



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

Requirements for WiMAX VoIP Services (WVS)

Phase-1

**WMF-T31-128-R020v01**

WMF Approved

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## 1. Introduction (Informative)

Mobile WiMAX® is one of the candidates for the next-generation broadband wireless networks. The service has been deployed in many countries & it is expected to continue growing in the next few years.

WiMAX operators are looking to complement their data offering with stationary and mobile VoIP services. In addition to the basic internet connectivity services, WiMAX systems are required to provide various communication services. One of the key services of a mobile network system is the voice service. Since WiMAX is an all IP network, the voice service will be voice over IP (VoIP). VOIP applications are well-established in fixed networks, but mobile VoIP is relatively new. Furthermore, it is important to support interoperability with PSTN, cellular operators, and supply a complete set of services that are currently offered on 2G/3G networks.

This document defines stage-1 requirements specification for Voice over IP service for the WiMAX broadband wireless networks. It describes usage scenarios and functional requirements for Voice over IP Service. Architecture details shall be specified in stage-2 and stage-3 specifications based on the requirements outlined in this document.

---

## 1 **2. Objective and Scope**

2 The objective of this specification is to identify use case scenarios and to define requirements to enable VoIP  
3 services. The scope of the specification is to identify the following:

- 4 • Use cases to support VoIP services
- 5 • Policy control for VoIP service
- 6 • The support for service flow and QoS management for VoIP services
- 7 • Provisioning/activation/deactivation for VoIP services
- 8 • Charging and security aspects for VoIP services
- 9 • Support for mobility applications for VoIP services

10 Due to the urgent deployment timeline, the overall scope of the VoIP specification will be split into phases. The  
11 phase addressed by this specification will focus on the basic VoIP service and follow on phases will provide  
12 additional services.

13

---

## 3. Abbreviations, Definitions, and Conventions (*Informative*)

### 3.1 Conventions (*Informative*)

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in Ref. [2] RFC 2119.

### 3.2 Abbreviations and Acronyms (*Informative*)

ASN	Access Service Network
BS	Base Station
CSN	Connectivity Service Network
DTMF	Dual-Tone Multi-Frequency
IP	Internet Protocol
NAP	Network access Provider
NSP	Network Service Provider
QoS	Quality of Service
SF	Service Flow
TTY	Teletypewriter
VoIP	Voice over IP
VSP	Voice Service Provider
WVS	WiMAX VoIP Service

### 3.3 Definitions (*Informative*)

#### **Interoperability:**

IEEE defines interoperability as the ability of two or more systems or components to exchange information and to use the information that has been exchanged Ref. [1].

In this specification, the term is used to indicate supporting the scenario where a VoIP call may originate in the WiMAX system & terminate in another access technology or vice versa. The term interoperability here is not to be mixed with interworking where mobility is supported between different access technologies.

#### **Inter-working:**

“A technical and business relationship between a WiMAX network and a non-WiMAX network (either the Access Network or the Core Network could be non-WiMAX) that enables the subscribers of the first network (home network) to connect and receive services in the second (visited or serving network). The WiMAX and non-WiMAX networks may be owned by the same entity or different entities” Ref. [4].

In this specification, the term is used to indicate supporting mobility between WiMAX & non WiMAX accesses, i.e., the scenario where a VoIP call may start in a WiMAX system then hands over to a non WiMAX access technology (or vice versa).

#### **Restricted Devices:**

1 A restricted device is a device that has access to Emergency Services only, i.e., can call emergency service & have a  
2 call back capability.

3

4 **WVS Infrastructure:**

5 For the purpose of this specification, WVS infrastructure is defined as the application layer infrastructure needed to  
6 support WVS, it includes any entities (e.g. SIP Servers, Media Gateways, etc) necessary to support the service.

7

8 **WiMAX Network:**

9 For the purpose of this specification, WiMAX Network refers to the concatenation of ASN and CSN network nodes  
10 and services.

11

12 **WiMAX System:**

13 For the purpose of this specification, WiMAX System refers to the concatenation of the WiMAX network & the  
14 User Device.

