TeliaSonera

Mobile Broadcast/Multicast Service (MBMS)

White Paper

August 2004

MediaLab
TeliaSonera Finland

www.medialab.sonera.fi
info@medialab.sonera.fi

Contents

01. Introduction

MBMS (Multimedia Broadcast/Multicast Service) is an IP datacast (IPDC) type of service that can be offered via existing GSM and UMTS cellular networks. The infrastructure gives the possibility to use an uplink channel for the interactions between the service and the user. This is not a straightforward issue in usual broadcast networks, as for example conventional digital television is only a one-way (unicast) system.

MBMS has been standardized in various groups of 3GPP (Third Generation Partnership Project), and the first phase standards are to be finalized for UMTS release 6. The service seems to be rather attractive, as quite a lot of operators, equipment manufacturers and other representatives have participated in the standardization work. It can consequently be assumed that there will be several services offered via MBMS in the near future.

MBMS is a solution for transferring light video and audio clips, although real streaming is also possible via the system. For heavy duty streaming in a wide area for a large, concentrated audience there are more suitable solutions such as DVB-H (Digital Video Broadcast, Handheld) which is an extension to terrestrial digital television. [14] Nevertheless, MBMS is a suitable method also for mass communications. [6]

The freezing target of the first version of MBMS has been set for Release 6. As Release 6 will be ready by the 3rd quarter of 2004, practical network implementations may be expected by the 3rd quarter of 2007, and the first functional mobile terminals supporting MBMS could be estimated to be available by the third quarter of 2008. From 2008 onwards, the service will be introduced both in networks and terminals. According to rough estimations, a total of 30 % of terminals and networks could support the service by the year 2010.

02. MBMS Architecture

Broadcast and Multicast Services

A broadcast service can be generalized to mean a unidirectional point-to-multipoint service in which data is transmitted from a single source to multiple terminals (UE, user equipment) in the associated broadcast service area. In the other words, broadcast services can be called push-type services. On the other hand, a Multicast Service can be defined as a unidirectional point-to-multipoint service in which data is transmitted from a single source to a multicast group in the associated multicast service area. Only the users that are subscribed to the specific multicast service and have joined the multicast group associated with the service can receive the Multicast Services. As a difference, a Broadcast Service can be received without separate indication from the customers. [1] In practice, multicast users need a return channel for the interaction procedures in order to be able to subscribe to the desired services.

MBMS is thus a unidirectional point-to-multipoint service in which data is transmitted from a single source entity to a group of users in a specific area. As its name indicates, MBMS has two modes in practice: broadcast mode and multicast mode.

MBMS provides a new method for transferring data for the number of users simultaneously. As a general rule of the evolution path of GSM (Global System for Mobile communications) and UMTS (Universal Mobile Telecommunications System) networks and terminals, backwards compatibility issues apply also to MBMS. This means that MBMS will not interfere with already existing GSM and UMTS services, and mobile terminals not supporting MBMS will work in networks that offer MBMS for customers with MBMS capable terminals. [2][11]

The architectural model of MBMS can be seen in Figure 1. [3][4][5]

