Mobile broadcast/multicast in mobile networks

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During 2004, many mobile operators launched mobile TV services, which allow users to watch TV on their mobile terminals. At present mobile TV is offered via streaming technology over point-to-point connections. However, large-scale market deployment of "mass media" services like mobile TV will require new mobile network capabilities commonly referred to as broadcast/multicast.

In this article the authors give an overview of the new mobile broadcast/multicast services specified in 3GPP and 3GPP2. They also compare the performance gains from new point-to-multipoint radio bearers with the performance of existing point-to-point radio bearers.

Introduction

Telephony, messaging and on-demand streaming and download services are based on point-to-point (PTP) communication. The end-points are either two telephones in a voice call, or in the case of a download or streaming session, a client-server connection.

BOX A, TERMS AND ABBREVIATIONS

3GPP	Third-generation Partnership Project	MICH	MBMS notification indicator channel
3GPP2	Third-generation Partnership Project 2	MMS	Multimedia messaging service
ARQ	Automatic repeat request	MSCH	MBMS point-to-multipoint scheduling channel
BCMCS	Broadcast/multicast service	MTCH	MBMS point-to-multipoint traffic channel
BM-SC	Broadcast/multicast service center	OFDM	Orthogonal frequency-division multiplexing
CBS	Cell broadcast service	OMA	Open Mobile Alliance
C/I	Carrier-to-interference ratio	OMA BCAST	Sub-working group of the OMA "Browser and Content" Working Group whose focus is on mobile broadcast services
DAB	Digital audio broadcasting	PDAN	Packet downlink Ack/Nack
DVB	Digital video broadcasting	PDCH	Packet data channel
DVB-H	DVB handheld	PTM	Point-to-multipoint
EDGE	Enhanced data rates for global evolution	PTP	Point-to-point
FACH	Forward access channel	RLC	Radio link control
FEC	Forward error correction	RNC	Radio network controller
FLUTE	File delivery over unidirectional transport	S-CCPCH	Secondary common control physical channel
GERAN	GSM EDGE radio access network	SGSN	Servicing GSN
GGSN	Gateway GSN	SMS	Short message service
GPRS	General packet radio service	TCP	Transmission control protocol
G-RAKE	Generalized rake receiver	TPF	Traffic plane function
GSM	Global system for mobile communications	TTI	Transmission time interval
GSN	GPRS support node	UDP	User datagram protocol
HTTP	Hypertext transfer protocol	UMTS	Universal mobile telecommunications system
IETF	Internet Engineering TaskForce	UTRAN	UMTS terrestrial radio access network
IP	Internet protocol	WAP	Wireless access protocol
MAC	Medium access control	WCDMA	Wideband CDMA
MBMS	Multimedia broadcast and multicast service		
MCCH	MBMS point-to-multipoint control channel		

Broadcast and multicast on the other hand are synonyms for point-to-multipoint (PTM) communication where data packets are simultaneously transmitted from a single source to multiple destinations. The term *broadcast* refers to the ability to deliver content to all users. Known examples are radio and TV services, which are broadcasted over the air (either terrestial or via satellite) and over cable networks. *Multicast,* on the other hand, refers to services that are solely delivered to users who have joined a particular multicast group. Ordinarily, a multicast group is a group of users interested in a certain kind of content, for example, sports, news, cartoons and so on. A multicast-enabled network ensures that the content is solely distributed over those links that are serving receivers which belong to the corresponding multicast group. This is thus a very resource-efficient way of delivering services to larger user groups. Multicasting was first introduced via the internet. Today, it is used for delivering internet radio services.

Two years ago, 3GPP and 3GPP2 began addressing broadcast/multicast services in GSM/WCDMA and CDMA2000 respectively. In 3GPP, the work item is called Multimedia Broadcast and Multicast Service (MBMS). In 3GPP2 it is called Broadcast and Multicast Service (BCMCS). The specifications of mobile broadcast services were functionally frozen in 2004. 3GPP MBMS and 3GPP2 BCMCS have many commonalities. Therefore, throughout the rest of this article we will only distinguish between them when needed. Otherwise we will use the term "mobile broadcast" keeping in mind that MBMS and BCMCS each support multicast as well.

Whereas MBMS and BCMCS introduce efficient support for broadcast/multicast transport in mobile networks, OMA BCAST is working on the specification of broadcast/multicast-related service-layer functionalities that can be applied to mobile and non-mobile digital broadcast networks. For instance, OMA BCAST addresses content protection, service and program guides, and transmission scheduling. It is agnostic of the underlying broadcast/multicast distribution scheme, which could be MBMS, BCMCS or a non-mobile digital broadcasting system such as DVB-H.

