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A Novel Framework of LBS Application Using Multimedia Broadcast and Multicast Services in 3G Mobile Networks

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Abstract

Location-based services (LBS) provide content that is dynamically customized according to the user's location. These services are commonly delivered to mobile devices. In this paper, we propose a novel LBS application framework that Point of Interest (POI) messages are coded and embedded into the TPEG protocol (transport protocol experts group), and then TPEG Frame messages are economically and effectively broadcasted over 3GPP MBMS using the stream delivery method and download delivery method. The implementation details are explained and analyzed in terms of the design of POI Message with TPEG, The accessing of MBMS Services and delivery performance of TPEG using MBMS.

Keywords：Point of interest, Location based service, Broadcast, TPEG, MBMS, UTMS, FLUTE

1. Introduction

A Location based Service (LBS) is an information and entertainment service, accessible with mobile devices through the mobile network and utilizing the ability to make use of the geographical position of the mobile device. On the driving or walking around, consumers want to find an optimal path to destination or information of POI (point of interest) such as park, restaurant, hotel, cinema, gas station, traffic jam, and so forth. Location based services usually also rely on real-time traffic information that be often encoded in TPEG protocol. TPEG (Transport Protocol Expert Group) standard designed by EBU (European Broadcasting Union) is a new traffic information transfer protocol which has three major

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characteristics, language independent, bearer independent, and multi-modal application [1][2][3]. Broadcasting based transmission technology is one of main methods to provide dynamic traffic information or public emergency service in recent years, which is used by countries all over the world.

The Third Generation Partnership Project (3GPP) suggests an enhancement of current cellular networks to support Multimedia Broadcast and Multicast Services (MBMS). MBMS is a broadcasting service that can be offered via cellular networks using point-to-multipoint links instead of the usual point-to-point links. Because of its operation in broadcast or multicast mode, MBMS can be used for efficient streaming or file delivery to mobile phones [4] [5].

In this paper, we present a novel POI application specification based on TPEG over MBMS, which is satisfied to LBS applications in mobile devices, and explain the practicability and feasibility of that.

2. The Implemention of TPEG over MBMS

2.1. The Design of POI Message using TPEG

In order to provide greatest flexibility, the TPEG system was designed to allow a number of different service providers to deliver a number of different types of information for ITS, without needing to rely on any facilities provided by the bearer system. This was done to void compromising the bearer independence of the protocol. For this reason, the first level of TPEG framing - *the `Transport Frame'* - carriers a multiplex of TPEG *`Application Frames'* carrying potentially different types of information, and a TPEG stream is constructed from a sequence of transport frames from potentially different service providers [2][3].

We design a new POI application specification, which is satisfied to be interoperable with TPEG protocol. The hierarchical transport frame structure including the POI message made up three data fields is shown in Fig.1 and it is embedded into the existing TPEG applications. Each data field is called container, and the first one of the message management container is used to manage the POI information in the receiving side. As shown in Fig.2, the second one, POI event container, consists of the four items such as classification, description, reservation, time information. The POI information is divided into more than ten categories and each category is also classified into several sub-categories. For example, restaurant category is consist of Chinese, western and fast-food restaurant, and so forth. The last one, TPEG-location container, represents the exact position of POI by using the WGS84 co-ordinate or descriptor.

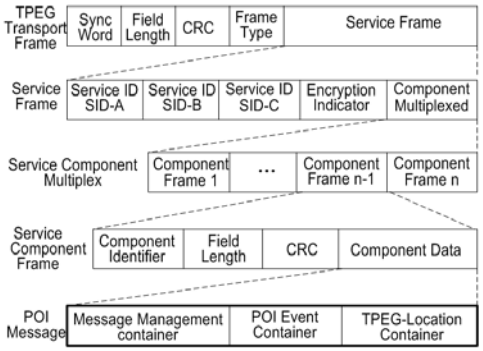

Fig. 1 The Structure of TPEG-Message.