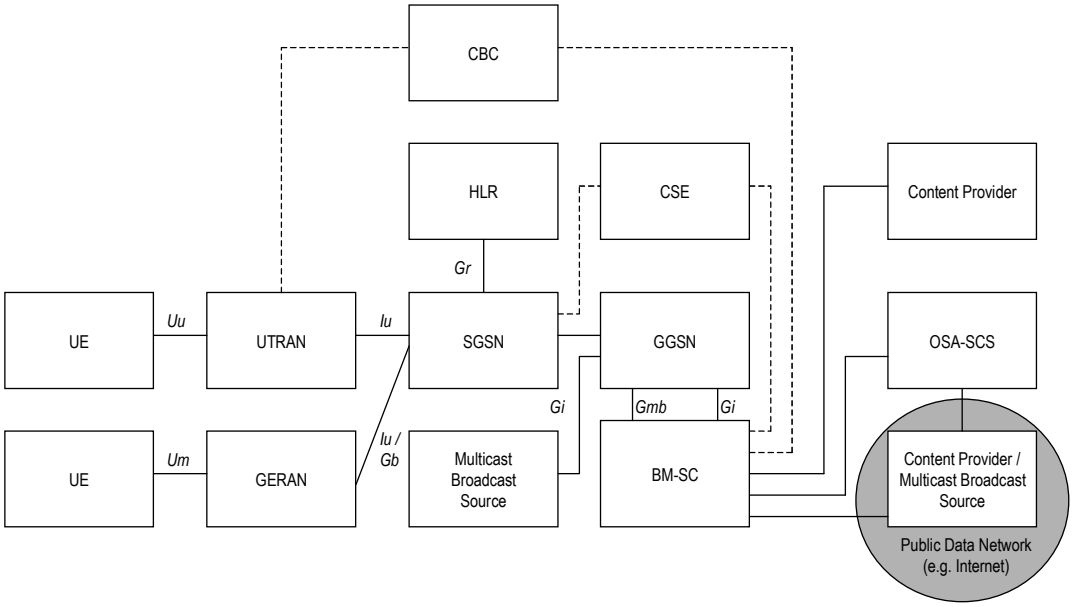

Figure 1. The architecture of MBMS.

According to the specifications, there are some high-level requirements that apply to the MBMS [7][8]:

- MBMS shall utilize the radio resource in an efficient manner.
- MBMS data transfer shall be downlink only.
- The reception of MBMS data blocks in PTM (point-to-multipoint) is not guaranteed at the GERAN (GSM EDGE Radio Access Network) level. MBMS does not support individual retransmissions at the radio link layer, nor does it support retransmissions based on feedback from individual subscribers at the radio level. This does not preclude the periodic repetitions of the MBMS content based on operator or content provider scheduling or retransmissions based on feedback at the application level.
- Simultaneous reception of MBMS and non-MBMS services shall be possible and shall depend upon MS capabilities.
- Simultaneous transmission of more than one MBMS service shall be possible and the reception shall depend upon MS capabilities.
- MS controlled "service based" cell selection/reselection shall not be permitted.
- A mechanism to enable the network to move MBMS subscribers, in an MBMS session, between radio access technology (RAT) and cell is required.
- Supported quality of service (QoS) attributes shall be the same for MBMS multicast and broadcast modes.
- During MBMS data transmission it shall be possible to page a given mobile station (MS), irrespective of the radio resource mode of operation.
- The MBMS notification procedure shall be used to indicate the start of MBMS data transmission in the cell.
- A mechanism shall be defined to enable the network to start the MBMS data transmission for a multicast session in a cell if there is at least one user joined to multicast session in the cell.
- A mechanism shall be defined to allow the BSS to stop the MBMS data transmission for a given multicast session in a cell that does not contain any MBMS MS joined to this multicast session.

Note that these requirements may be still changed during the specification work. There are still plenty of open MBMS related issues with high priority in GERAN specifications by the spring 2004.

Gmb

The Gmb reference point (Figure 1) handles the broadcast multicast service center (BM-SC) related signaling, which includes the user specific and bearer service messages.

MBMS bearer service specific Gmb signaling includes the following issues:

- The GGSN establishes the MBMS bearer context and registers at BM-SC.
- The GGSN (gateway GPRS support node) or the BM-SC releases the MBMS bearer context and deregister the GGSN from the BM-SC.
- The BM-SC indicates session start and stop to the GGSN including session attributes like QoS or MBMS service area.

User specific Gmb signaling includes:

- The BM-SC authorizes the user specific MBMS multicast service activation at the GGSN.
- The GGSN reports to the BM-SC the successful user specific MBMS multicast activation to allow the BM-SC to synchronize the BM-SC UE MBMS context and charging with the MBMS UE contexts in SGSN (serving GPRS support node) and GGSN.
- The GGSN reports to the BM-SC when a user specific MBMS multicast service is released or deactivated (e.g. when the radio contact is lost) to synchronize BM-SC UE MBMS contexts and charging with the MBMS UE contexts in SGSN and GGSN.
- The BM-SC initiates the deactivation of a user specific MBMS bearer service when the MBMS user service is terminated.

BM-SC

The BM-SC (broadcast multicast service center) includes functions for MBMS user service provisioning and delivery. It may serve as an entry point for content provider MBMS transmissions, used to authorize and initiate MBMS Bearer Services within the PLMN, and can be used to schedule and deliver MBMS transmissions.

