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PP	Restricted to other programme participants (including the Commission Services)	
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1 INTRODUCTION

1.1 PROJECT SCOPE

The CHORIST project will propose solutions to increase rapidity and effectiveness of interventions following natural hazards and industrial accidents, in order to enhance citizens' safety and communications between rescue actors.

1.2 PURPOSE OF THE DOCUMENT

This document is to provide a study into the Multimedia Broadcast / Multicast Service (MBMS) and how this technology can be used as a communications bearer for dissemination of public warning messages.

In the CHORIST project MBMS will not be used in the demonstration, because there are currently no mobile phones commercially available that support MBMS and the service is commercial in mobile networks. Vodafone plans to hold first trials during 2008 in Spain and the available information will be incorporated to this document as soon as it becomes available.

1.3 DOCUMENT VERSIONS SHEET

Version	Date	Description, modifications, authors
1.0	27-06-08	Official release
1.0.3	10-04-08	Update of 3GPP releases of MBMS
1.0.2	19-10-07	Some comments added by VODAFONE
1.0.1	04-07-07	Initial draft by one2many

Table 1 : Document versions sheet

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2 REFERENCE DOCUMENTS

2.1 REFERENCE DOCUMENTS

- [1] 3GPP TS 22.146: "Multimedia Broadcast/Multicast Service; Stage 1".
- [2] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description".
- [3] 3GPP TR 22.968: "Study for requirements for a public warning system"
- [4] CHORIST deliverable SP3.D3: Communication network architecture (Content Casting Network) definition and requirements, including Message Creation and Dispatching requirements and the Open Interface specification.
- [5] 3GPP TS 32.273 Telecommunication management; Charging management; Multimedia Broadcast and Multicast Service (MBMS) charging
- [6] 3GPP TS 25.346 Introduction of the Multimedia Broadcast/Multicast Service (MBMS) in the Radio Access Network (RAN); Stage 2
- [7] 3GPP TS 33.246 3G Security; Security of Multimedia Broadcast/Multicast Service (MBMS)
- [8] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs"
- [9] 3GPP TS 22.168 V2.0 "Earthquake and Tsunami Warning System"
- [10] CHORIST meeting Report SP1.R53-V1.0
- [11] CHORIST meeting Report SP1.R52-V1.0
- [12] CHORIST deliverable SP1.D4-V1.2 Report on user requirements and initial supporting cases

2.2 DEFINITION

Broadcast communication	Information is sent to every user on a service area.
Multicast communication	Information is sent to those users who have been previously registered for that specific service
Public Warning System	It is a system that delivers information about natural hazards and industrial accidents in order to minimize its consequences.
Warning Notification Provider	It is an agency (e.g. Government, local government, public service organisations) that provides Warning Notifications and requests PLMN operators to deliver them.
Warning Notification	This is beforehand all-hazard (natural hazards, accidents, etc) information sent to users in order to prevent or deliver them information or instructions to be taken. This information may be delivered in different formats (e.g. Text, multimedia, images, etc).
SMS – CBS	Service to send SMS to multiple users which are geographically located within a coverage area.

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2.3 ABBREVIATION

3GPP	Third Generation Partnership Programme
BM-SC	Broadcast Multicast Service Centre
CB(S)	Cell Broadcast (Service)
CN	Core Network
EDGE	Enhanced Data rates for GSM Evolution
E-MBMS	Enhanced - Multimedia Broadcast Multicast Service
FEC	Forward Error Correction
FM	Frequency Modulated
GERAN	GSM/EDGE Radio Access Network
GSM	Global System for Mobile communications
GGSN	Gateway GPRS Support Node
HPLMN	Home PLMN
MBMS	Multimedia Broadcast / Multicast Service
OTA	Over The Air activation
PLMN	Public Land Mobile Network
PtP	Point to Point
PtM	Point to Multipoint
PWS	Public Warning system
QoS	Quality of Service
RNC	Radio Network Controller
SGSN	Service GPRS Support Node
SMS	Short Message System
TV	Television
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network

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3 MBMS

MBMS is specified by 3GPP in [1] and [2] in 3GPP Release 6, later modified in Release 7 and Release 8

The text in this chapter is partly based on a 3GPP study into PWS; both on the Technical Report [3] itself and the contributions that served as input for this study.

3.1 SUMMARY OF THE MBMS CAPABILITIES

MBMS is a unidirectional point-to-multipoint bearer service in which data is transmitted from a single source entity to multiple recipients. It may be implemented over GERAN and/or UTRAN.

Transmitting the same data to multiple recipients allows networks resources to be shared. MBMS architecture enables the efficient usage of radio-network and core-network resources, specially on the radio interface side.

MBMS feature is split into MBMS Bearer Service and MBMS User Service. MBMS User services can be built on top of MBMS Bearer Services.

The MBMS Bearer Service includes a Multicast and a Broadcast mode. One of the advantages of MBMS compared to actual UMTS service is the MBMS Bearer Service shares transmission resources in the core and radio network.

MBMS User Services offers two delivery methods: Streaming and Download. Depending on the application the former or the latter will suit better. Streaming service best fits for those applications with tight constraints related to the size and/or the time delivery. On the other hand, Download services are convenient for high quality applications or those which, due to its size, may be stored in the terminals and do allow certain delay before presenting the content.

In order to deploy MBMS on the current mobile networks (GERAN and UTRAN) it is necessary to add some new entities which provide new capabilities required for its deployment. Actually, the only new network entity required is the BM-SC. Moreover, the existing functional entities (GGSN, SGSN, UTRAN, GERAN and UE) are enhanced to provide the MBMS Bearer Service.

