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CELL BROADCAST IN IS95 CDMA, FOR LOW COST WARN ACT COMPLIANCE

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Warn Act

President George W Bush, in August 2007, issued an Executive Order calling for the development of an Integrated Public Alert Warning System incorporating all media. Shortly thereafter Congress passed The Warn Act which required the formation of the CMSAAC (Commercial Mobile Service Advisory Alert Committee) which had the mandate to submit recommendations to the Federal Communications Commission for adopting the rules for a wireless provider to qualify as CMAS (Commercial Mobile Alert Service) compliant. In its initial rule making in March, 2008 the FCC adopted provisions defining the criteria for an emergency alert to qualify as CMAS compliant. These criteria included: mass scalability, geo-targeting, secure, and timely. The rulings required that by September 2008 every FCC licensed carrier notify the FCC as to its intention to offer CMAS compliant messages to their subscribers. The consequences of opting out of this include requiring the carrier to notify its subscribers and potential customers of the decision to not provide CMAS services. This makes it optional for mobile networks to participate in warning and informing the public, particularly during periods of national emergency. Networks also must declare by September '08 the conditions under which they will provide emergency warning.

The WARN act did not specify which bearer service the network must use, but following consultation with the industry, the FCC report and order did recommend that SMS texting was inappropriate due to several deficiencies, and that a "Point to Multipoint" bearer would be more effective .

The obvious reason for point to multipoint is scale. A carrier may be asked to reach tens of millions of subscribers with a short text message, in two minutes, and during full overload conditions.

Fortunately the IS95 CDMA is already endowed with a highly effective "Point to multipoint" bearer, which is called "Short Message Service - Cell Broadcast (SMS-CB)". As this functionality is already built in to the system, deployment times should be very low, and costs should be minimal.

In fact IS95 SMS-CB was designed from the start, to support emergency broadcasts and has a number of useful features.

US networks may have little experience with CB in CDMA but South Korea and India are two examples of countries that are using CDMA cell broadcast without reported problems.

IS95 has a lot of features for prioritizing emergency messages and reducing battery drain to almost nil. It also features support for multiple languages and can support up to 192 characters of text in some configurations, though 160 is more sensible. It is a very good fit as a point to multi point bearer service, and seems like an obvious bearer to carry the commercial mobile alert service (CMAS) messages.

There are some areas in which improvements are still needed before it is perfect, however what is available now is a good fit with CMAS requirements, and is easy to implement immediately and cheaply by any participating IS 95 CDMA network.

How it works

SMS Broadcasts can be transmitted over the Um interface using the Paging Channel, Primary Broadcast Control Channel or the Forward Traffic Channel. This means Broadcast messages can be received both on the hook and off the hook in CDMA. In GSM you can only receive a message when off On the hook.

Five interfaces support emergency cell broadcasting;

IS 95 B 7.6.2.4.1.2.1.2 (CDMA Um air interface between base station and mobile phone),
IS 637 A (SMS message broadcast parameter/ sub parameter format),
IS 634 (A interface between the MSC and the BSS),
IS 41 (SMDPP BTTC parameters).
TIA/EIA IS 824 generic broadcast teleservice transport capability.

All five have support for prioritizing 'Emergency' messages and defining languages among many other things.

Battery drain

Battery drain and spectrum use are minimized in IS95 CDMA. Cell broadcast messages are carried in the paging channel on an 'SMS data burst', according to standard IS 95B. 7.6.2.4.1.2.1.2. The base station transmits a BCAST_INDEX parameter (3 bits) in the extended system parameter message from the base station to the mobiles. If there are no pending broadcast messages, BCAST_INDEX=0, then the mobiles don't even bother scanning for a broadcast message at all. Hence there is no battery drain at all if the system has no broadcast messages pending. Neither is any capacity taken out of the system as all paging slots are then returned to the base station for paging use.

If there are active broadcast messages, (such as an Emergency), then the BCAST_INDEX parameter now has to indicate length of the Broadcast Paging cycle, (BCAST_INDEX 1-7). This tells the mobile how often the FIRST paging slot of the broadcast cycle is repeated. This first slot contains the parameters of the broadcast such as if it is Emergency, Urgent, Normal or Interactive. Also it states the language and the service category. If the mobiles owner has not indicated that the mobile should receive this message, then the mobile immediately goes back to sleep without reading any more during this broadcast cycle. This way battery drain is truly minimal.

If the mobile decides that the broadcast is of interest, then the burst may contain, in addition to the parameters more than one short message in the burst. There may be multiple data burst messages in the first burst, or a broadcast page message indicating that a message is taking up to 3 subsequent consecutive bursts all belonging to the same message, or any combination of those parameters.

