following data multiplex [22].

The service component multiplex is a collection of one or more component frames, the type and order of which are freely determined by the service provider. Each component frame comprises the service component identifier, the length of the component data (Field Length), the component header CRC and the component data. The service component identifier with value 0 is reserved for the service and network information (SNI) application. The field length consists of 2 bytes and represents the number of bytes of the component data. The component header CRC is equal to the header CRC in transport frame level [22].

2) The Structure of UCM Message:

As shown at the shaded area of the bottom of Fig. 5, the TPEG-UCM application service is designed to deliver UCM message using three containers, which are the message management container, the event container for transmitting UCM information, and TPEG-location container having the geographical position information [6]. It is similar to the other TPEG application services, such as the RTM, PTI, and so on.

To manage the UCM in the receiving side, the message management container includes information such as the date and time references, the effect and reliability, the cross reference information (CRI). To server for presentation and filtering of information in TPEG decoder, the date and time references describe start and stop time, generation time, expiry time, and so on. The effect and reliability information provide severity factor and unverified information to make a judgments about the effect on travel for an end-user. The CRI would allow each message to be cross-referenced to other messages, either within the UCM application, or in other TPEG applications [6].

The TPEG-Location container which is used TPEG Part 6: TPEG-LOC (Location) specification of all existing TPEG application service has the geographical location information of the travel site and can be used coupled to the map of the receiver [24].

The message management container and the TPEG-Location container of three TPEG-UCM application service data field are the same as TPEG-POI application service [23]. In this paper, only event container component frame is designed and proposed. The following section describes the UCM event container which is to transmit the user created travel information.

3) The Detailed Structure of UCM Message Event Container:

The detailed structure of TPEG-UCM event container proposed in this paper is shown Fig. 6. The TPEG-UCM event container consists of two kinds of elements such as story and information. Each element also contains several sub elements in detail.

The story element contains title and picture. The title of story element describes in detail for travel site. The picture of story element presents a thumbnail picture which is created by the user. The information element is defined for more information about travel site. It contains author, date, site, and advertisement of local area banner ad for new earnings source. As shown in Table 2, the travel site information is newly defined in UCM10 table for increasing the transfer efficiency. To compress the UCM data, it is used the table newly defined. Since the maximum size of event container is up to 64Kbytes, a variety of image data can be included in it.
**Fig. 6** The event container structure of UCM message

### TABLE II TPEG-UCM REFERENCE TABLE UCM10 FOR SITE INFORMATION

<table>
<thead>
<tr>
<th>Code</th>
<th>Word(English)</th>
<th>Word(Korean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unknown</td>
<td>알 수 없음</td>
</tr>
<tr>
<td>1</td>
<td>Seoul</td>
<td>서울 및 경기</td>
</tr>
<tr>
<td>2</td>
<td>Kangwon</td>
<td>강원도</td>
</tr>
<tr>
<td>3</td>
<td>Chongchung</td>
<td>충청남북도</td>
</tr>
<tr>
<td>4</td>
<td>Julla</td>
<td>전라남북도</td>
</tr>
<tr>
<td>5</td>
<td>Kyungsan</td>
<td>경상남북도</td>
</tr>
<tr>
<td>6</td>
<td>Jeju</td>
<td>제주도</td>
</tr>
</tbody>
</table>

### B. The Syntactical Representation for UCM Message Event Container

Table 3 shows the syntactical representation for encoding the story and the information element of UCM message. All information of TPEG-UCM application service message protocol proposed in this paper is coded by grammar and concept which is defined at TPEG Specification ‘Part 2: Syntax, Semantics, and Framing structure’ [22].

The data element in TPEG protocol is composed by the byte. The “intunti” data type means integer unsigned tiny and its size is 1 byte. The “intunli” stands for integer unsigned little and its size is 2 bytes [22].