MBMS and BCMCS each introduce only minor changes to existing radio and core network protocols. The same applies to OMA BCAST for broadcast/multicast-specific service-layer functions. This reduces implementation costs in terminals and in the network, and makes mobile broadcast a relatively inexpensive technology compared to non-mobile broadcast technologies, which require new receiver hardware in the terminal and additional investments in the network infrastructure. Another advantage of mobile broadcast is that mobile operators can retain established business models. Current services, such as mobile TV, will greatly benefit from the capacity-boosting effect of mobile broadcast. Certainly mobile broadcast will also stimulate the development of new, mobile, mass-media services. Likewise, it will enable operators to provide a full triple-play service offering—telephony, Internet, and TV—for mobile handheld devices in a cost-effective way over a common service and network infrastructure.

The need for broadcast/multicast

Several recently launched mobile multimedia services closely resemble traditional broadcast services. Like radio and TV, they aggregate content into channels that are "pushed" to channel subscribers.

Mobile users in Japan, for example, who subscribe to KDDI's EZChannel multimedia service receive various genres of content in their terminals. In Europe, a number of operators have launched sports information services that push short video clips of game highlights via MMS. Elsewhere, Vodafone (Germany and the Netherlands), TIM (Italy and Greece), Three (Italy and Sweden), and Sprint (US) have each launched mobile TV services. In some cases, the content is taken from existing TV channels; in other cases, mobile users are offered specially edited versions of TV programs.

At present, mobile TV services are delivered over point-to-point connections. As a consequence, a content server that delivers content to several users at a time must establish and maintain a separate point-to-point connection for each recipient. This approach works well for low to moderate numbers of subscribers but does not scale well as the number of subscribers increases.

Imagine, for instance, a "Mobile Music Box" service that synchronizes a list of top-ten pop music songs in a user's phone. Further, let's assume that 50,000 users subscribe to the service and each user connects at an average wireless link speed of 128kbps. Similarly, we will assume that each music file is approximately 3MB in size. Each time a new title enters the top-ten list it must be delivered to all 50,000 subscribers. Assuming the content server can handle only 1,000 parallel connections at a time, it will take more than 2.5 hours to deliver one music clip to all 50,000 users. During this period, the server will generate continuous 128Mbps outgoing traffic. Note also that 50,000 subscribers is a relatively small number compared to the total addressable market of potential subscribers per operator.

Next consider how much capacity will be consumed by real-time services such as mobile TV. In this case, "serializing" (as described above) will not work. Instead, a mobile TV service with 50,000 subscribers requires a server farm that can handle 50,000 simultaneous connections. Although this is technically possible it is not economical. Furthermore, the service would generate a tremendous amount of outbound traffic when many subscribers use it at the same time.

Because spectrum is a limited and expensive resource, the radio access network, in particular the wireless link, can also easily become a bottleneck if numerous recipients of the same service are located in the same cell. Imagine, for example, a soccer stadium where fans use their mobile phones to monitor parallel games, much the way they currently use transistor radios. In this case, the use of point-to-point radio bearers would be very inefficient if not prohibitive. Therefore, there is a clear need for new point-to-multipoint radio bearers that can support broadcast/multicast services more efficiently.

MBMS and BCMCS in mobile networks

MBMS and BCMCS add the following features to mobile networks:

- A set of functions that control the broadcast/multicast delivery service. MBMS uses the term broadcast/multicast service center; BCMCS calls it BCMCS controller.
- Broadcast/multicast routing of data flows in the core network.
- Efficient radio bearers for point-to-multipoint radio transmission within a cell.

In addition, MBMS and BCMCS specify protocols and media codecs for the delivery of multimedia data. Few of the protocols and none of the media codecs are new features; instead, they are "shared" with other services much like on-demand unicast streaming.

BOX B, NON-MOBILE DIGITAL BROADCASTING SERVICES

Non-mobile digital data broadcasting services, such as digital video broadcasting (DVB) and digital audio broadcasting (DAB), have recently begun to address the challenges of mobile environments. However, due to the nature of handheld devices (small antennas and displays, power consumption restrictions, limited processing power, and the need to work at different speeds indoor as well as outdoors) the current data broadcast technologies will have to be extended or modified. This is because the definition of digital broadcasting technologies has not seriously considered handheld reception devices.

The DVB project has initiated a dedicated activity called DVB-H (where "H" stands for handheld). To date, it has finalized the specification of open systems interconnection (OSI) layers 1 and 2, and the DVB convergence of the broadcast and mobile services (CBMS) group recently began specifying the protocols and codecs above IP. It is likely that the group will adopt major parts of 3GPP MBMS. The major challenges associated with DVB-H are network requirements and related deployment costs for providing coverage comparable to that of mobile networks. Moreover, in most countries virtually all suitable DVB-H spectrum is being used by analog or digital TV services. And even if spectrum in this band were made available for DVB-H, in many countries this spectrum is assigned to TV services only, which is to say it cannot be used for other types of IP datacast service, such as the delivery of media clips.