This is one of the strengths of MBMS compared to other point-to-multipoint systems. There is no need to develop a whole new network. In order to deal with MBMS few changes are required on the existing mobile infrastructures, in most of the cases those are software based solutions. This leads to became it into a cost effective solution compared to other alternative that would require to build up a new network.[REF]

There are three main modes of operation defined:

1. The **Broadcast mode**.

The broadcast mode is a unidirectional PtM transmission of multimedia data (e.g. text, audio, picture, video) from a single source entity to all users in a broadcast service area. The broadcast mode is intended to efficiently use radio access and core network resources, e.g. data is transmitted over a common radio channel. Data is transmitted in the broadcast service area as defined by the network (Home environment). However, when few users are attending to this service, it over uses the network and occupies a large amount of spectrum.

All content provided over the MBMS Broadcast bearers will be available to all MBMS capable handsets. Therefore, it brings simplification since no specific requirement to activate or subscribe to the service.

On the other hand it lacks in the sense of radio resources efficiency. It will broadcast in all cells regardless to the number of users, becoming it very inappropriate when few users are present.

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2. The **Multicast mode**.

The multicast mode allows the unidirectional PtM transmission of multimedia data (e.g. text, audio, picture, video) from a single source point to a multicast group in a multicast service area. The multicast mode is intended to efficiently use radio access and core network resources e.g. data is transmitted over a common radio channel.

It introduces in Release 7 a Counting mechanism which is used to estimate the number of users in a specific cell and this information is used to trigger a switch from a PtP to PtM bearer service in a per node basis.

Due to the user's subscription functionality the network can select which cells shall receive the MBMS content (i.e. where the interested users are). Those users shall belong to multicast groups which they have been previously subscribed to.

Compared to Broadcast mode, Multicast allows using radio resources in a more efficient way. Thus, if there are no interested users in a specific cell, no radio resources are consumed.

It is fair to mention that Multicast mode implies extra amount of signalling as well as extra delays compared to the Broadcast mode due to the 'Joining', 'Leaving' and 'Subscription' actions that must be carried out.

3. The **E-MBMS Broadcast mode**

It takes the benefits of MBMS Multicast from a radio point of view but it does not require the development of Multicast functions in the Core Network. To sum it up, this is Broadcast mode in the core and Multicast mode in the radio network. Thus it has the benefits of a more efficient use of radio resources with the implementation of Point-to-Point and Point-to-Multipoint bearer switching and UE counting. Moreover, it leads to a faster service activation and session switching times due to Signalling is reduced (i.e. some of the Multicast procedures are removed).

Among its strengths it can be highlighted the possibility to transmit multimedia data (e.g. Text, audio, picture, video) rather than just text as with other non-MBMS systems.

There are other broadcast services available. CBS is an existing broadcast service currently used for low bit rate services (messaging). However it does not allow multimedia delivery services, making it less attractive for users and operators. Furthermore Cell Broadcast messaging is not widely deployed today; most handsets do not include this capability and operators have not deployed this technology in their networks.

In addition to that, MBMS enable handsets to receive multiple radio links of common channels from different cells and to combine them. This technique is known as 'Combining' [6]. This method reduces the block error rate at the cell boundary and as a consequence, the cell capacity is increased since less transmission power is requested from the Nodes B.

Ciphering for MBMS multicast data is done between the BM-SC and the UE. Within MBMS point-to-multipoint data transmissions no radio interface ciphering is needed.

On Unicast each session has a separate connection. MBMS, as a point-to-multipoint system, enables a wider number of users at the same time. Actually, it can reach an unlimited number of users with constant network load.

It is fair to mention that, compared to other systems; it has the ability to send notifications regardless to the number of registered users within each cell.

The reception of MBMS must be activated locally in the terminals for both modes. In case of the MBMS Multicast mode, the terminals inform the network about the local reception activation of MBMS. MBMS offers up to 256kbps per MBMS bearer in UTRAN. The bearer capacity in GERAN depends on the actual network design. MBMS bearers may use up to 4 downlink timeslots per carrier.

The MBMS service layer offers a streaming and a download delivery method. Both methods can be used on MBMS Multicast and MBMS Broadcast mode. The MBMS streaming delivery method is intended for TV or

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FM-radio like of transmissions. The MBMS download delivery method is intended for download and play services. A number of files can be delivered during a single MBMS transmission session.

3.2 MBMS STATE OF THE ART

Multimedia Broadcast and Multicast Services (MBMS) is part of 3GPP release 6 and defines a toolbox for multicast and broadcast delivery over UTRAN and GERAN. The release was functionally frozen by Q4/2004.

The MBMS release 6 specifications for the broadcast mode can be reused for PWS with the addition of:

- Interface specification for the interface towards the Message Dispatcher. This specification need not necessarily be specified by 3GPP.
- Definition of the PWS service layer in the mobile terminals: The use of the MBMS service layer tools need to be defined. A specific behaviour of the terminals is required, when receiving a PWS message.

These two issues can be considered as an absolute minimum. The following section mentions other issues that require attention to make MBMS a truly useful communications bearer for PWS.

