

# **Attachment 4-2-12**

## **WiMAX Forum<sup>®</sup> Network Architecture**

### **System Requirements, Network Protocols and Architecture for Multi-cast Broad-cast Services**

(MCBCS Subteams Common Sections)

**WMF-T33-111-R015v01**

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for Multi-cast Broad-cast Services

(MCBCS Subteams Common Sections)

**WMF-T33-111-R015v01**

WiMAX Forum<sup>®</sup> Approved  
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## 1. Revision History

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November 6, 2009	Initial version of Release 1.5.
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## 2. Document Scope

- 1
- 2 This document captures the common technical references, terms and definitions, usage scenarios as well as the
- 3 system requirements and design principles to support the WiMAX MCBCS services.

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## 3. References

### 3.1 Normative References

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## 4. Abbreviations, Terms and Definitions

### 4.1 Abbreviations

AAA	Authentication, Authorization, Accounting
ASN	Access Service Network
ASN-GW	Access Service Network - Gateway
ASP	Application Service Provider
BS	Base Station
CRC	Cyclic Redundancy Check
CSN	Connectivity Service Network
GRE	Generic Routing Encapsulation
IGMP	Internet Group Management Protocol
MAC	Media Access Control
MBS	Multicast Broadcast Service
MCBCS	MultiCast and BroadCast Service
MCID	Multicast Connection IDentifier
MLD	Multicast Listener Discovery
MR	Multicast Router
MS	Mobile Station
NAP	Network Access Provider
NSP	Network Service Provider
OMC	Operation & Maintenance Center
PDU	Packet Data Unit
RRM	Radio Resource Management
SC	Sync Controller
SDU	Service Data Unit
SE	Sync Executor

### 4.2 Terms and Definitions

#### 4.2.1 ASP (Application Service Provider)

ASP is a business entity that uses the network service interfaces exposed by the Network Service Provider (NSP) to offer value added services to Subscribers. The services provided by the ASP could be internet-based. An ASP may also need to establish contractual agreements with the NSP (depending on NSP choice).

#### 4.2.2 MCBCS

A Multicast Broadcast Service (MCBCS) which involves network's ability to provide a common content to multiple user. MCBCS Services can be broadly categorizes into Multicasting or Broadcasting Services:

- Multicast Service: The Multicast Service in which users may dynamically join and leave a Multicast IP session and the system may monitor the number of users at each MCBCS Zone to decide on data transmission and its mode.. In particularly, subset of the Multicast Service is supported in Phase-1 MCBCS is Static Multicast Service which is defined as follows:
  - Static Multicast Service
    - The Static Multicast Service for which the content is always transmitted through one or more broadcast channels that would have been pre-established prior to the user(s) join and leave a MCBCS session at one or more MBS Zones which are belonged to the same

MCBCS Transmission Zone. A subscription based broadcast service is considered as static multicast service.

- Broadcast Service: A special type of MCBCS for which the content is always transmitted through broadcast channels by the access network without considering the number of MS's receiving the content in the BS's involved..

#### **4.2.3 MCBCS Program**

A group of MCBCS contents to which a mobile may subscribe as a service package.

#### **4.2.4 MCBCS MS Session**

MCBCS Session refers to a single or group of logical connections established between the MS and the WiMAX Network through which MCBCS data is delivered to the user. An MCBCS session may continue even while the mobile is going into and coming out of power saving modes.

#### **4.2.5 MCBCS Network Session Management**

MCBCS Network Session Management between the MCBCS Controller/Server and the MBS Proxy is to manage the MCBCS session creation, modification and termination according a given set of service parameters (e.g. Session ID, QoS profile, Session start-time/end-time, Session IP classifiers - i.e. IP address and port id etc.)

#### **4.2.6 Multicast group**

A set of hosts identified by a single IP multicast destination address. A multicast datagram is delivered to all members of its destination host group.

#### **4.2.7 MCBCS Transmission Zone**

MCBCS programs may be transmitted to all or selected regions of the network. These contiguous or non contiguous regions called MCBCS Transmission Zones are defined for each MCBCS Program, as groups of BS's which concurrently, or almost concurrently, multicast/broadcast the contents of the Program. The MCBCS Transmission Zones are not necessarily tied directly to any MAC features or frequency reuse. Note that, this particular definition is applicable only to MCBCS-DSx specification.