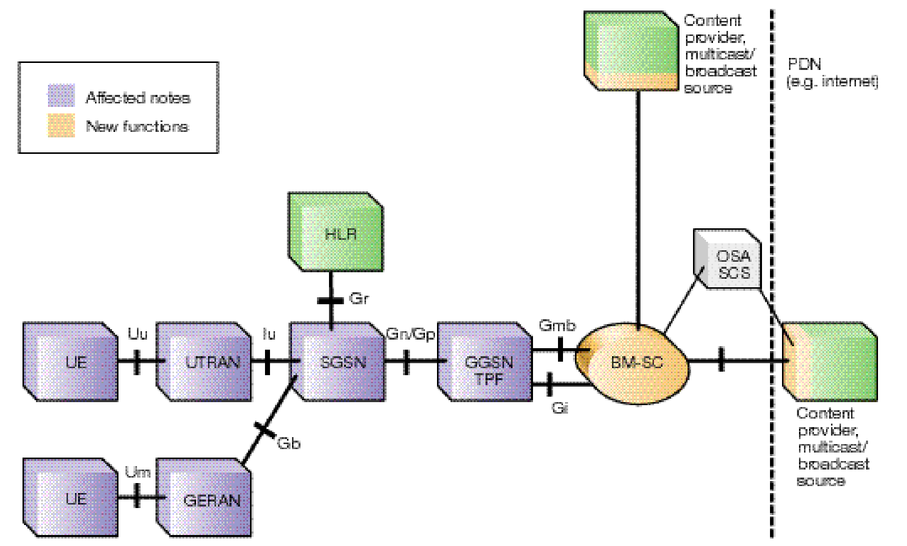


Figure 1
3GPP nodes affected by MBMS. The basic 3GPP2 architecture differs somewhat from that of 3GPP, but has been amended in a similar manner to accommodate BCMCS.

Figure 1 indicates which nodes of the 3GPP architecture are affected by MBMS. It also highlights the new BM-SC, which is responsible for providing and delivering mobile broadcast services. The BM-SC serves as an entry point for content-delivery services that want to use MBMS. It sets up and controls MBMS transport bearers to the mobile core network and can be used to schedule and deliver MBMS transmissions. The BM-SC also provides service announcements to end-devices. These announcements contain all necessary information (such as multicast service identifier, IP multicast addresses, time of transmission, media descriptions, and so on) that a terminal needs in order to join an MBMS service. The BM-SC can be used to generate charging records for data transmitted from the content provider. It also manages the security functions specified by 3GPP for multicast mode.

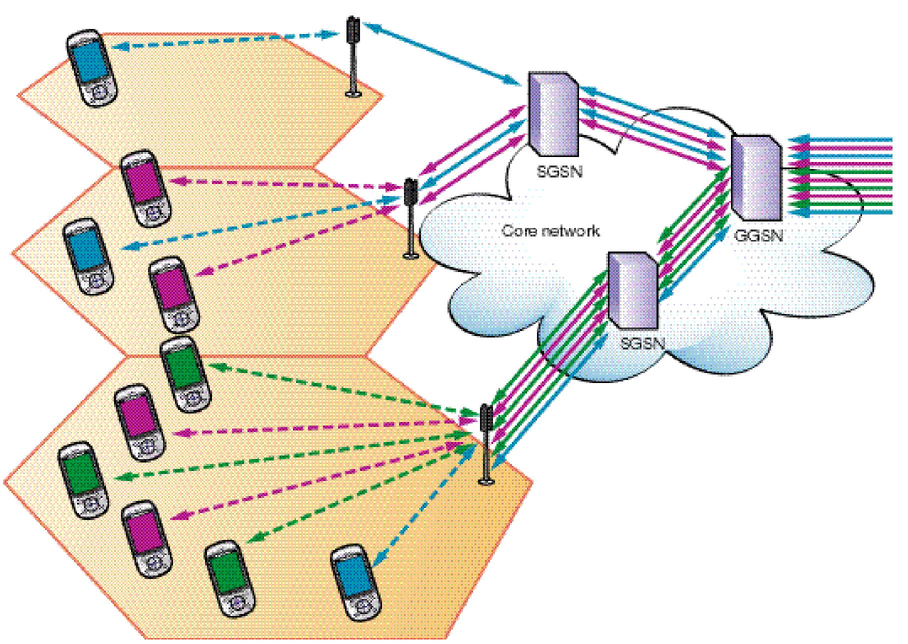
The MBMS standard does not mandate how the BM-SC functions are to be implemented. Some vendors might offer them in a separate node; others might integrate them into existing core and service network nodes.

In the core network, MBMS and BCMCS add the functions and protocol messages needed to create and manage broadcast and multicast data distribution trees.

A particular feature of MBMS is that it enables operators to define broadcast and multicast services for specific geographical areas at very fine granularity—essentially down to the size of individual radio cells. These geographical areas are configured via the MBMS service area. Each node in the core network uses the list of downstream nodes to determine where (to which nodes) it should forward MBMS service data. At the gateway GPRS support node (GGSN) level, the list contains every serving GSN (SGSN) to which the data should be forwarded. At the SGSN level, the list contains every radio network controller (RNC) node of the WCDMA terrestrial radio access network, or in the case of the GSM radio access network, every base station controller (BSC) node, that needs to receive the data. For services that operate in multicast mode, the core network manages a dynamic data-distribution tree by keeping track of users currently registered to the service. As with IP multicasting, each core network node forwards MBMS data to the downstream nodes that are serving registered users.