There are some updates in the MBMS standard over the time. New MBMS functionalities shall arise as new 3GPP releases come up.¹

3.2.1 New capabilities required for PWS

New capabilities of MBMS that should be considered for PWS could be classified as follows, based on PWS service aspects as listed in [3]

Priority

- Functionality that core network can determine preferred service of the subscriber
- Functionality to deliver warning information to the preferred service

Support of roaming subscribers

- Common definition of PWS message identifier on MBMS for cross border PWS services
- Default character encoding that the terminal supports

Congestion situation

- Priority control for PWS MBMS data

Enabling and disabling of PWS service

- Capability that core network can manipulate configuration information on the terminal
- User interface that can manipulate configuration of behaviour of the terminal
- Functionality to store the configuration
- Functionality to load and activate the configuration

¹ At the time that this document is written 3GPP is working on Release 7 and Release 8 (not released yet).

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- Functionality to utilize PWS identifier (type) in the roaming network
- Functionality to identify whether user device is in HPLMN or in a roaming network and change the configuration e.g. through OTA to set the configuration automatically for PWS on the roaming network and to reset it to the original configuration once back in the HPLMN.

3.2.2 Support of Pre-release 6 Handset Devices

MBMS based PWS requires MBMS capabilities in the handset devices. There is no MBMS support in pre-release 6 devices.

At this moment (spring 2008), MBMS capable devices are not commercially available but some sample sets are being issued to Mobile Operators for testing purposes.

3.3 HOW MBMS WORKS:

3.3.1 Multicast Mode:

MBMS Multicast service is enabled by a set of procedures. 'Subscription', 'Joining' and 'Leaving' phases are performed individually per user. The rest of the phases are performed for all users interested in a specific service. Some of them may run in parallel to other phases.

- Subscription.

This is the user's agreement to receive some MBMS service provided by any operator. This information is stored in the BM-SC.

- Service Announcement.

Within this phase a UE retrieves a set of available MBMS services (e.g. Mobile TV, news, Multimedia Downloads, etc) provided by an operator or an external authorized content provider. It gets not only the set of services but also their related parameters. They may contain a schedule of Session Start times before the services start.

There are different service announcement mechanisms: sending SMS' to advertise MBMS Multicast and Broadcast services (i.e. CB-SMS), MBMS Broadcast mode, PUSH mechanisms (WAP, MMS, SMS-PP), URL., etc. [8] for a more extended explanation about announcement.

It can be done anytime before or after Service announcement.

- Joining

This is a specific Multicast mode phase. Once a UE has been subscribed to a Multicast service, it is time to become a member of any Multicast group in order to receive MBMS Multicast data of a specific MBMS bearer service. A MBMS user service may be carried by more than one MBMS bearer service.

The user decides when to join a Multicast group regardless to when the Service Announcement was, so the period between Announcement and Joining may be very long or very short. Joining time may be randomised according to some Announcement parameters in order to avoid 'Joining' overloads.

- Session Start

It is the trigger for bearer resource establishment for MBMS data transfer. At this point the BM-SC is ready to send MBMS data. When an MBMS user service is carried by more than one MBMS bearer service, a Session Start message is sent for each MBMS bearer service. Actually, there are as much Session Start messages sent as MBMS bearer services are.

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- MBMS Notification

It advises UE about ongoing/forthcoming MBMS data transfers.

- Data Transfer

MBMS data is transferred to user terminals.

- Session Stop

At this phase bearer services are released. BM-SC determines that no more data will be sent for some period of time, long enough to justify removal of bearer resources associated with the session. Whether this idle period is not long enough, it may not be appropriate bringing more signalling and processing.

- Leaving

The subscriber does not want to belong to a specific multicast group so the subscriber deals with the end of a multicast group membership.

This phase is Multicast specific.

3.3.2 Broadcast Mode:

As the operation is concerned, the main difference between Multicast and Broadcast modes is that the latter one lacks on the 'Subscription', 'Joining' and 'Leaving' phases.

This makes the Broadcast mode lighter and faster than the Multicast one since there is no signalling associated to these remarked phases.

On the other hand there is not that much control and information about the user as in the Multicast case.