## 5. Usage Scenarios Summary

### 5.1 Detailed Usage Scenario Support

Usage Scenario Information Highlights	Descriptions of the information (streaming)	
Usage Scenario	<b>Name of the usage scenario</b> Local streaming broadcast -- like advertising with music, TV	
Description	<b>Description of the usage scenario</b> The program is distributed locally through broadcast. End users attending a major event like trade show, concert, sporting game, etc want to receive a broadcast/multicast of advertisement, event introduction, other relevant events (e.g., football game) happening concurrently. That information may be delivered based on registered users' profile through users' pre-operation, for example age, sex and to increase value added.	
Usage Context	<b>Context of usage</b> Listening, watching.	
Value Chain	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NSP ⇔ ASP, NAP ⇔ NSP	
Role of Actors	Content Provider	Provide the TV, music or advertisement program to the user.
	Service Provider	Provide the service locally. It may only need the user to subscribe to the network, but not to this particular program.
	Network Operator (NAP, NSP)	NAP delivers it to through broadcast channel regardless of number of users listening.
	End User	Receiving the program.
Remarks	1. Depending on the business model, the broadcast may be available for all end users or only those who purchase/subscribe to the service. While receiving the content selection, the user can originate (or receive) a voice call and/or initiate an Internet web session. 2. This is insensitive to the absent or present of the terminal for the DL transmission scheduling. 3. The network support terminal to receive data while it is in idle mode. 4. Bill type can be: Free; Flat Rate; Charging can be subscription based 5. The subscribers could be provided a TV program list (there are many TV programs) by NSP. NSP picks out the limited programs by statistical results of subscribers VOD and then provides these limited programs to end-users.	

Usage Scenario Information Highlights	Descriptions of the information (Streaming)
Usage Scenario	<b>Name of the usage scenario</b> Stream broadcast, multicast the program—sensitive of terminal absence

<b>Description</b>	<b>Description of the usage scenario</b> Stream delivery over broadcast/multicast channel. That information may be delivered based on registered users' profile through users' pre-operation, for example age, sex and to increase value added.	
<b>Usage Context</b>	<b>Context of usage</b> The user is watching a program like sport and trade show	
<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NSP ⇔ ASP, NAP ⇔ NSP	
<b>Role of Actors</b>	Content Provider	ASP provides the content to the service provider. It may encrypt the content.
	Service Provider	Service provider gets the content, may merge different contents in one program, and deliver it to NAP, and NSP can also be act as content provider.
	Network Operator (NAP, NSP)	NAP further delivers it by using multicast/broadcast channel.
	End User	Watching the or play the program
<b>Remarks</b>	1. This is sensitive to the absence or presence of the terminal. 2. The network support terminal may receive the broadcast/multicast data when it is in idle mode. 3. Bill type can be: Free; Pay per program/channel; Flat Rate; Charging can be subscription based, traffic based.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (online gaming)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Interactive service -- Online gaming	
<b>Description</b>	<b>Description of the usage scenario</b> A subscriber plays a game, which is at the central server with one or more subscribers. The action result of one player will distribute to all the players.	
<b>Usage Context</b>	<b>Context of usage</b> The user actively plays a game	
<b>Value Chain</b>	<b>Involved player</b> ASP (game server), NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NAP ⇔ NSP, NSP ⇔ ASP	
<b>Role of Actors</b>	Content Provider	ASP provides the game files to the server.
	Service Provider	Service provider gets the content and provide the services, control user subscription, and deliver it to NAP

	Network Operator ( NAP, NSP )	NAP take the user action through interactive channel to the server at NSP or ASP, and the action result is delivered through unicast or multicast channel down to all the players. The transmission method depends on the number of users who play the game.
	End User	Playing the game, send its action result through interactive channel to the game server.
<b>Remarks</b>	1. This is real time services. We will consider unicast based capability and static multicast first; dynamic multicast will be the next. Architecture and framework should be flexible enough to consider the support of multicast. 2. Bill type can be: Pay per game; Flat Rate; Bundle of playing; Daily sessions;	

<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (push to talk)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Interactive service – push to talk	
<b>Description</b>	<b>Description of the usage scenario</b> A subscriber talks to one or more subscribers.	
<b>Usage Context</b>	<b>Context of usage</b> Conversation.	
<b>Value Chain</b>	<b>Involved player</b> NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NAP ⇔ NSP	
<b>Role of Actors</b>	Content Provider	N/A
	Service Provider	Service provider control user subscription and authentication
	Network Operator ( NAP, NSP )	One user is talking and NAP delivers it through unicast uplink to the NSP and then delivers it through multicast down to other listeners.
	End User	Listen to the talk from others and also talk to the others.
<b>Remarks</b>	1. This is a real time service. We will consider unicast based capability and broadcast or non dynamic multicast. Dynamic multicast push to talk will be supported next. Architecture and framework should flexible enough to consider the support of multicast. 2. Bill type can be: Free; Pay per call; Flat Rate; Bundle of calls; Daily sessions; Pay-per-click. Charging can be subscription based or traffic based.	