At minimum then, a broadcast paging cycle takes 34 timeslots to repeat, each slot takes 80ms to complete. This is calculated as (2 exp [BCAST_INDEX] *16) +3.This means that it takes about 2.8 seconds to complete one broadcast paging cycle. If there is a concatenated message of 3 data bursts, they are transmitted one after the other during the same broadcast paging cycle. Several messages can be sent in

one paging cycle, but if we were to use say 160 characters of message, then one message can be transmitted every 2.8 seconds.

Accordingly if one wanted to transmit in three languages, say English, Spanish and French, then the last messages would be displayed 5.6 seconds after the first.

However the BCAST_INDEX parameter is settable by the network operator. The most extremely long broadcast cycle is BCAST_INDEX 7, (2 exp7 *16) +3, which would give a result of 2051 paging slots. This is about 2.7346 minutes, so the last language message would display about 5.6 minutes after the first. In non emergency cases this may be well enough, but in emergency situations some compromise figure may have to be arrived at, at the network operator's discretion. All of these matters are decided and programmed into a Gateway Broker as a result of a trust protocol process. This process determines the rules affecting the passage of a message from origination to delivery, i.e., authorized senders, content, security requirements, accountability procedures, etc.

Meanwhile traffic is not affected as the voice paging and call set up messages are not affected by the broadcast message system at all. Therefore there is no impact on voice call set up latency even when the service is being used to the maximum. In addition an 'SMS Traffic Channel delivery' option can be adopted whereby SMS messages are delivered on traffic channels (as with GSM), to relieve paging channel congestion due to SMS load.

As the terminal has an indication from the IS 95B over the air signaling protocol, (via the IS 637A bearer data parameter 0000 0011) that the message is an 'Emergency' then it prioritizes it above all other activity that it is doing at the time and may activate the user specified ring tone for emergency broadcast messages. However terminal behavior is at the discretion of the terminal vendor and its user.

Furthermore, while operators can set 'Throttling' on the SMS traffic, system software makes 'Emergency' messages exempt from such throttling. Therefore an inexperienced engineer cannot kill emergency messages by shutting it down or throttling it too much.

Maximum message size

There are many factors which control how large a CDMA message can be. The first of these is the speed of the paging channel. If the paging channel is a 4800bps, then the available size of the user part will be 111 octets. If it is the more usual 9600 bps rate then the user part size is 203 octets.

One must then take into account how many parameters the user part will use up for other purposes. In addition to the text of the message there is provision on the IS 637A interface for;

Service category (like the MI in GSM)
Priority of the message, (Normal, Urgent, Emergency)
Language for the text (language indicator)
Call Back Number (probably not in emergency cases)
Alert on Message Delivery (how the user is to be alerted)
Message Display Mode (how the user is to see the message)
Broadcast Zone ID (where to transmit the message)

In the simplest case, if the message is a normal priority, in English, and there is the message center time stamp, 168 octets are available for the message. If we were using 7 bit Latin characters this would leave 192 characters.

On the other hand if we use all of the parameters (which seems unlikely in an emergency) then we would have 139 octets for the message, which is for 7 bit coded Latin messages, 159 characters.

If the paging channel is the 4800 bps type, then there are only 86 characters left for the message itself unless further unnecessary parameters are removed. For example the call back number should obviously not be used and some other parameters are not needed.

Therefore, in most cases, provided unnecessary parameters are suppressed, 160 characters is perfectly sensible for all but the smallest systems.

There is space for further development in this regard so that concatenation as is done in GSM can be accommodated. There are no obvious technical problems to overcome.

Languages

As with GSM, there are two possible solutions for support of multiple languages.

IS 637A sets an 8 bit code for language in the 'SMS broadcast message parameter /sub parameter format protocol. The protocol TSB 58A is used to describe the language.

On the other hand, the IS 637A also defines a 16bit code for 'service category', which is the same number as the Message (type) Identifier, MI, in GSM. The ITU in Geneva are considering a framework for multiple languages, which can accommodate both systems for sorting out languages. In fact a network can choose to use both together- side by side without any problems.

Therefore either TSB 58A or ITU-T SG2 frameworks could be used to separate languages. In one example, Swahili is needed in east Africa but may not be supported as a distinct language. Since Africans text each other in Swahili using 7 bit ASCII Latin characters, there is no technical problem other than the cultural implications of having Swahili separate. The government of Tanzania has supported the ITU-T SG2 position for this reason.

In any case terminals must also support the font concerned. Obviously if I am a Chinese resident or roaming visitor, I would have a Chinese capable mobile so I can read my menus.