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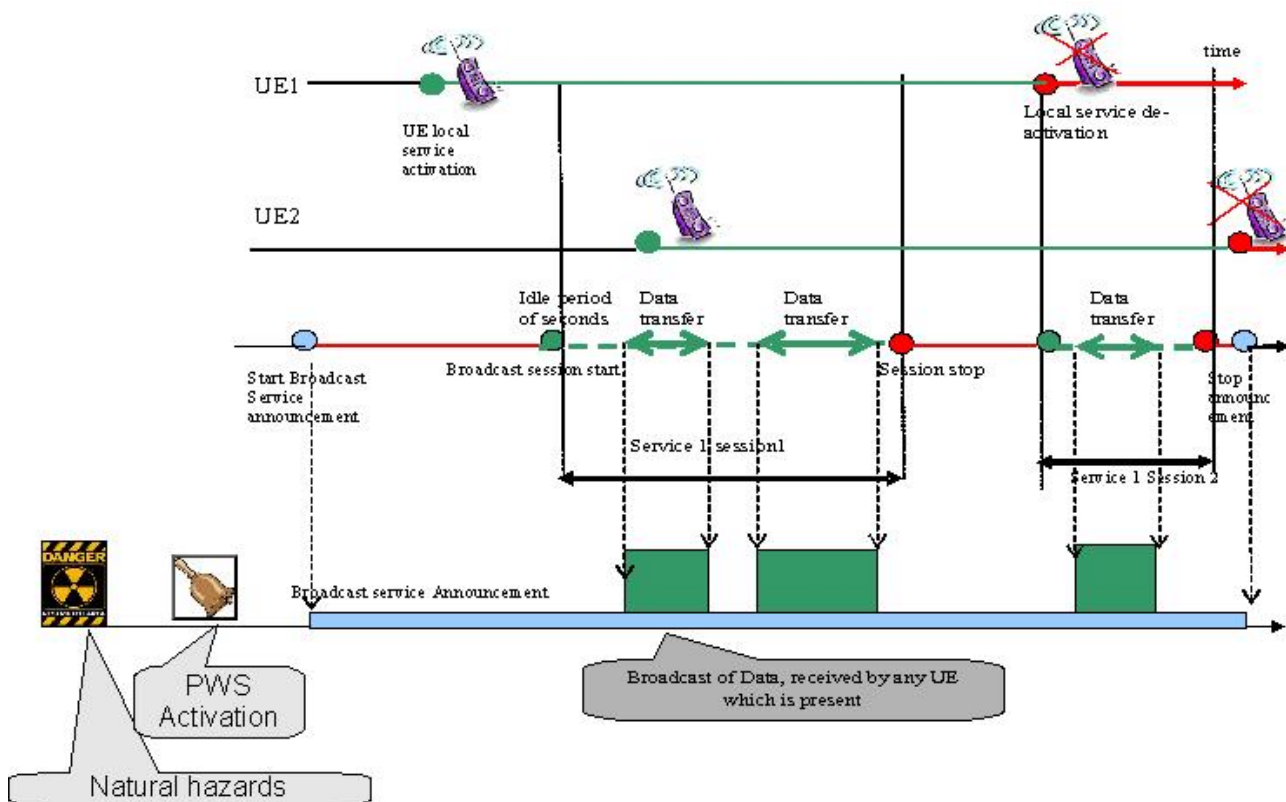


Figure 1: Broadcast Timeline (source: [2])

3.3.3 Enhanced MBMS Broadcast

As it was previously introduced, MBMS may perform on a Broadcast mode or Multicast mode.

Broadcast mode underperforms in radio aspects because it uses, regardless of the real needs, the same amount of resources. Thus, in situations where few users are available, it comes up with poor trade-off between resources required and service provided.

Multicast mode is interesting since it efficiently manages the radio resources, in terms of radio bearer resources, even in those scenarios where few users are present in a cell. However, despite of its spectral efficiency it adds a substantial signalling in the whole RNC, SGSN, GGSN, BMSC chain as well as among RNCs due to the phases 'Subscription', 'Joining' and 'Leaving' phases. As a consequence, this signalling leads to increase delays in the service.

E-MBMS Broadcast is the best meeting both the radio and core network efficiency requirements. E-MBMS deploys in the Core Network the Broadcast mode since it lacks some phases compared to the Multicast one. Signalling is simplified due to the removal of the Multicast 'Join' and 'Leave' procedures.

In the radio network it applies Multicast mode due to its radio resources efficiency.

Compared to the standard Broadcast implementation, it does not require any additional interface. It is fully 3GPP standardised since the ratification of the following MBMS 3GPP change requests CR 25346-680, CR 25413-6a0, CR 25423-6a0, CR 24008-6d0, CR 25331-6a0

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Enhanced-MBMS Broadcast has clear benefits over the Broadcast-alone and Multicast modes for scheduled broadcast-type Mobile TV. It is easy handling in BMSC. Moreover, it allows faster channel activation and switching times

Summarizing, this mode of operation is a fully standard, very efficient for the purposes of PWS, easier to implement than Multicast and fully interoperable with CN, RAN and Terminals of previous releases solution.

3.4 MBMS ATTRIBUTES

3.4.1 MBMS UE Context

It is created in the UE, SGSN, GGSN and BM-SC entities when the UE joins a MBMS bearer service. It contains UE-specific information related to a particular MBMS bearer service.

3.4.2 MBMS Bearer Context

It is created within each node involved in the delivery of MBMS data in the Radio Access Network. It contains all the information describing a particular MBMS bearer service. It is statically configured in the BM-SC 'Proxy and Transport' function previously remarked.

'Active' state means that bearer plane resources are required in the network. It holds on as long as there is a corresponding MBMS session ongoing. 'Standby' state reflects that no bearer plane resources have been allocated in the network since there is no MBMS session ongoing.

3.5 ARCHITECTURE

3.5.1 Radio Networks

There is a more efficient use of radio resources with the implementation of Point-to-Point and Point-to-Multipoint bearer switching and UE counting within the E-MBMS.

At the cell level, Counting determines the most optimal transfer mode: PtP or PtM depending on the received UE responses (e.g. more than 1 response means PtM bearer, otherwise PtP). Furthermore, it requires MBMS procedures for UE notification and handling UE responses.

Combining enables UE to receive multiple radio links of common channels from different cells and combine them. There are some procedures at the cell level in order to support Selective/Soft combining. In order to go through it, E-MBMS manages neighbouring cell list for implementation of soft combining and mobility.

UTRAN MBMS Architecture

As it has been previously remarked, MBMS may be deployed over GERAN and/or UTRAN networks (this section will focus on MBMS impact on UTRAN networks due to their larger impact in the future). Specific details about them are out of the scope of this document. In order to get a deeper understanding about how MBMS is implemented within UTRAN you can check [6].