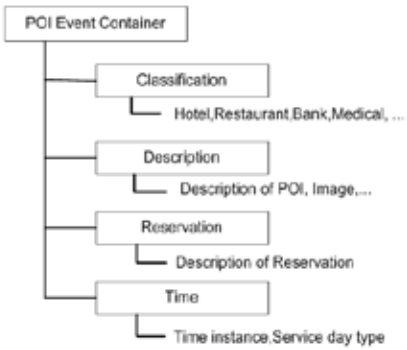

Fig. 2. A example of TPEG Road Traffic Messages

The TPEG specifications comprise two separate message representations, TPEG Binary and tpegML. TPEG Binary is a space-efficient description used for digital radio delivery, while tpegML is an XML implementation developed for Internet services. The hierarchical nature of XML fits perfectly to TPEG.

2.2. MBMS overview

MBMS is an IP datacast type of service that can be offered via existing GSM and UMTS cellular networks, which has been standardized in various of 3GPP, and the first phase standards are to be finalized for UMTS release6 [5].

The MBMS is a unidirectional point-to-multipoint bearer service in 3GPP cellular network in which data are transmitted from a single source entity to multiple mobiles. Various MBMS user services can be made up of these MBMS bearer services. To support the MBMS, Broadcast and Multicast-Service Center (BM-SC) is newly added to the network, and MBMS controlling functions are added to the existing network entities such as UMTS Terrestrial Radio Access Network (UTRAN), Serving GPRS Support Node (SGSN), and Gateway GPRS Support Node (GGSN). For user equipments (UEs) (or mobiles) to support the MBMS, much additional functionality are also required to be added. Some of them, for example, the interaction among protocol entities which is beyond of the standardization should be defined in detail. New protocols such as File Delivery over Unidirectional Transport (FLUTE) and media codecs are also needed to be implemented [5] [6][7].

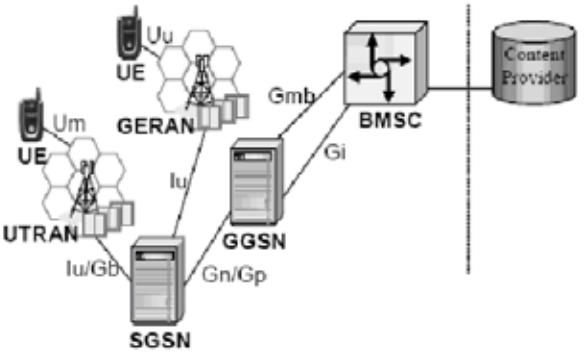

Fig.3 The MBMS architecture designed in 3GPP

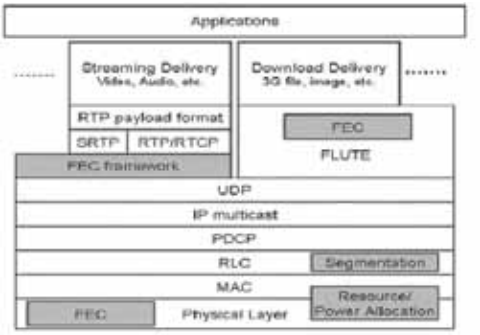

Fig.4 MBMS Protocol Stack

The content is distributed via unicast (point-to-point) connections, forcing the network to process multiple requests for the same content sequentially and therefore wasting resources in the radio access and core networks. With the expected increase of high bandwidth applications, especially with a large number of UEs(User Equipments) receiving the same high data rate services, efficient information distribution becomes essential. Broadcast and multicast are methods for transmitting datagram from a single source to multiple destinations. Thus, these techniques decrease the amount of transmitted data within the network. This results in a dramatic cost reduction.