If no language is defined, then the terminal defaults to interpreting it as the default language for that terminal, usually the user's menu language.

Service Category Programming Teleservice (SCPT)

According to 3GPP2 C.S0015-B "Short message services for wideband spread spectrum systems release B", 13 May 2004, Service Category Programming Teleservice (SCPT) is used to remotely program the

mobile terminal's service categories on or off. This can be done by an SMS deliver message or an SMS submit message. This means that the feature and the correct emergency SC can be commanded on from the NOC, so terminal users don't have to do this manually themselves.

By such messages the network can remotely command that the broadcast feature should be commanded on (or off) [OPERATION_CODE], which service categories should be accepted (or switched off) [CATEGORY], the Languages to be received [LANGUAGE], the maximum number of message to be stored in memory [MAX_MESSAGES], the alert options (what sort of ringing and vibration should be done by the mobile when it gets messages from a particular SC [ALERT_OPTION].

The options are; No alert, Mobile station default alert, Vibrate alert once, Vibrate alert repeat, Visual alert once, Visual alert repeat, Low priority alert once, Low priority alert repeat, Medium priority alert once, medium priority alert repeat high priority alert once, high priority alert repeat. This means a different tone for emergency alerts can be commanded on remotely, one of the 'requirements' that the CMSAAC set.

The service center will get a Service Category program result message back from the mobile, stating if it did program correctly.

In other words when the network decides to offer emergency alerts they can send SCPT messages to all customers and turn on the right channel overnight. This way the participation is increased. This is similar to the Over the Air Activation Teleservice (OATS) in GSM.

Message ID

This field prevents the mobile from again displaying a message if it has already been received and is not an update.

Broadcast Zone Mapping.

One respect in which CDMA is different compared with GSM is in the area of 'broadcast zone' mapping.

At the present time, it seems that some implementations of CDMA do not allow a single cell to be addressed, rather a 'broadcast zone' which corresponds to a paging area. While experts conclude that there is no particular technical difficulty in providing single cell resolution, in some switches a software upgrade may be needed to achieve this, in some cases vendors have already allowed for single cell resolution.

However regular software upgrades are quite normal on such switches and so it is reasonable to suggest that a switch vendor could implement cell resolution within two years. In the mean time paging zone resolution may be the best to offer with no modifications. In this respect GSM has an advantage as most GSM switches offer per cell resolution today without any upgrades.

A paging zone is configured for reasons of paging channel load, and so there is no easy correlation between a zone or group of zones and a jurisdiction. In a dense area a zone may correspond roughly to a borough, in a rural area it may correspond roughly to a county, but this may not always be the case. It may

be possible to adjust paging areas to match jurisdictions but at the cost of some engineering compromises regarding paging load.

As regards the protocols IS 637A, IS 41, IS 824 and IS 634, they are all configurable for a cell identity list, if such is useful.

In another solution, the terminal can read the cell identity list, read the cell identity it is in from the base station, and then delete any message which is not on the list. This has the disadvantage of adding network load as the message must be trafficked over the whole paging zone first.

Deployment

In order to deploy SMS-CB, the network needs to take the following steps.

1) Check the vendor of the switch and the version of software now running.
2) Check with the vendor if the present revision already includes SMS-CB
3) If so, then unlock the feature from the maintenance console at the NOC
4) If not, then ask about the needed upgrades.
5) Arrange for the switches concerned to be connected to a Cell Broadcast Center, in order to administer the feature. Either the network can do this or they can hand this out to a third party provider.

A third party vendor, such as CellCast Technologies then makes the arrangements for proper authorities to provide the information in accordance with local laws. CellCast then codes them into the Gateway Broker which manages the remainder of the message transmission process. The network is then free from any liability from the contents of the message, though it can still stay in control stating under what conditions specific provisions will apply. The provider of the Gateway Broker provides ongoing reporting of all activity carried out in the emergency message sending process in order to have accountability by all parties. ---

ABOUT CELLCAST TECHNOLOGIES: With headquarters in the United States, CellCast Technologies has long been committed to making the delivery of emergency messages "personal" with their browser based EAGLE™ messaging front-end, their Trust Protocol Consulting services and their innovative Aggregator/Gateway (AG) Broker technology necessary for the deployment of geo-targeted cell broadcast notifications and alerts. The author of this white paper is Mark Wood. Mark Wood is the Chief Technology Officer of CellCast Technologies, LLC. Among his many international contributions to the industry, he authored *Disaster Communications*; the crisis communication book used by the International Red Cross for training, and is leading cell broadcast harmonization efforts for the United Nations.