A Traveler Information Service Structure in Hybrid T-DMB and Cellular Communication Network

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***Abstract*—This paper introduces a structure of delivering traveler information service including point of interest information through the terrestrial multimedia broadcasting system, in which, the receiver is connected with cellular communication terminal to enable the interactivity of the service. By combining real time traffic information and point of interest information, we could get an efficient traffic and traveler information service system that could be used for many location based applications.**

Keywords-component; traffic and traveler information, point of interest, location based service, digital multimedia broadcasting

I. INTRODUCTION

Among the traveler information services, POI (Point of Interest) service is one of the most important components in the location based services. As the interested point information should be used at anytime, anywhere in the service area, the mobility and the navigation functionality at the receiver side are absolutely necessary in the future LBS systems.

T-DMB (Terrestrial Digital Multimedia Broadcasting) system, which is also known as European DAB (Digital Audio Broadcasting) system, is one of the well known COFDM (Coded Orthogonal Frequency Division Multiplexing) based broadcasting systems that can deliver massive data service to the mobile receivers which are running in high speed. The T-DMB system can also employ bidirectional data service by being connected with communication network [1~3]. Furthermore, the T-DMB system has the functionalities to deliver the TPEG (Transport Protocol Expert Group) [4~11] application services, which has a well organized TTI (Traffic and Traveler Information) service message structure. Therefore, our motivation was that the combination of T-DMB system and TPEG message structure would be a better structure for point of interest service.

However, as the information of the points of interest increases, traditional balancing problem of what to push and what to pull data arises so that the service provider can deliver the traveler information service in cost effective way[12~14]. Furthermore, before scheduling the broadcast data stream of the point of interest, there needs to be the careful examination and categorization of the massive number of the points of interest. By doing this process, we could organize the information of the points according to the characters of them and make tables similar to TPEG message format. For the balancing of the broadcast and communication channel usage, as well as the scheduling the categorized data stream, we defined some criteria for each of the data delivery scheme for the minimum usage of communication channel.

This paper introduces the structure of an efficient traveler service in the T-DMB system, in which, the terminal has mobile communication capability. In the system, a message author for the traveler information service encodes the POI data with the real time traffic information [15~16], which then converted into the TPEG messages. And a stream server provides the traveler information data stream into the T-DMB transmission system. At the receiver side, a traveler information decoder decodes the stream so that they could be used in the navigation software equipped with GPS (Geographical Positioning System) module.

The result shows that with efficient classification of the points and criteria for push and pull scheme, the system can be used as an efficient traffic and traveler information service system.

II. POINTS FOR THE TRAVELER INFORMATION SERVICE

As a traveler information service element, POI is actually the set of destinations that people visit everyday. The main purpose of the POI service is to provide people the information of the points of their interest. Therefore, the messages for POI services are a set of categorized points according to the actual preferences of the people to visit. This chapter introduces the classification result of the target

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points and how the results are formatted as the TPEG style reference tables.

A. Classification of the Points

The classification of all the existing points of the world according to the preferences of the people can be a time consuming work. However, it is the most important work because the resultant structure of this categorization decides the value and usability of the service. The inefficient categorization will cause the traveler information data service useless and eventually wasting the valuable transmission channel capacity.

Figure 1 shows the categorization result of the points of the traveler interest. This categorization structure was used in the implementation of the traveler information service in this paper.