<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (file downloading)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Non-scheduled file downloading	
<b>Description</b>	<b>Description of the usage scenario</b> Download on demand. A subscriber may request for downloading files, for example	



	software patch, videos etc.	
<b>Usage Context</b>	<b>Context of usage</b> View, or fixing old bugs.	
<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, ASP ⇔ NSP, NAP ⇔ NSP	
<b>Role of Actors</b>	Content Provider	Provide the file for downloading
	Service Provider	Service provider gets the file, control user subscription, billing management, QoS and deliver it to NAP
	Network Operator (NAP, NSP)	NAP delivers it to through either unicast or multicast depending upon the number of users requesting the files.
	End User	Receiving the files
<b>Remarks</b>	1. Any file format 2. Bill type can be: Free; Pay per download; Flat Rate; Charging can be subscription based, traffic based.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (file downloading)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Pre-scheduled/static broadcast multicast file downloading.	
<b>Description</b>	<b>Description of the usage scenario</b> A subscriber may request and subscribe for downloading files, and/or network can download the files (for example patches) at a certain time. User may or may not actively send the request. That information may be delivered/downloaded based on registered users' profile through users' pre-operation, for example age, sex and to increase value added.	
<b>Usage Context</b>	<b>Context of usage</b> View, or fixing old bugs.	
<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NAP ⇔ NSP, NSP ⇔ ASP	
<b>Role of Actors</b>	Content Provider	Provide the file for downloading
	Service Provider	Service provider gets the file, control user subscription, billing management, QoS and deliver it to NAP
	Network Operator (NAP, NSP)	NAP delivers it to through either unicast or multicast depending upon the number of users requesting the files.
	End User	Receiving the files
<b>Remarks</b>	1. Any file format 2. The network can support terminal reception of data when terminal is in idle mode. 3. Bill type can be: Free; Flat Rate; Charging can be subscription based, traffic based.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Service Guide)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Delivery of Service Guide having the information about MCBCS contents and programs	
<b>Description</b>	<b>Description of the usage scenario</b> MCBCS service provider provides the service information, the access information, and the subscription information of contents and programs to the end user and his device.	
<b>Usage Context</b>	<b>Context of usage</b> The User and his terminal can get the service information of MCBCS contents and programs and he and his terminal can use this information to access MCBCS contents and programs	
<b>Value Chain</b>	<b>Involved player</b> CP , SP, AP, End User	
	<b>End user Relationship with the player(s)</b> End user ⇔ SP, SP ⇔ AP	
<b>Role of Actors</b>	Content Provider	CP will provide the service information of MCBCS contents and programs to SP, which will generate Service Guide for MCBCS Service.
	Service Provider	SP will generate Service Guide and deliver it to the End User through AP's network.
	Access Provider	AP will deliver Service Guide to the End User.
	End User	End user can know the service information of MCBCS contents and programs after receiving it. He will use the information of service guide to subscribe and to enjoy contents or programs.
<b>Remarks</b>		

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Alert)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Alert – traffic, weather, subscribe to the blog or forum for large amount of data sent at low data rate.	
<b>Description</b>	<b>Description of the usage scenario</b> A subscriber will select multiple information feeds from a set of choices, such as stock price updates, weather, traffic, or subscribe to a blog or forum for information update notice, etc. and after the request, the user continues to get the updated information being broadcasted or multicasted. Alternatively, the end user can request and receive emergency broadcast messages from the system.	
<b>Usage Context</b>	<b>Context of usage</b> The user wants to get the updated information for better planning of activities; or get emergency messages for survival.	

<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NSP ⇔ ASP, NSP ⇔ NAP	
<b>Role of Actors</b>	Content Provider	Provide information like storm, road closure information etc. It may encrypt the data to NSP.
	Service Provider	Deliver it to NAP. Manage the subscription, billing. Note, NSP can also be the content provider.
	Network Operator (NAP, NSP)	NAP delivers it to through local multicast or broadcast. The multicast or broadcast region and confirmation of the DL transmission may be based on regulation of the service requirement.
	End User	Receiving the information
<b>Remarks</b>	1. At any time during the reception, the user can change its selection or completely discontinue the reception. The user can originate (or) receive a voice call and/or initiate an internet web session while receiving the updated content. 2. Prioritization may be needed to ensure RF resource availability. 3. The terminal is able to receive data while in idle mode 4. Bill type can be: Free; Flat Rate; charging can be subscription based or traffic based.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Alert)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Alert – un-admitted notification	
<b>Description</b>	<b>Description of the usage scenario</b> MCBCS service provider can provide the notification message containing various information e.g. service provider information; service information update to its end user, emergency/disaster information as nationwide or local services.	
<b>Usage Context</b>	<b>Context of usage</b> Service Provider can have the method for the delivery of various information, including updated SP information and/or disaster information like earth quake, storm, or tsunami.	
<b>Value Chain</b>	<b>Involved player</b> SP, AP, End User	
	<b>End user Relationship with the player(s)</b> End user ⇔ SP, SP ⇔ AP	
<b>Role of Actors</b>	Content Provider	None
	Service Provider	SP will generate Notification message and deliver it to the End User through AP's network.
	Access Provider	AP will deliver notification to the End User through its network. AP may use Broadcast channel or Unicast channel.
	End User	End user can get the latest information of Service Provider
<b>Remarks</b>		