15

---

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- 24 [10]
- 25

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## 5. Use Cases (Informative)

### 5.1 Use Case 1 - VoIP service under non-roaming within WiMAX® network

#### Background:

Bob is a subscriber of MAXNSP1 and he is attaching to his WiMAX home network, Carl is a subscriber of MAXNSP2 and he is also attaching to his WiMAX home network. MAXNSP1 has a contractual agreement with MAXNSP2. Bob initiates a VoIP conversation to Carl. Bob and Carl have compatible Codecs and audio clients.

Expected Outcome #1:

Bob and Carl establish an audio conversation through MAXNSP1 and MAXNSP2.

### 5.2 Use Case 2 - VoIP service Interoperability between WiMAX network and non-WiMAX network

#### Background:

Bob is a subscriber of MAXNSP1 (WiMAX operator) and he is attaching to his WiMAX home network, Carl is a subscriber of 3GPPNSP1(3GPP operator) and he is also attaching to his home network. MAXNSP1 has a contractual agreement with 3GPPNSP1. Bob initiates a VoIP conversation to Carl.

Expected Outcome #1:

Bob and Carl establish an audio conversation through MAXNSP1 and 3GPPNSP1.

### 5.3 Use Case 3 - VoIP service within WiMAX network with HO support

#### Background:

Bob is a subscriber of MAXNSP1 and he is attaching to his WiMAX home network and driving home, Carl is a subscriber of MAXNSP2 and he is also attaching to his WiMAX home network. MAXNSP1 has a contractual agreement with MAXNSP2. Bob initiates a VoIP conversation to Carl. Bob and Carl have compatible codecs and audio clients.

Expected Outcome #1:

Bob and Carl establish an audio conversation through MAXNSP1 and MAXNSP2 while Bob's User Device is handing over from one BS to another.

Expected Outcome #2:

If Bob and Carl do not have compatible Codecs they establish an audio conversation through MAXNSP1, MAXNSP2 and the transcoding mechanism provided by the networks.

1 **5.4 Use Case 4 - WiMAX VoIP service interworking with 3GPP2 CS**

2 **Background:**

3

4 Bob is a subscriber of MAXNSP1 and he is attaching to his WiMAX home network and driving home, Carl is a  
5 subscriber of MAXNSP2 and he is also attaching to his WiMAX home network. Bob initiates a VoIP conversation  
6 to Carl. Bob and Carl have compatible codecs and audio clients. Bob handover to 3GPP2.

7

8 Expected Outcome #1:

9 The handover is successful; Bob and Carl establish an audio conversation through 3GPP2 and MAXNSP2.

10

11 **5.5 Use Case 5 - Emergency VoIP call for a restricted device**

12 **Background:**

13

14 Bob has no subscription to WiMAX network. He initiates a VOIP call to Emergency Services through MAXNSP1.

15

16 Expected Outcome #1:

17 Bob establishes an audio call to local Emergency Services through MAXNSP1.

18

---

## 6. Requirements (Conditional Normative)

### 6.1 Service Requirements

#### 6.1.1 Basic VoIP Service Requirements

R [1] The WiMAX® Network using the WVS Infrastructure SHALL support WVS between WiMAX User Devices Ref. [4] (inter/intra WiMAX NSPs).

R [2] The WVS SHALL support interoperability with the non WiMAX voice services (namely, 3GPP, 3GPP2 and PSTN),

[11] VoIP service from a User Device in a WiMAX network to a user device in a non WiMAX network.

[12] VoIP service from a user device in a non WiMAX network to a User Device in a WiMAX network.

R [3] The WiMAX Network & the WVS Infrastructure SHALL support emergency WVS from a restricted device.

#### 6.1.2 Bearer Services Requirements

R [4] The WVS Infrastructure SHALL support sending/receiving real time analog fax over the WiMAX network (e.g. via regular phone connector like RJ-11).

R [5] The WVS Infrastructure SHALL support narrow band voice.