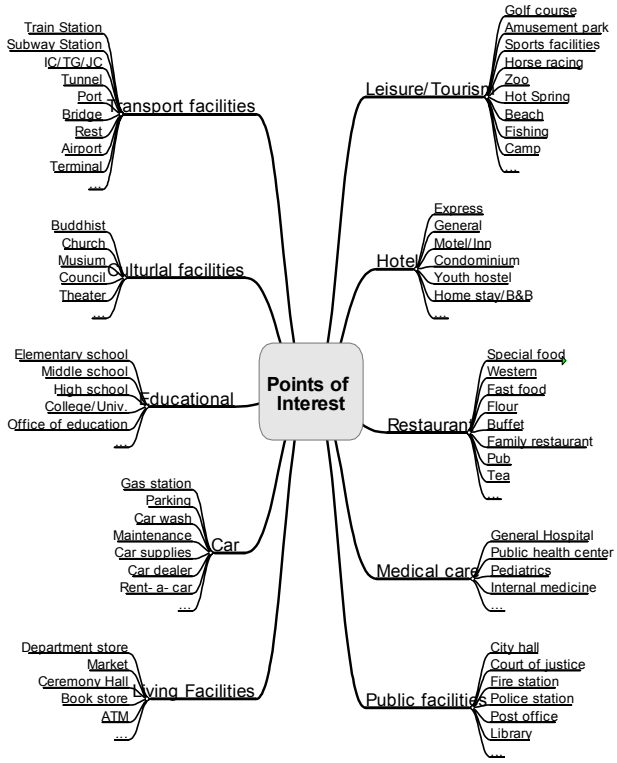

Fig. 1. The categorization of points

The general criteria of the categorization were the importance that the points have. The importance will vary according to the people who wish to use the information. Therefore we set up the criteria following the general public preferences. The transmission frequency of the specific point information depends on the major purpose of the service-public free service or value added, special purpose traveler information service.

In this paper, regarding the traveler information service as a public service which targets everyone in the service area with low or no cost, we gave the same priority to all of the points. However, inside the information of any points, there can be differences between information elements. Some information of a certain point will not change all the time while the other information elements change frequently. The example for this situation is described in the next section, which shows the structure of the point information.

B. Classification of the information

Figure 2 shows one of the message structures in case that the point is one of the tourist attractions, which is one of the main categories in the figure 1 (Leisure/Tourism). Each of the information of any point will have a kind of the message structure similar to the figure according to the main category which the point is assigned in. A tourist attraction point has the information elements like classification, name of the place, opening/closing time according to the season and parking information. Among the other information elements, parking availability is likely to be changed frequently.

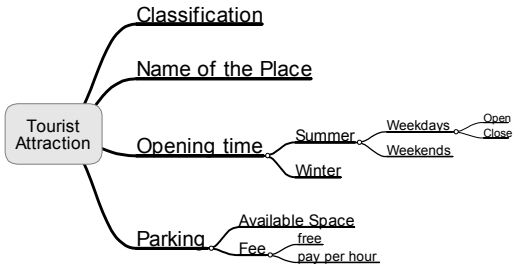

Fig. 2. The sub-class example of a category

C. Criteria for communication channel usage

For some points like hotels and restaurants, in which we need to make a reservation, current availability will be very important data and thus the data changes and updates most frequently. While current status of the reservation availability is given by the broadcasting server, reservation itself is done by the communication channel. There can be several ways to use interaction channel in the process of reservation service. For example, reservation service can be done with separate web page when the receiver supports the web browsing functionality. In this case the user gets only the hotel information from the broadcasting channel. Just hotel web-link is connected to the browser with communication channel. If the broadcasting server provides the specific script for registration service in the hotel information data stream, the user can do the process only by selecting and clicking registration button at the receiver. In

this case the user terminal do not need additional browser to connect to the hotel registration web-page. Figure 3 shows the hybrid network structure for T-DMB and communication interactive service.