The BM-SC is a functional entity, which must exist for each MBMS User Service. According to the specifications, the following requirements apply to BM-SC:

- The BM-SC shall be able to authenticate 3rd party content providers, providing content for MBMS transmissions.
- 3rd party content providers may wish to initiate an MBMS transmission. In such cases, the BM-SC shall be able to authorize content providers to transmit data over MBMS bearer services depending on operator policy.
- The BM-SC shall be able to verify the integrity of data received from content providers.
- The BM-SC shall be able to generate charging records for content provider transmitted data.
- The BM-SC shall be able to provide service announcements for multicast and broadcast MBMS user services.
- The BM-SC shall be able to provide the UE with media descriptions specifying the media to be delivered as part of an MBMS user service (e.g. type of video and audio encoding).
- The BM-SC shall be able to provide the UE with MBMS session descriptions specifying the MBMS sessions to be delivered as part of an MBMS user service (e.g. multicast service identification, addressing, time of transmission, etc.)
- The BM-SC shall be able to deliver media and session descriptions by means of service announcements using IETF specified protocols over MBMS multicast and broadcast bearer services.
- The BM-SC should be able to accept content from external sources and transmit it using error resilient schemes (e.g. specialized MBMS codecs).

- The BM-SC might be used to schedule MBMS session transmissions, retrieve content from external sources and provide this content using MBMS bearer services.
- The BM-SC should be able to schedule MBMS session retransmissions, and label each MBMS session with an MBMS Session Identifier to allow the UE to distinguish the MBMS session retransmissions. These retransmissions are transparent to the RAN and MBMS user service.

UMTS Terminals

The following list identifies the most important User Equipment requirements [7]:

- The UE shall support functions for the activation/deactivation of the MBMS bearer service.
- Once a particular MBMS bearer service is activated, no further explicit user request is required to receive MBMS data although the user may be notified that data transfer is about to start.
- The UE shall support security functions as appropriate for MBMS.
- The UE should, depending on terminal capabilities, be able to receive MBMS user service announcements, paging information (non MBMS specific) or support simultaneous services (for example the user can originate or receive a call or send and receive messages whilst receiving MBMS video content). Reception of this paging or announcements may however, create losses in the MBMS data reception. The MBMS user service should be able to cope with such losses.
- Some UE depending upon terminal capability may be able to store MBMS data. This may involve DRM but this is out of scope of this document.
- The MBMS session identifier contained in the notification to the UE shall enable the UE to decide whether it needs to ignore the forthcoming transmission of MBMS session (e.g. because the UE has already received this MBMS session).

Other MBMS Related Components

The cell broadcast center (CBC) may be used to announce MBMS user services to the users.

The SGSN may use CAMEL (customized applications for mobile network enhanced logic) to handle prepaid services, e.g. credit checking for on-line charging.

The BM-SC might use OSA-SCS (open service access) to interact with third parties.

03. Functioning of MBMS

As the term Mobile Broadcast/Multicast System indicates, there are two types of service modes included in practical solutions: broadcast and multicast modes. They differ from each other as described in the following chapters. [3][8][9]

Broadcast Mode

The broadcast mode refers to a unidirectional point-to-multipoint type of transmission of multimedia data from a single source to all users that are found in a defined broadcast service area. The broadcast mode uses radio resources efficiently, since the data is transmitted over a common radio channel.

MBMS data transmission adapts to the most logical RAN capabilities, depending also on the availability of radio resources. If needed, the bit rate of MBMS data may be varied in order to optimize radio resources.

Figure 2 shows the basic principle of the broadcast mode of a MBMS network in order to broadcast several high data rate services within the defined broadcast service area via a packet switched (PS) core network.

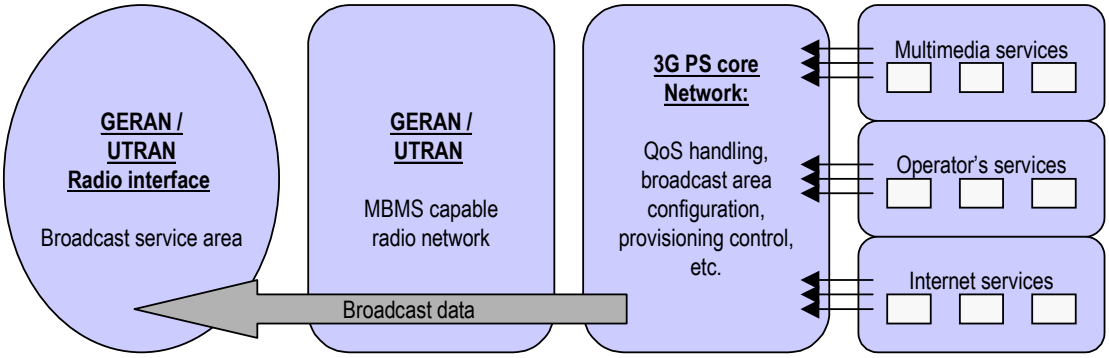

Figure 2. The basic principle of the MBMS broadcast mode.