#### TABLE III SYNTACTICAL REPRESENTATION FOR UCM MESSAGE EVENT CONTAINER FOR TPEG-UCM APPLICATION SERVICE

#### a. Story

```xml
<UCM_component(80)>
<intunti> (id),
<intunli> (n),
m*<story_component()>;
```

**Story event class**

**Identifier, id=80 hex**

**Length of component data in bytes, n**

**Story component**

#### a.1 Story component template

```xml
<story_component(x)>
<intunti> (id),
<intunli> (n),
n*<byte>;
```

**Story component template**

**Identifier, id=x hex**

**Length of component data in bytes, n**

**Component data**

#### a.2 Title

```xml
<story_component(00)>
<intunti> (id),
<intunli> (n),
m*<short_string>;
```

**Title of story component**

**Identifier, id=00 hex**

**Length of component data in bytes, n**

**Title of information**

#### b. information

```xml
<ucm_component(81)>
<intunti> (id),
<intunli> (n),
m*<information_component()>;
```

**Information event class**

**Identifier, id=81 hex**

**Length of component data in bytes, n**

**Information component**

#### b.1 Information component template

```xml
<information_component(x)>
<intunti> (id),
<intunli> (n),
n*<byte>;
```

**Information component template**

**Identifier, id=x hex**

**Length of component data in bytes, n**

**Component data**

#### b.2 Site

```xml
<information_component(00)>
<intunti> (id),
<intunli> (n),
m*<ucm10>;
```

**Site of information component**

**Identifier, id=00 hex**

**Length of component data in bytes, n**

**Site, TPEG table ucm10**

#### b.3 Author

```xml
<information_component(01)>
<intunti> (id),
<intunli> (n),
m*<short_string>;
```

**Author of information component**

**Identifier, id=01 hex**

**Length of component data in bytes, n**

**Author**

#### b.4 Date

```xml
<information_component(02)>
<intunti> (id),
<intunli> (n),
m*<date>;
```

**Date of information component**

**Identifier, id=02 hex**

**Length of component data in bytes, n**

**Date**

#### b.5 Advertisement

```xml
<information_component(03)>
<intunti> (id),
<intunli> (n),
m*<graph_type>,
m*<byte>;
```

**Local advertisement of information component**

**Identifier, id=03 hex**

**Length of component data in bytes, n**

**Picture format**

**Picture file**

### C. Bidirectional UCM Data Transmitting and Receiving

As the UCM application service is a new application based on TPEG, its data should be integrated into the
existing TPEG service. Therefore, the UCM application service is implemented both on the TPEG data server and the TPEG decoder on the receiver. The details of each system are described in the following sub section.

1) UCM Data Server and Client:

The system configuration of the bidirectional UCM data server system in T-DMB is shown in Fig. 7. It consists of a contents database, an advertisement database, an encoder, a streamer, and an UCM client. The TPEG encoder converts the bidirectional UCM data read from the database into binary UCM messages. Next, the streamer transfers encoded TPEG stream to the T-TMB ensemble multiplexer with the user specified data rate. In the T-DMB transmitter, the incoming TPEG stream from the data server is multiplexed in the TDC (Transparent Data Channel) with the stream mode of T-DMB ensemble channel [25]. The details of each module are described in the following.

![Fig. 7 The structure of the bidirectional TPEG-UCM application service transmitting system](image1)

The encoder module reads UCM messages, generated by the UCM authoring tool, from a contents database and an advertisement database. Next, it encodes them into the TPEG binary stream according to the proposed UCM application described in the previous section.

The streamer module works as the mediator between the UCM data server, the UCM client and the T-DMB transmission system. It reads the binary file stored by the TPEG encoder and provides the data to the data server or the ensemble multiplexer of the T-DMB transmission system.

The UCM client has a general management user interface which can handle database and overall functionality of the UCM data server. It enables the user to access the database and modify, delete, and sometimes, manually add new UCM messages. All the TPEG messages are processed in hierarchical structure. The data rate for bidirectional UCM service in the T-DMB channel can be controlled in the streamer module. Also, it should be notified by the T-DMB ensemble multiplexer to be used in the multiplexing with other T-DMB television, audio, and data services. The number of transmission times of the other TPEG application services is managed using user interface for the controller.

2) TPEG Decoder with UCM Supported:

When TPEG service is detected in the DMB receiver, it provides the UCM and other TPEG service data stream to the TPEG decoder. Fig. 8 shows the decoding structure of the TPEG stream with UCM message and the processing structure on the navigation application layer. The received TPEG stream in the DMB receiver is parsed and decoded before they are used in the navigation application. All the service type like RTM, CTT, CTT-SUM, SDI, POI, and UCM will be decoded separately and provided to the application layer.

When the bidirectional service from the user is requested, the UCM service performs as the following procedure using wireless communication network of the DMB receiver. It is shown in Fig. 8. First, it is checked whether a user is authorized or not. Next, according to the user request, contents created by the user are transmitted to the contents provider. As a result, data of the contents provider are updated by the user.

![Fig. 8 The structure of the bidirectional TPEG-UCM application service receiving system](image2)

V. THE SIMULATION OF TPEG-UCM APPLICATION SERVICE

The interoperability of the TPEG-UCM application service must be verified through incorporating smooth the current existing TPEG application service and implementing in broadcasting. Therefore, the proposed TPEG-UCM application service protocol is necessary to verify the stability by the experimental simulation. However, it is, in fact, difficult to prove its stability on T-DMB full system including the broadcasting. Instead, in this paper, the stability and the capability are verified by using the example of the authoring tool and the decoding tool for service as shown in Fig. 9. The collected travel information database and the advertisement database with banner ad of local area is encoded by file method make ‘*.bin’ file as ‘Guideline for TPEG on the internet (B/TPEG PG02/080)’, not stream method [26].