R [6] The WVS Infrastructure SHALL support wide band voice.

R [7] The WVS Infrastructure SHALL support DTMF tones.

#### 6.1.3 Supplementary Services Requirements

R [8] WVS SHALL provide Originating Identification Presentation (OIP) as defined in Ref. [7]

R [9] WVS SHALL provide Originating Identification Restriction (OIR) as defined in Ref. [7]

#### 6.1.4 Handover/MMSC Requirements

R [10] The WiMAX System using the WVS Infrastructure SHALL support simultaneous VoIP and data session handover within the NAP.

R [11] In handover scenarios with concurrent VoIP Emergency Service (ES) & data sessions from the same MS, the WiMAX System SHALL give the VoIP session the preference over the data session if the WiMAX System resources are limited.

1

2 R [12] In handover scenarios with concurrent VoIP & data sessions from the same MS, the WiMAX System  
3 SHOULD give the VoIP session a preference over the data session if the WiMAX System resources are limited.

4

5 R [13] The over the air interruption time when performing intra frequency within an ASN handover SHOULD be  
6 less than 60 ms.

7

## 8 **6.1.5 Interworking Requirements**

9 R [14] The WiMAX System & the WVS Infrastructure SHOULD support WVS through WiFi access networks.

10

11 R [15] If WVS is provided through WiFi access networks, then the WiMAX Network SHALL provide WiMAX –  
12 WiFi service continuity using the existing Single Radio/Dual Radio WMF WiFi interworking capability Ref. [8].

13 Note 1: The above requirement is optional on the device.

14 Note 2: The WiMAX – WiFi interworking requirements for this phase of WVS assumes that a common WVS  
15 provides voice service over both accesses. Any scenario where a WiFi VoIP service interacts (interworks) with  
16 WVS for voice service continuity is for further study.

17

18 R [16] The WiMAX Network SHOULD provide voice service continuity between WVS and 1XRTT voice service  
19 (CS) on CDMA2000 access networks.

20 Note: This requirement is equivalent to R-[8] in MMSC specification Ref. [9] with emphases on voice service.

21

22 R [17] Assuming network entry is achieved on alternate radio access technology for CS domain, the interruption  
23 time SHOULD be less than 300ms.

24

25 R [18] Assuming network entry is achieved on WiFi access technology, the WVS interruption time SHOULD be  
26 less than 300ms.

27

## 28 **6.1.6 Location Based Service Requirements**

29 R [19] The WVS Infrastructure SHALL interact with the LBS server to get the location information for emergency  
30 calls and lawful interception.

31

32 R [20] The WVS Infrastructure MAY interact with the LBS server to get the location information for billing and  
33 location dependent VoIP applications.

34

## 35 **6.2 Functional Requirements**

### 36 **6.2.1 System Requirements**

37 R [21] The WiMAX System SHALL support the simultaneous operation of WiMAX VoIP service & WMS  
38 (WiMAX Messaging Services).

39

1 R [22] The WiMAX real-time Fax service SHALL support analog fax machine for sending and receiving fax over  
2 the WiMAX network (e.g. via regular phone connector like RJ-11).

3 Note: The above requirement applies to the network. The requirement is only applicable to devices with an Rj-11  
4 connector.

5

6 R [23] The WiMAX Network SHALL be capable of supporting an ITU T. International E-164 telephony number  
7 for a WiMAX VoIP Service subscriber.

8

9 R [24] Mouth to ear end to end delay (within the same NAP) SHOULD be less than 180ms.

10

11 R [25] The WiMAX System supporting WVS SHOULD support and maintain the requested QoS for voice  
12 services.

13

14 R [26] The WVS SHALL support transcoding free and transcoding based connectivity between VoIP peers.

15

16 R [27] The WVS SHALL support at least one mandatory common signaling protocol such as Session Initiation  
17 Protocol (SIP) for both IMS and non-IMS deployments .