In order to deal with UTRAN, communications are carried along through logical, transport and physical channels. Some MBMS specific channels come up due to MBMS:

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Logical channels:

- **MBMS Control Channel (MCCH):** It deals with the transmission of control plane information between network and UEs who have previously joined an MBMS service. It is always mapped to one specific FACH in the S-CCPCH. This channel broadcasts the MTCH configuration of the neighbouring cell(s) available for soft/selective combining.
- **MBMS Traffic Channel (MTCH):** This channel manages the transmission of user plane information between network and UEs who have previously joined an MBMS service. It is always mapped to one specific FACH in the S-CCPCH.
- **MBMS Scheduling Channel (MSCH):** It may be used for MBMS service transmission schedule between network and UEs. This is an optional channel. Due to different error requirements the MSCH is mapped to a different FACH than MTCH.

Physical channels:

- **MBMS Notification Indicator Channel (MICH):** This is the only new physical channel. It is used to notify all users subscribed to a specific MBMS service that some new information is to be transmitted on the MCCH during the next modification period.

3.5.2 Core Networks

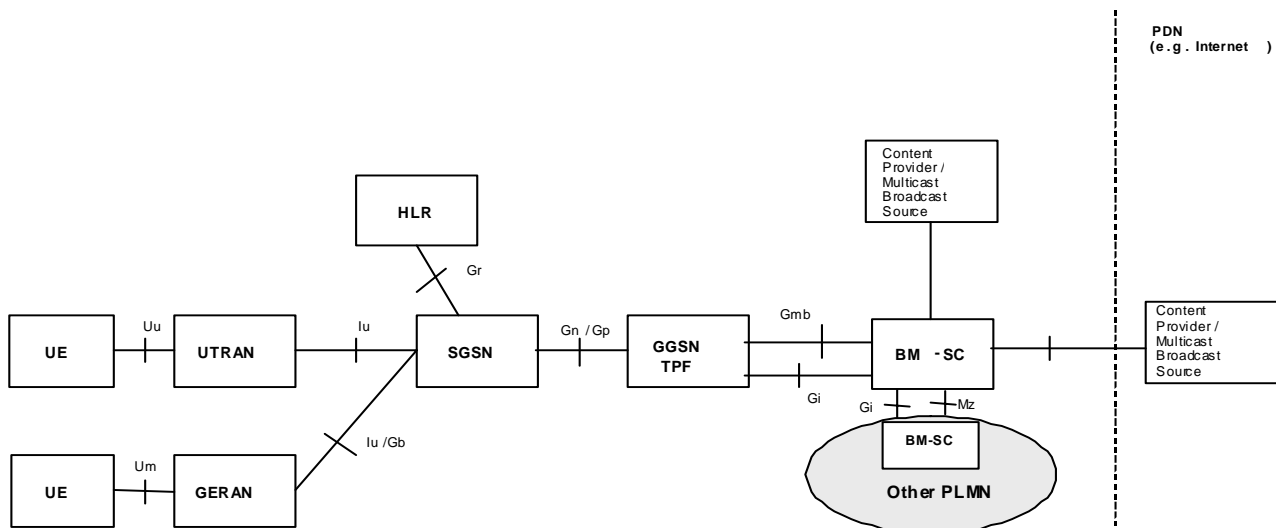


Figure 2: Architecture for support the MBMS bearer service (source: [2])

SGSN

It performs MBMS bearer service control functions for each individual UE and to provide MBMS transmissions to UTRAN /GERAN.

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Mobility procedures should be provided. This requires to store in the SGSN a user-specific MBMS UE context for each activated multicast MBMS bearer service and to move these contexts to the new SGSN during mobility procedures.

It shall indicate to UE its MBMS support as well as to be able to synchronise with UE so it knows which of the MBMS contexts are still active.

Moreover, it shall be able to generate charging data per multicast MBMS bearer service for each user (online charging is handled in the BM-SC).

It shall be able to establish Iu and Gn bearers shared by many users upon receiving a Session Start from GGSN. In the same way it shall be able to tear down these bearers upon instructions from the GGSN

Only requirements associated with the Start and Stop MBMS Contexts, as well as passing media content are required.

GGSN

This is an entry point for IP multicast traffic as MBMS data. Upon notification from the BM-SC, the GGSN shall be able to request the establishment of a bearer plane for a MBMS transmission as well as requesting to tear down media sessions.

It shall be able to receive MBMS specific IP multicast traffic and to route this data to the proper tunnels as part of the MBMS bearer service.

It provides features that support the MBMS bearer service that are not exclusive to MBMS

BMSC

This is an MBMS specific purpose entity, and one of the key ones in the MBMS architecture. It provides functions for MBMS User Service provisioning, scheduling and delivery. It may serve as an entry point for authorised MBMS content provider. It is able to carry on the next functions:

- Membership:

It provides authorization for UEs requesting to activate an MBMS service. It may or may not have Subscription data depending on whether it belongs to a Broadcast (it does not) or Multicast (it does) mode.

This is an MBMS service level function but it may also provide User service level (e.g. membership management).

It may generate Charging records.

- Session and Transmission

Its aim is to schedule MBMS session transmissions and label each MBMS session with an MBMS Session Identifier to allow UE to distinguish them. Transmissions and subsequent retransmissions of a specific MBMS session share a common MBMS Session Identifier. They are as well in the MBMS Session Start Request message.

It provides the GGSN transport associated parameters (e.g. QoS, MBMS service area, etc).

It shall be able to initiate and terminate MBMS bearer resources before and after transmission of MBMS data.

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It should be able to send MBMS data as well as apply Error Correction mechanisms.