The following example illustrates the performance gains of using mobile broadcast for streaming services. Figure 2 describes a situation where several mobile TV users are watching three different channels streamed over unicast. In this case, each user requires

Figure 2
Mobile TV service without MBMS support. Ten users are watching three different channels (red, green and blue). Each user requires a separate unicast streaming connection to the server. Server, network and cell load increase with the increasing numbers of users.



a separate streaming connection to the server. Server and network traffic load are thus directly linked to the number of users. In this example, the streaming server must handle ten streaming connections, because there are ten mobile TV users. It should be obvious that with a rising number of users, server load increases and heavy volumes of traffic are generated in the core and radio networks.

Figure 3 describes the same situation when the mobile TV service is offered over MBMS. The server delivers just one stream per channel to the MBMS BM-SC. The data flow for each channel in the core and radio network is solely replicated when necessary. In this example, the streaming server must only handle three simultaneous streams. Furthermore, radio resources in the bottom-most cell need only be allocated for three parallel broadcast transmissions instead of six separate unicast transmissions. Note: Although the example was given for 3GPP MBMS it also applies to 3GPP2 BCMCS.

In addition to the streaming delivery method supported by MBMS and BCMCS, MBMS also supports download. MBMS download can be used to efficiently deliver arbitrary files from one source to many receivers. Existing content-to-person MMS services (such as a service that delivers short video clips of a sports event) will greatly benefit from this feature. Today, these services use point-to-point connections for MMS delivery. In the future, the MMS subsystem can easily be interfaced to a BM-SC that can distribute the clip via MBMS download. In contrast to MBMS, BCMCS does not define protocols that explicitly support the file delivery service.

File delivery over broadcast/multicast bearers as provided by MBMS requires special attention. Broadcast and multicast are one-way transmissions in the downlink. Therefore, the transmission control protocol (TCP) cannot be employed because it requires a bidirectional unicast connection. However, the Internet Engineering Task Force (IETF) provides a framework for file delivery over unicast called file delivery over unidirectional transport (FLUTE). FLUTE employs the user datagram protocol (UDP) as its underlying transport protocol. However, because UDP is unreliable, FLUTE also employs forward error correction (FEC) as a framework for protecting encapsulated data against occasional packet loss. But because even strong error protection (FLUTE) cannot guarantee error-free delivery, MBMS also specifies a point-to-point file-repair procedure that can be executed after a file has been broadcast or multicast. During this phase, recipients can connect to and request data from a file repair server. MBMS can thus always guarantee reliable file delivery.

BOX C, HISTORY OF MOBILE BROADCAST/MULTICAST

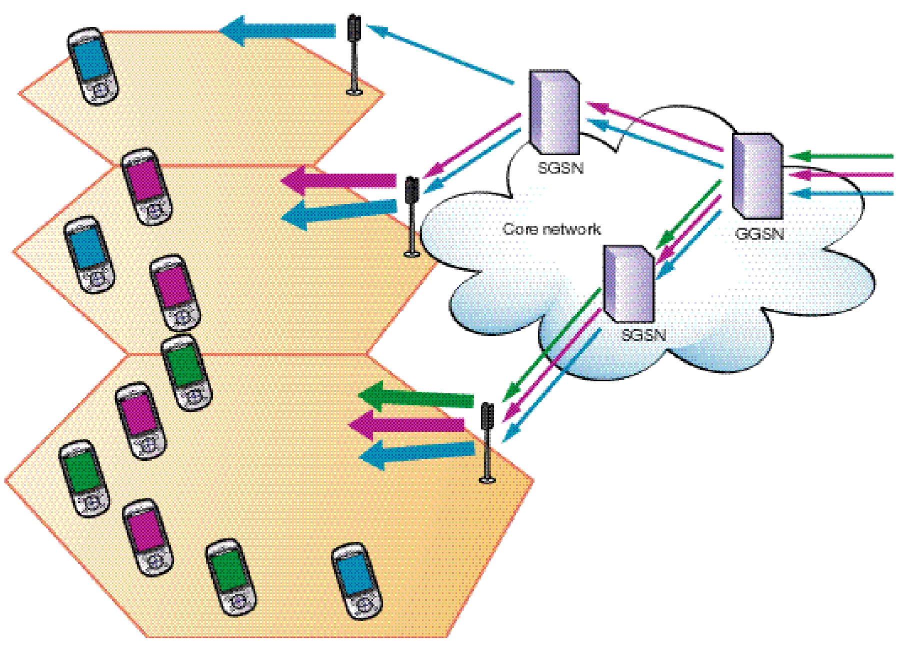
The cell broadcast service (CBS) in GSM was the first broadcast service introduced in a mobile network. CBS was later also specified for UMTS in 3GPP Release-99 (Rel-99). The service broadcasts short text messages to every recipient within a particular region. The messages are sent in blocks or pages. Each page can contain up to 93 characters. A total of 15 pages can be concatenated to form one message. Therefore, the maximum length of any given message is 1395 characters.