18

19 R [28] The WVS solution in the mobile SHALL be interoperable with both the IMS & non IMS architectures.

20

21 R [29] The WVS related parameters SHOULD be configurable using existing WiMAX OTA mechanisms..

22

23 R [30] The WVS session setup between two active devices from the origination attempt until receiving the alert  
24 message on the termination device SHOULD be less than 5 seconds.

25

26 R[31] The WiMAX VoIP infrastructure and user device SHALL support a default codec for narrowband voice,  
27 default codec for wideband voice & a default codec for fax.

28 The codecs for WVS will be selected taking into account the following factors:

- 29 ▪ Spectrum efficiency
- 30 ▪ Audio Quality
- 31 ▪ Interoperability/roaming
- 32 ▪ Exclude transcoding
- 33 ▪ cost (implementation, patents)
- 34 ▪ network capacity
- 35 ▪ robustness over IP transport
- 36 ▪ voice activity detection mechanism

37

38 R [32] For an active intra WiMAX VoIP session, the jitter SHOULD be less than 100ms.

## 39 **6.2.2 Network Requirements**

40 R [33] The WiMAX Network SHALL initiate network resource release on all relevant ongoing VoIP sessions upon  
41 losing connectivity to the user device.

42

1 R [34] The WVS SHALL map CS bearers to particular WiMAX Service Flows (e.g. pre-configure WiMAX  
2 Service Flow) that support voice services.

3

### 4 **6.2.3 Air Interface Requirements**

5 R [35] WVS SHALL operate over WiMAX Systems supporting air interface Releases 1.0 & 1.5.

6

7 R [36] The device SHALL meet the following requirements for VoIP support at the R1 interface between BS and the  
8 User Device.

- 9 ○ Dynamic service flow initiation by BS based on IEEE802.16-2009 (such as a Service Flow  
10 initiated by detection of SIP Signaling message/RTP Packets).
  - 11 ○ Dynamic service flow modification by BS based on IEEE802.16-2009 (such as a Service Flow  
12 modification by detection of change in VoIP Codec used/parameter changes for RTP  
13 Packets/change required for service flow parameters).
  - 14 ○ Dynamic service flow deletion by BS based on IEEE802.16-2009 (such as a Service Flow  
15 deletion by detection of end RTP packets/SIP Signaling messages).
- 16

## 17 **6.3 Charging and Network Management Requirements**

18 R [37] The WVS SHALL generate events (example; end of call) to support various WVS charging models,  
19 including pre-paid and post-paid.

20

21 R [38] The WVS SHALL provide call control to support online or pre-paid charging.

22

## 23 **6.4 Security Requirements**

24 R [39] The WVS SHALL NOT impact the Network layer (& below) security mechanism defined in WiMAX  
25 Release 1.0, Release 1.5 and Release 1.6.

26

27 R [40] Any reuse of the existing security mechanisms to support WVS SHALL be backward compatible with the  
28 current deployment of the existing security mechanisms.

29

30 R [41] The WVS SHALL provide mechanisms to establish a security framework such as recommended in Ref.  
31 [5].

32

33 R [42] The WVS SHALL provide the ability to mitigate VoIP security threats such as those identified in Ref. [6].

34

35 R [43] The WVS SHALL support a security mechanism independent of the WiMAX Network security mechanism  
36 (VSP & NSP may be different).

37

38 R [44] The WVS client & the WVS Infrastructure SHALL mutually authenticate before the WVS services are  
39 provided.

40

41 R [45] WVS SHALL support mutual authentication that is secure against crypto-analysis.

- 1  
2 R [46] When enabled by the operator, the WVS signaling & media between the client and the WVS Infrastructure  
3 SHALL be secured.  
4  
5 R [47] When enabled by the operator, the WVS signaling between the client and the WVS Infrastructure SHALL be  
6 encrypted.  
7