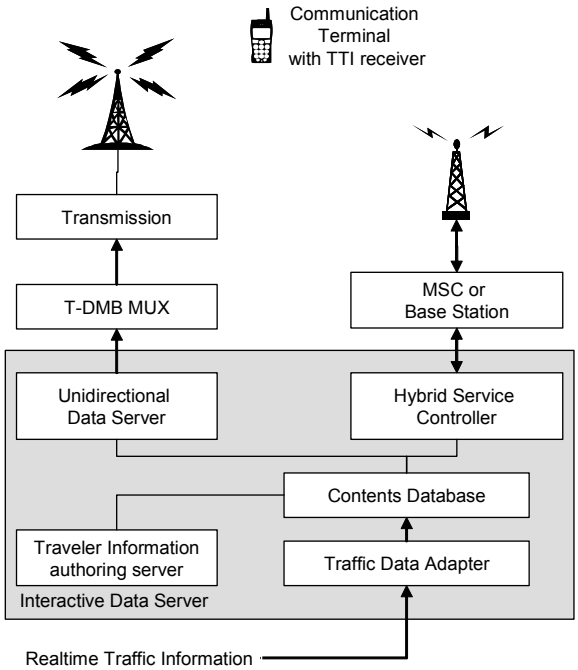

Fig. 3. Bidirectional data service architecture over T-DMB

III. POI MESSAGE STRUCTURE FOR THE IMPLEMENTATION

A. *Basic structure of TPEG message*

Figure 4 shows the basic TPEG message structure for POI service. It is similar to the RTM (Road Traffic Message) and the other TPEG applications. The general TPEG message has three parts-message management container, event container and TPEG location container. The message management container has the information of the management of the whole message such as the generated time, expiry time. The event container delivers the actual contents of the message-information of the POI in case of the POI message. The last one is the location container for the location reference of the POI.

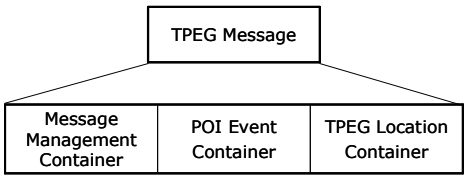

Fig. 4. The basic message structure

B. *Event container*

In order to fill in all the classified information into the POI event container, the POI components in the message structure in the figure 4 should be structured like in the figure 5. All the components are multiplexed in the service frame with the appropriate service identifications (SIDs) and then, make the transport frames with the frame header.

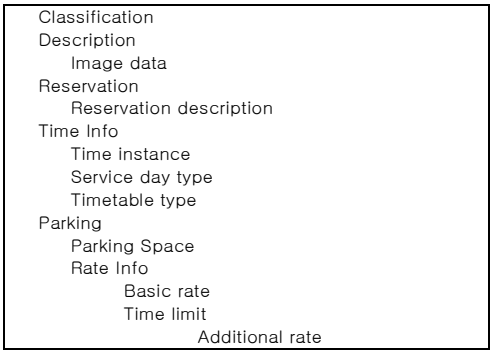

Fig. 5. POI Event Container

IV. MESSAGE GENARATION AND TRANSMISSION

Figure 6 shows the traffic and traveler information message generation procedure for T-DMB transmission system.

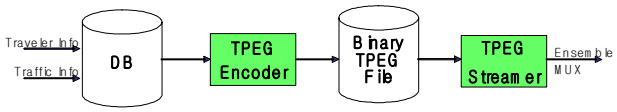

Fig. 6. Traveler information message generation procedure

For the database management server of the database, we used MS-SQL 2000 server and MSXML4.0 parser in the implementation. Operators can insert actual POI messages for the traveler information into the database with an appropriate authoring tool. By reading the data from the database, the TPEG encoder makes actual binary TPEG frames for traveler and traffic information. The TPEG streamer reads the binary file and provides the data to the T-DMB ensemble multiplexer or data inserter before the data being provided into the ensemble provider through Ethernet connection.

As the TPEG application uses TDC (Transparent Data Channel) of the T-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 POI encoder and streamer inside the system. The binary file works as a buffer to constantly control the

rate of the traffic and traveler information data to be provided to the T-DMB ensemble multiplexer.

V. Receiver and Traveler Information decoder

If the terrestrial DMB signal is received by the receiver and the FIC (Fast Information Channel) of the T-DMB ensemble says that it contains the traffic and traveler application service in the TPEG data applications, the data stream will be provided to the application decoder. Figure 7 shows several displays of the receivers with software based POI decoders and internal car navigation modules, which provide navigation with digital map in them. (a) is the traveler information which displays a certain POI information. The additional information such as telephone numbers of the reservation desk, number of currently available rooms are displayed in the information. (b) shows exact position of the hotel on digital map of the navigator. The WGS84 location information is following in the LOC field of the TPEG frame for the easy navigation to the destination point.