The broadcast service may include one or several successive broadcast sessions. According to the specifications, a broadcast service might consist of a single on-going session as a media stream, or may involve several intermittent sessions (e.g. messages) over an extended period of time.

The broadcast mode is an enabler for the broadcasting of multimedia services. It differs, though, from the "traditional" messaging services of GSM or UMTS, being more versatile. Similarly as in cell broadcast functionality, users should be able to control the enabling or disabling of the MBMS broadcast mode service (e.g. the receiving of welcoming notes).

The broadcast mode cannot guarantee the error correction of the transmitted data by any means. Nevertheless, the terminal may be able to recognize data loss that occurs during reception.

Multicast Mode

The difference between broadcast and multicast modes is that the user does not need to subscribe in each broadcast service separately, whereas in multicast mode, the services can be ordered separately. The subscription and group joining for he multicast mode services could be done by the mobile network operator, the user him/herself or a separate service provider. The current understanding about the broadcast mode is that the services are not charged, whereas the multicast mode can provide services that are billed.

There are many similar requirements in multicast with the broadcast mode. As some examples, the multicast mode allows the unidirectional point-to-multipoint transmission of multimedia data within the multicast service area. The multicast mode uses radio resources in efficient way by using a common radio channel. Data is transmitted over the multicast service area as defined by the network. As a difference, multicast mode offers the possibility for the network to selectively transmit to those cells within the multicast service area that contain members of a multicast group.

A multicast service might consist of a single on-going session or may include several simultaneous multicast sessions over an extended period of time.

One of the examples of the multicast mode service could be sport event result information, which requires a subscription. Logically, the service could mean an extra charge for the subscriber, depending on the service provider's billing strategies.

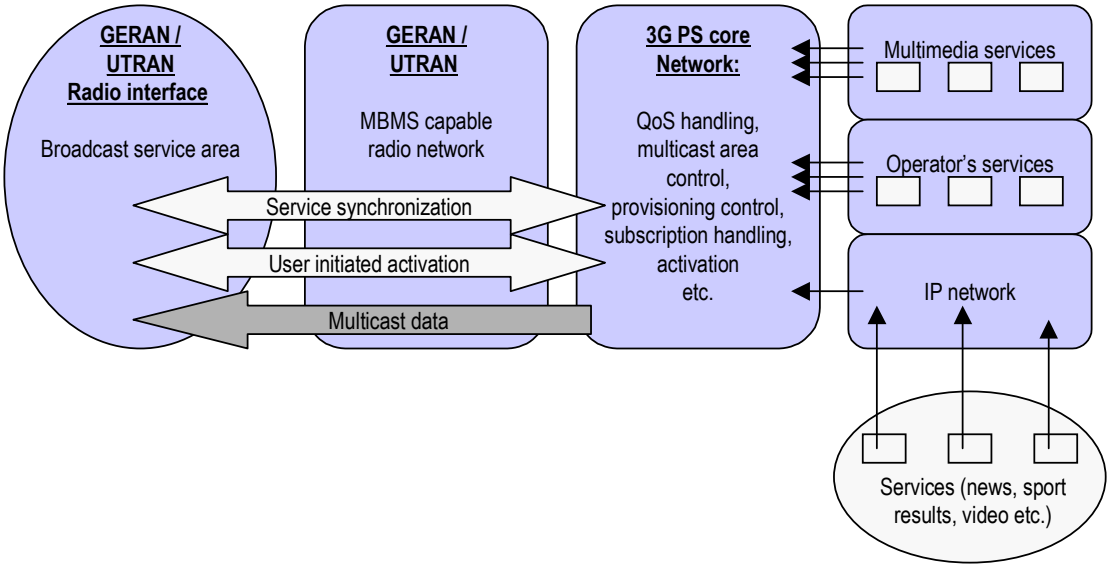

Figure 3. The principle of MBMS multicast mode.

As in broadcast mode, multicast services cannot be guaranteed over the radio network. Nevertheless, the reliable data transmission of applications and services can be enhanced using proper higher layer methods for protecting the data.