3GPP Release-4 (Rel-4) added an IP multicast service that allows mobile subscribers to receive IP multicast traffic. Note: The IP multicast service defined in 3GPP Rel-4 only enables tunneling of IP multicast packets over point-to-point connections. Therefore it does not provide resource savings in the radio or core network compared to unicast point-to-point delivery.

In 2002 3GPP and 3GPP2 started to work on more efficient mobile broadcast/multicast delivery services for GSM/WCDMA and CDMA2000 respectively. In 3GPP the work item is called Multimedia Broadcast and Multicast Service (MBMS). In 3GPP2 it is called BroadCast and MultiCast Service (BCMCS).

Whereas MBMS and BCMCS introduce efficient support for broadcast/multicast transport in mobile networks, OMA BCAST specifies broadcast/multicast-related service layer functionalities that can be applied to mobile and non-mobile digital broadcast networks.

Figure 3
Mobile TV service with MBMS support. Same scenario as in Figure 2, but now with MBMS support. The server delivers just three streams (one stream per channel) to the MBMS BM-SC. Radio resources in the bottom cell need only be allocated for three parallel broadcasts instead of for six separate unicast transmissions. Server, network and cell load are thus independent of total number of users.



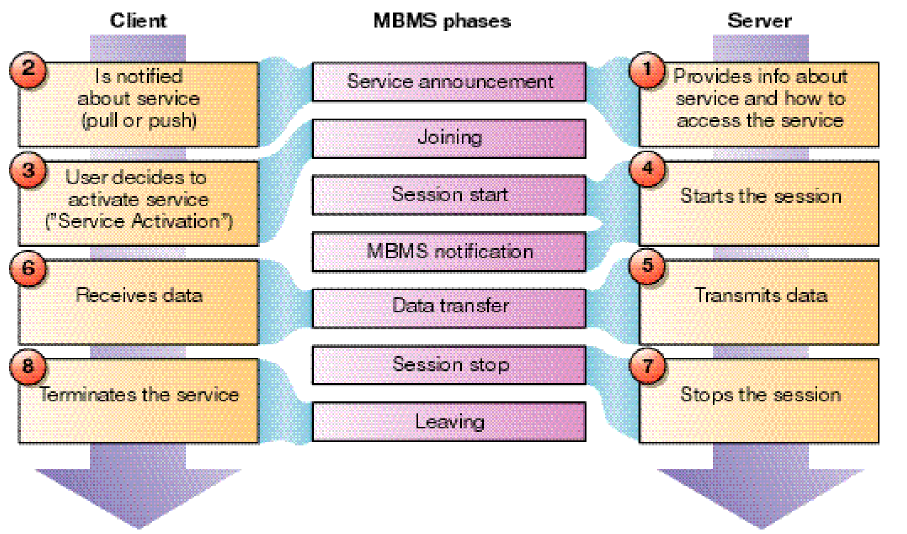


Figure 4
Typical phases during an MBMS session. Note: The solution for BCMCS is quite similar, but for simplicity sake only MBMS nomenclature is used.

Typical MBMS workflow

Figure 4 gives a high-level overview of a typical MBMS workflow. The solution for BCMCS is similar, but for the sake of simplicity only MBMS nomenclature is used.

To begin with, information on a particular MBMS service is sent to a service-provisioning server. This information is commonly referred to as a service announcement. Service announcements provide information on the service and how terminals may access it. There are several ways of delivering MBMS service announcements to end-users. The easiest way is to store them on a web server from which they can be downloaded via hypertext transfer protocol (HTTP) or wireless access protocol (WAP). One can also push service announcements to terminals by means of existing mechanisms, such as SMS or MMS or they can be delivered over a special MBMS service-announcement channel.

What happens after an end-user has decided to use the service described in the service announcement depends on whether it is a broadcast or multicast service. Broadcast services require no further action. The terminal simply "tunes" to the channel whose parameters are described in the service announcement. If the service is a multicast service, a *session join* request must be sent to the network with parameters extracted from the service announcement. The user terminal becomes a member of the corresponding MBMS service group and, as such, receives all data delivered by the service.

Before transmission can start, the BM-SC must send a *session start* request to the GGSN in the core network. The GGSN allocates the required internal resources and forwards the request to the affected SGSNs. The SGSNs, in turn, request the allocation of radio resources necessary for providing the required quality of service (QoS). Finally, the terminals of the corresponding MBMS service group are notified that the service is about to deliver content.

The server can then send multimedia data to the BM-SC, which forwards the data to the MBMS bearer. The data is tranmitted to every terminal taking part in the MBMS session.

