

Displaying Cell Broadcast Messages

Alert Notifications in Public Warning Systems

Abstract—This paper discusses how a mobile device may display Cell Broadcast messages based on the parameters that two 3GPP specifications provide. A standard for displaying of Cell Broadcast messages does not exist today, which leads to different implementations by mobile device vendors, which ultimately results in a service that is not easy to configure and use by the subscriber. However, consistent behaviour becomes relevant now that Cell Broadcast is being introduced in Public Warning Systems in many countries across the world.

Introduction

This paper explains one2many’s view on how a Cell Broadcast (CB) message shall be displayed on a mobile device, based on the parameters that are defined in 3GPP specifications 3GPP TS 23.038, “Alphabets and language-specific information” [1] and 3GPP TS 23.041 “Technical realization of Cell Broadcast Service (CBS)” [2].

Currently no standards exist for implementation of services on mobile devices. This is generally left to the mobile device vendors. The success of a service such as SMS text messaging has led to a de facto standard for the implementation of this service on the mobile device. CB has not yet reached this stage. This paper intends to propose a standard implementation for CB on the mobile device, which gains relevance now that CB is more and more being deployed in Public Warning Systems across the world.

The way a mobile device displays a CB message is determined by three parameters

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in the CB message that is received by the mobile device:

- Serial Number
- Data Coding Scheme (DCS)
- Message Identifier

The significance and usage of each of these parameters for displaying CB messages is discussed in the next sections of this paper, followed by a discussion on support of multiple languages and configuration of the service through a user menu.

Serial Number

The Serial Number is defined in 3GPP TS 23.041 [2] as follows: A Serial Number (see Figure 1) is a two-octet parameter which consists of three parts:

- A 2-bit Geoscope
- A 10-bit Message Code
- A 4-bit Update Number

Octet 1		Octet 2	
Bits 7 - 6	5 - 0	7 - 4	3 - 0
Geoscope	Message Code		Update Number

Figure 1: Serial number

The Serial Number identifies a particular CB message and is altered every time the CB message with a given Message Identifier is changed.

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Geoscope

The Geoscope consists of two bits only. The value of Geoscope = 0 indicates a Geoscope of cell-wide validity and immediate display.

Cell-wide validity means that the message is unique in the cell that broadcasts the message. If a mobile device receives a repetition of this message in the same cell, then the mobile device shall not display the message again if the message was displayed earlier.

Messages are generally repeated for a number of reasons. The mobile device may enter the area where the message is being broadcasted some time after the message has started broadcasting. Secondly, the mobile device doesn't receive CB messages when it is engaged in a voice call or the mobile device was in an area with bad coverage, such as an elevator.

Uniqueness of a message is not only determined by the Geoscope, but in fact by the entire Serial Number in combination with the Message Identifier. (Use of the Extended Channel is not considered in this paper.) If a message is received with a particular Message Identifier and a particular Serial Number and the Geoscope is cell-wide, then this message is different from a message that is broadcasted in another cell with that same Serial Number and that same Message Identifier. After all, the validity is only cell-wide.

If the Geoscope would be PLMN-wide (Geoscope value = 1), then a message with a particular Serial Number and a particular Message Identifier is unique in the entire network. When such a message is received in another cell, then the message shall not be treated as new, and shall not be displayed again.

A consequence of cell-wide validity is that when a mobile device has done a handover to another cell, then a message with Geoscope cell-wide shall be removed from the screen. After all, it had only cell-wide validity.

A Geoscope value = 0 also indicates Immediate Display. This Immediate Display mode has priority over any display mode that is indicated by the DCS, which is specified as such in 3GPP TS 23.041 [2] from release 10 onwards. The 3GPP TS 23.041 [2] states that immediate display means that the message is supposed to be on the display all the time, but this is only indicative of its intended use, without indicating a mandatory requirement or constraining the detailed implementation by mobile device manufacturers.

Since a message with Immediate Display mode is supposed to stay on the screen all the time it is proposed in this paper that such a message shall be displayed on the screen on a single line, without any user notification (no beep, no buzzer). If the message is too long to be displayed on a single line, it shall scroll automatically at a speed that can easily be followed by users. It shall not be possible for the user to remove the message from the screen.

A typical use case for such a message is location information or dynamic discount information for which the proposed display mode is already common practice. The message is often truncated if it is longer than a single line, so no scrolling is needed. The Message Identifier for location information and dynamic discount information is typically 50. Mobile devices often display any message with Message Identifier = 50 as described above. However, the display mode shouldn't be

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dependent on the Message Identifier, but on the Geoscope.