It should be able to authenticate and authorized external sources

- Proxy and Transport

This is a MBMS bearer service function. It may act as an intermediate device for the MBMS data sent from the BM-SC 'Session and Transmission' function to the GGSN. The Proxy function manages the control plane, handling the signalling between GGSNs and other BM-SC. The Transport function deals with the multicast payload.

It may generate charging records regarding to the transmitted data.

- Service Announcement

This is an MBMS User service function. It provides the UE with MBMS session descriptions specifying the MBMS sessions to be delivered as part of tan MBMS user service (e.g. multicast service identification, addressing, time of transmission, etc.).

Furthermore it provides the UE with media descriptions specifying the media to be delivered (e.g. type of video and audio encodings).

Even though they may be triggered by the BM-SC, they are not necessarily sent by this entity. As it was previously remarked, announcements may be sent by different methods (e.g. PUSH mechanisms, URL, PtP SMS, SMS-CB, etc.).

- Security

The goal is to achieve integrity and/or confidentiality protection of MBMS data. In order to authorise UEs, this function is used for distributing MBMS keys. Extra information may be found in [7].

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4 MBMS ECOSYSTEM

4.1 ACTORS

In order to develop and deploy a Warning System, it is necessary to reach an agreement between some actors that must be coordinated. These actors are network operators, service providers, terminal, and network manufacturers. Actually, the decision to implement a WS must be taken between operators and national/international regulators.

The notification procedure can be described as follows. Some sort of disaster comes up. It is detected by the Warning Notification Provider (e.g. Local government). At this stage, the notification may be forwarded to some superior organisation which belongs to the Warning Notification Provider (e.g. National government). The Warning Notification Provider may be able to select the specific area where the warning must be delivered through the PLMN. This notification shall be delivered to UEs regardless to their status.

Different sort of notifications may be created and delivered depending on the location. For instance, the most damaged / threatened areas may receive a content specific notification alerting users to start evacuation as soon as possible. Afterwards, areas in the boundary are warned with a different kind of notification and so on and so forth.

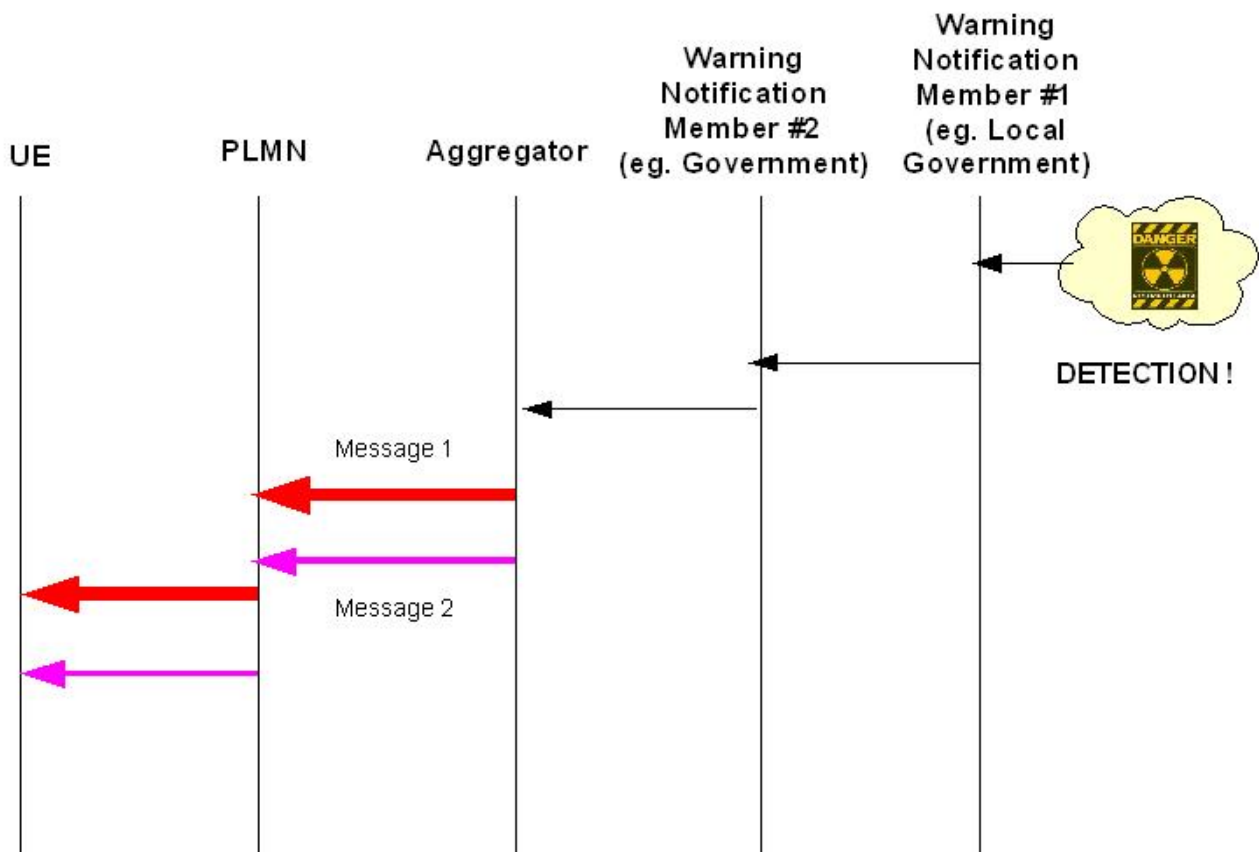


Figure 3: Actors coordination

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4.2 REQUIREMENTS

As the requirements are concerned, some data about them have been gathered from the reports written by CHORIST partners.