Eventually, the server sends a *session stop* notification to indicate that the data transmission phase has ended.

End-users who want to leave an MBMS multicast service send a *service leave* request to the network, which removes the user from the related MBMS service group.

Broadcast and multicast bearers in radio access networks

Along with MBMS and BCMCS, new broadcast and multicast radio bearers and protocols have been developed for GSM, WCDMA, and CDMA2000. Moreover, because broadcast and multicast radio bearers must serve multiple users simultaneously, many of the bit-rate and capacity-enhancing functions developed for high-speed, bi-directional point-to-point communication cannot be used. In other words the signal cannot be adapted to individual users and it must always be good enough for the user with the poorest radio quality. In essence the new radio bearers must provide full area coverage regardless of user location and radio conditions.

GSM broadcast/multicast radio bearer

In GSM systems, MBMS uses GPRS and EDGE modulation and coding schemes (that is, CS1-4 and MCS1-9). MBMS also uses the GPRS and EDGE packet data channel (PDCH) for point-to-multipoint transmissions, and the radio link control/medium access control (RLC/MAC) protocols on layer 2. As for point-to-point transmissions, MBMS also supports multi-slot operation.

In this case, the radio network may use up to four timeslots per MBMS session.

Early simulations have shown that the performance of a straightforward MBMS bearer implementation is not satisfactory. Therefore, to increase performance, two enhancements have been introduced:

- RLC/MAC with automatic repeat request (ARQ)—also called packet downlink Ack/Nack (PDAN) mode. In this mode, session feedback is provided from up to 16 terminals in a given cell. This way, the RLC data blocks that a terminal did not receive correctly are rebroadcasted over the MBMS radio bearer so that the terminal can use incremental redundancy techniques.
- RLC/MAC without ARQ—also called blind repetition mode. In this mode, RLC blocks are repeated a pre-defined number of times, using an incremental redundancy technique, before the next RLC block is sent.

Figure 5 compares blind repetition and PDAN mode for different numbers of users and retransmissions. For simplicity sake, the simulations assume that every mobile station experiences the same carrier-to-interference ratio (C/I). In reality they will experience different C/I because they are distributed throughout the cell. Note: This example uses the MCS-6 EDGE coding scheme. The results of simulations with GPRS coding schemes yielded roughly half the throughput.

The simulations indicate that video broadcasting at 40kbps requires two to four timeslots with EDGE channel coding in PDAN mode depending on the number of users whereas four timeslots are needed in blind repetition mode. Note that a regular point-to-point EDGE channel can provide streaming at the same bit rate using two timeslots, but only to one user. For three users, six timeslots are required; for four users, eight, and so on. Therefore, if there are two users in the cell, the MBMS point-to-multipoint bearer is as efficient as a regular point-to-point connection and becomes much more efficient with an increasing number of users.

MBMS terminals will probably be based on existing EDGE hardware with a software update to support MBMS signaling procedures.

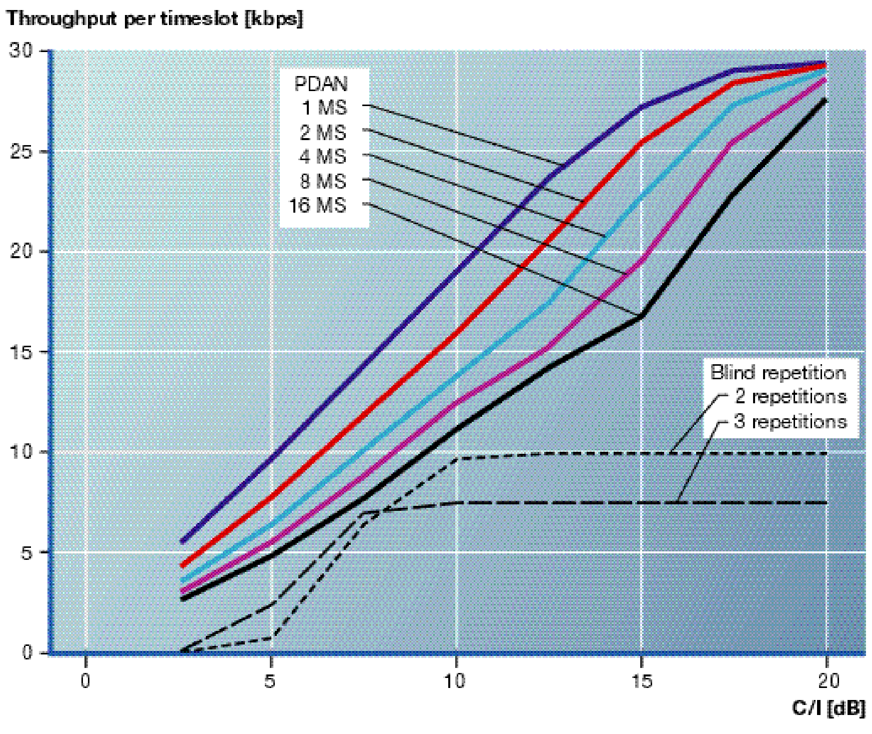
In GSM, MBMS radio bearers can be multiplexed with GPRS/EDGE data flows—even on the same timeslots. One deployment scenario might be to activate MBMS in dense areas where EDGE is deployed; in areas without EDGE, MBMS can be provided over point-to-point GPRS. One other deployment scenario might entail phasing in levels of functionality—for example, starting with MBMS broadcast and adding MBMS multicast. This would save capacity in cells that do not have users asking for the service.