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Video/Audio Podcasting)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Video/Audio Podcasting	
<b>Description</b>	<b>Description of the usage scenario</b> Video/Audio Podcasting – Alert to user for new video/audio content that has been posted and available. The content is pushed to the user by the Service Provider usually during off-peak network traffic hours.	
<b>Usage Context</b>	<b>Context of usage</b> Users want to enjoy the updated new video/audio show.	
<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NSP ⇔ NAP, NSP ⇔ ASP	
<b>Role of Actors</b>	Content Provider	CP offers a comprehensive selection of information content that is attractive to the end users
	Service Provider	SP provides a large variety of information content choices to draw end users for its services.
	Network Operator (NAP, NSP)	AP contracts with SP to deliver the content to the end users.
	End User	Selects multiple information feeds from a set of choices. End user will be alerted and receive the information feed when the SP pushes this onto its device. The downloaded information can be viewed later by the end user.
<b>Remarks</b>	1. The user can originate (or) receive a voice call and/or initiate an internet web session while receiving the updated content. 2. Prioritization may be needed to ensure RF resource availability. 3. The network supports MS reception of data while in idle mode 4. Bill type can be: Free; Flat Rate; charging can be subscription based or traffic based.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Interactive TV)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Interactive TV—voting application with real time streaming video/audio services	
<b>Description</b>	<b>Description of the usage scenario</b> It offers a variety of video and audio content channels from which users can choose. The contents require continuous transmission and are streamed at a pre-scheduled time dictated by the service providers over dedicated broadcast/multicast channels to a large number of audiences. The subscriber can be involved in a TV program in which the outcome of the show depends on the voting from the user. E.x. an advanced dancing with the star.	
<b>Usage Context</b>	<b>Context of usage</b>	

	Watching the TV and vote.	
<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NSP, NAP ⇔ NSP, NSP ⇔ ASP	
<b>Role of Actors</b>	Content Provider	Provide the TV program to the user.
	Service Provider	Deliver it to NAP. Manage the subscription, billing, and authentication.
	Network Operator (NAP, NSP)	NAP delivers it to through multicast or broadcast channel depending upon the number of users watching the TV. QoS maybe required for guaranteed end-user experience based on the contract.
	End User	Receives the TV program, watches the TV program, votes and sends voting decision through interactive channel via unicast.
<b>Remarks</b>	1. The user should be able to originate a web session simultaneously to respond via Internet when viewing/receiving interactive shows. The user can originate or receive a voice call while receiving the MCBCS program. 2. The feedback mechanism is more user-aware. 3. Bill type can be: Free; Flat Rate; Pay per vote; Pay per program; charging can be subscription based or traffic based.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Real-time monitoring)</b>
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Real-time monitoring.
<b>Description</b>	<b>Description of the usage scenario</b> In the web-based, real-time monitoring services environments, there should be one or more cameras connected to the monitor centre via the WiMAX (or other broadband networks). In the monitor centre, the camera video is encoded into streaming, and can be viewed by users through the Internet. The user can also be connected to Internet through WiMAX (or other broadband networks). The typical real-time monitoring applications include kindergartens and public hot spots. For the former applications, there are cameras in the teaching-room, dinner-room, playground, reading-room, and so on; and the video can be viewed by the children's parents/grandparents. There exists the case that many users view the same video at the same time, so there are many video streams in the network. And even worse is that more camera videos are viewed by many other viewers. So there is more pressure on the network bearer and servers' processing capability & connection bandwidth. The one solution is multicast and the server can send a single stream to the network which supports multicast and can be received by all related viewers. The user can view the video in unicast mode first; as more users view the same video, the network of the service provider should be triggered to transfer from unicast mode to multicast mode to deliver the video.
<b>Usage Context</b>	<b>Context of usage</b> Viewing/Monitoring