(a) (b)

Fig. 7. Received traveler information

VI. Conclusion

This paper introduces the result of the implementation of traveler information service in T-DMB network. We developed TPEG based traveler information authoring and encoding tools and also developed a stream server to provide the encoded TPEG messages to the T-DMB ensemble multiplexer with the user specified data rate. We also implemented software based TPEG decoder in the receiver to verify that the transmitted traveler information could be used in the navigation system.

The result shows that well established architecture of TPEG can be used successfully to the traveler information service like point of interest service. Furthermore, it showed that the service is very useful as a public service for the people living in the service region as well as the drivers who do not have prior information of the region. With some modifications to the priorities to deliver traveler information, it appeared that any kind of value-added traveler information service is also possible. However, as the general data size for the POI information is relatively larger than the traditional TPEG messages, it appeared that there needs to be a kind of management strategy of the massive POI information data delivery especially when the information increases. Therefore, careful scheduling strategies are necessary for traveler information services with relatively larger data sizes.

References

[1] ETSI EN 300 401 Ver. 1.4.1 "Radio Broadcasting Systems; Digital Audio Broadcasting(DAB) to mobile, portable and fixed receivers" Jan. 2006.

[2] ETSI TS 201 737: Digital Audio Broadcasting(DAB); Interaction channel through Global system for Mobile communications (GSM) the Public switched Telecommunications System (PSTN); Integrated Services Digital Network (ISDN) and Digital Enhanced Cordless Telecommunications (DECT)".

[3] ETSI TS 201 736: Digital Audio Broadcasting (DAB); Network Independent Protocols for Interactive Services.

[4] Transport Protocol Experts Group(TPEG) Specifications, Part 1 : Introduction, Numbering and Versions TPEG-INV/002

[5] Transport Protocol Experts Group(TPEG) Specifications, Part 2 : Syntax, Semantics and Framing Structure TPEG-SSF_3.0/002

[6] Transport Protocol Experts Group(TPEG) Specifications, Part 3 : Service and Network Information Application TPEG-SNI_3.0/002

[7] Transport Protocol Experts Group(TPEG) Specifications, Part 4 : Road Traffic Message Application TPEG-RTM_3.0/003

[8] Transport Protocol Experts Group(TPEG) Specifications, Part 3 : Road Traffic Message Application ML, EBU BPN 036-1

[9] Transport Protocol Experts Group(TPEG) Specifications, Part 5 : Public Transport Information Application TPEG-PTI_3.0/001

[10] Transport Protocol Experts Group(TPEG) Specifications, Part 4 : Public Transport Information Application ML, EBU BPN 036-1

[11] Transport Protocol Experts Group(TPEG) Specifications, Part 6 : Location Referencing for Applications TPEG-Loc_3.0/001

[12] Swarup Archarya, Michael Franklin and Stanley Zdonik, "Balancing Push nd Pull for Data Broadcast," *Proceedings of ACM SIGMOD International Conference on Management of Data*, pp. 183~193, 1997

[13] Yufei Guo, M. Cristina Pinotti and Sajal K. Das, "A New Hybrid Broadcast Scheduling Algorithm for Asymetric Communication Systems," *Mobile Computing and Communications Review*, Vol. 5, No. 3, pp. 39-54, 2001.

[14] Jing Hu, Reinhard German, Armin Heindl, Ronald Kates and Matthias Unbehaun, "Traffic modelling and cost optimization for transmitting traffic messages over a hybrid broadcast and cellular network," *IEEE Proceedings of 8th International Conference on Intelligent Transportation Systems*, pp. 1171~1176, Sep., 2005.

[15] Sammo Cho et. al., "An Efficient Transmission of Traffic and Traveler Information using Digital Multimedia Broadcasting Network," *Proc. of 62nd IEEE Vehicular Technology Conference*, Sep., 2005.

[16] Byungjun Bae, et. al, "Design and Implementation of the Ensemble Remultiplexer for DMB Service Based on Eureka-147," *ETRI Journal*, vol.26, no.4, Aug. 12, 2004, pp 367-370