WCDMA broadcast/multicast radio bearer

In WCDMA, MBMS reuses existing logical and physical channels to the greatest possible extent. In fact, the implementation in WCDMA requires only three new logical channels and one new physical channel. The new logical channels are:

- MBMS point-to-multipoint control channel (MCCH), which contains details concerning ongoing and upcoming MBMS sessions;
- MBMS point-to-multipoint scheduling channel (MSCH), which provides information on data scheduled on MTCH; and
- MBMS point-to-multipoint traffic channel (MTCH), which carries the actual MBMS application data.

Figure 5
Performance of GERAN MBMS bearer.



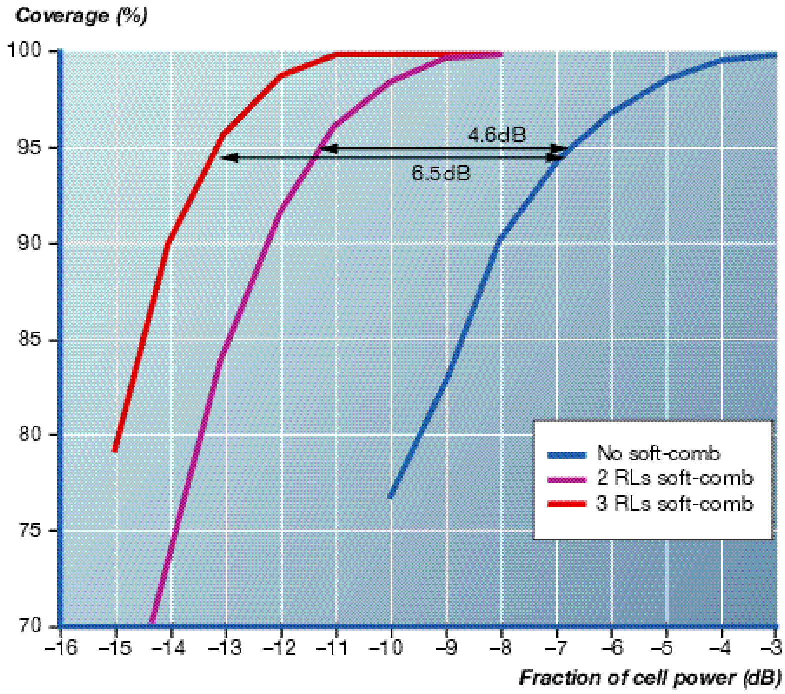


Figure 6
WCDMA MBMS coverage vs. power for vehicular A3, 64kbps, 80ms TTI and single-receive antenna.

The new physical channel is the MBMS notification indicator channel (MICH) by which the network informs terminals of available MBMS information on MCCH.

MCCH, MSCH and MTCH reuse the forward access channel (FACH) transport and secondary common control physical channel (S-CCPCH) in WCDMA. The RLC and MAC layer reuse much of the existing protocol stacks.

Two interleaving depths (TTI) are used in MBMS for the MTCH: 40 and 80ms. The selection of a long interleaving depth (TTI) provides greater diversity in the time domain by spreading user data over the fading variations. This, in turn, yields improved MBMS capacity.

MBMS in 3GPP Rel-6 introduced several capacity enhancements for the physical layer for MTCH. One of these, soft-combining for FACH, is especially noteworthy. Figure 6 shows the gains attained from soft combining. Compared with a single radio link, soft-combining of two radio links yields a gain of about 4.6dB; soft-combining of three radio links yields a gain of up to about 6.5dB.

An important characteristic of MBMS in WCDMA is that the MBMS radio transmission cost is independent of the number of subscribers in the cell.

Clearly, MBMS has a capacity advantage over point-to-point connections when several subscribers of an MBMS service reside in the same cell. When there are very few MBMS users in a cell, it might be more efficient to use a point-to-point connection to each. Considerable effort has been made to determine when a single MBMS point-to-multipoint bearer becomes more efficient than multiple, dedicated, point-to-point connections. The crossover point depends on the assumptions made, including level of functionality for point-to-point and point-to-multipoint. Interestingly, simulations show that the crossover point might be only one or two users. To provide full flexibility, a counting procedure has been introduced in the standards to enable the network to keep track of the number of MBMS users in a cell, thereby helping the network to decide which bearer to use.