The Metropolitan Police Service in London was visited in order to get a snapshot about how they deal with risk management. The general idea was that there is an effort to adopt cutting edge technology (e.g. image-based information) in order to provide to the public the more information possible. They seem to be unwilling to process raw data from environmental sensors. There was an interest on CBS although there was not a large knowledge about it. Risk assessment is not software managed but human decision based. They crave for visual data since they allow a quick assessment (sometimes they even get these images from Police and/or News helicopters or CCTV) [10].

Cleveland Police Control Room has been visited as well. Regarding to this visit, valuable recommendations were pointed out in [11]. Let us highlight some aspects that they would be willing to adopt within an improved Warning System would be: friendly user interface, integrity of multiple information sources like and good visual display integrated.

Citizens would expect a system that shall provide services across local, regional, national and international levels. It would be appropriate that self-configuration was considered: installation and configuration should require as less technical skills and human intervention as possible. Moreover, as it was previously remarked, authorities should be able to generate minor changes/updates in the system with no need to request a third party. The main information exchanges in the system shall use international standards.

Requirements from citizens and authorities are further detailed in [12], Chapters 6 and 7. They have been taken into consideration when producing the following sections.

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5 MBMS AS A PWS TECHNOLOGY

The MBMS broadcast mode fulfills the localization requirements of a public warning system. Using this MBMS broadcast mode, a PWS transmission is sent only in the defined broadcast area for the given session.

A reception reporting procedure is available for all MBMS delivery methods, which includes the user.

A generic PWS architecture is depicted in Figure 4. The authorized agencies are connected to PLMN via a PWS gateway. The task of the PWS gateway is to translate the PWS message into MBMS specific format and protects the PWS distribution channel against un-authorized usage. Furthermore, the PWS gateway supports the authorized agencies to define the transmission area for PWS message.

In a CHORIST environment the content would not be delivered by "authorized bodies" as depicted in **Erreur ! Source du renvoi introuvable.**, but by the Message Dispatcher [4].

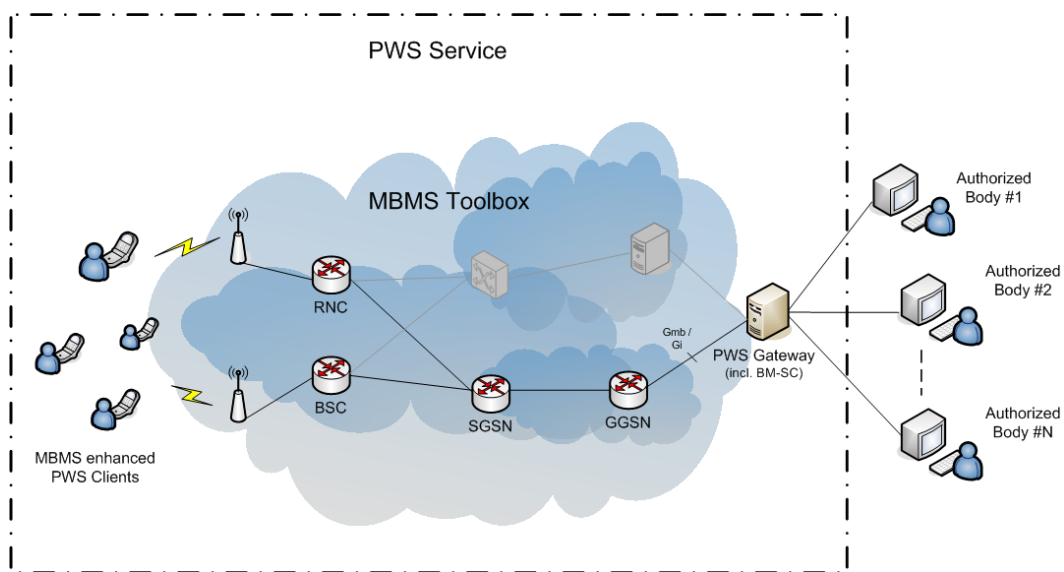


Figure 4: MBMS based public warning system (after internal Vodafone documentation)

The 3GPP study for requirements of a PWS lists a number of aspects that should be considered when defining requirements in a PWS stage 1 specification. This stage 1 work is still to be done by 3GPP and may not become available anymore in 2007. These aspects are as follows:

Duration of delivery time

MBMS requires one more step than CBS to initiate data transmission when the mobile device is in idle state, so delivery time over MBMS would be a few milliseconds longer than CBS.

Granularity of the distribution

The granularity of the broadcast area coincides with granularity of cell sites.

Information element and volume

There is no volume limitation on the delivered information in MBMS.

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Currently there is no specification which specifies behaviour of the mobile device after reception of the warning notification.

User Interface

The capability for the subscriber to configure the behaviour of a terminal when having an ongoing communication is not defined. Currently it depends on the implementation of the application. The following should be considered:

- User interface where the configuration for the behavior of the terminal can be set.
- Functionality to store that configuration.
- Functionality to load and activate that configuration.

There's no specification for the user operation when a warning notification is received. An example can for instance be that the acoustic/ visual signal can be suppressed by users' manual operation (e.g. by pushing keys). It depends on the implementation on the terminal what the behaviour is. The following should be considered for support on the user interface:

- User interface for controlling the configuration of terminal behavior
- Functionality to store that configuration
- Functionality to load and activate that configuration

It is possible to suppress duplicate notifications received later after the user suppressed the signal by manual operation.