<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> NAP ⇔ NSP, Subscriber ⇔ NSP/ASP	
<b>Role of Actors</b>	Content Provider	NSP's subscriber prepares content which maybe captured by the cameras to be uploaded to the NSP's dedicated web hosting server/site. Also, it will register with the NSP for the list of permitted viewers (e.g. NAI) of the contents
	Service Provider	Provides the web hosting toolkits for the subscriber to register and to upload their web contents; also, manages the viewer group of the subscriber's contents.
	Network Operator (NAP, NSP)	Provide the MCBCS transport for the real-time monitoring contents. Note that it is likely the NAP & NSP are the same operator in order to be able manage the list of subscriber and the list of associated permitted viewers (who are also the subscribers of the NAP + NSP) to access to the contents.
	End User	Upload, select, receive, and consume the content.
<b>Remarks</b>	File format: video.	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Multi-Party Conference Call)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Interactive service -Multi-Party Conference Call (voice or multimedia CC)	
<b>Description</b>	<b>Description of the usage scenario</b> The voice or multimedia of one or more users can be delivered to all subscribers by unicast/multicast channel at the same time	
<b>Usage Context</b>	<b>Context of usage</b> Voice or multimedia CC.	
<b>Value Chain</b>	<b>Involved player</b> NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NAP, Subscriber ⇔ NSP	
<b>Role of Actors</b>	Content Provider	
	Service Provider	Service provider control user subscription and authentication. Service provider may merge different contents from different channels (data, voice or multimedia) targeted for different active subscribers into one program, and send out by unicast or multicast. The transmission method depends upon the number of users who subscribe to this CC.
	Network Operator (NAP, NSP)	NAP delivers voice or multimedia from multiple users to NSP through multiple unicast uplinks; then the NSP merges multiple unicast contents into one program and delivers it through unicast or multicast down to all subscribers.

	End User	There maybe two kinds of end users. 1. Interactive end users, has right to uplink their voice or multimedia to NSP; 2. Non-interactive end users, only has right to receive CC.
<b>Remarks</b>	1. This scenario is different from push to talk in that it may have multiple unicast uplink at the same time. 2. This scenario is different from online game in that it doesn't involve ASP 3. This scenario may include two kinds of end users, interactive end users or non-interactive end users 4. Bill type can be: pay per conference call, duration, charging can be subscription based or traffic based	

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<b>Usage Scenario Information Highlights</b>	<b>Descriptions of the information (Interactive TV-VOD)</b>	
<b>Usage Scenario</b>	<b>Name of the usage scenario</b> Interactive TV—video on demand (The MS has relationship with ASP)	
<b>Description</b>	<b>Description of the usage scenario</b> There are more MCBCS programs that need to multicast/broadcast, but radio resources used for multicast or broadcast are limited. There exists a contradiction between more MCBCS programs and limited multicast/broadcast radio resources. There needs to be a method for choosing the limited number of MCBCS programs from many MCBCS programs. ASP subscribes to a set of channels from NSP/NAP, - i.e. the NSP/NAP are acting as the MCBCS channel "wholesaler" for different ASPs so that the ASPs can provide MCBCS programming to its customer by MCBCS broadcasting or multicasting. The subscribers could be provided a TV program list (there are many TV programs) by ASP. ASP picks out the limited programs by statistical results of subscribers' VOD and provides these limited programs to end users.	
<b>Usage Context</b>	<b>Context of usage</b> Demand and Watching the TV.	
<b>Value Chain</b>	<b>Involved player</b> ASP, NSP, NAP	
	<b>Subscriber Relationship with the player(s) (i.e. player can be subscriber, NAP, ASP, NSP, MS if explicit handset performance is required)</b> Subscriber ⇔ NAP, subscriber ⇔ ASP, Subscriber ⇔ NSP	
<b>Role of Actors</b>	Content Provider	ASP subscribes to a set of channels from NSP/NAP. ASP provides the TV program list to end users and pick out limited TV programs for multicast/broadcast.
	Service Provider	NSP provide MCBCS service to end users.
	Network Operator (NAP, NSP)	NSP provide MCBCS service, NAP delivers it to subscribers through multicast or broadcast channel
	End User	First order program from TV program list, then receive the TV and watch the TV program at an explicit time.
<b>Remarks</b>	1. This scenario can maximize the ASP's revenue. 2. Bill type can be: pay per click, pay per program, charging can be subscription based or	

	traffic based
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## 5.2 Summary of the Supported Usage Scenarios

The usage scenarios that are shaded in the following usage scenarios table will be supported by phase-1 MCBCS. For more details on the usage scenario description, the following document shall be referred.