3. MBMS Protocols and Codecs

MBMS defines two methods for service announcements: pull (the initiative comes from the receiving UE) and push (the initiative arises from the service itself). In the case of a pull method, the devices fetch the announcements (HTTP or WAP) from a web server. As push method, SMS (Short Message Service)

cell broadcast, SMS-PP (point-to-point), WAP-PUSH, MBMS broadcast, MBMS multicast and MMS (Multimedia Message Service) are used [5][6].

Essentially, MBMS offers a scalable mechanism for delivering multimedia content over 3G networks. MBMS User services use the protocol stack shown in Fig.4. A general distinction between two delivery methods exists: the download delivery method and the streaming delivery method. Streaming uses RTP (Real-time Transport Protocol) is used, which in turn uses UDP (User Datagram Protocol). For downloading, the FLUTE (File Delivery over Unidirectional Transport) protocol applies.

FLUTE bases on ALC (Asynchronous Layered Coding) and thus inherits its requirements including massively scalable multicast distribution. ALC itself is a protocol instantiation of LCT (Layered Coding Transport building block) providing in-band session management functionality. The most important feature of FLUTE is to provide the properties of the files in-band together with the delivered files. FLUTE builds on the unreliable UDP but offers a strong FEC (Forward Error Correction) which however gives no absolute delivery reliability. Therefore, MBMS offers the possibility of error correction after finishing the transmission with dedicated channels to a file repair server. Raptor Codes are in use for FEC [8].

The FLUTE packets are encapsulated in UDP/IP packets and are forwarded to the Packet Data Convergence Protocol (PDCP) layer. The packets are then sent to the Radio Link Control (RLC) layer. The RLC layer functions in unacknowledged mode. The RLC layer is responsible for mapping IP packets to RLC SDUs. The Media Access Control (MAC) Layer adds a 16 bit header to form a PDU, which is then sent in a transport block on the physical layer. The protocol stack introduces the following headers, reducing the Maximum Transmission Unit (MTU) payload from 1500 bytes for an Ethernet maximum frame size to a payload of 1444 bytes:

- FLUTE header: 16 bytes
- UDP/IP header: 8+20 bytes
- GTP-User traffic header: 12 bytes

The GTP tunnel in UTRAN is not represented in the protocol stack since the GTP tunnel connects the GGSN to the RNC, thus is not seen by the UE, but reduces the MTU payload size if IP fragmentation is to be avoided in the core network. The maximum packet payload size is one of the input parameters of the Raptor parameter derivation algorithm. The list of the parameters needed to calculate the number of symbols per packet and the size of symbols in bytes is (recommended maximum and minimum values are shown in parenthesis) [9].

- ***F:*** the file size, in bytes.
- $\boldsymbol{K}_{\min}$ (1024): the minimum target on the number of symbols per source block.
- $\boldsymbol{K}_{\max}$(4096): the minimum target on the number of symbols per source block.
- $\boldsymbol{G}_{\max}$ (10): a maximum target number of symbols per packet.

The number of symbols per packet, ***G***, the size of symbols, ***T*** , and the number of source blocks, ***Z*** , depending on file size are shown in Fig.5. The parameters in Fig.5 are derived as specified by 3GPP TS 26.346 Annex B [9].

F(KB)	G	T	G*T	Z
128	10	144	1440	1
256	6	240	1440	1
512	3	480	1440	1
1024	2	720	1440	1
1536	1	1440	1440	1
3072	1	1440	1440	1
10000	1	1440	1440	3

Fig.5 G, T, and Z for different file sizes

4. Conclusion

MBMS has the major benefit that the network infrastructure already exists for mobile network operators and the deployment can be cost effective compared with building a new network for the services. The broadcast capability enables to reach unlimited number of users with constant network load. Open standards will be a necessary catalyst for LBS growth. Therefore, In this paper, we propose a novel POI application based on the TPEG over Multimedia Broadcast and Multicast(MBMS), and explain the implement of that using the stream delivery method and download delivery method. The performance analysis of TPEG delivery over MBMS is also provided. The results show that this LBS application framework is economically and effectively.

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