With WCDMA MBMS technology (3GPP Rel-6), one 5MHz cell carrier can potentially support 16 point-to-multipoint MBMS channels at a user bit rate of 64kbps per channel, as seen from Figure 6 for a single-receive-antenna terminal. Terminal implementation options, such as dual-antenna receive diversity and advanced receiver techniques, such as generalized rake receiver (G-RAKE), will further significantly increase the total capacity per cell carrier. Straightforward dual-antenna receive diversity can improve the WCDMA MBMS capacity by a factor of 2, allowing for 32 channels per cell carrier. The introduction of additional interference-supression techniques, such as G-RAKE, will further improve capacity, to perhaps 40 channels and beyond, corresponding to a total cell carrier capacity of 2.5Mbps and beyond.

One important aspect of MBMS is flexibility—MBMS can be set to use only a portion of a cell carrier, leaving the rest for other services such as regular voice and data. The MBMS portion comprises a variable number of MBMS radio bearers. Moreover, each radio bearer can have a different bit rate. Although MBMS supports user bit rates of up to 256kbps, given current handheld terminal dispay sizes and resolutions, 64kbps is adequate for a news channel application and 128kbps for a sports channel application.

TRADEMARKS

CDMA2000 broadcast/multicast radio bearer

Much like WCDMA, CDMA2000 uses existing physical channels defined for IS-2000 (1x) and IS-856 (1xEV-DO). To compensate for the lack of a radio-link retransmission protocol in point-to-multipoint communication (no PDAN), an additional error-correcting coding layer has been introduced on top of the coding of existing bearers. In contrast to MBMS, this coding is placed in the radio access network, to allow optimum cooperation between the two layers of decoding in the receiver. The coding is a matrix where rows constitute the existing frames and coding type (Turbo coding) and a set of Reed-Solomon codes spans the columns, each column being 1 octet wide. There are *k* rows in the matrix that constitute information. The Reed-Solomon codeword spans across the column adding *n-k* rows. All *n* rows are then individually encoded by the turbo code and sent over the air to the receiver, which soft-combines BCMCS signals from multiple base stations.

The standards do not specify minimum or maximum terminal capabilities. At present, commercially available 1xEV-DO modems for point-to-point communication can handle 2.4Mbps in the downlink. However, this rate cannot be provided to the cell edge, and a broadcast service must be receivable by every user including those users at the cell edge. Furthermore, it represents the total bandwidth of 1xEV-DO; consequently, there would be no capacity left for point-to-point communication on this carrier. The added complexity of the new coding layer and the complexity related to media processing of the data stream (media players) might further lower the bit rate. Given these limitations, the BCMCS terminal user bit rate will probably be similar to that of MBMS in WCDMA.

1xEV-DO facilitates concurrent services; that is, BCMCS can be mixed with other point-to-point data communication, including—in the future—VoIP.

The mobile systems assume that neighboring cells contain different signals that must be suppressed to reduce interference. Broadcast services, however, transmit the same content, which means there is no need to suppress transmissions to neighboring cells. With this in mind, a new radio bearer for 1xEV-DO has been proposed for broadcast and multicast. One proposal, based on orthogonal frequency-division multiplexing (OFDM), employs the same modulation technique as found in DVB. One other proposal calls for existing CDMA spreading and a more advanced receiver. Neither of these channels will be backward-compatible with the current bearer. Therefore, carriers who are interested in deploying BCMCS must either choose between the current channel, the new channel, or both (which consumes more bandwidth).

Conclusion

Mass-market deployment of broadcast-like services will require the mobile broadcast and multicast capabilities specified by 3GPP MBMS, 3GPP2 BCMCS and the related broadcast/multicast service layer functions standardized by OMA.

Both MBMS and BCMCS reuse much of the existing radio and core network protocols. This reduces the implementation costs in terminals and in the network. Furthermore, mobile operators can retain their business models. Due to the fairly small size of cells, mobile broadcast services can easily be customized to broadcast different content with very fine granularity in different areas of the network. Therefore, mobile broadcast has several advantages compared with non-mobile networks (such as DVB-H), which require new receiver hardware, additional investments into the network infrastructure and new business models.

The introduction of MBMS and BCMCS will boost the capacity of existing services. WCDMA, for example, could be set up with a mix of 64kbps news channels and 128kbps sports channels with an aggreagated channel bandwidth of 2.5Mbps on a cell carrier. This enhanced capacity will stimulate the development of new , mobile, mass-media services. Because mobile broadcast services can be multiplexed with existing mobile services, such as voice and data, interactive broadcast services will become a new service.

Ericsson demonstrated truly interactive mobile TV services for the first time in April 2005. At the Milia TV and broadcasting event, Ericsson showed how an existing interactive TV format can be delivered to mobile phones with multimedia capabilities. Viewers were able to interact with mobile TV shows, voting or sending greetings (SMS-to-TV or MMS-to-TV) by merely pushing a response key on their phones.

Mobile broadcast also enables operators to offer telephony, Internet, and TV for mobile (small handheld) devices over a common service and network infrastructure.

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