04. Services and Applications

MBMS can be used as an enabler for various data streaming services. In practice, MBMS can be used for any kind of services, regardless of the content, as long as the limitations of the data transmission (data rate, possible errors etc.) do not cause major problems to the quality of service. Compared to the "traditional" broadcast messaging solutions of e.g. GSM (cell broadcast, CB), MBMS provides a multimedia type of transferring method with relatively high data rates and considerably greater capacity than CB is capable of doing. Nevertheless, due to its characteristics, MBMS might not be an optimal solution for providing long-duration broadcasting streams, e.g. complete videos or television programs. Instead, DVB-H type of networks can handle the program type that needs constant streaming more efficiently.

The MBMS service scenarios can be divided into three main groups: streaming (continuous data flow), download (and play) and carousel. The latter one means the method to deliver contents repeating or updating the transmission of the data cyclically (comparable to the text television). [2]

Some of the identified applications for MBMS could be the following ones:

- News clips; the contents could be differentiated for separate news channels of MBMS areas (main news, sports results, economics etc.). The stream could be continuous, or it can be ordered separately. The service can be realized e.g. by the text distribution, picture delivery or low quality video.
- Audio stream; as MBMS is offering a method to broadcast data stream for the big audience, the traditional radio type of broadcast with stereophonic sound is also feasible. Via MBMS, the more specialized solutions can be realized, as music clips and important voice notifications. The audio clip could be delivered automatically ("the musical entertainment session of the week").
- Localized services; there might be e.g. a local tourist information channel offered via MBMS, showing the most important places, restaurants etc. as a continuous stream.
- Combined audio and picture / video clip services. This service applies to various applications. Some examples are the advertisements, interactive television voting (beauty contests) and real time betting.
- Video distribution services, either via streaming, carousel or downloads methods.

- Content distribution in general; e.g. downloading individual files, http, video, audio or combination of those. This can be used e.g. for the software updates of the user equipment.
- Game delivery; the games can be found in the main menu of the MBMS stream, and the game can be downloaded to the mobile. In order to charge the game, the separate interaction can be made, normally after the testing period of the game.

The charging of the multicast mode services could be carried out by basing on the events (similarly as normally done in multimedia messaging service), on the subscription (the duration of the usage of the service), and on the content (e.g. the transferred amount of data or the type of the service). Logically, the charging can be realized also as a combination of these methods.

As GSM and UMTS networks have been designed to handle the charging of the mobile services already, e.g. SMS (short message service) or GPRS (general packet radio service) data transmission can be used in order to subscribe and charge the services.

In order to secure the MBMS transmission, MBMS provides the authentication, key distribution and data protection for the multicast service. In addition to the normal security related processes of the mobile network, the functionality of MBMS security is stored in MB-SC or UE. MB-SC is responsible for generating and distributing the keys that are necessary for multicast security to the UEs and for applying the appropriate protection to data that is transmitted as part of a multicast service. The BM-SC also provides the MBMS bearer authorization for UEs attempting to establish multicast bearer. [10]

One of the important aspects in using MBMS services is to provide the means for the users to find the offered services. Service discovery includes, thus, the main menu of the available services, programs etc. (ESG, electronic services guide).

05. Role of MBMS

There are also other relevant services and systems that would suit to deliver the broadcast type of traffic to the great number of audience simultaneously.

DVB-H is an extension to the already existing DVB-T (as well as to DVB-S and DVB-C) definitions. Depending on the modulation, the DVB-H is capable of transferring around 5-11 Mb/s per carrier, which can be further divided to several sub-channels. The practical number of the broadcast channels could be e.g. 40-80, which provides the data rates of around 100-250 kb/s per sub-channel. [14]

There are also other examples of the broadcasting services in the mobile environment. One of the most concrete one is the Japanese ISDB-T (Terrestrial Integrated Services Digital Broadcasting), which can be used both to fixed and mobile reception. There are already prototypes of the hand-held terminals available in the markets since 2003.

The American version of the digital broadcasting system, ATSC (Advanced Television Systems Committee), is not considered very suitable for the mobile environment since the technical realization causes too much Doppler shifts in reception. There are ideas of extending the ATSC to the mobile environment presented, but the backwards compatibility is not a straightforward task with this technology. [13]

Also WLAN (Wireless Local Area Network) could be used as a solution for the local broadcasting purposes. One of the WLAN solution could be WiMax (IEEE 802.16a/e), although its development is still under construction.