![Fig. 9 The simulation of the TPEG-UCM application service](image3)
A. The UCM Message Authoring Tool

The authoring tool converts a UCM message information to data files in the format of '*.bin' which is suitable for the proposed specification in this paper. The hardware of the developed authoring tool is a PC of Pentium 4 dual core 1.87GHz and the software is implemented by the dialog based MFC (Microsoft Foundation Class) with Visual Studio 2005 C++. The collected travel information database is implemented based on Microsoft Access 2007. The feature of GUI (Graphic User Interface) is an easily and intuitively operable authoring tool interface as shown in Fig. 10.

Fig. 10 The example of the UCM message authoring tool

Pictures use jpg format among jpg, pna, and mng in TPEG specification and the resolution is 320x240. Therefore, the capacity of UCM message is about 55Kbytes per one message. At the present, the receiver of car navigation or mobile phone is over 1GB capacity in storage area. The proposed service requires 1,000 messages more for thinking receiver storage capacity and information value. Therefore, the transferring whole capacity becomes about 55Mbyte.

The result shows the best receiving rate when it is transferred under 2Kbytes which is MSC (Main Service Channel) data group basic size by TPEG application service matching test [27]. The TPEG-UCM application service message is split into 2Kbytes parts by multiplexing the existing TPEG application service and the form of a carousel. The TPEG-UCM service is not a real time service. Therefore, we think suitable that its update duration is a week and it is received in background mode in the receiving side.

B. The UCM Message Decoding Tool

The hardware basis of the developed decoding tool is a PC of Pentium 4 dual core 1.87GHz and the software is implemented by the dialog based MFC of the Visual Studio 2005 C++. Data transferred from the UCM message authoring tool is made database based on Microsoft Access 2007 and stored in a hard drive.

The easy and simple graphic user interface example for mobile phone user is shown in Fig. 11. If the user selects the title want to view, the receiver displays the additional information such as title, site, writer, date, and so on. In the lowest part, it displays the transferred banner ad for local area, which not disrupting the travel information. As a result, we may have the advertisement effect. If the user clicks the ‘more view’ menu for more picture or information, it is connected the story map of cyworld by PC internet service [28]. Also, if the user knows the route to the destination, the user clicks the ‘map’ menu. As a result, prompt optimal route is presented by the inner map of the receiver with travel site location information. The example shown in Fig. 11 is the optimal route of the almap in the PC internet service [29].

VI. CONCLUSIONS

In this paper, it is proposed the novel interactive TPEG-UCM application service as a business model combining the T-DMB with wireless communication network such as CDMA, WiFi, WiBro, and so on. Also, it is proposed the UCM message protocol structure and event coding for implementation of the new service. The proposed service is designed to effectively transfer the information of a LBS website to the user through not wireless communication but T-DMB network. On the other hand, uploading for the user created information is performed using internet service of wireless communication network, which is return channel.

The effectiveness of the proposed service is expected to acquire a variety of TPEG application services, and come true the bidirectional service in the stage of DMB 2.0 or more. The T-DMB service provider side also easily obtains the new information as broadcast contents, and creates the new source of income from banner ad for local area. As a result, the T-DMB service has acquired the robust position as new media in the future convergence period of broadcasting and communication.

It is necessary to develop automation techniques to insert and to update the UCM information provided by the contents provider. Also, it is necessary to further develop another TPEG application service which transfers the user created movie contents like UCC (User Created Contents). Besides picture, a movie clip is large data size. Therefore, as future work, it is necessary to set up new business model. It transfers the movie thumbnail as well as the link
information at the UCC web site to the TPEG application service. On the other hand, the full movie can be downloaded with the return channel of the wireless communication network.

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Sang-hee Lee received the B.E. degree in electronic engineering from the National Kyoungbuk University, Dae-Gu, Korea, in 1994, and M.E. degree in Institute of e-Vehicle Technology, University of Ulsan, Korea in 2009. He is currently pursuing the Ph.D. degree in school of electrical engineering from the Ulsan University, Korea. He is working at the Ulsan Broadcasting Corporation, Ulsan, Korea as a broadcasting engineer since 1997. His research interests are in the area of multimedia broadcasting, new media, intelligent system, and computer vision.

Kang-hyun Jo received his B.E. degree in Mechanical and Precision Eng. from Busan National University, Korea and his M.E. and Ph.D. degrees in Computer-Controlled Machinery Eng. from Osaka University, Japan, in 1989, 1993, and1997, respectively. He is currently a Professor at the Faculty of Electrical Eng. and Information Systems, University of Ulsan, Korea. His research interests include computer vision, human-computer interaction, robot applications in town and health-care and intensive intelligent systems. He is actively participating as a member of in very many professional research societies, like IEEE, IEEK, ICROS, KRS, KIPS, KIHEE, and KSAE.