Update Number

The Update Number is a four bit number, which indicates an update to a previous message. There can only be one update active at any time. Previous messages are no longer broadcasted.

When the mobile device receives an update message it shall replace a previous message in the mobile device. The user shall not be confused with (warning) information that is no longer relevant. Messages that are stored in memory by the user shall not be replaced.

Message Code

The Message Code is a 10 bit number and is used to distinguish a message from other messages with the same Message Identifier. Distinguishing one message from another also depends on the Geoscope. If the Geoscope is cell wide, the messages need to be unique when broadcasted from the same cell. When the Geoscope is PLMN wide (Geoscope value = 1), messages need to be unique in the entire network.

A Geoscope of Location Area wide in 2G and Service Area wide in 3G (Geoscope value = 2) seems irrelevant since the 3GPP TS 23.041 [2] specification states that for CB a Service Area always consists of one cell: in 3G there is no practical difference between Cell wide and Service area wide validity.

A Geoscope value = 3 indicates cell wide validity, but the display mode is not Immediate (as with Geoscope value = 0), but Normal and is determined by the DCS. In the case of Earthquake and Tsunami Warning System (ETWS) messages, as are currently used in Japan, the two most significant bits of the Message Code have a

different meaning. However, ETWS is not considered in this paper.

Data Coding Scheme

If the Geoscope has another value than 0, then the display mode is determined by the DCS. The DCS is defined in 3GPP TS 23.038 [1].

The display mode can be divided into classes:

- Class 0
- Class 1
- Class 2
- Class 3

Class 0

The 3GPP TS 23.038 [1] states that a class 0 message shall be displayed immediately without providing any details as to what this means.

In this paper it is proposed that a class 0 message shall be displayed immediately on the entire screen without user intervention but with a notification (sound and buzzer, if this is configured). If the message is too long to be displayed on a single screen, it shall be possible to scroll up and down through the message.

Class 0 messages are typically required in Public Warning Services (see J-STD-100 [3], and ETSI TS 102 900 [4]). Generally, it shall be possible for the user to remove such messages from the screen, and store and delete such messages.

Class 1

The 3GPP TS 23.038 [1] states that displaying of a class 1 message is mobile device specific. However, class 1 is also used in the SMS text service and for this service a de facto standard exists because of the popularity of the service.

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In this paper the same behaviour is proposed for class 1 messages, regardless if they are received via SMS or via CB.

Reception of a class 1 message is indicated to the user with a notification (sound and buzzer, if this is configured), and the user may click a key to open the message for reading. If the message is too long, it shall be possible to scroll up and down through the message.

Generally, it shall be possible for the user to remove such messages from the screen, and store and delete such messages.

Note that both class 0 type messages as well as messages with Geoscope 0 are called “Immediately Display” messages in 3GPP specifications 3GPP TS 23.038 [1] and 3GPP TS 23.041 [2] respectively, even though the display behaviour is quite different.

Class 2

Class 2 messages are directed to a (U)SIM application and are not displayed directly on the screen.

Class 3

Class 3 messages are directed at Terminal Equipment that is attached to the mobile device, and are not displayed directly on the screen.

Message Identifier

The Message Identifier indicates the message type and source.

In case the Message Identifier indicates that the message is a Public Warning Service (PWS) message, then the notification (sound and buzzer) shall be specific for PWS (see J-STD-100 [3], and ETSI TS 102 900 [4]). The specific sound and buzzer cadence may depend on regulatory requirements.

Message Identifiers for PWS use are defined in 3GPP TS 23.041 [2] and are all in the range of 4352 – 6399 (decimal). The PWS specific notification could (and perhaps ‘should’) have been defined by the DCS, that has ample reserved values for this purpose, because the DCS determines the (audible and visual) display mode, but 3GPP has chosen to link this notification to a range of Message Identifiers. However, PWS messages are required to be displayed on the screen as class 0 messages, and could do so, independently of the DCS value.

Display modes summarized

This section summarizes the display modes and the parameters that determine the display mode.

If Geoscope = 0, then the display mode is Immediate and the message shall be displayed on a single line without user notification and without any option to remove the message from the screen.

If the Geoscope != 0 then the display mode is determined by the DCS.

If the DCS indicates that the message is a class 0 message, then the message shall be displayed across the entire screen with a notification and without the need for user intervention.

If the DCS indicates that the message is a class 1 message, then reception of the message shall be indicated to the user with a notification. After the user has clicked a key, the message shall be displayed across the entire screen.

Languages

CB messages and Public Warning messages in particular, may need to be broadcasted in

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multiple languages. There are two ways languages can be supported in CB:

- Message Identifier
- Data Coding Scheme

In case the Message Identifier is used, each language is allocated to a specific Message Identifier, and in case the DCS is used, each language is allocated to a specific DCS value, but would use the same Message Identifier.