#### 8 **6.4.1 Privacy Requirements**

- 9 R [48] The WVS SHALL maintain subscriber privacy settings based on operator policy or through subscriber  
10 interaction.  
11  
12 R [49] WVS SHALL use subscriber privacy settings to control the reporting and transport (in signaling) subscriber  
13 sensitive information (which may be defined in local regulations) such as identity and location except where  
14 required by local regulations and for internal network purposes (e.g. billing).  
15  
16 R [50] WVS SHALL enforce privacy settings both for WVS subscriber originated calls and WVS subscriber  
17 terminated calls.  
18

#### 19 **6.5 Policy Control & QoS Requirements**

- 20 R [51] The WiMAX Network SHALL support operator VoIP service Policy provisioning and updates.  
21  
22 R [52] The decision to enable VoIP service for a given User Device SHALL be based on operator policy.  
23  
24 R [53] The WVS SHALL specify the particular Service Flow QoS attributes for different bearers & signaling  
25 required for the default WVS codecs.  
26

#### 27 **6.6 Regulatory Requirements**

- 28 Regulatory requirements must always be considered in accordance with the applicable national/regional laws and  
29 technical regulations.

##### 30 **6.6.1 Lawful Intercept Requirements**

- 31 R [54] The WVS SHALL comply with the Lawful Intercept requirements of Ref. [5].  
32  
33 R [55] The WVS SHALL report WVS registration events (e.g., SIP registration).  
34  
35 R [56] The WVS SHALL report terminal registration events associated with WVS.  
36  
37 R [57] When an intercept subject dials or signals digits in the VoIP content stream after a session is established,  
38 the WVS SHALL isolate and report the dialed or signaled digits as Communications Identifying Information  
39 (CmII).

1  
2 R [58] The WVS SHALL have the capability to activate/deactivate isolation and reporting of dialed or signaled  
3 digits as CmlI on a per-lawful authorization basis.

4  
5 R [59] The invocation of VoIP services SHALL NOT impact any ongoing lawful interception.

6  
7 R [60] When changes in the identification of intercept (example; change in session ID or change in delivery  
8 function) occur in the delivery of the interception communication by a service provider, the WVS SHALL report  
9 information that allows the intercept identification before and after the change to be correlated by LEA.

10

## 11 **6.6.2 Emergency Services Requirements**

12 R [61] The WVS SHALL support the VoIP service provider Emergency Services access (per US Federal  
13 Communication Commission mandates for VoIP service providers)

14  
15 R [62] The WVS SHALL support the wireless service provider Emergency Services access (per US Federal  
16 Communication Commission mandates for wireless service providers)

17  
18 R [63] The WVS SHALL support network supplied caller identification and call back numbers overriding User  
19 Device provided caller identification when applicable for emergency services access.

20

## 21 **6.6.3 Hearing Aid Compatibility (HAC)**

22 R [64] The WiMAX system SHALL NOT interfere with the Hearing Aids operation, either used in conjunction  
23 with a WVS call, or when a User Device is in proximity to an operational Hearing Aid.

24

## 25 **6.6.4 TTY and TTY Relay Service (TRS)**

26 R [65] The WiMAX system (including WVS) SHALL support TTY and TRS users.

27

28 R [66] Codecs specified for the WiMAX system and WVS SHALL support TTY and TRS.

29

---

## 7. Design Requirements and Recommendations

This section has requirements and recommendation for NWG and TWG.

Requirements;

1. NWG WVS specifications SHALL provide both IMS and non-IMS based solutions.

Note: Each of the two solutions may be developed in different time frames.

Recommendations;

1. SPWG recommends that NWG WVS specifications reuse the existing WiMAX® framework, to the extent possible, in order to meet the dynamic flow QoS requirements.
2. SPWG recommends that NWG align the non-IMS interfaces & protocols with that of IMS in order to facilitate potential future migrations.

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## 8. Recommendations to Vendors (Informative)

- The WiMAX® network should support addition of new codec(s) and deletion of existing codec(s) via software upgrades without requiring hardware change.
- The transcoding function in the WiMAX network should support addition of new codec(s) and deletion of existing codec(s) via software upgrades without requiring hardware change.
- The dropped call rate (excluding RF) within WiMAX SHOULD be less than 2%.