**Table 5-1 : Summary of the MCBCS Phase-1 Supported Usage Scenarios**

Use case	Content Formats				Need for uplink interaction	Need for bearer optimization			Preferred Downlink Transport		
	Text	Audio	Video	Binary		Likelihood of consumption coincidence in time  [low – medium – high]	Likelihood of consumption coincidence in time and space (one BS)  [low – medium – high]	RRM benefits from optimization using multicast/broadcast in R1  [Yes/No]	Broadcast	Multicast	Unicast
Streaming delivery over Broadcast/Multicast Channel											
Local advertisement, music, TV (location insensitive)		Y	Y	Y		Med-High	Med-High	Yes	Y	Y	
Streaming (location sensitive)		Y	Y	Y		Med - High	Med-High	Yes	Y	Y	
Alert											
Alert (traffic, weather, new content has been posted on the forum/blog)	Y	Y	Y	Y		Med	Med	Yes (for forum and blog it depends on the # of user who subscribe it)	Y	Y	Y
Alert (unadmit notification)	Y					Med	Med	Yes, depends on the # of users and the content of the notification.	Y	Y	Y



Notification + file download over broadcast/Multicast Channel											
video/audio podcasting		Y	Y			Med	Med	Yes		Y	
File download over Broadcast/Multicast Channel											
Non-scheduled file downloading	Y	Y	Y	Y		Low	Low-Med	Yes, depends on the # of users currently downloading		Y	
Scheduled file downloading	Y	Y	Y	Y		Med	Med	Yes	Y	Y	
Service Guide delivery	Y	Y	Y	Y		High Note: depends on the number of users in a BS	High Note: depends on the number of users in a BS	Yes	Y	Y	Y
Main Services and the corresponding interactive service											
Distributed online gaming		Y	Y	Y	Y	high	Medium	Yes, depends on the # of users play it		Y	Y
Push to Talk		Y			Y	high	Medium	Depend on the number of users joined this service		Y	Y
Interactive TV – voting application		Y	Y		Y	Med-high	Med - High	Yes	Y	Y	
Multi-Party Conference		Y	Y		Y	Med	Med	Yes, depends on the # of users play it		Y	Y
Real-time Monitoring		Y	Y		N	Med	Low-Med	Yes, depends on the # of users viewing it.		Y	Y
Whole sell model											
Interactive TV – VOD(The MS has relationship with ASP)		Y	Y		Y	high	High	Yes	Y	Y	

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## 6. Commonalities of the ASN Protocol

Unless otherwise specified, following things are complied with chapter 3 of WiMAX Forum Network Architecture (Stage3); Version 1.5 [5].

- the format for the message primitives of the ASN control protocol
- the transport protocol for the ASN control protocol
- transport requirements for the ASN control protocol
- the error handling for the ASN control protocol

### 6.1 MCBCS Specific Notation

- (1) For MCBCS data path creation/release messages in R6, MSID in message header should be set to zero because those messages aren't related to any specific MS.

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## 7. Requirements and Principles

### 7.1 MCBCS Data Synchronization Support

#### 7.1.1 Optionality of the Feature

MCBCS is optional for deployment, however, if the MCBCS feature is supported the data synchronization support for the macro diversity, frame-level and frame-offset synchronization for MCBCS shall comply with the IEEE Std 802.16-Rev2 specification [3].

#### 7.1.2 Synchronization Delay

If data are delivered to the BSs over asynchronous medium, synchronization of the air transmission can be achieved only at the expense of some delay. The minimum delay of synchronization is close to the latency introduced by communication between the two most distant elements in the network.

The need to cope with packet loss increases the synchronization delay.

MBS Scheduler may introduce delay up to 255 airframes for intra-MBS Zone and up to 262 airframes for inter-MBS Zones. Scheduler is in control of how much delay it introduces.

#### 7.1.3 Fundamental Assumptions

The entity which synchronizes transmissions in an MBS Zone has its clock synchronized with the BSs that belong to the MBS Zone. If the inter-MBS Zones synchronization is also required, then, the clock synchronization support needs to span across multiple MBS Zones. If this entity resides in the ASN GW then the clocks of this ASN GW and the BSs in the MBS Zone are synchronized. The specific technique of synchronization is out of scope. The likely techniques to be used are GPS and IEEE 1588.

Data unicast conditions are different in each BS and can vary from frame to frame. Therefore, when Multicast transmissions are synchronized between a numbers of BSs, the unicast demand may be larger than can be accommodated in a particular frame on a particular BS. In the case of conflict over available resources the preference is given to Multicast to preserve the ability to perform macro-diversity synchronization of transmissions.