3GPP TS 23.038 [1] has assigned the DCS values 0–15 and 32-36 to 21 languages. Unspecified however, is the display behaviour for these values of the Message Identifiers. Class indications all have Message Identifier values of 64 or higher. DCS values 16 and 17 define messages with a language indicator. The first 3 characters of the message are a two-character representation of the language encoded according to ISO 639 [5], followed by a CR character. The CR character is then followed by 90 characters of text in the case the message is encoded with the default GSM 7 bit alphabet (DCs value = 16). In case the message is UCS-2 encoded the message starts with a two GSM 7-bit default alphabet character representation of the language encoded according to ISO 639 [5]. This is padded to the octet boundary with two bits set to 0 and then followed by 40 characters of UCS2-encoded message. DCS values in the range of 144-159 define messages that use a Data Header Structure. The Data Header occupies the first three characters of the message body to indicate the language, and also allows for class indications.

The mobile device could have a language filter which contains a list of preferred languages, which is configured by the user. In case the language as indicated in the

DCS or in the Data Header is not contained in this list, the message would not be displayed.

Neither CMAS, nor EU-Alert has defined the method to support multiple languages today.

Menu structure

CB in general, Message Identifiers in particular, and possibly also languages of preference, shall be managed from a menu in the mobile device. It is proposed in this paper to handle CB messages similarly to SMS text messages. In fact CB messages are also text messages; only the way these messages are sent to the mobile device differs: CB is a broadcast service, and SMS text messaging is a point-to-point service, but on the mobile device both are text messages with a similar presentation. Therefore CB messages and SMS text messages should be managed similarly in the same menu. In today's mobile devices CB is often hidden as a setting or option in the messages menu or in another menu. Mobile device vendors are now developing applications to support regional public warning services CMAS and EU-Alert (see [4] for more details). The CMAS "Mobile Device Behaviour" specification, J-STD-100 [3], suggests a menu structure to opt-in to various levels of alert messages. EU-Alert is quite compatible with CMAS and a similar menu structure is applicable to EU-Alert as well.

Mobile operators around the world are looking into offering public warning services, or are even deploying such services on request of their government. Once the Cell Broadcast infrastructure is available, the operator may want to use the infrastructure for commercial services too

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in order to redeem their investment in the infrastructure.

Mobile device vendors are now developing applications to make the discovering of available public warning services easy for the user, but discovering which CB services are offered besides public warning services remains the same as it always has been: fairly difficult.

Yet, the 3GPP TS 23.041 [2] specification offers a very versatile mechanism to display available services: the Index message. The Index message is a specially formatted message with a fixed Serial Number (1010101010b) and a fixed Message Identifier (MI=0).

Through the formatting options it is possible to display the message as a tree with services announced on each line. An example of what could be shown on the display is as follows:

CMAS
■ Presidential alerts
□ Extreme alerts
□ Severe alerts
□ AMBER alerts
Buy and Sell
□ Selling cars
□ Selling cell phones
□ Buy tickets for events
Dating
□ He wants to meet her
□ She wants to meet him

The Index feature allows scrolling up and down the list, and to select or deselect the topics of interest. The Message Identifiers of the selected topics are entered into the search list of the mobile device and when a message is received with a Message Identifier that is in the search list, the message will be displayed. Note that the Message Identifiers themselves are not

displayed and users do not need to be aware of them.

The topics under Buy and Sell and under Dating are examples of commercial services.

Discovering the CMAS service and the commercial services is achieved in a user-friendly manner, using existing capabilities in 3GPP specifications, and without the need to develop a special application for CMAS.

Conclusion

This paper shows that it is quite possible to standardize the way CB messages can be displayed on a mobile device, based on the possibilities that existing 3GPP specifications provide. This should result in a consistent behaviour of configuring and displaying CB messages on mobile devices, much like today's behaviour for SMS text messages for which also no formal standard exists. Citizens that need to rely on the information provided to them in a Public Warning message would greatly benefit from consistent behaviour.

References

- [1] 3GPP TS 23.038, "Alphabets and language-specific information", 3GPP, chapter 5.
- [2] 3GPP TS 23.041 "Technical realization of Cell Broadcast Service (CBS)", 3GPP, section 9.4.1.2.1.
- [3] J-STD-100, "Mobile Device Behaviour Specification", ATIS-TIA, 2009
- [4] ETSI TS 102 900, "EU-Alert using the Cell Broadcast Service", ETSI, 2010
- [5] ISO 639: "Code for the representation of names of languages"