There's no specification regarding the storage of received warning notifications and accessing them at a later time. It depends on implementation of application on the terminal how this is handled.

The followings should be considered:

- User interface that can configure configuration of behavior of the terminal.
- Functionality to store that configuration.
- Functionality to load and reflect that configuration.

Priority

There is a specification for the quality of service. However there is no priority control between MBMS PWS and normal MBMS.

The following should be considered:

- Functionality that the core network can identify preferred service of a subscriber
- Functionality to deliver warning information to the preferred service

Security

A data spoofing prevention and data integrity aspect that could be considered:

- Key distribution

The interface between the PWS gateway and the Message Dispatcher, including security related items, is not specified.

Authentication, key distribution and data protection are necessary to be provided. Nearly all the security functionality is in the Terminal (UE) or the BM-SC, except for the normal network bearer

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security. BM-SC is responsible for generating and distributing the keys necessary for MBMS security to the Terminal as well as providing appropriated protection to data.

The Terminals are authenticated and authorised so only legitimate users would be able to join MBMS services. They have the ability to request keys whenever they need them in order to successfully decrypt the data. This request may be initiated by either Terminals or the BM-SC

The keys used within the MBMS service are periodically updated in order to avoid unauthorized use and delivery of keys.

Prevent spoofing Warning Notifications.

Protect integrity Warning Notifications.

Ability to authenticate Warning Notification sources.

More information about Security is available in [7].

Support of roaming subscribers

The core network specifies the area where the MBMS message is to be distributed. However it depends on terminal settings whether the message is displayed or not. A common definition of a PWS message identifier on MBMS is needed, especially for roaming purposes. The message identifier will be set in search list on the terminal.

Definitions exist in the standard specifications. However, definitions about the default character encoding that the terminal should support is not specified.

It is initially considered that MBMS roaming would not be available, at least during the first stage.

Support in legacy handsets

Legacy handsets handle the warning notification in the same way as other normal messages. Therefore PWS functionalities are limited.

Support of Warning Notification Sources

Basic MBMS Session Start Procedure and an MBMS Session Stop Procedure enables start and stop of warning information distribution. The basic functionality to support the Message Dispatcher is available in MBMS.

Terminal aspects

A mode to save the battery exists: scheduling using DRX. Pre-configured handsets in order to be able to receive MBMS information in an feasible way.

Subscription & Charging Aspects

It is possible to send MBMS messages free of charge to the recipient subscriber and charge the sender. It shall be possible for the PLMN operators to bill the Warning Notification Provider. Extra information about how to deal with Charging can be checked out in [5].

Delivery & Receipt Confirmation Aspects

Acknowledgements can be sent to the network in MBMS multicast mode. This is not possible in MBMS broadcast mode. However, repeating messages also increases the likelihood of a successful reception.

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Congestion situation

MBMS specifies traffic classes (i.e. background and streaming class). However, network congestion has a bad effect on the duration time of information delivery. The combination of traffic class and Allocation/Retention Priority (ARP) will satisfy the requirement.

Enabling and disabling of PWS service

The network distributes MBMS messages per specified area, not per user, so it is currently impossible to enable/disable the functionality on a per user basis.

To satisfy the requirement, two possible ways exist:

- Subscribers activate/deactivate PWS by specifying a message identifier allocated to PWS (Provided that a definition of message identifiers for PWS on MBMS exist). By defining special message identifiers that forces a terminal to receive the message information may also be effective.
- Capability that the core network can modify configuration information on the terminal.

Turning on/off the PWS functionality could be done. Activation/Deactivation on message ID basis is also possible. The following should be supported:

- User interface provides the possibility to configure the behaviour of the terminal
- Functionality to store the configuration
- Functionality to load and activate the configuration.

When roaming, PWS identifier (type) should also be available in the roaming network.

All subscribers can receive a warning notification with broadcast service mode. However HPLMN can not enforce on each terminal the required configuration, i.e. whether to receive the warning notification. Functionality to identify whether the terminal is in HPLMN or in a roaming network and activate the configuration for each situation would be required.

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6 CONCLUSIONS

MBMS is a very suitable technology for PWS. Its ability to reach a large amount of audience in an efficient way makes it a good solution fulfilling the most important user requirement. MBMS presents two main configurations, Multicast and Broadcast modes. In order to get a more efficient usage it is possible to use the recently defined Enhanced mode which takes the best from both modes. This Enhanced version uses the most efficient mode in each part of the network: Multicast mode in the RAN in order to use radio resources in an efficient way and Broadcast mode in the Core network so signalling remains lower than in the Multicast mode.

Furthermore, as it was previously remarked, MBMS can deliver multimedia information besides pure text, increasing the quality of information that can be delivered to the UE.

Time delay is a main constraint in PWS. Do remain that the shorter it takes since the emergency comes up until UEs receive the notification, the more efficient the PWS will become. Compared to other PtP PWS, MBMS shall save up very valuable time.

In terms of costs the MBMS architecture becomes a very interesting solution because it just needs one new entity (the BM-SC) and software updates in current mobile networks. This would get them more affordable than dedicated PWS infrastructures starting from scratch.

The main disadvantage for MBMS is the lack of installed base of UE, because current handsets do not includes support for this feature. The replacement ratio of devices by the users is below 18 months in Western Europe, therefore MBMS as a PWS technology looks promising in the mid-term.