06. Conclusions

Mobile broadcast type of services might be quite attractive for customers that already have adapted to the advantages of cellular systems. Not only the TV broadcast, but also a set of solutions could be delivered via IPDC networks, taking into account the limitations of data rates and QoS.

Even if there exist more and more enablers in the cellular environment, the important issue is to be able to provide meaningful and attractive services for customers. MBMS seems to be one of the enablers that could provide an interesting new tool for application developers in order to offer new methods for customers to be able to utilize efficiently information society services on the road.

As MBMS will not be reality until late 2007 and early 2008, i.e. the first terminals and services will appear by that time, there is still quite long time to wait. The first DVB-H networks might be seen already during 2006, but nevertheless, MBMS and DVB-H are not exclusive of each other, as they are optimal in different environments.

Terminal evolution will be seen nearer practical network solutions, but the general trend might be the development of sufficiently large displays. The Nokia 7700 represents a possible approach for DVB-H terminals, although the first prototype versions will be used only for testing and piloting purposes.

The other aspect to be considered will be the technical realization of the programs; as the terminal screen will be relatively small and the data stream will not exceed a couple of hundred of kb/s in practical solutions, the content might have to be modified specifically for the mobile environment. This means that the content will be edited from its original format to fit to the screen more efficiently.

References

[1] 3GPP TS 22.146. Multimedia Broadcast/Multicast Service (MBMS); Stage 1 (Release 6)

[2] 3GPP TS 22.246. Multimedia Broadcast/Multicast Service (MBMS) user services; Stage 1 (Release 6)

[3] 3GPP TS 23.246. Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description (Release 6)

[4] 3GPP TR 23.846. Multimedia Broadcast/Multicast Service (MBMS); Stage 2 (Release 6)

[5] 3GPP TS 25.346. Introduction of Multimedia Broadcast/Multicast Service (MBMS) in the Radio Access Network (Release 6)

[6] 3GPP TR 25.803. S-CCPCH performance for MBMS (Release 6)

[7] 3GPP TR 25.992. Multimedia Broadcast/Multicast Service (MBMS); UTRAN/GERAN requirements (Release 6)

[8] 3GPP TS 26.346. Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs (Release 6)

[9] 3GPP TR 29.846. Multimedia Broadcast/Multicast Service (MBMS); CN1 procedure description (Release 6)

[10] 3GPP TS 33.246. 3G Security; Security of Multimedia Broadcast/Multicast Service (Release 6)

[11] 3GPP TS 43.246. Multimedia Broadcast/Multicast Service (MBMS) in GERAN; Stage 2 (Release 6)

[12] IETF RFC 1112: "Host extensions for IP multicasting"

[13] Guide to the Use of the ATSC Digital TV Standard. Advanced Television Systems Committee, 4 Dec 2003.

[14] DVB-H Implementation Guidelines, draft version 0.0.7.

Definitions, acronyms and abbreviations

ATSC	Advanced Television Systems Committee
BM-SC	Broadcast / Multicast Service Center
BSC	Base Station Controller (GSM)
CAMEL	Customized Applications for Mobile network Enhanced Logic
CB	Cell Broadcast
CBC	Cell Broadcast Center
CBS	Cell Broadcast Service
CSE	Camel Server
DRM	Digital Rights Management
DVB-C	Digital Video Broadcast, Cable
DVB-H	Digital Video Broadcast, Handheld
DVB-S	Digital Video Broadcast, Satellite
DVB-T	Digital Video Broadcast, Terrestrial
EDGE	Enhanced Data rates for GSM Evolution
ESG	Electronic Services Guide
GGSN	Gateway GPRS Support Node
GERAN	GSM EDGE Radio Access Network
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HLR	Home Location Register
IPDC	IP Datacast
ISDB-T	Terrestrial Integrated Services Digital Broadcasting
MBMS	Multimedia Broadcast/Multicast Service
MS	Mobile Station (GSM)
PTP	Point-to-Point
PTM	Point-to-Multipoint
PS	Packet Switched
QoS	Quality of Service
OSA	Open Service Access
RAN	Radio Access Network
RAT	Radio Access Technology
SMS	Short Message Service
RNC	Radio Network Controller (UMTS)
SGSN	Serving GPRS Support Node
UE	User Equipment (UMTS)
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network
WiMax	World-wide interoperability for Microwave Access
WLAN	Wireless Local Area Network