MCBCS Traffic should be prioritized over unicast in the backhaul unless the bandwidth is guaranteed.

#### 7.1.4 The Scope of Frame-level Coordination, Frame-offset Coordination and Macro-Diversity Synchronization

For the MCBCS data synchronization support, the current IEEE 802.16-Rev2[3] provides the mechanisms for the intra and inter MBS zones data synchronization support.

##### 7.1.4.1 Intra-MBS Zone Data Synchronization

Two main mechanisms are specified for intra-MBS zone data synchronization support:

- Frame-level coordination, and
- Macro diversity

If the frame-level coordination is supported, all BSs that belong to the same MBS Zone, the following coordination shall be assured:

- The set of MAC SDUs carrying MBS content shall be identical in the same frame in all BS in the same MBS zone;
- The mapping of MAC SDUs carrying MBS content onto MAC PDUs shall be identical in the same frame in all BS in the same MBS Zone, meaning, in particular, identical SDU fragments and identical fragment sequence number (block sequence number) and fragment size

Coordination in the MBS Zone assures that the SS may continue to receive MBS transmissions from any BS that is part of the MBS Zone, regardless of the SS operating mode—Normal Operation, Idle Mode—without need for the SS to register to the BS from which it receives the transmission.

If the macro-diversity synchronization is required across the entire set of the BSs that belonged to the same MBS Zone area, in addition to the above considerations, the following synchronization level shall be assured:

- MBS Bursts positions and dimensions as well as PHY parameters associated with each MBS Burst (e.g. FEC Type, Modulation Type, Repetition Coding, Boosting, HARQ Settings) must be identical.
- Mapping SDUs into the MBS Bursts must be identical.
  - SDUs must be identically mapped into MAC PDUs, which implies identical ordering of SDUs; identical Headers and Subheaders used; identical fragmentation, if applicable.
  - Ordering of the MAC PDUs within a Burst must be identical.

MBS Zones may overlap, hence, a BS may participate in more than one MBS Zone. When a BS participates in more than one MBS Zone, the resources (time and frequency) should be synchronously allocated to avoid conflict.

#### 7.1.4.2 Inter-MBS Zone Data Synchronization

For the inter-MBS Zones data synchronization, IEEE 802.16-Rev2 [3] supports the Frame-offset coordination.

Frame-offset coordination implies the transmission of the same MBS service flow within the specified frame-offset boundary across MBS zones. The synchronization of the MBS service flow downlink transmission is coordinated across the MBS Zones via the support of MBS MAP Message over the R1 interface. The synchronization of the MBS service flow shall be conformed to an allowable number of R1 frames that may be arrived earlier or later than the current serving MBS zone for the MS. Thus, the number of R1 frames is specified in term of frame offset. The range of this frame offset is from +7 to -7 frames, inclusive, between any two neighboring MBS zones.

There are two-level of frame-offset coordinations across the MBS Zones:

Level-1: The frame-offset coordination focuses only on the daisy-chaining of the MBS MAP messages without the restriction of the synchronization of user data (i.e. see Level-2 descriptions below). Such level of the frame-offset coordination maintains the power-saving capability for the MS when it is crossing MBS Zones.

Level-2: A more strict form of frame-offset coordination requires that the data transmissions between neighboring MBS zones are synchronized as for the MBS MAP message. In terms of the transmission contents, the data synchronization requirement in this case is the same as for frame-level coordination within an MBS zone. With the Level-2 frame-offset coordination, not only the power savings can be supported via the MBS\_MAP message chaining, but also the continuity of data reception can be maintained for the MBS service flow.

## 7.2 MCBCS Coverage Area Considerations

Multi-BS MBS is expected to improve the error rate of traffic transmitted over the air without H-ARQ and MAC ARQ.

MCBCS phase-1 may support the multi-BS MBS with:

- MBS Zone with #of BS(s) > 1 within an ASN, and
- macro-diversity within an MBS zone with SFN for a given ASN
- frame-level coordination for intra and inter MBS Zone within the WiMAX network

Although the Multi-BS MBS without macro-diversity can be supported, the Multi-BS MBS with macro-diversity is recommended in this document.

In term of the frame-offset coordination for inter MBS Zone within the WiMAX network, this capability will be deferred until phase-2 MCBCS development.

## 7.3 MCBCS MS Requirements

### 7.3.1 MCBCS-App MS requirements

The MCBCS MS should have synchronized reference time between network either with GPS or with NTP. If the MCBCS MS has the capability of receiving MCBCS contents during idle state, it shall have NTP in order to receive MCBCS contents at the scheduled time.

MCBCS MS shall have an interface between the MAC layer and higher layer, which is capable of delivering information to the MAC layer for mapping between Multicast IP address and MCID/MBS Zone ID in order to perform selective decoding at the MAC layer.

Table 7-1 shows necessary functions for MCBCS Client Application of MCBCS MS.

**Table 7-1 : Requirements and Functions of MCBCS MS and Client Application**

No.	Function Name	Operation Timing	Content	Mandatory / Option
1	Program information acquisition	When the user operates it	Function to access portal server etc. and to acquire program information. (This information may be acquired via ftp or E-mail attachment.)	Option
2	Program cancellation	When the user operates it	Function to cancel Multicast reception.	Option
3	Program information storage	Always	Program information to receive the multicast is preserved.	Mandatory
4	Program information deletion	When program is canceled.	Function to delete program information when program is canceled.	Option
5	Device Setup	Before receiving data	Function to configure wireless settings by notifying MCBCS Device of MCID and MBS Zone ID, etc.	Mandatory
6	Device Release	After receiving data	Function to do wireless release.	Mandatory
7	Multicast receive	When data is received	Function to receive data to which multicast is delivered from MCBCS Server at specified time.	Mandatory

No.	Function Name	Operation Timing	Content	Mandatory / Option
8	FEC decoding	After receiving data	Function to decode FEC encoded contents.	Option
9	Contents decoding	After receiving data	Function to decode contents that were encrypted and delivered.	Option
10	Result notification	When MCBCS Server specifies it	Function to notify result of multicast notice assignment.	Option
11	Unicast retransmission	When MCBCS Server specifies it	Function to retransmit contents by unicast when multicast notice assignment fails.	Option

### 7.3.2 MCBCS-DSx MS Requirements

MS is required to be compliant to the IEEE 802.16 airlink interface specification. MCBCS-DSx is designed to support any kind of MCBCS application layer signaling (e.g. Bcast, 3GPP MBMS, 3GPP2 BCMCS etc.) and the application layer signaling for MCBCS-DSx are outside the scope of the MCBCS-DSx phase-1.

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## 8. MCBCS Identifiers

### Program ID

A Program ID uniquely identifies MCBCS program defined in [4].

### Contents ID (16 bits)

A Contents ID uniquely identifies MBS contents in MBS Server. One Contents ID is mapped to one R3 IP Multicast Address. It is the same as MBS Contents ID defined in IEEE 802.16e [2].

### Transmission Zone ID (16 bits) - *applicable only to MCBCS-App*

A Transmission Zone ID uniquely identifies MCBCS Transmission Zone defined in [4]. One Transmission Zone consists of one or more MBS Zones. MCBCS Server allocates and manages this ID. This ID shall not be transmitted to NAP.

### Transmission Zone ID (Variable – ASCII string) – *applicable only to MCBCS-DSx*

A Transmission Zone ID uniquely identifies MCBCS Transmission Zone defined in [4] for a given NSP. One Transmission Zone consists of one or more MBS Zones. MCBCS Controller/Server allocates and manages this ID. This ID can be transmitted to NAP during the MS's initial network entry, dynamic service registration or session start/stop to support the mapping between a given NSP's MCBCS Transmission Zone to one or more MBS Zones at the NAP. Alternately, this ID can be statically configured at the NAP.

### MBS Zone ID (7 bits)

This is defined in IEEE 802.16e[2]. One MBS Zone consists of one or more BSs. MBS Zone ID = 0 shall not be used.

### R3 IP Multicast Address

IP multicast address used for multicast transport over R3. The IP address also reaches MSs. One Contents ID is mapped to one R3 IP Multicast Address.

### R6 IP Multicast Address

IP multicast address used for multicast transport over R6. It is assigned by ASN-GW or NAP.

### MCID (0xFEAE0~0xFEEE)

MCID is defined in IEEE 802.16e[2]. It is defined in IEEE 802.16e that an MCID is 12 bits over the R1 interface.

### MBS Proxy ID

MBS Proxy ID is the same as the MBS Distribution DPF ID as it is co-located with the MBS Distribution DPF.

**MBS Distribution DPF ID**

Identifier represents the MBS Distribution DPF which is responsible for MCBCS bearer control and management.

**MBS Sync Controller ID**

Identifier represents the MBS Sync Controller which is responsible for specifying the MBS data synchronization rules for one or more MBS Zones for a given MCBCS service content.

**MBD Sync Executor ID**

Identifier represents the MBS Sync Executor which is responsible for following and the execution of the MBS data synchronization rules that are specified by the MBS Sync Controller.

**MBD DPF ID**

Identifier represents the MBS DPF which is responsible for supporting the MCBCS bearer control and management operation specified by the MBS Distribution DPF.